

NEKROTOPIO

SCENERY OF THE DEAD

An unconventional landscape approach to designing a burial site that disposes of corpse sustainably, whilst taking users through a narrated landscape that confronts them with their own mortality and role in the greater cosmos.

by
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In accordance with Regulation 4(e) of the General Regulations (G. 57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Landscape Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

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Client: Johannesburg City Parks
Users: Deceased Johannesburg residents
Family and friends of the deceased buried on site
Nature lovers

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“then man's dust will go back to the earth, returning to what it was, and the spirit will return to the God who gave it.” -Ecclesiastes 12:7

Summary

The city of Johannesburg is rapidly running out of space to bury the dead. With 78% of cemeteries passive, it is necessary to rethink how corpses are disposed of, and how we, as landscape architects can redesign these archetypical spaces.

This thesis focuses on three grave matters: sustainable corpse disposal, atypical cemetery design through local grounding, and the experience of the user.

Sustainable corpse disposal

Conventional burial is not a sustainable manner to dispose of corpses. The only other available corpse disposal method in South Africa is cremation. Cremation is not an option to many cultural and religious groups in South Africa due to the fire being associated with hell or an undesirable afterlife. New sustainable corpse disposal methods that respect cultural beliefs are required. This thesis proposes the introduction of promession and green burial to South Africa. Finally the Author also designed a system to compost corpses in a safe and dignified manner.

Atypical cemetery design through local grounding

Cemeteries have become placeless due to their archetypical design. Burial sites should be grounded in the local environment. This thesis draws inspiration from the site's topography and unconventional corpse disposal methods to design a burial site that emphasizes the nature reserve in which it is situated.

User experience

Cemeteries are for the living, not the deceased. Typical cemeteries are one-dimensional and lack user experience. According to the theory set forth in the second chapter, cemeteries hold the potential to be powerful and meaningful spaces. Meaning in the landscape can be evoked through designing spaces that evoke a predetermined emotion. A narrated landscape can aid in creating a meaningful landscape. The narrative told through the site is one of mortality and holism.

All three of the focus points are overlaid and interwoven to create a rich burial site: Nekrotopio, scenery of the dead.

Samevatting

Die stad van Johannesburg sit tans met 'n dilemma: daar is nie genoeg plek om die dooies te begrawe nie. Aangesien 78% van dié stad se begrafplase onaktief is, is dit nodig om die manier waarop ons van lyke ontslae raak, so wel die wyse waarop landskapargitekte die ruimtes ontwerp, te herevalueer.

Hierdie skripsie fokus op drie hoofpunte: volhoubare lykswegdoening, atipiese begrafplaasontwerp deur middel van plaaslike begroning en die ervaring van die gebruiker

Volhoubare lykswegdoening

Konvensionele begrawing is nie volhoubaar nie. Die enigste ander opsie vir lykswegdoening in Suid Afrika is verassing. Talle kultuurgroepe is gekant teen verassing omdat die verbranding van 'n lyk lei tot 'n ongewenste hiernamaals. Suid Afrika benodig nuwe volhoubare lykswegdoeningmetodes wat kulturele gelowe respekteer. Hierdie skripsie stel voor dat stikstofbevriësing en natuurlike begrawing toegepas word. Die Outeur het ook 'n sisteem ontwerp wat lyke kompos.

Atipiese begrafplaasontwerp deur middel van plaaslike begroning

Begrafplase is tipies en het 'n gebrek aan identiteit. Begrafplase behoort gegrond te wees in die omgewing. Die natuurreservaat se topografie het gedien as inspirasie, en is beklemtoon deur die begrafplaas se ontwerp.

Ervaring van die gebruiker

Begrafplase word gebou vir die mense, nie vir lyke nie. Tipiese begrafplase is eendimensioneel en het 'n gebrek aan gebruikerervaring. Volgens die teorieë wat bespreek word in hoofstuk twee, besit begrafplase die potensiaal om kragte en betekenisvolle ruimtes te wees. Betekenis in 'n landskap kan bereik word deur om ruimtes te ontwerp wat voorafbepaalde emosies ontlok. 'n Verhalende landskap kan betekenisvolle landskap skep. Die verhaal van die skripsie se begrafplaas gaan oor mortaliteit en holisme.

Al drie hoofpunte word as 'n eenheid gebruik om 'n ryk begrafplaas te ontwerp. Nekrotopio, landskap van die dood.

Glossary

Active cemetery: A cemetery that has not reached its burial capacity. There is still space left for more graves.

Burial: The action or practice of burying a corpse. (The Oxford English Dictionary. 3rd ed. 2010. Online)

Cemetery: A large burial ground where corpses are buried or otherwise interred. (The Oxford English Dictionary. 3rd ed. 2010. Online)

Circle of life: The cycle of procreation, birth, life, death and predation.

Composting chamber: A constructed container, made from concrete and clad with timber on the inside, where a corpse and the added organic material decompose to form humus.

Composting: The biological decomposition and stabilization of organic substrates, under conditions that allow development of thermophilic temperatures as a result of biologically produced heat, to produce a final product that is stable, free of pathogens, and can be beneficially applied to land. (Haug 1993)

Conventional burial: The action or practice of burying an embalmed corpse placed in a timber/ or metal coffin in a government-owned cemetery and marking the grave with a personalized tombstone.

Corpse: a dead body, especially of a human being rather than an animal. (The Oxford English Dictionary. 3rd ed. 2010. Online)

Green burial: A practice where a non-embalmed corpse is buried in a shallow grave without a coffin to accelerate the decomposition.

Holism: The theory that parts of a whole are in intimate interconnection, such that they cannot exist independently of the whole, or cannot be understood without reference to the whole, which is thus regarded as greater than the sum of its parts. Holism is often applied ecology. (The Oxford English Dictionary. 3rd ed. 2010. Online)

Local grounding: Basing on the indigenous surroundings and local culture.

Nature reserve: Open space proclaimed by the government as a protected area for fauna and flora.

Nekrotopio: “*Scenery of the dead*”. Latin phrases *nekro*, which means death, and *topio*, which means landscape or scenery. (The Oxford English Dictionary. 3rd ed. 2010. Online)

Passive cemetery: A cemetery that has reached its burial capacity. All the graves have been filled; no more corpses can be buried in the cemetery.

Promession forest: The area where eco-urns containing ashes of the deceased, compost, and tree seeds are planted to form a forest.

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01

Introduction



Der Prediger. Der Tod. Der Tod zum Teufel. Der Tod zum Kaiser. Der Tod zum Kaiserin. Der Tod zum König. Der Tod zum Königin. Der Tod zum Cardinal. Der Tod zum Bischof.



Der Tod zum Aerey. Der Tod zum Kriegerin. Der Tod zum Grafen. Der Tod zum Abt. Der Tod zum Ritter. Der Tod zum Juristen. Der Tod zum Mathematik. Der Tod zum Schochern. Der Tod zum Doktor.



Der Tod zum Edelmann. Der Tod zum Edelmann. Der Tod zum Kaufmann. Der Tod zum Klebsien. Der Tod zum Krüppel. Der Tod zum Nalbinder. Der Tod zum Jüngling. Der Tod zum Wüchere. Der Tod zur Jungfrau.



Der Tod zum Kuepferer. Der Tod zum Aereid. Der Tod zum Schultzeiss. Der Tod zum Blatrogel. Der Tod zum Drucken. Der Tod zum Krämer. Der Tod zum Blinden. Der Tod zum Duden. Der Tod zum Teuten.



1.1 Danse macabre

Wer war der Tor, wer der Weise[r], “Who was the fool, who the wise man,
Wer der Bettler oder Kaiser? who the beggar or the Emperor?
Ob arm, ob reich, im Tode gleich. Whether rich or poor, all are equal in death.”

(Totentanz, Heidelberger Blockbuch 1460)

Figure 1. Watercolor copy of the Basler Totentanz of 1806 by Johann Rudolf Feyerabend (Miller 2010)

1.2 Prologue

Feyerabend's Basler Totentanz painting is a duplication of an image painted in the late Middle Ages in Basel on the inside of the cemetery wall at the Predigerkirche located in Zürich, Switzerland (Miller 2010). The painting is a *memento mori*, meaning it forms part of the medieval Latin theory and practice of reflection on mortality, it serves as a reminder that we are temporary and that death, regardless of our ranking, makes us all equal (Museum of Art and Archaeology 2007).

This *danse macabre*, *Dance of the Dead*, painting, as seen in Figure 1, illustrates a dance led by Death, followed by a chain of alternating deceased and living dancers. The mediaeval hierarchy is shown: Starting with the highest ranks, the pope or emperor, and descending to its lowest: beggars, peasants, or children. A skeleton or an extremely decayed body takes each of these mortals by hand. The obvious class distinction is entirely counterbalanced by Death, the ultimate equalizer. This painting successfully illustrates socio-critical elements, which is inherent to the entire genre. A short dialogue, as seen in the *Totentanz, Heidelberger Blockbuch* on page 2 is attached to each victim, here Death is summoning the mortal to dance and the summoned is moaning about impending death.

Corresponding with *danse macabre* the Author agrees that death makes all humans equal and that, like this *memento mori* suggests, the temporality of a human life and a physical human body should not be overlooked. *Birth* and *Death* are words we chose to describe the doorways in and out of a cycle. However, this cycle is connected to a much larger cycle, which awaits our return, for we are all part of the great circle of life, Figure 2.

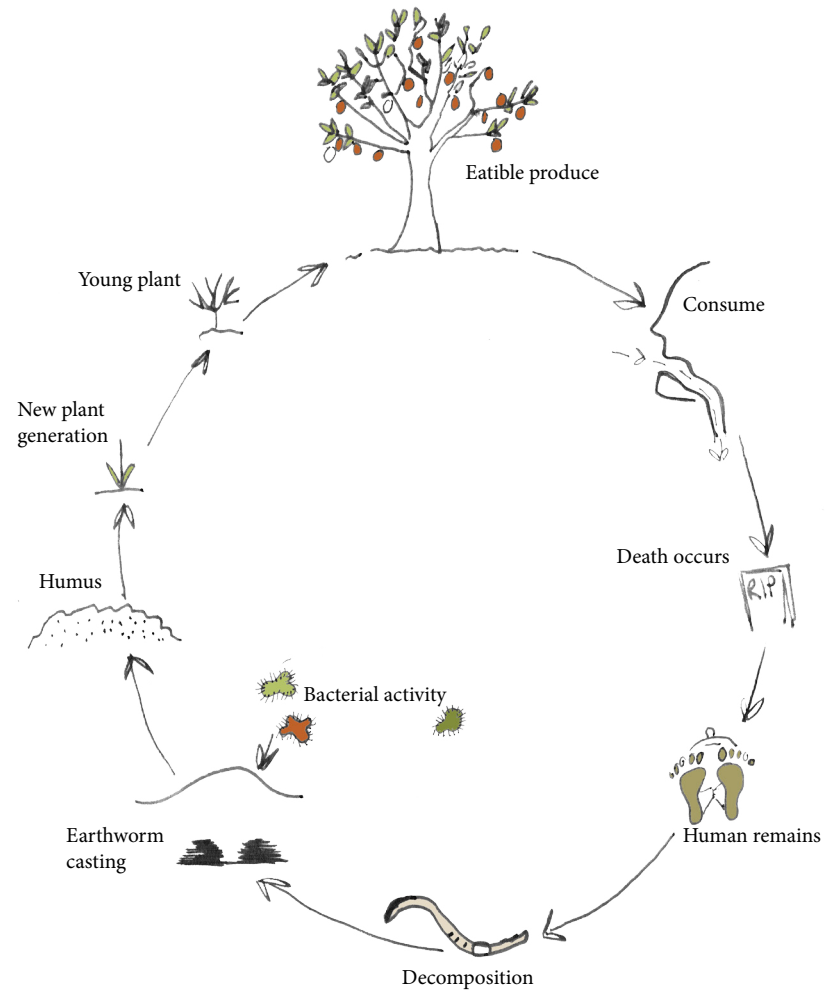


Figure 2. Circle of life: from death comes new life. (Author 2015).

¹ *Memento mori*: Latin phrase meaning: “remember (that you have) to die” (Oxford English Dictionary, Third Edition, June 2001.) It developed with the growth of Christianity, which emphasized Heaven, Hell, and salvation of the soul in the afterlife. The phrase is associated with a

1.3 Introduction

On 13 November 1789, in a letter to Jean Baptiste Le Roy, Benjamin Franklin stated that in this world, nothing could be said to be certain, except death and taxes (Shipside 2008). Death is inevitable, but rather than it being an ending; it is a sense of completion in which each human is returned to the cosmos that formed and nurtured them. The place and manner in which we return human remains to the earth is influenced by socio-politics, culture, and beliefs. Although burial in a cemetery is the most popular end of life choice in South Africa, it is neither a sustainable practice, nor a place that regards the experience of the actual user.

Designing a burial site is a sensitive topic; the landscape architect needs to design for the living, as well as for the deceased. This thesis will focus on three aspects of burial site design: sustainable corpse disposal; grounding the design locally; and the experience of the user through a narrated and expressive landscape. The Author believes that landscape architecture is the vehicle through which a sustainable and locally appropriate burial site can be designed.

Chapter 1 will clarify the focus and structure of this thesis. This includes discussing the real world problem and the landscape design problem which builds up to the problem statement, research questions, hypothesis and aims of this thesis.

1.4 Real world problem

Despite a range of alternatives in South Africa, conventional traditional burial remains the most popular end-of-life choice (Leuta & Green 2011). According to Buff (Johannesburg City Parks 2008), ninety-four percent of corpses are still being buried, whilst the remaining six percent are cremated. Various faiths, religions, and cultures believe that burial is the most respectful and dignified way to treat a deceased human. For the mourning loved ones, having a specific gravesite to visit brings great comfort and forms part of coping with loss (Leuta & Green 2011). The primary drawback to conventional burial is the excessive space it requires. There is a lack of suitable and affordable land for the development of urban cemeteries. Town planners have neglected to identify adequate space for cemeteries in urban and suburban areas (Moodley 2007).

Currently, within the boundaries of Johannesburg, there are 35 cemeteries, 27 of these are passive, meaning they have reached their burial capacity. The remaining eight cemeteries are filling at an alarming rate (Johannesburg City Parks 2008), as illustrated in Figure 3. The only other end-of-life option available in South Africa,

besides burial and cremation, is mausoleums. Mausolea offer a corpse catacomb option, instead of placing corpses in soil dug graves; bodies are laid to rest in tombs situated in a mausoleum above the ground. This is an extremely expensive method and is not widely practiced in South Africa. It is less space consuming than traditional burial, however, the bodies natural decay is hindered by not being buried.

In Gauteng alone, Johannesburg City Parks projected the death rate to be approximately 160 000 per annum, in Johannesburg, the death rate already exceeds the birthrate. According to Stats SA, the burial rate has doubled between 1992 and 2002, and has been increasing due to the high mortality rate throughout the city's townships. Poverty, horrific living conditions, and the accelerated spreading of HIV contribute to this hike (Moodley 2007). Consequently, in just half a century, 1000 hectare of land will be needed for conventional burial in Johannesburg, this is enough space for 100 000 low income houses (Wilkins 2011).

Only 6% of South Africans are cremated. Many African communities have shown resistance towards cremation due to cultural beliefs and fire being associated with an undesired afterlife (Du Toit 1980). According to Anderson (2000), death is believed to be the beginning of a deeper relationship with creation, thus human remains need to be returned to the soil. In addition, if a body is not buried the spirit becomes a wandering ghost. Deviation from these conventions is seen as a sign of disrespect towards ancestors (Setsiba 2012).

Thus, despite land consumption, the high cost of burial and available cheaper alternatives, African communities are determined to burying their loved ones. This has become the source of even more problems. The high cost of funeral and burial means that many poor families cannot afford to bury their dead. This leaves them with two options: either apply for a Pauper's burial or bury the corpse illegally. A Pauper's burial is a burial funded by the government due to a family's inability to pay. An application must be submitted to a municipality for an indigent burial. Due to a lack of municipal funds and slow administrative processes, receiving a Pauper's burial could take up to a year.

This has led to overcrowding of hospital morgues in Johannesburg. One of the worst examples, shown in Figure 4, is the Chris Hani Baragwanath Hospital in Soweto. On an average day, the morgue stores a minimum of 90 adult cadavers, most of which have long passed the statutory 30 days for bodies to be kept in a mortuary. Additionally, a 100 babies who were either stillborn or abandoned

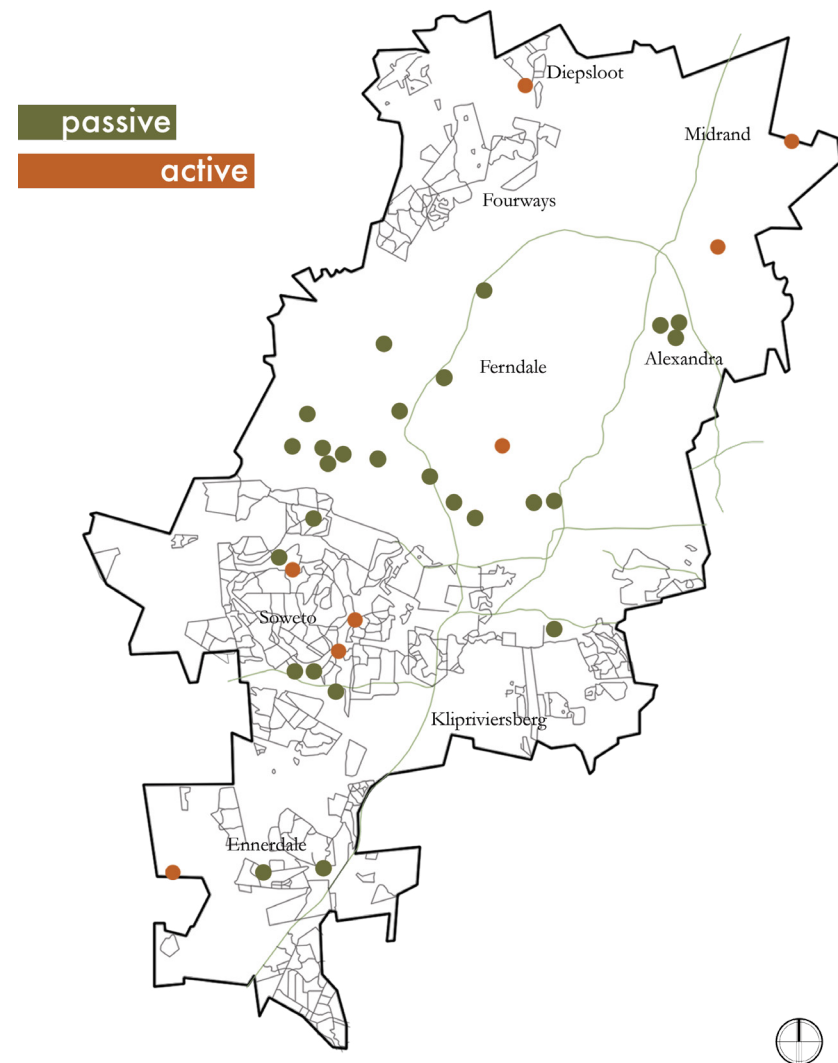


Figure 3. Johannesburg cemetery mapping (Author 2015).

lay piled on a tray designed for a single adult cadaver. Stretchers and shelves are stacked with bodies, which have already started to decompose (Bauer 2011).

Aside from a Pauper's burial, many corpses are buried in illegal cemeteries. According to Dambudzo (2012) in the City of Johannesburg, an increasing percentage of corpses are being disposed of illegally. People partaking in illegal burial are usually poor township dwellers. Informal cemeteries on the outskirts of townships have become standard. In the Diepsloot Township in Johannesburg, between 16 and 40 people die daily. Many of these corpses are illegally buried in the veld adjacent to the township. Unfortunately on many occasions, the residents find that stray dogs dig up their deceased family members (Dambudzo 2012). To conclude, South Africa partakes in unsustainable burial practices. We need a space saving, cost effective, and environmentally friendly alternative.

1.5 Landscape design problem

The Author argues that the designers of cemeteries are guilty of first designing generic cemeteries, and secondly disregarding the experience of the mourner when designing them.

Generic Cemeteries

The majority of cemeteries in Johannesburg are extremely similar with regard to aesthetics and layout. They are imitations of European examples, which haven't been adapted to fit into the South African context.

The first cemeteries in Johannesburg came with the discovering of gold in 1886 and the gold rush, which followed. Optimistic prospectors from Europe stormed to Johannesburg, hoping to find wealth. Due to the accelerated increase of Johannesburg residents, a town leapt into existence, which quickly required burial facilities. The cemeteries were built according to the only frame of reference



the residents had: a European one. Thus, cemeteries were lush and evergreen, consisting on lawn and trees, something that felt foreign to the grassland biome of Johannesburg (Johannesburg City Parks 2008).

More than a century later, cemetery design remains unaltered. In addition, the Author believes that the emblematic quality embedded in cemeteries has been lost due to the commercialization of the funeral and burial industry.

For the most part, cemeteries are typical and undistinguishable; they have lost their identity and become placeless. This thesis will aim to demonstrate how this can be prevented through understanding the burial practices of local cultures, responding to it, as well as celebrating the Egoli Granite Grassland with the goal of locally grounding the design of a burial site in its context.

Disregarding user experience

The average Johannesburg cemetery is designed according to a grid to accommodate as many corpses as possible. It usually consists of a single horizontal plane with marked graves, trees, and a few allocated walkways. The site has no hierarchy and the commemoration of a loved one is restricted to a tombstone. In the Author's opinion the experience of the user is limited and dissatisfactory. The Author argues that a place of burial should not only be a place where loved ones are bid farewell, but also, like a *memento mori*, make the user come to terms with their own morality. The user should realise that death is not the end, but rather a sense of completion. We are all part of the greater cosmos; from our death, comes new life. "The landscape becomes a vehicle to understand the self, rather than the place", Treib (1995).

This thesis will aim to illustrate how the experience of the user can be improved through a narrated and expressive landscape.

Figure 4. Chris Hani Baragwanath Hospital: Corpses littered and stacked on stretchers and shelves in an open-plan refrigerator (Bauer 2011).



1.6 Problem statement

The problems this thesis aims to address are threefold:

1. **Unsustainable practice:** Passive cemeteries render large pieces of land unsuitable for any future use. With suitable burial space being limited, an environmentally beneficial, and space saving approach has to be considered.
2. **Placelessness:** Cemeteries are generic and undistinguishable, leading to a loss of identity and the notion of non-place. The Author argues that cultural knowledge should be referenced as inspiration to locally ground the design of the burial site.
3. **Disregarding user experience:** Seldom the experience of the cemetery visitor is taken into account. The author suggests that through a narrated and expressive landscaped burial site, the place will become meaningful to its users.

1.7 Study area

The selected study area is the southern half of the Diepsloot Nature Reserve (DNR), Figure 5. It is located in Region A of Johannesburg and falls within the Egoli Granite Grassland. The Diepsloot nature reserve, also known as the Northern Farm, is separated into a northern and southern half by two highways: the R114 and the N14, Figure 6. Due to these roads, the two halves function as unrelated entities. The northern half of the nature reserve is well protected and used for recreational purposes, while the southern half is neglected.

Its close proximity to the Diepsloot township, the waste water treatment plant, and the lack of a defined edge have led to the degradation of the nature reserve.

In 2007 the Diepsloot cemetery, marked on Figure 5, was constructed on the property of the southern half of the reserve. An extension of this cemetery is planned to accommodate more corpses.

The Author argues that instead of expanding the existing cemetery, which practices unsustainable corpse disposal, a burial site practicing sustainable corpse disposal should be designed into the reserve, as a supportive program to the proposed upgraded nature reserve.

Appropriate locations for new burial sites in Johannesburg are limited. The process of rezoning land to be used for corpse disposal is tedious. Thus since the Diepsloot Nature Reserve is owned by Johannesburg City Parks and a part



Figure 6. Diepsloot Nature Reserve split in two by the R114 and the N14 (Author 2015).

of the southern half has already been approved and zoned as appropriate burial space, it is deemed to be a suitable site to propose an alternative to conventional cemeteries.

1.8 Hypothesis

Through an expressive landscape design, a sustainable and locally grounded burial site, which focuses on the experience of the living visitor, can be designed.



Gauteng



Johannesburg



Region A



Figure 5. Selected site: Diepsloot Nature Reserve . Indicating location and overview (Author 2015).

1.9 Research questions

How can a burial site be designed to stay active through sustainable corpse disposal practices?

How can landscape architects prevent generic cemetery design through local grounding?

How can a burial site be designed to not only focus on the deceased, but rather to also acknowledge the experience of the living visitor?

Integrated living between the wealthy and marginalized is not the focus of this thesis and will not form part of it.

1.10 Aims and objectives

This thesis aims to:

- Illustrate that landscape architecture is a vehicle through which a sustainable burial site which disposes of human remains in a manner that is beneficial to the environment, can be designed.
- Demonstrate how using culture knowledge as inspiration can locally ground a design to create a non-generic burial site with a strong identity.
- Engage with the notion that landscape design, which draws on the experience of the user can be effective in creating places that evoke predetermined emotions and thus suggest meaning.
- Argue that landscape narratives enrich commemorative landscapes, such as burial sites.

1.12 Research methodology

The design process is a non-linear, it is iterative. It is where research, analysis, and intuition come together.

A descriptive survey method will be used in order to investigate and observe the site, the intangible qualities, and the site's context. An analytical survey will be conducted during the site analysis and will include mapping and data analysis. A literature review will take place to investigate suitable landscape architecture theory. The analysis of contemporary and appropriate case studies will enrich the theory.

1.11 Assumptions and delimitations

- The site borders on the Diepsloot Township. The upgrading or improvement of the township's conditions will not form part of this thesis.
- The site, southern half of the Diepsloot Nature Reserve, is dealt with as a proclaimed nature reserve. Areas of proposed development are based on analysis of vegetation sensitivity and disturbed areas.
- The Northern Waste Water Works in the DNR is assumed to be a sanitary and safe operation.
- Although the DNR is situated between gated communities and Diepsloot, the issue of isolated living due to financial hierarchy will not be addressed in this thesis. The Author acknowledges this issue and accepts this division.



02

Theory discussion

2.1 Introduction

This thesis aims to design a burial site, which practices sustainable corpse disposal, prevents placelessness through locally grounding, and focuses on the experience of the living user. This theory chapter is divided into two sections:

1. Sustainable corpse disposal
2. Placelessness and user experience

In the first section current corpse disposal methods as well as the influence of culture on selecting how to dispose of a loved one's corpse is discussed. Following this, sustainable and appropriate corpse disposal methods for this thesis is selected and explained.

Section two is a theoretical discussion on the loss of identity and increased placelessness of cemeteries, as well as how the experience of the user can be made meaningful through a narrated landscape.

Section I: Sustainable corpse disposal

2.2 Unsustainable burial practice

Johannesburg's Cemeteries are quickly filling up and the city is rapidly running out of burial space (SAPA 2010). This calls for a change in the long established custom of traditional burial. A less land intensive and more sustainable corpse disposal method is required. Cremation and traditional burial are the only legal body disposal methods in South Africa, however many other methods are used internationally; Figure 7 illustrates some of these methods.

2.3 Corpse disposal methods

1. Traditional burial

Despite a range of inexpensive alternatives, traditional burial remains the preferred method of corpse disposal in South Africa. The cost of a grave in a governmentally owned cemetery is R1900. Traditional burial, also referred to as

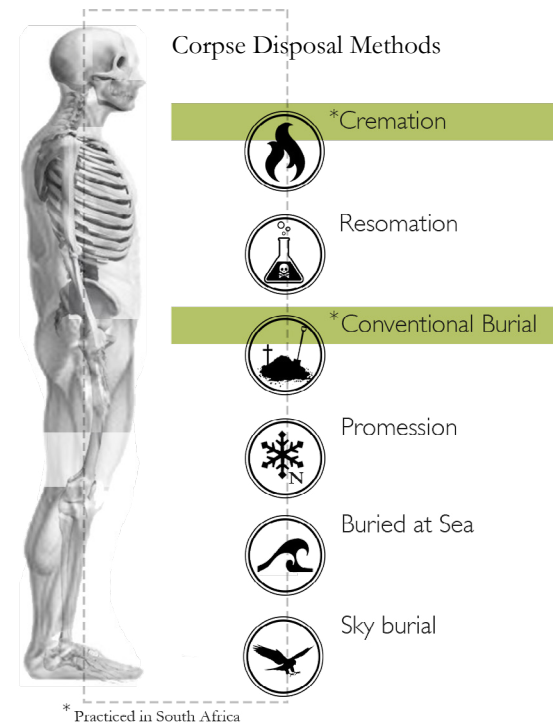


Figure 7. Current corpse disposal methods (Author 2015).

conventional burial, is the placing of a corpse underground in a casket or coffin (Leuta & Green 2011). The grave is traditionally marked with a tombstone to commemorate the deceased.

The coffin is lowered two meter into the soil and covered with the backfill soil. Decomposition is extremely slow, and often delayed with more than a century, for two main reasons: first the coffin is buried below the active soil layer, thus very little micro organisms and macro organisms are present to enable decomposition. Secondly, the casket or coffin is made from robust material, which hinder and decreases the speed of decomposition (Leuta & Green 2011).

With space for corpse burial being limited, traditional burial is not a viable option, nor a sustainable one.

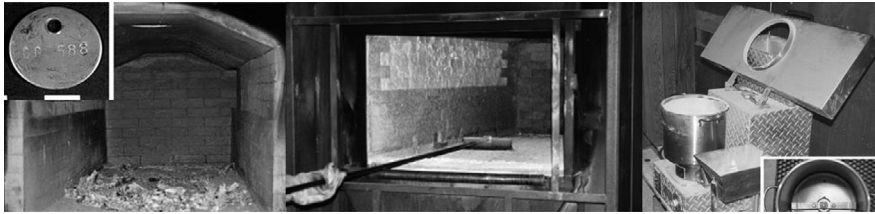


Figure 8. Cremation process. From left to right: cremation chamber, hopper removing ashes and the rotary blade processor (Schultz, J et al 2001).



Figure 9. Resomator used for resomation of a corpse (Davies & Rumble 2012).



Figure 10. Examples of famous mausoleums: the Taj Mahal in India, the Panthéon in France, and the Pantheon in Italy (Wakely 2008).



Figure 11. Sky burial: rogyapas disassemble the corpse and leave it for the vultures (Batt 2001).

2. Cremation

Cremation is practiced in South Africa, however only about 6% of the population is cremated. Cremation is a two-step taphonomic process, which consists of the combustion, vaporisation, and oxidation of corpses to basic chemical compounds. Step one consists of the corpse being placed in a cremation casket and slid into a fire resistant cremation chamber, Figure 8. The process of incinerating the corpse is started with the ignition of the burner. The chamber is fueled by either propane or natural gas to reach temperatures between 900°C - 1100°C. After approximately two hours, the corpse is reduced to bone fragments. During step two the bone fragments are reduced to ashes. The bone fragments are removed from the cremation chamber with a wire brush and placed in a rotary blade processor, Figure 8, which grinds the fragments into a homogenous fine ash (Schultz, J et al 2001). Following the cremation, the ashes are returned to the family of the deceased to either be scattered, or placed in a memorial wall.

Although cremation is space saving, it is not an environmentally friendly method to dispose of a corpse; during the combustion of the corpse, the body is broken down into basic chemical compounds, which include gasses such as carbon dioxide, carbon monoxide, nitrogen oxide, sulphur dioxide, hydrogen chloride gas, hydrogen fluoride and mercury vapour (Schultz, J et al 2001). It has been calculated that a male adult corpse releases 50 kilograms of CO₂ when cremated (Wakely 2008)

3. Resomation

Resomation is an environmentally friendly alternative to cremation and traditional burial. Instead of using fire, resomation uses water and alkali in a process called alkaline hydrolysis to chemically break down the corpse. When the corpse is placed in the resomator, Figure 9, with the water and alkaline solution, the body decomposes at an accelerated rate: proteins break down into peptides and individual amino acids, while fats are converted to fatty acids and glycerol. The alkaline hydrolysis reduces the corpse to a brownish liquid of amino acids, peptides, fatty acids, sugar, and salt. The consistency of the liquid is oily with suspended pieces of skeleton (Davies & Rumble 2012).

Resomation takes three hours and the end-result is a sterile liquid with bone ashes. Similar to cremation, the ashes can be returned to the family or used as fertilizer. Although resomation is a fast and sustainable method to dispose of corpse, it is not a financially feasible solution in South Africa, due to a single resomator costing around R6 500 000 (Davies & Rumble 2012).

4. Promession

Another environmentally friendly alternative to cremation is promession. The process reduces corpses to a substance that can be used to feed earth and plants. In the process of promession, the corpse is submerged in liquid nitrogen at a temperature of -196°C , this is known as freeze-drying and makes the corpse extremely brittle and easy to shatter. The chamber is mechanically vibrated, causing the corpse to shatter into ashes (Wakely 2008).

The human body consists of 65% water, all of which is removed through promession. The corpse is reduced to a granulated, organic, and odorless material. Unlike cremation, no nutrients are lost during the process, making the promession ash excellent fertilizer (Davies & Rumble 2012).

5. Immurement

Immurement refers to the permanent storage of a corpse in an aboveground tomb or mausoleum. Mausoleums are external freestanding buildings constructed as a monument enclosing the entombment space or burial chamber of a deceased person or people. In the presence of oxygen the corpse rots immediately, leaving a foul smell and causing health risks, thus in the case of an aboveground burial, the corpse is placed in an airtight coffin, which is also sealed. This build up of moisture, pressure, and heat can cause the corpse and coffin to explode (Wakely 2008).

Immurement is an extremely unsustainable method of corpse disposal and is land intensive like traditional burial. Some of the most famous mausoleums include the Taj Mahal in India, the Panthéon in France, and the Pantheon in Italy, Figure 10.

6. Sky burial

Sky burial is an environmentally friendly method of corpse disposal; it is a form of excarnation. The term excarnation, commonly known as defleshing, refers to the corpse disposal practice where flesh and organs are removed from the body, leaving only the bones. Sky burial is where a corpse is placed on a mountaintop on stone structures called Dakhmas to decompose while exposed to the elements and birds of prey (Batt 2001).

In preparation for sky burial, rogyapas, more commonly known as body-breakers, disassemble the corpse and leave it for the vultures, Figure 11. When only the skeleton remains, it is crushed with mallets and mixed with barley flour. This mixture is given to the crows and hawks that have waited for the vultures to depart (Batt 2001).

From these examples, it is clear that multiple space saving and environmentally friendly alternative corpse disposal methods are available. It seems rather easy to select the most sustainable process and implement it in South Africa. However, corpse disposal is not only a scientific process as discussed above. Two crucial aspects have been intentionally excluded from the methods: culture and religion.

2.4 Corpse follows culture

People select corpse disposal methods according to their cultural beliefs, rather than sustainability and affordability. Moodley (2007) makes the bold statement that the high number of passive cemeteries in Johannesburg, as well as those nearing its capacity suggests the need for cultural change and acceptance of cremation or other means as an alternative to burial. The Author disagrees with this statement: communities should not be forced to adapt to corpse disposal methods that contradict their beliefs. According to Alan Buff (Johannesburg City Parks 2008), the manner in which human remains are laid to rest is not only a reflection of the living community, but also their religion and culture.

2.5 Vajrayana Buddhists of Tibet

An example of burial that reflects the living community's culture and beliefs is the sky burial practiced in the autonomous regions of Tibet, Sichuan, Mongolia, Bhutan, Nepal and Qinghai. People living in these areas, especially Tibet and Mongolia, still adhere to the Vajrayana Buddhist traditions (Faison 1999). Vajrayana Buddhism believes in the transmigration of spirits, thus, there is no need to preserve corpses, as they become empty vessels after physical death. Further, according to Vajrayana Buddhism, the corpse should be disposed of in the most generous way possible. Sky burial is considered an act of generosity from the deceased; his corpse will feed the living and continue the circle of life. Generosity and compassion are two fundamental pillars of Buddhism. It is also believed that sky burial unites the deceased with the sky, a sacred realm, while Tibetan Buddhists also see sky burial as a temple of instructional teaching on the temporality of life on earth (Batt 2001).

Sky burial is not only religiously driven, but also considers the environment. The Tibet mountains are rocky, thus even if someone wanted to bury their dead, they would not be able to dig a grave in the hard and rocky soil. Cremation, the

preferred Buddhist practice, is also not performed, due to the scarcity of fuel and timber. Vajrayana Buddhists were able to respect and adhere to religious beliefs whilst adapting to the needs of their landscape.

The Author believes that a similar process will have to be followed in South Africa. Culture, beliefs, and the landscape environment should be acknowledged, understood, and respected to come up with an appropriate and sustainable solution.

2.6 Selected community focus

According to Wilkins (2011), black African communities in South Africa have shown the most resistance towards cremation, as well as any other alternative to conventional burial. With 76.4% of the South Africa population being from the black African community (Census 2011), it is vital to change the manner in which they dispose of their dead, while retaining the cultural and religious aspects. Before a new and appropriate alternative to traditional burial can be created, the culture and beliefs of the black African community need to be understood.

2.7 Black Africans: burial culture and believes

Conventional burial in South Africa is heavily influenced by Christian and traditional African religions. In African societies, pre and post burial rituals, as well as corpse disposal, is meticulously followed, to avoid offending the departed or other ancestors (Mbiti 1975). African societies believe in the continuation of life after death. Death is merely a transformative process from living human to eventual ancestor (Ilhagale 2000). Deceased community members are buried to separate the dead from the living (Setsiba 2012). Failure to complete the appropriate funeral rituals or disposing of the corpse incorrectly results in the deceased's spirit to either wonder amongst the living or cause them an undesirable afterlife (Wiredu 1995). An example of failure to bury the corpse is to have it cremated; the fire used is associated with hell, thus the deceased will not be able to return to the community as an ancestor. This is the main reason for the low cremation rate in South Africa.

Following the death of a community member, the deceased is collected from the morgue and brought back into their home for an overnight wake known as

moletelo (Bopape 1995). The function of this is to provide the community with the opportunity to say their last goodbyes to the deceased. During this, a killing ritual takes place; a beast is slaughtered as a sacrifice to the ancestors, as well as to provide food for the community members attending the moletelo (Ilhagale 2000).

At the break of dawn, the morning after the moletelo, before the burial, the final viewing of the corps takes place (Selepe & Edwards 2008). After this, the corpse is removed from the house and taken to the cemetery. Once at the cemetery, the eulogy is read as a means to honour the deceased. After the eulogy has been read, close family accompany the coffin containing the corpse to the grave and watch as it is lowered into the soil. The deceased is returned to the soil upon which they lived. African societies believe that once you have died, your body should be made one with the African soil (Bopape, 1995). Before contemporary cemeteries, community members were buried in a lesaka; a circular structure commonly found in southern African villages where generation upon generation was buried (Freedom Park Trust 2004). After the burial, the family of the deceased is cleansed through rituals, as they have been contaminated from the contact with the dead. To prevent sudden deaths, the cleansing needs to happen before they return to the community (Ngubane 1977). Following the burial and cleansing, there is a after-tears-party; an event where instead of mourning a loved one's death, they celebrate their life (Setsiba 2012). Exactly a year after death, the deceased person returns too the community as an ancestor, to celebrate this, the tombstone is unveiled (Leuta & Green 2011). Ancestors are believed to be the mediators between God and the living (Hogan 1999), they protect and take care of the living (Mbiti 1975).

In conclusion: African societies believe that the body should be dealt with in a dignified and respectful manner. The corpse needs to be returned to the earth to decompose and become one with the soil. The physical lowering of the intact body is important and connected to various rituals. Lastly, the unveiling of the deceased's name a year after the burial is significant.

2.8 Appropriate sustainable corpse disposal in South Africa

From the analysis of the traditional African culture, it is clear that none of the corpse disposal methods discussed in 2.3 adheres to the cultural beliefs. New corpse disposal methods will have to be invented to cater for the African culture. Three types of corpse disposal methods are proposed for a burial site: green burial, human composting, and promession foresting.

2.8.1 Promession foresting

The process and benefits of promession has already been discussed in 2.3.4. Ash from the promession process is nutrient rich, making it a great fertilizer for plants. This provides the opportunity to use the ash in a bio-urn to grow trees and scrubs. A bio-urn consists of two compartments; in the top compartment, the tree seed and compost it placed, while the ash is placed in the second compartment, Figure 12.



Figure 12. Bio-urns: seeds and compost are placed in the top compartment, while the ash remains are placed in the bottom compartment (Fletcher 2015).

The seed will germinate and grow in the top compartment, and as the roots become established, they will grow through to the ash compartment, Figure 13. The rich ashes will nourish the tree and enable it to flourish (Fletcher 2015). Through this process each corpse that is reduced to ashes via promession, will in essence be turned in a tree. Thus not only is this process environmentally friendly, it gives back to the environment.

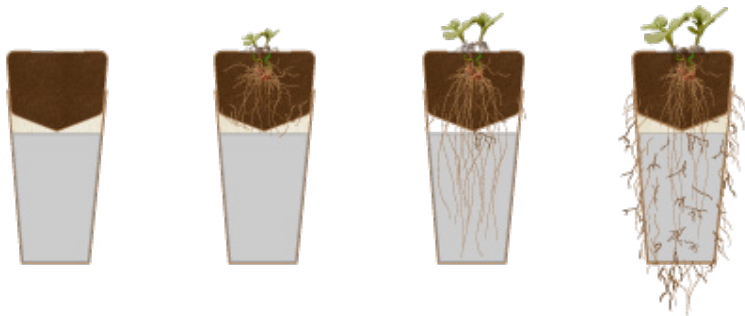


Figure 13. Bio-urns: once the seed has germinated, the roots grow through the compost into the bottom chamber containing the ashes (Fletcher 2015).

Promession foresting is suggested in the design, to make the burial site not only accessible to people from the African culture, but to anyone who prefers reducing their deceased loved one to ashes.

2.8.2 Green burial

Although green burial may seem like a new concept, it epitomizes the saying: what is old is new again. Until the late 1800's, all burials were green, after this, embalming came into fashion and the funeral industry kept growing (Sullivan 2011). Today traditional burial includes embalming and an expensive casket complete with metal adornments and interior cushions and drapes. This prevents and slows down the decomposition of a corpse. According to the Green Burial Council, green burial is a way of caring for the dead with minimal environmental impact (Sullivan 2011). The function of a green burial, is to have a corpse decompose as fast as possible, to achieve this goal the corpse may not be treated with formaldehyde embalming fluid or be placed in a casket that is not biodegradable. Acceptable caskets are plant derived, such as a woven wicker casket. Corpses may also be wrapped in cotton linen. Instead of digging, the grave 2 000mm deep like with a traditional grave, the green grave is dug only 600mm deep, Figure 14.

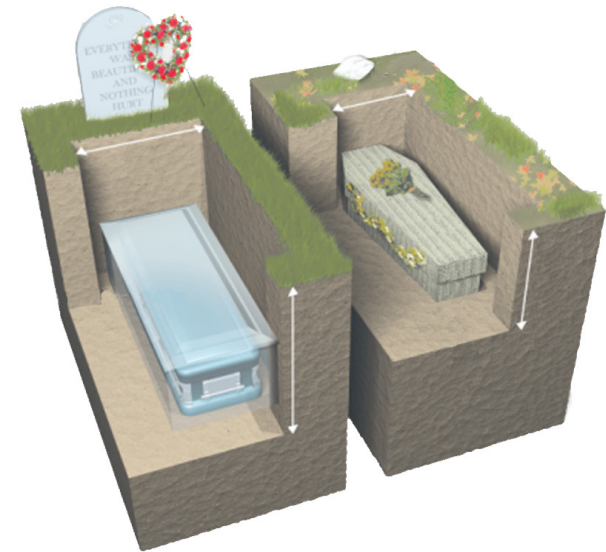


Figure 14. Traditional burial versus green burial. The grave for green burial is shallow compared to the depth of a traditional grave. A wicker coffin is used and no permanent tombstone is placed (Sullivan 2011).

This ensures that the corpse is close to the active soil layer, where decomposition can take place (Sullivan 2011). Graves remain unmarked, as they are re-used after 10 years, once the corpse has decomposed completely.

Although green burial still takes up space, the fact that new corpses can be buried in the same grave after 10-15 years, makes it much more sustainable. African communities can use Green Burial, the reveal of the tombstone will not take place, but the names can be engraved on a memorial wall onsite.

2.8.3 Human composting

Although Green burial is more sustainable than traditional burial, it still requires a rather large land portion. The quickest way to return any organic matter to the soil as a useable substance is through composting. Human composting is not practiced anywhere in the world, however, farmer often compost deceased pigs and cows and use the compost for crops. The Author proposes working with the basic principles of composting and turning it into a sophisticated and dignified system to dispose of corpses. The Author believes that it can be designed in such a way that the corpse can be dropped into the composting chamber, retaining the idea of lowering the corpse into the ground. The outcome of the composting will be humus, organic matter, which can be immediately returned to the soil and used to nourish vegetation. This lines up with the African culture's belief that a human body should be made one with the earth/soil.

The system, process, and detailing of the composting chambers is discussed in chapter 7: Technification.

2.9 Conclusion

Appropriate corpse disposal is where sustainability and cultural acceptance unite. The goal is to design a burial site that provides a range of corpse disposal methods to cater to as many culture and religious groups as possible. Three acceptable and sustainable corpse disposal methods were selected: green burial, human composting, and promession foresting.

Emphasis was place on the African culture since no existing sustainable corpse disposal method is available to them. This has been resolved via proposing green burial and human composting, no further reference will be made to any ethnic group, as it is not the intention to design a burial site for a specific cultural or religious group.



Section 2: Placelessness and user experience

2.10 Archetypal cemeteries

“When I think of a cemetery, I involuntarily envision arrays of tombstones, crosses, weeping angels, boulevards of evergreen trees, and rolling green lawns lavished with colourful flowerbeds.” (Author 2015)

Cemeteries have become typical. The lack of geographic and cultural consideration has left us with repetitive cemeteries. Furthermore, cemeteries are no longer emblematic. The discussion surrounding emblematic landscapes dates back to the 18th century. According to Hunt (1971), an emblematic landscape requires ‘reading’. It must be examined, compared, and explained before the design can be understood as a whole.

William Kent’s garden at Rousham, Oxfordshire, England is a worthy example of an emblematic garden. It has spaces of specific meaning and significance, as well as iconography in the form of writing and statues. The garden has many interpretations. The most simplistic interpretation is that the garden pays homage to ancient Rome and the Imperial games. A deeper level of interpretation can be made when, for example, studying the Sheermaker’s statue, Figure 16, of a fatally wounded gladiator, in his final moments before death. The gladiator can first be seen for what he is: a gladiator dying due to injuries sustained during the games. This is a simple reference to ancient Rome. Considering a deeper meaning, it may be argued that the gladiator represents General James Dormer, the owner of Rousham. He personally commissioned Kent in 1738. Dormer was wounded at

the battle of Blenheim and the dying gladiator most likely symbolized the General (Hunt 1971). This is but merely one example of how symbols are used to create this emblematic landscape.

Similar to Rousham, the tradition of cemeteries were also emblematic and filled with meaningful iconography. An angel depicted a guardian guiding the deceased



Figure 16. Wounded Gladiator at Rousham (Hunt 1971).

to heaven, doves symbolized peace, a star meant that death could never overpower light, and an urn represented immortality (Reid 2000). However, according to Reid (2000), many tombstone and cemetery symbols have lost their meaning. In the funeral industry, statues in the form of angels, small animals, and crosses are mass-produced and catalogued. People simply have to select a coffin, tombstone, picture frames, and ornamental statue, based on price and aesthetic value.



Figure 15. Collage of Johannesburg cemeteries (Johannesburg City Parks 2008).

Due to the commercial nature of the funeral industry, catalogue iconography is contributing to the increased placelessness of many contemporary cemeteries.

Augé (1995) defined the notion of place and non-place within the urban environment. He stated that place can be defined as relational, concerned with identity, and individuality, while non-place cannot. Non-place or placelessness is described as desolate and predictable spaces. The spaces offer no mystery, uncertainty, or adventure. Michel de Certeau strengthens the idea of non-place, stating that it is a negative quality of place, as well as an absence of the place from itself (Augé 1995). According to Jacky Bowring the loss of place is due to rapid globalisation and the taking for granted of familiarity of landscape. Jala Makhzoumi supports this notion by stating ‘because it is “everywhere”, the landscape is ironically invisible’ (Bowring et al 2013). Due to globalisation, landscapes are morphing into one another and becoming indistinguishable regardless of geographical location or culture. In accordance with Marc Augé description of non-place many cemeteries within the boundaries of Johannesburg can be classified as non-place, as they are indistinguishable from each other and have been designed without any regard for unique geographical location.

There is a need to reconsider how cemeteries are designed. In order to revolutionise cemetery design, their essence and function have to be abstracted, this can be done by deconstructing cemeteries.

2.11 Deconstructing cemeteries

What makes a cemetery a cemetery? Is a cemetery a static evergreen landscape consisting of a lawned garden with precisely plotted graves and tombstones? A

deserted space reserved for the dead?

According to Curl (1999) a cemetery is a burial ground, a large landscaped park or ground which has been laid out expressly for the deposition or interment of the dead. Whilst Kolbuszewski (1995), states that cemeteries have two essential connected aims: to be a priori formulated resolution, and to facilitate burial, which is carried out in an appropriately ritualised way. Meyer (1997) argues that the defining feature of a cemetery is grave markers; it acknowledges deceased person’s life. He believes that the site carries the purpose of commemorating the departed.

Considering the abovementioned definitions, the essence of a cemetery can be deconstructed into four characteristics: a place to lay someone to rest, a commemorative space, a contemplative space a landscaped garden space.



2.11.1. Laying a deceased loved one to rest

Cemeteries, as per the Greek origin, *κοιμητήριον*, literally means “sleeping place”. Thus, the first characteristic of a cemetery is laying to rest the bodily remains, a corpse or ashes, of departed loved ones in a dignified and safe manner. According to Hunt (2001:20), “there is a desire for the protected preservation of human remains”.

2.11.2. Identity commemoration

The second characteristic, is the acknowledgment and commemoration of an individual in the form of an inscription (Meyer 1997).

Inscriptions in cemeteries become very meaningful and significant. They influence the living visitor; by becoming a voice from beyond, the grave. The theoretical term for this phenomenon is ‘prosopopeia’, it is a method, which allows an absent figure to speak. This voice can either be of a deceased person or of the *genus loci* of the place (Hunt 2001:22).

According to Wolschke-Bulmahn (2001:3), “identity”, and “commemoration” are two terms that refer to humanity’s fundamental concerns. Consciously or unconsciously, everyone is occupied with identity: who he or she is, where they fit in, as well as the urge to belong.

Death plays a significant role in the process of establishing identity. Places that commemorate the dead are important in society. The commemoration of death and the designed environments for the departed help to establish identity (Wolschke-Bulmahn 2001:3). Gardens and landscapes have played commemorative roles in the process of identity formation at different times and for different cultures. Cemeteries as places of commemoration have developed over the past centuries and are today an important part of public space (Hunt 2001).

2.11.3. Grief and remembrance

The third characteristic is the provision of contemplative, grief, and remembrance spaces. Mourners require a safe space to express and process feelings regarding their departed loved ones.

2.11.4. Landscape for the loved one

The final characteristic is the nature of cemeteries. Cemeteries are outdoor landscaped garden spaces. It is said that the relationship between tombs and gardens dates back centuries (Wolschke-Bulmahn 2001). According to Etlin (1984), the tombstone was as much part of the landscape garden as the meandering path. Hunt (2001:10) states that the garden is poised between life and death, it is a compassionate and healing world. It becomes an intermediate zone between the dreadful past and the projected happy future.

From this discussion, it is clear that the essence of a cemetery does not lay in the archetypical image we have of it. Perhaps we should avoid using the term “cemetery”, because of the typical image connected to it. Instead, we should rather refer to these landscapes where we lay our loved ones to rest and commemorate them, as burial sites.

Places of burial are not scary or creepy hollow memorials. They rather possess the power to be moving, rich and provocative places, with real powerful and positive meanings (Eggenger 2010).

2.12 The leftover humans

In the previous section, the four main characteristics of an typical contemporary cemetery were discussed. Interestingly enough, three of the four characteristics; focus on the living visitor and not on the deceased. Who do we design commemorative landscapes for?

...my one saving grace is distraction. It keeps me sane. Still it's possible you might be asking, what does he need a distraction from?

Which brings me to my next point.

It's the leftover humans.

The survivors.

They're the ones I can't stand to look at, although on many occasions I still fail. I deliberately seek out the colors to keep my mind off them, but now and then, I witness the ones who are left behind, crumbling among the jigsaw puzzle of realization, despair, and surprise. They have punctured hearts. They have beaten lungs.

Prologue, narrated by Death, *The Book Thief* (Zusak 2007)

In the *Book Thief*, Figure 17, a novel by Markus Zusak, Death, the narrator, addresses inevitable demise. He states that mortality makes all humans equal. He urges the reader to not be fearful or despair, for he is gentle and always fair. Regrettably, the people who are left behind make his job exceptionally difficult. He tries to avoid them, but ever so often, he catches a glimpse. They are heartbroken and overcome with emotions, not only of grief, but also the realisation of their own inescapable death. It is not about the deceased, but about the living.

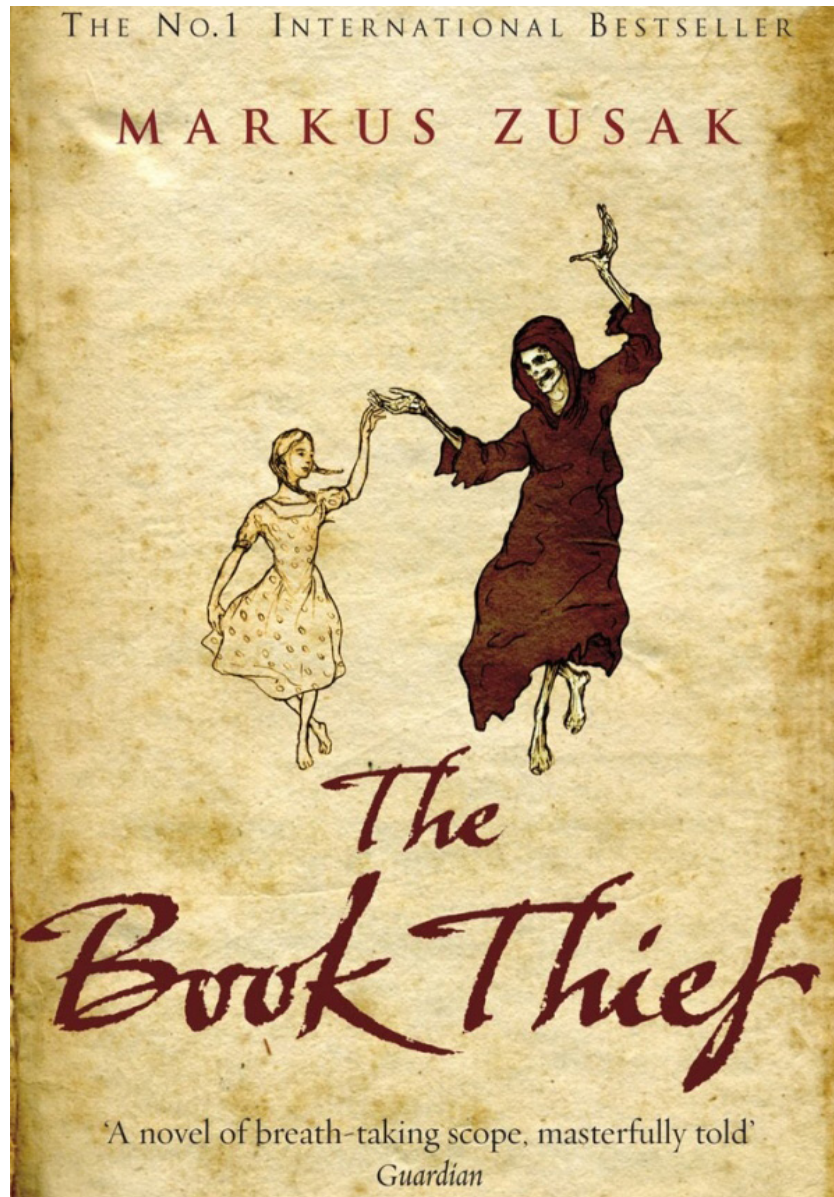


Figure 17. The Book Thief cover art by Judy White (2005)

Hunt (2001:13) stated that the commemoration of a departed loved one is to make it bearable for the living, not the dead. A burial ground becomes a place to remember the dead. Commemoration lies with those who remember, not those who are remembered. The notion of commemoration implies the presence of some idea of the past, which is preserved in the present as a conscious thought (Treib 2001). Treib (2001) and Hunt (2001) places emphasis on the people who are left behind once someone has departed. Commemoration requires the essential activity of memory, without it, there would be no need to design burial grounds.

Considering this, when designing a burial site, the emphasis should be on the user. This notion leads to the question: How do we design a commemorative landscape?

2.13 Types of commemorative landscapes

Commemorative landscapes are designed for the living user, the people who have someone to remember. Eaton suggests in (Treib 2001) that in these commemorative spaces, we should depict life, not death. Landscape architects should design safe places for our treasured departed and places for the living to respectfully enjoy.

According to Treib (2001), there are four types of commemorative landscapes. They vary in method, as well as the degree of explicit communication.

Type 1: Reordering the elements in the landscape to establish a human presence or convey a notion.

Rocks for example: granite boulders deposited onto a coast demonstrates a natural order, due to glacial sediments and environmental forces. One can indicate human presence simply by rearranging these stones. Pure geometric figures, as seen in the rows of stones at Carnac in Brittany or the stone circles at Stennes in the Orkney Islands, Figure 18, are deliberately used to contrast the natural context. The geometry establishes spatial zones.

The elements are natural and unworked; it is only the form, which is artificial. The focus is on the relationship between the elements. In addition, the elements may be reformed.

Type 2: Visual iconography and verbal inscription overlay and reinforce the intention embodied by natural elements, which have been reconfigured



Figure 18. Example of type 1: Standing stones, Carnac France (Prima 2010; Schneider 2002) and Stone circles, Stennes, Orkney Islands (Gorman, 2011; Handoll 2015).



Figure 19. Example of type 2: Kongenshus Mindepark, Sweden (Sorensen 2007) and Kring van Kennis, Johannesburg (Hamblin 2000).

Figure 20. Example of type 3: Woodland cemetery, Sweden (Jiranek 2011, Telling 2011).



in a unnatural order. Kongenshus Mindepark, Sweden and Kring van Kennis, Johannesburg, Figure 19, are examples of this type.

Type 3: Instead of relying on symbols the landscape modulates compartments. The recovery of memories rely on the individual and their associations. A deep, directly perceptual program engages the individual, through experience rather than explicit reference. The main form of communication is through the landscape design. Example: Woodland cemetery, Enskede, Sweden, Figure 20.

Type 4: The balance between the tangible experience of architecture and landscape is diminished. The emphasis is completely on visual cues and verbal captions. Words and symbols prevail, by buying into eternity. It attempts to stop the clock in such a way that our moment is continually eternal.

These four types provide guidelines on how to design commemorative space, however, designing a burial site requires more than the ordering of elements. By default, burial sites are significant; they are landscapes containing deceased loved ones. The manner in which we design these spaces will influence how meaningful the space becomes to the mourner. How do we design a meaningful landscape?

2.14 Making landscape mean

The notion of instilling significance, designing spaces of deliberate meaning, and narrative landscapes is nothing new. Meaning and significance has been enriching landscape designs for centuries. In 1995 Marc Treib asked a simple question: Must Landscape Mean? In this controversial article, he questioned whether it is possible to add a semantic layer into landscape architecture. Could we as designers communicate our intended meaning to the user? And should we?

It is daunting to define meaning or significance; Olin (1988) argues that it can be accumulated through use and ritual, while Treib (1995) is hesitant to define meaning and considers it to consist of ethics, values, history, and affect. He states that landscape architects usually apply one of five approaches to landscape significance: the neoarchaic, the genius of the place, the zeitgeist, the vernacular landscape, or the didactic (Treib 1995):

In the neoarchaic approach designers try to retrieve something that has been lost

by reviving elements from earlier periods, such as the Neolithic. This approach attempts to reclaim meaning from historical points in time and displays it in a contemporary design, believing that it will have the same meaning now as it did at a specific point in time (Treib 1995).

Genius loci literally means spirit of place, thus in the genius of the place approach, designers focus on the pre-existing characteristics of the specific place or site. Within this approach, it is believed that emphasizing or reflecting these unique conditions, a meaningful design is produced for the users (Treib 1995).

Moving away from the spirit of the place, the zeitgeist approach is about spirit of the times. Many artists' work reflects the period they are created in, and thus become meaningful. In this approach, it is argued that the same is true for landscape architecture. It becomes part of the ethos on the era and thus becomes significant (Treib 1995).

In the vernacular landscape, the approach includes sourcing materials and forms from a place's rich vernacular. Unfortunately, in the process of reframing vernacular elements in contemporary projects, they have semantically nearly nothing in common with their original sources (Treib 1995).

The final approach is didactic; it dictates that forms should communicate the natural workings of a place. Through revealing them, they become meaningful (Treib 1995).

Are these approaches enough to establish meaning. Are they not just good design principles? When designing any landscape, the architect should consider the spirit of the place and the existing site conditions, just like the design should be contemporary and appropriately placed within the zeitgeist. Vernacular design should be studied regardless, for it reveals information regarding locally available materials, artisanship, and even climatic conditions. The above-mentioned approach aids landscape architects to design enriched and appropriate landscapes, however they do not instantaneously make a place significant or meaningful.

The question whether or not is it possible to imbue a place with meaning from the outset remains. Treib (1995) suggests considering the value of the Zen garden. The uninitiated user of a Zen garden has no knowledge of Japanese culture and could not appreciate the meaning of the embodiment of religious belief in the

garden. They could however appreciate the framing of the space, the arrangement of materials, and the quality of rocks. The manner in which the space is designed reveals the function and spirit of intention. Although the user does not understand the meaning behind the garden, the experience and function is not lost. Treib states that the garden, through its design, stimulates individual contemplation; the garden itself becomes a vehicle for understanding the self rather than the place (Treib 1995).

This notion implies that meaning and significance in landscape design cannot solely rely on the designer. According to Treib (1995), meaning occurs at the intersection of people and place, Figure 21.

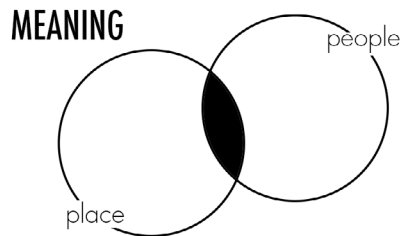


Figure 21. Meaning can only occur where people and place intersect (Author 2015)

Treib believes that significance lies with the beholder, not alone in place. The design of a space translates what the designer intended into what the user experienced. Reid (2007) suggests the following ideas when designing to evoke significance from a user.

Themes: Have a unifying topic, select something that can be pulled through into each aspect, such as form giving, detailing, and planting.

Symbols: Elements or forms that represent something else by association can be empowering and enrich the design.

Metaphors: Objects or ideas used to describe dissimilar objects or ideas in order to suggest comparison makes for an intriguing design.

“I do believe that we can circumscribe the range of possible reactions to a designed place. We cannot make a place mean, but we can, I hope, instigate reactions to the place that fall within the desired confines of happiness, gloom, joy, contemplation, or delight.”
(Treib 1995:100)

In conclusion: a designer can aid in creating a significant or meaningful place for a user through creating the required landscape experiences. Significance cannot be designed into a place, however, designing landscape experiences that will evoke predetermined emotions, Figure 22, can create a meaningful commemorative burial site for the living visitor. Dealing with the loss of a loved one is by default an extremely emotional and spiritual experience. Designing the journey of the mourner into the commemorative landscape could potentially result in a powerful expressive landscape, which will evoke emotion and thus become meaningful. The notion of a journey can be conveyed through a narrated landscape.



Figure 22. Landscape architects can create spaces that evoke predetermined emotions (Author 2015)

2.15 Narrative landscape

Meaning evolves around the place and the user’s interaction with the landscape. The experiences that stimulate meaning can be grounded in a narrative landscape.

According to Potteiger & Purinton (1998) narratives can aid in the establishment of significant spaces in the landscape. The relationship between place and expression is the narrative. Landscape narratives are inspired by a variety of different elements; including culture, myths, events, rituals, the site, or even literature.

The landscape narrative is described as the chemistry and mutualism that develops between landscape and narrative. Storytelling plays a critical role in place making. Rakatansky (1992) states that instead of grafting an explicit disassociated storyline onto the site as if the site is tabula rasa, the function of the site, in this thesis case a burial site, and the cultural practices of the area, can start to give an idea of what the landscape narrative will entail. The purpose of the landscape architect is to conceptualize the narrative and give form to it (Cohan & Shires 1988). A story embedded in landscape takes shape through practices of naming, sequencing,

revealing/concealing, erasing, gathering, and opening (Potteiger & Purinton 1998).

Naming

Naming something is as creative as giving form to it; it bestows identity, and aims to illuminate the essence of the place, as well as the projected hopes and aspirations. In literature, characters are given names to identify them. In landscape architecture, place names assist in situating a place within its larger cultural identity (Potteiger & Purinton 1998). Names can start to reveal a character or genius loci of a place. An example of a place name, which reveals the spirit of the space, is Isivivane, located in Freedom Park, Salvokop. Isivivane, Figure 23, literally refers to a cairn of stones, while the deeper meaning is monument, memorial, and testimonial (Ngubane 2003). As expected from the name, Isivivane is a sanctuary, a place of pilgrimage, renewal, and inspiration. At the core of this contemplative space, stones are arranged in a circular form, it represents isivivane and makes an African cultural reference to a lesaka, a circular space where people from the community are buried (Ngubane 2003).



Figure 23. Isivivane, Freedom Park, Salvokop (Ngubane 2003).

Sequencing

In a story, a sequence is made up of any two or more events, Figure 24. The first event refers to the existing condition, while events after the first is a modification. This modification can be contrasting, cataclysmic, or it can be a barely subtle shift in routine.

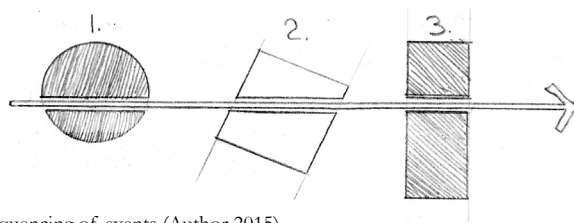


Figure 24. Sequencing of events (Author 2015).

In a landscape narrative, sequencing involves the user through a series of juxtapositions; this includes bringing the old into direct contrast with the new, or placing a glade in a forest to emphasize the dissimilarity.

Maya Lin's Vietnam Veterans Memorial, Figure 25, in Washington, D.C represents a cyclical, open-ended sequencing. Instead, on starting at the beginning of a memorial wall to tell the story of the war, Lin's memorial wall starts in the middle of the war. In the middle of the wall, the beginning and end of the war collide at the vertex of the chevron. The confusing collision poses questions of why and how the war began. The achronological nature of the wall forces visitors to walk along the wall, they metaphorically descend back and forth in time. The sequencing of this space communicates a strong narrative. (Potteiger & Purinton 1998)



Figure 25. Maya Lin's Vietnam Veterans Memorial (Betsy 2002).

Revealing/Concealing

An important characteristic of a novelist is the ability to engage their readers by building suspense and intensifying ambiguities through plot and character development. A landscape architect can use similar techniques to engage users in narratives. Revealing and concealing elements create a feeling of discovery and suspense (Reid 2007), as seen in Figure 26.

Three ways of doing so includes:

- Revealing the concealed details of a place
- Challenging convention with regard to the status quo of similar spaces
- Masking and unmasking knowledge and meanings with the aim of encouraging user engagement and inquisition from the visitor's perspective (Potteiger & Purinton 1998)

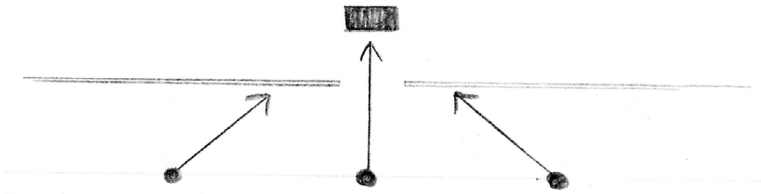


Figure 26. Revealing and concealing can create suspense (Author 2015)

Erasing

The notion of erasing, or subtracting for the landscape is discussed by Treib(1987) in his article entitled; *The Presence of Absence: Places by Extraction*. He states that every act is some form of disturbance, however, sometimes disturbance can improve the existing condition or contribute to the design. One can think of absence as omission or as abstraction. Instead of adding onto the landscape, one can create negative space to form expressive spaces. Psychologically speaking we perceive contrast first: before we notice the texture or colour of a leaf, we notice the shape due to the contrast between the leaf and the background. The same is true for a user experiencing a landscape; the contrast between positive and negative will draw the most attention. An example of such a space is Mormon Mesa, Figure 27, in Nevada; the sculpture is created solely by removal and displacement (Treib 1987).

The notion of Presence of Absence seems rather fitting considering this thesis evolves around designing a burial site, a place where users are already experiencing the presence of absence of their loved one.



Figure 27. Mormon Mesa, Nevada, Eforcing the concept of the double negative (Treib 1987).

Gathering

Just like stories in literature have structure: a beginning, body, and end, narrative comprises of the same structure, with the optional addition of returns and cycles. No narrative is merely a series of scattered random events. The notion of gathering refers to the clear spatial connection between the events of the narrative, Figure 28. (Potteiger & Purinton 1998).

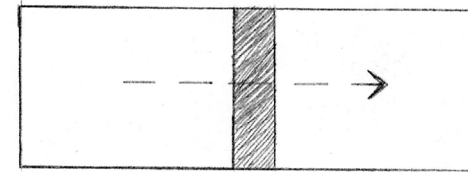


Figure 28. Diagrammatic representation of gathering (Author 2015).

Opening

Having an open narrative, one open to interpretation, instead of a closed narrative, holds great potential for users to interpret and to be open to the voices, stories, and cultures that shaped that particular environment. A closed narrative is controlling and restrictive, it silences diverse voices (Potteiger & Purinton 1998).

2.16 Conclusion

In order to locally grounded the design of the burial site, the local geography and culture will be studied, while the experience of the user will be emphasized through an expressive and narrated landscape design.

We should reconsider how we design cemeteries. In order to revolutionise cemetery design, the essence and function have to be abstracted, this will be done by deconstructing cemeteries.

03

Site analysis

3.1 Introduction

This chapter is an analysis of the Diepsloot Nature Reserve. The aim is to comprehend the site within its surroundings, as well as the current state and workings of the reserve. From this the site's opportunities and constraints can be identified.

3.2 Site selection

Johannesburg, like many other cities in South Africa, is rapidly running out of burial space. Since 78% of cemeteries are passive, Johannesburg City Parks issued the development of two additional cemeteries: Waterval and Diepsloot (Johannesburg City Parks 2008). The Diepsloot Cemetery, Figure 29, located in the northern suburbs of Johannesburg, is considered South Africa's first eco park concept. In 2007, 60 hectares of the Diepsloot Nature Reserve (DNR) was rezoned to burial space, with an additional 200 hectares to be developed at a later stage (Wilkins 2011). According to Alan Buff, Johannesburg City Park's technological support specialist, the idea behind the Diepsloot cemetery was to design a cemetery that is ecologically sound, as well as a place for passive recreation. In drawing up the brief, Johannesburg City Parks decided to move away from the traditional square layout and adopted a circular pattern, Figure 30, inspired by the central cattle pattern, trying to build on the heritage idea of the Cradle of Mankind (Wilkins 2011). Furthermore, MLA Engineers requested an environmentally friendly cemetery, which would require little to no maintenance. In order to comply with the above-mentioned requests, local flora was studied and implemented. To address the issue of suitable burial, gaps between graves were narrowed and headstones were flush with the ground surface to gain space (Wilkins 2011).

Although the Diepsloot cemetery has received praise, as well as a featured article in the Urban Green File in June 2011, the Author does not consider this an eco cemetery. Instead of addressing the issue of unsustainable burial practice, all that have changed are the grave layout and the surface treatment. Phase one of the Diepsloot cemetery has a burial capacity of 120 000 corpses (Johannesburg City Parks 2008), which is not even enough to cover the current 150 000 residents of the Diepsloot township. Once the graves have been filled, the Diepsloot cemetery will be added to the list of passive cemeteries, regardless of its indigenous planting and water wise systems. Instead of green washing cemeteries, town planners, landscape architects, and local authorities need to address the actual concern: we require sustainable and environmentally friendly corpse disposal methods.

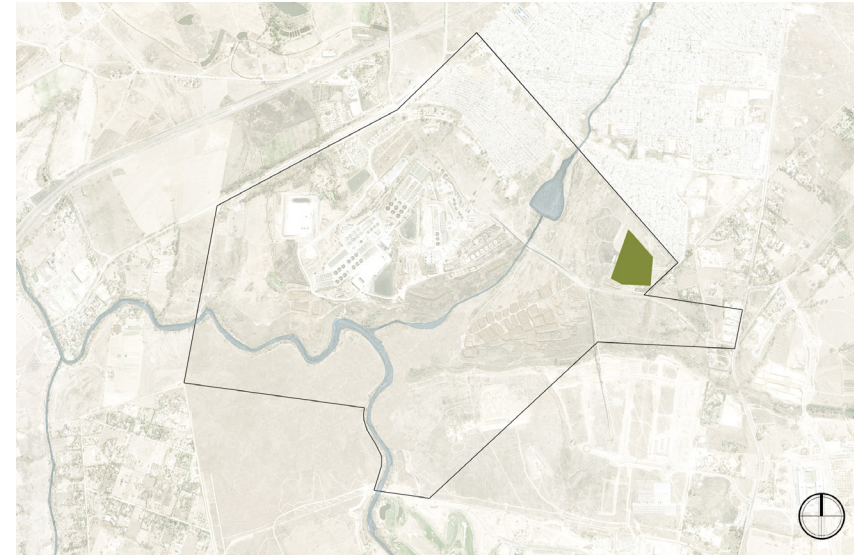


Figure 29. Location of the Diepsloot cemetery within the boundary of the DNR (Author 2015).



Figure 30. Aerial view of the Diepsloot cemetery's circular grave layout inspired by heritage idea at the Cradle of Mankind (Author 2015).

Since Johannesburg City Parks has already approved the DNR for additional burial space, it will be used as the study area for this thesis. Instead of implementing phase two of the unsustainable Diepsloot cemetery, this thesis will strive to provide an alternative, which will focus on the problems stated in chapter one.

3.3 Adjacent land use

The DNR is located in region A of Johannesburg, it is situated between extremely high-density informal settlements in the north and very low density private estates in the south, Figure 31. These different residential densities are indicated in Figure 32.

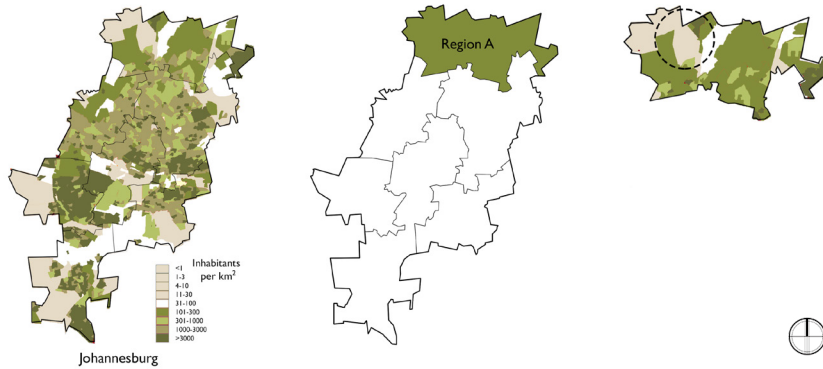


Figure 31. The DNR is located between extremely high and low population density areas (Author 2015).

Private residential estates have sprawled north up to the nature reserve's boundary, while the informal settlement of Diepsloot has sprawled south into the reserve, due to the absence of a proper reserve boundary fence. Figure 33 shows the rapid expansion of Diepsloot Township into the reserve from 2006 to 2014. Other adjacent land uses include mixed use (commercial and residential), and green open space, as illustrated in Figure 32.

3.4 Access

Although there are two mayor arteries, the N14 and R114, on the western side of the site, they do not provide access to the nature reserve. The three streets with access to the reserve are Runnymede Avenue, Zeven Street, and School Road, indicated on Figure 34.

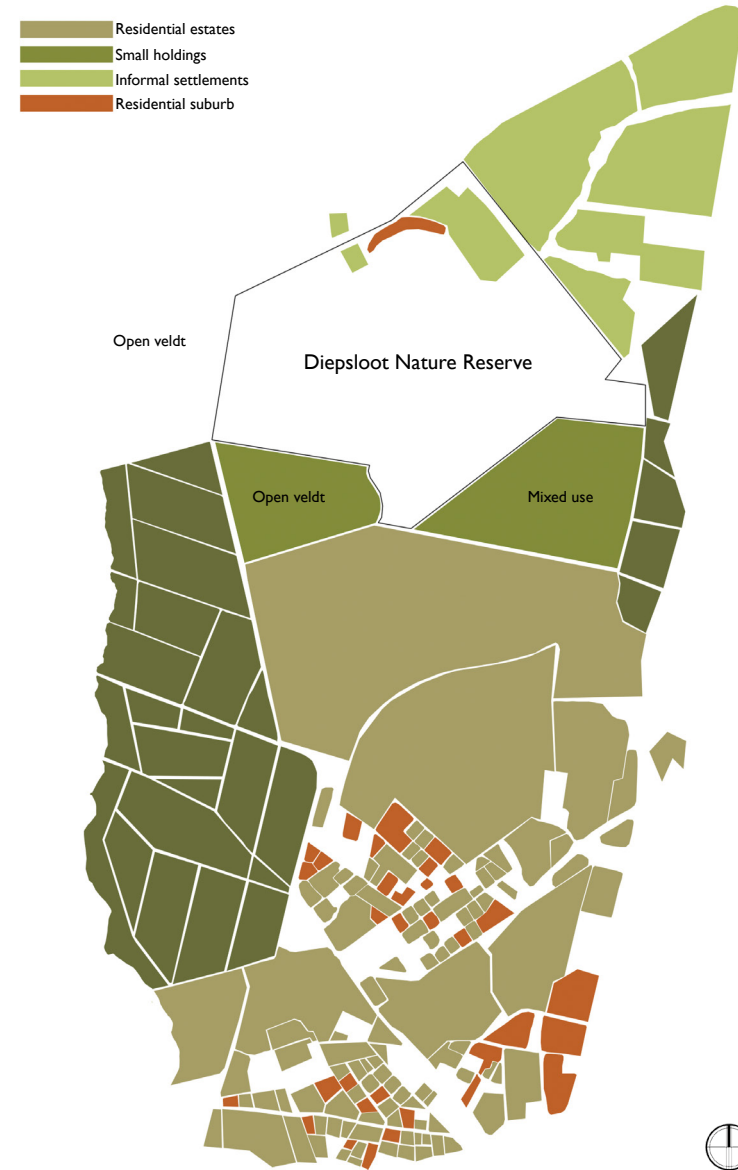


Figure 32. Types of residential areas surrounding the DNR (Author 2015).

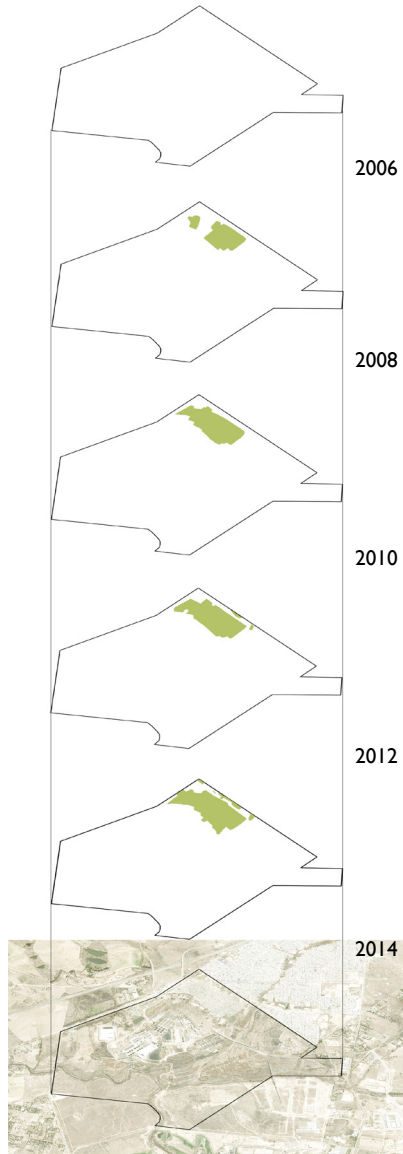


Figure 33. Expansion of the informal settlement into the Diepsloot Nature Reserve from 2006 to 2014 (Author 2015).

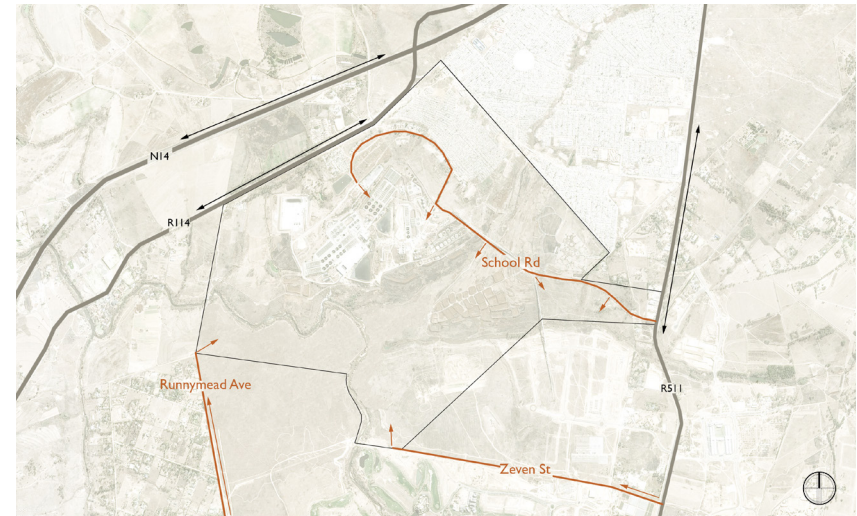


Figure 34. Adjacent roads and vehicle access to the Diepsloot Nature Reserve (Author 2015).

3.5 Visual Analysis

The DNR is a pastoral and romantic landscape with undulating plains, Figure 35 to 38. It is grassland with a few tree clusters. The on site sewage plant is not visually displeasing. The concrete sewage cylinders are submerged into the soil, thus it does not ruin the experience of the reserve, and instead the cylinders' tops form an interesting pattern on the surface, Figure 39. There are also two substantial elevated sewage lines running across the site. These act as a datums and emphase the topography of the reserve, Figure 40.





OPPOSITE PAGE Figure 35. Diepsloot extension resident walking through the reserve with a view of the sewage line (Author 2015).

TOP Figure 36. Old sewage drying pans overgrown with grasses and crops. Old concrete pillars remain from a broken palisade (Author 2015).

MIDDLE Figure 37. Diepsloot Nature Reserve's undulating planes, grassland, and the sewage line (Author 2015).

BOTTOM Figure 38. Less disturbed grassland area of the reserve (Author 2015)



Figure 39. Tops of the concrete sewage cylinders emerging from the landscape of the DNR (Author 2015).



Figure 40. Sewage Line as seen from within an informal road on the DNR (Author 2015).

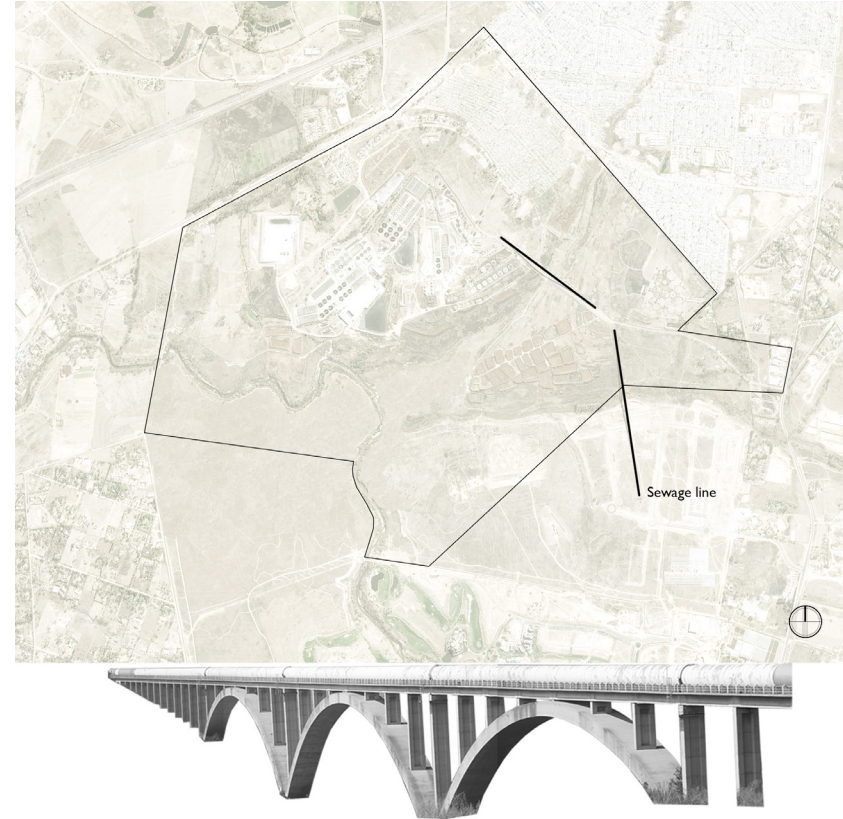


Figure 41. Location of the suspended sewage line in the Diepsloot Nature Reserve (Author 2015).

3.6 On site activities

3.6.1 Sewage treatment plant

The Northern Water Works is the largest sewage treatment plant in Johannesburg, Figure 42. It serves 1.6 million people and treats 400 million liter of soil water a day. During the past couple of decades, the sewage plant has tried numerous ways to treat the sewage, one of which degraded the reserve. The sewage plant initiated a project called JoGrow, where raw sewage was dried in drying pans and

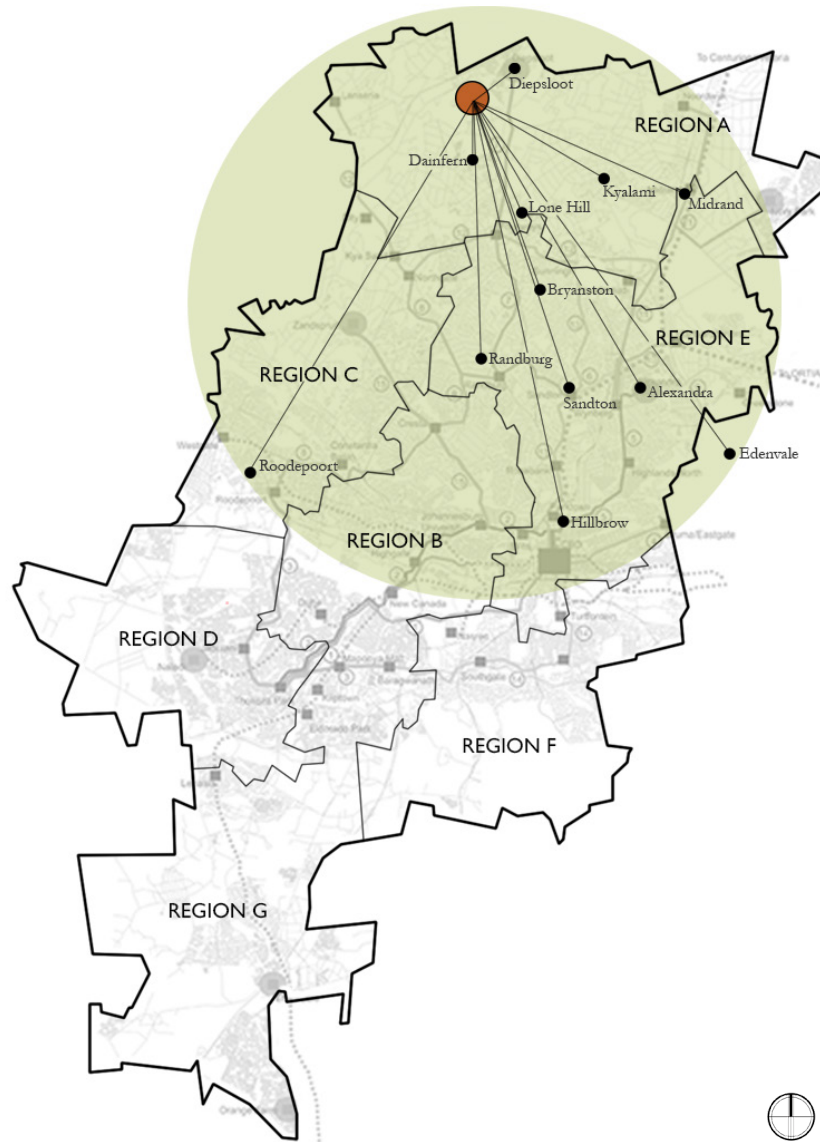


Figure 42. The Northern Waste Water Works is the largest sewage treatment plant in Johannesburg and serves almost 50% of its residents (Author 2015).

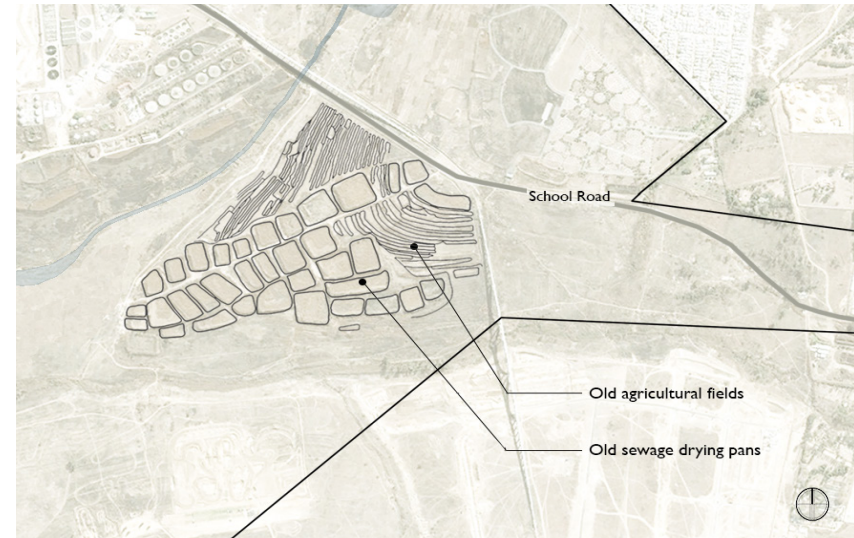


Figure 43. Remaining arial patterns of agricultural fields and sewage drying pans (Author 2015).

then applied to agricultural fields and lawn areas, Figure 43. Cattle were brought in to graze on the lawn. The agricultural fields, lawn areas, as well as the addition of livestock disturbed areas of natural vegetation. The project ended because it was not financially feasible. The pans, agricultural fields and lawn remain, the areas have not been rehabilitated by the Johannesburg City Parks, however through natural succession and pollination grassland species have established inbetween the lawn and crops, as well as in the drying pans. The remaining patterns are only visible on aerial photos.

Currently the sewage is fed into a bio digester, which turns the sewage sludge into electricity. The sewage plant is sanitary, safe, and not foul smelling. The water from the plant is treated before it is fed into the Jukskei river.

3.6.2 Racetrack

In 2005, an informal dirt bike track developed on site. A decade later, the track has caused substantial erosion, Figure 44.

3.6.3 Recreational

Hikers, mountain bikers, joggers, and dog walkers also use the reserve, mainly over the weekend.



Figure 44. Erosion causing informal dirt bike racetrack in the Diepsloot Nature Reserve (Author 2015).

3.7 Ecology

The reserve falls within the boundaries of the Egoli Granite Grassland. Portions of the natural vegetation have been extremely disturbed over the years. Due to the previously mentioned activities the area is no longer a pure Egoli Granite Grassland, and has very little sensitivity in this regard. Regardless of the type or types of grasslands on site, the reserve provides many ecosystem services as an open green space. Egoli Granite Grassland Restoration is not a feasible option, however rehabilitation of the grassland is. Many of the disturbed areas can easily be rehabilitated, and have already done so without any human interference: the sewage drying pans and old agricultural field is covered with grassland species.

Instead of mapping ecological sensitivity, where there is very little, the areas are grouped according to its rehabilitation feasibility, Figure 45. From this mapping conclusions can be drawn and decisions can be made. For instance: the informal settlement sprawling into the site is an area that is highly unfeasible to rehabilitate as a grassland, however a boundary surrounding the grassland next to the settlement will prevent further sprawl.

3.8 Soil

The underlying geology is Halfway House Granite Dome. The soil of the reserve is sandy, gravelly, and relatively deep. According to the Department of Water Affairs and Forestry the soil and underlying geology is suitable for corpse burial, this is discussed in chapter seven.

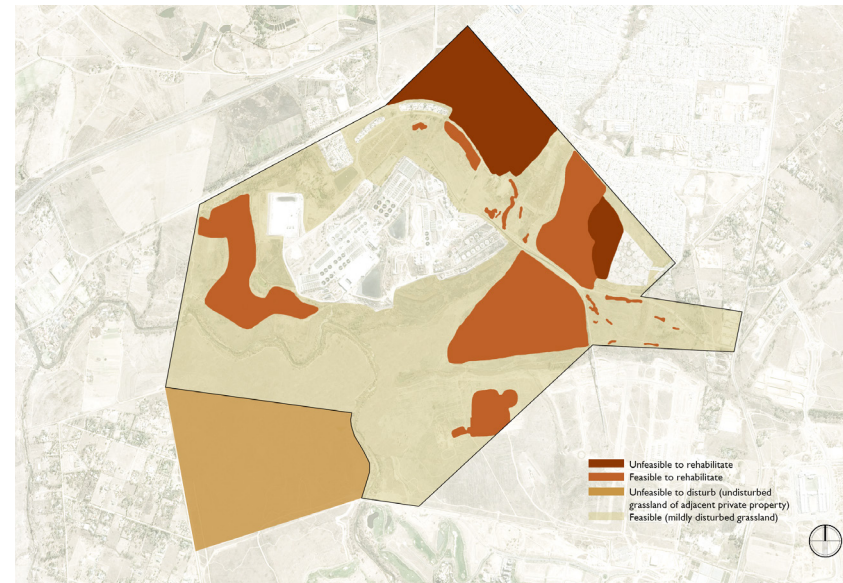


Figure 45. Rehabilitation feasibility mapping of the Diepsloot Nature Reserve (Author 2015).

3.9 Hydrology

There is one river, one perennial stream, and one seasonal stream running through the reserve, Figure 46. The perennial stream's catchment area is the entire Diepsloot township, thus the stream is highly polluted. The Jukskei River does not run through any developed areas before it reached the reserve and is therefore clean. The water from the sewage plant is purified before it is fed into river.

3.10 Climate

The site has a semi arid and cool climate with summer rainfall and an annual rainfall of 543mm. Valleys get cold, thus vegetation has to be frost resistant. The prevailing wind direction is north-east.

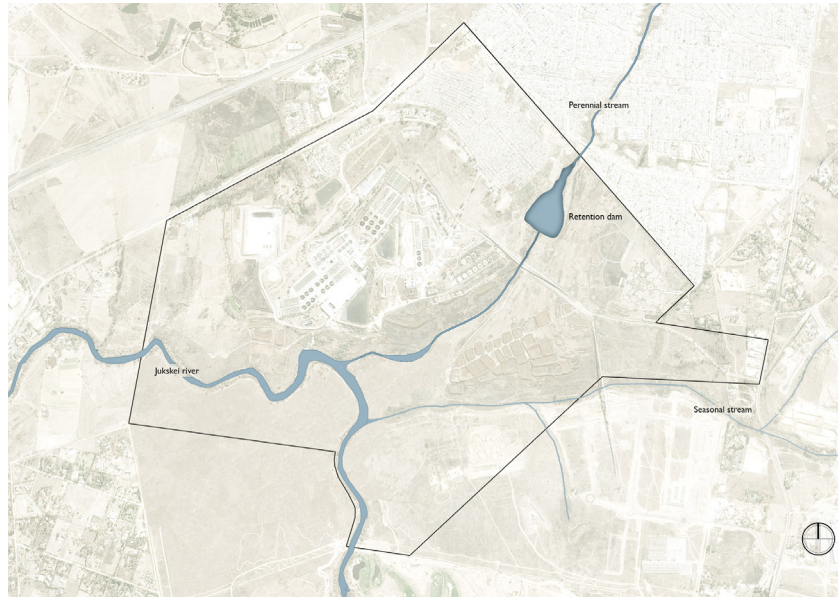


Figure 46. Streams, river, and retention dam on in the DNR (Author 2015).

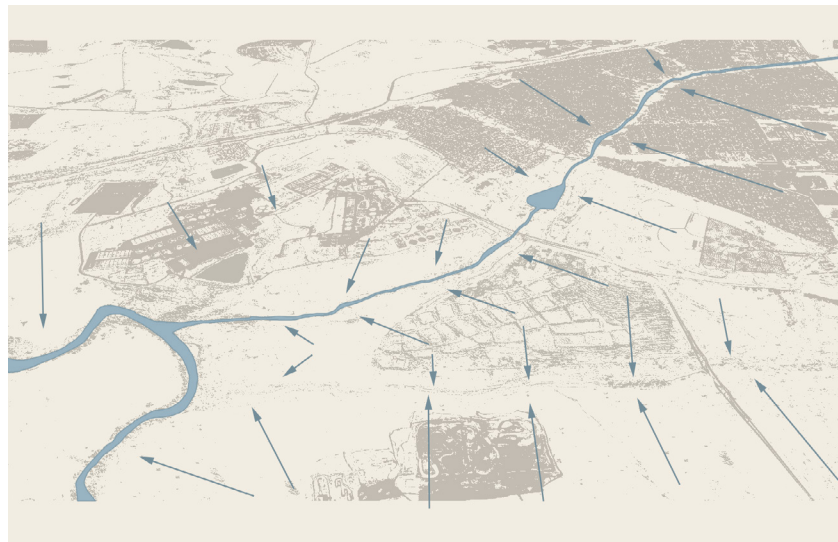


Figure 47. Hydrology of the Diepsloot Nature Reserve (Author 2015).

3.11 Opportunities and constraints

Opportunities	Constraints
Disturbed areas can be developed. If the entire reserve had a high sensitivity, it would have been difficult to justify development.	A large portion of the reserve is disturbed and of low ecological sensitivity; rehabilitating it may not be feasible.
Even in a degraded state people use the reserve. Through additional programmes more users can be drawn in.	The close proximity to Diepsloot township draws into question the safety of the reserve.
The rehabilitation of the site and the addition of wildlife will enable ecosystem services and increase the biodiversity of the area.	Wildlife such as game can not be brought in the reserve without upgrades to the site and the Diepsloot stream.

3.12 Conclusion

The DNR, although degraded has the potential to be rehabilitated into a proper nature reserve. Its close proximity to high and low-income residences, commercial centers, and numerous roads makes it easily accessible to both vehicles and pedestrians. The site has areas of disturbed vegetation, thus the development of a burial site is feasible. Without any intervention the reserve will continue to degrade due to township sprawl, erosion caused by dirt bike tracks, and the illegal dumping of rubble. This will result in the de-proclamation of the site's nature reserve status.

The next chapter discusses the proposed framework to upgrade the reserve, as well as where the burial site fits in.

04

Diepsloot Nature Reserve Framework

4.1 Landscape vision for the Diepsloot Nature Reserve

The vision for the DNR is a clearly demarcated and protected reserve, which is dynamic and multifunctional. One of the functions of the nature reserve, and the most important one for this thesis, is the proposed burial site that disposes of corpses in a sustainable manner and takes the user through a narrated landscape. In order to design the burial site inside of the DNR, a framework for the entire reserve has to be in place.

Figure 48 illustrates the proposed framework for the DNR. The goal of the framework is threefold. The first goal is to upgrade the reserve to a site worthy of being a proclaimed reserve. This is achieved through the rehabilitation of the Egoli Granite Grassland, purification of the Diepsloot stream, removal of dumped rubble, proper fencing, and the addition of wildlife, such as antelope and zebras. The second goal is to provide formal and proper access to the reserve, and the final goal is to create a dynamic and utilized landscape through alterations and additions to the programme of the reserve. (The burial site being one of the additions)

4.2 New nature reserve boundary

Due to excessive sprawl into the reserve from Diepsloot township the boundary of the reserve has been altered. The new boundary, Figure 49, excludes the informal addition of the township, as well as the Diepsloot cemetery. Proper fencing will be erected to prevent further illegal rubble dumping and keep the game inside of the reserve.

4.3 Addition of low-income housing

According to Wilkins (2011), once the Diepsloot cemetery has reached its burial capacity, it will be utilized as a neighborhood park. A successful neighborhood park should be central and surrounded by residences. The Diepsloot cemetery is currently surrounded by open veldt and residences only in the distance. Without the addition of residences adjacent to it, the cemetery, like numerous other cemeteries in Johannesburg, will become abandoned. It will not be a quaint neighborhood park. Passive cemeteries in Johannesburg are unsafe for users. Many murders and rapes take place in cemeteries close to informal settlements

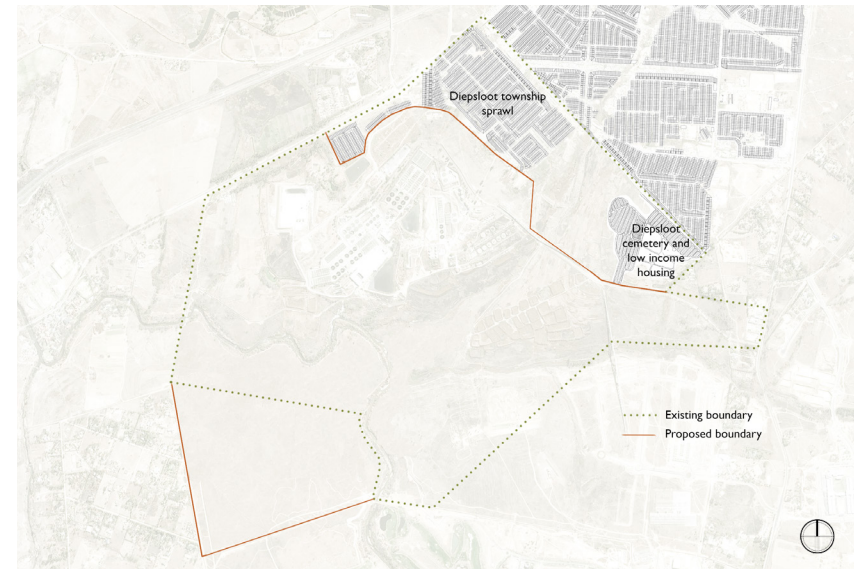


Figure 49. Existing and proposed nature reserve boundary (Author 2015).

due to a lack of passive surveillance (Johannesburg City Parks 2008).

To transform the soon to be passive Diepsloot cemetery into a park, instead of a criminal hotspot, formal low-income housing units are proposed adjacent to it. This extension is proposed in the area where the second phase of the Diepsloot cemetery would have been implemented. The roads for phase two has already been laid and is therefore used to structure the new housing development, Figure 51.

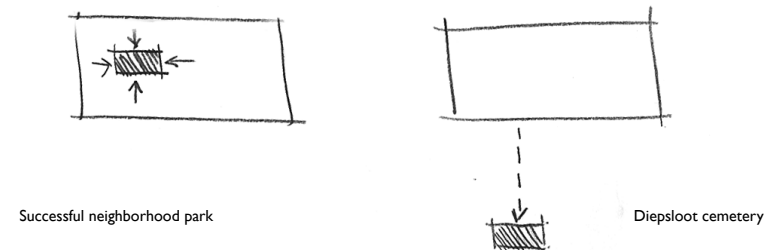
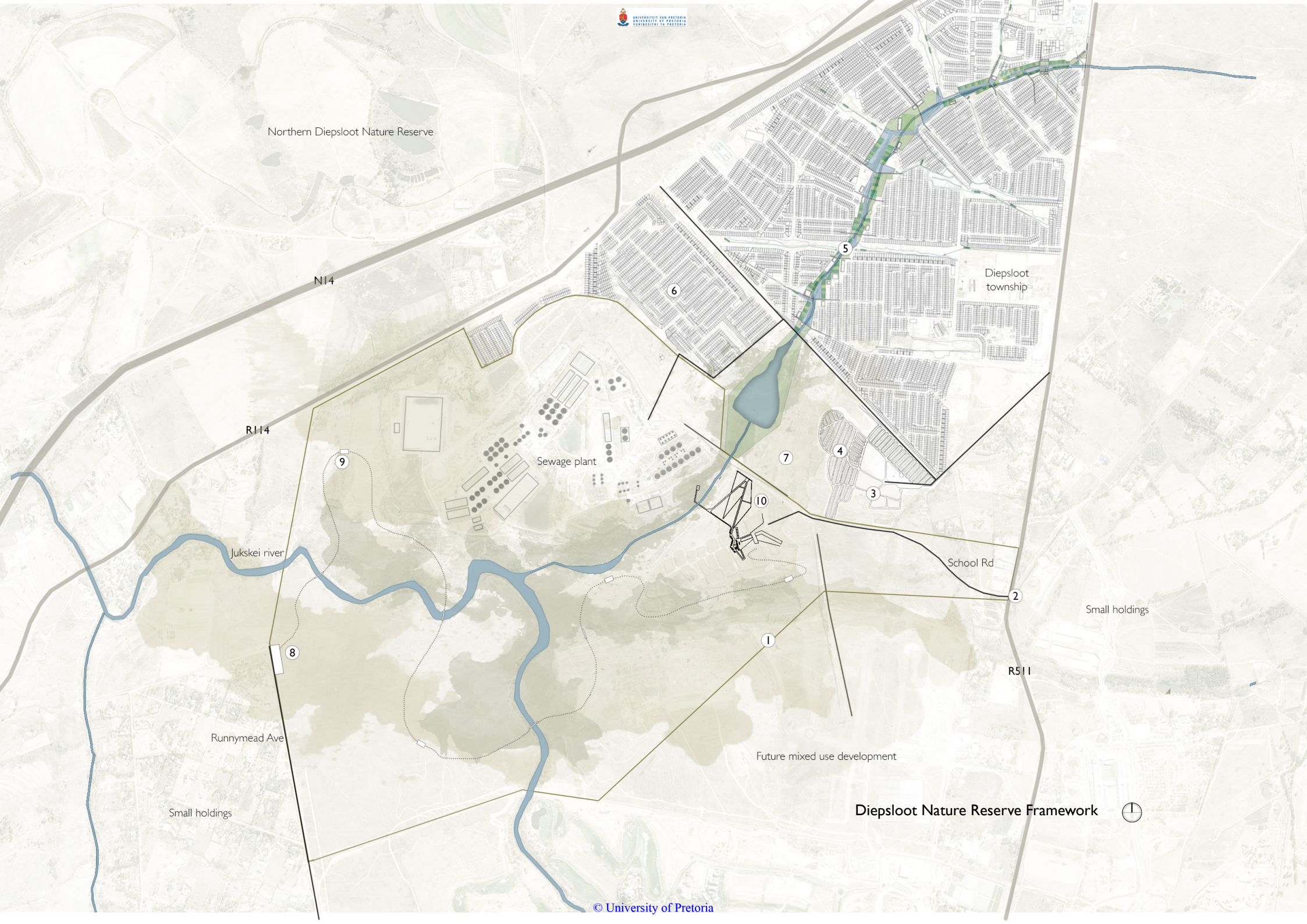


Figure 50. Relationship between a residential area and a neighborhood park and the Diepsloot cemetery's situation (Author 2015).



Northern Diepsloot Nature Reserve

N14

Diepsloot township

R114

Sewage plant

Jukskei river

School Rd

Small holdings

R511

Runnymede Ave

Future mixed use development

Small holdings

Diepsloot Nature Reserve Framework

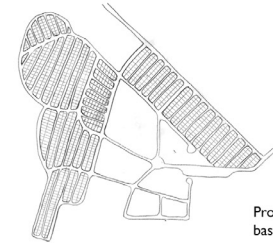
Diepsloot Nature Reserve Framework

1. New fenced nature reserve boundary
2. Main entrance to the reserve
3. Existing Diepsloot cemetery
4. Proposed low-income housing next to the Diepsloot cemetery
5. Proposed upgrade of the Diepsloot stream to provide the reserve down stream with clean water
6. Existing township extension formalised and excluded from the new reserve boundary
7. Rehabilitated grassland (old agricultural field)
8. Second entrance into reserve to non-burial site visitors. Consists of a small parking lot and access to the nature reserve trail.
9. Wheelchair friendly nature trail with hides to view wildlife.
10. Proposed core (activity hub). Consists of an information centre, coffee shop, venue and the burial site with associated activities.
11. New access road to Diepsloot township, Diepsloot extension, and the sewage treatment plant

Figure 48. Diepsloot Nature Reserve framework (Author 2015).



Existing first phase of cemetery with roads constructed for phase two



Proposed low-income housing based on the existing roads



Cemetery is no longer isolated and can be used as a neighborhood park



Figure 51. Proposed low-income housing to turn the soon to be passive Diepsloot cemetery into a neighborhood park (Author 2015).

4.4 Diepsloot cemetery

Within the next five to ten years, the Diepsloot cemetery will reach its burial capacity (Johannesburg City Parks 2008). Once a passive cemetery it can be used as a neighborhood park by the residents of the proposed low-income houses adjacent to the cemetery. The Diepsloot cemetery was designed to look like a park instead of a traditional cemetery; tombstones are flushed with the natural soil level, there are large lawn areas, benches, ponds, and drinking fountains (Wilkins 2011).

4.5 Diepsloot stream

The DNR is a proclaimed nature reserve; therefore, any water body in it should be clean and add value to the reserve. There is has one river, one perennial stream, and one seasonal stream running through the reserve. The perennial stream's catchment area is the entire Diepsloot township, thus the stream is highly polluted. In order for the stream to be clean enough for consumed by game and other wildlife, a water management system needs to be implemented in Diepsloot township. If the problem is not resolved upstream where the township's run off flows, the water will not be clean when it reaches the nature reserve. This system, marked number 5 on the framework plan, Figure 48, is discussed in detail in chapter seven as part of technification.

4.6 Main entrance: School Road

The main entrance to the reserve and the activity hub of the site is School Road. It directly connects to the upgraded R511. The intention of placing the entrance to the reserve next to an active street and commercial hub is to draw people in. School Road also has magnificent views of the reserve and impressive overhead sewage lines, Figure 52 and 53.

4.7 Core/ activity hub of the reserve

Fenced off nature reserves in suburbs are often not fully utilized. Due to its mono-function of being an area of undisturbed natural vegetation and its residential location, the user demographic is limited to weekend hikers, daily joggers, and dog walkers who live in the vicinity. Figure 54 illustrates this: protected nature reserves



Figure 52. View from School Road as one enters the Diepsloot nature reserve. (Author 2015).



Figure 53. view of sewage pipe with power plant in the background (Author 2015).

often only serves the residents adjacent to it. If a core, or activity hub, were added to the reserve, it would appeal to more users. Figure 54 illustrates how the addition of a core, with commercial, educational, or recreational value would bring in a larger diversity of users.

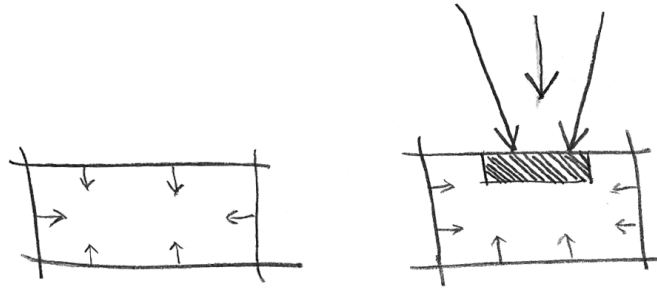


Figure 54. A nature reserve without and with a core/ activity hub (Author 2015).

People utilizing the core’s activities will start to filter into the rest of the reserve. Between the core and the undisturbed natural part of the reserve a buffer area, such as a picnic or peaceful bird and game watching area can be designed. At the core there is a high intensity of activities, as the user moves into the buffer zone there are less activities and more recreational facilities and finally low intensity activities, such as walking and observing nature, as the user gets deeper into the reserve where fauna and flora remain undisturbed.

The Author does not dismiss the importance and need for protected natural environments. They provide ecosystem services such as regulating services and habitat or supporting services. Regulating services include erosion prevention, maintenance of soil fertility, pollination, and biological control, while habitat or supporting services include the provision of living spaces for plants and animals, as well as the maintenance of genetic diversity (TEEB 2011). This does however not mean that nature reserves should not have additional commercial, educational, and recreational value. Such additions will not only increase the safety, conservational awareness, job opportunities, and utilization of the reserve, but will also generate an income that can be put towards maintaining the reserve.

The placement of the activity hub depended on access to the reserve, as well as the mapped ecological sensitivity. Conclusions drawn from the site analysis indicated the most appropriate place for a core, Figure 48 at number 10.

4.8 Programme

To fully utilize the DNR, it will not only function as a protected area of natural fauna and flora. The programme of the reserve consists of two main topics: the burial site and the nature reserve.

The programme for the DNR is as follows:

Burial programme	Nature reserve programme
Workshop where caskets are woven/ eco-urns are prepared	Information centre (information on the reserve, conservation, and sustainability)
Promession area (reducing corpse to ashes)	Restaurant
Placing corpse in woven casket or eco-urn	Venue (for conferences)
Final body viewing by family	Picnic area/ lawn
Chapel	Hiking trails
Venue (serving refreshments after service)	Game viewing

These programmes can be interwoven with each other to create a richer combined programme. Instead of the nature reserve’s information centre just being about the conservation of natural environments, it can be educational regarding sustainable and environmentally friendly methods to dispose of corpses. To enhance this, the workshop where the decomposable caskets are woven and the eco-urns are prepared can be next to the information centre. Users can see how the caskets are woven or where the seedling and compost are placed in the urns. This interaction will educate users on the importance of alternative methods to bury a loved one.

Certain programmes can not be interwoven with each other; the area where the body is viewed for the last time, and the restaurant can not be placed next to each other. Carrying corpses past users enjoying a picnic would not be appropriate. The programmes have to be grouped according to their sacredness.

Sacred (Private)	Sacred (Public)	Non-sacred (Public)
Promession area (reducing corpse to ashes)	Composting chambers	Information centre (information on the reserve, conservation, and sustainability)
Placing corpse in woven casket or eco-urn	Veldt where people are green buried	Workshop where caskets are woven/ eco-urns are prepared
Final body viewing by family	Forest where eco-urns are planted	Restaurant
Chapel		Venue (for conferences/ (serving refreshments after service)
		Picnic area/ lawn
		Hiking trails
		Game viewing

The site's programme can be grouped into three categories; sacred (private), sacred (public), and non-sacred (public). According to this, the programme will be placed on site at the demarcated activity hub area.

The activity hub is further discussed and designed in chapter six: Design

4.9 Vision images

Figure 55 and Figure 56 illustrate initial intuitive visions of the nature reserve. Figure 55 shows a proper trail turning through the site and Figure 56 the entrance to the activity hub with a type of orientation space overlooking the reserve.

4.10 Landscape vision conclusion

The Diepsloot Nature Reserve will be a clearly demarcated and protected reserve, which is dynamic and multifunctional. Driven by the theme of sustainability, the burial site and nature reserve programmes are interwoven at the activity hub. The burial site remains the focus on this thesis, but how it fits and functions within the activity hub is discussed in chapter six.

In the next chapter, the focus shift from the framework to the concept and design of the burial site.



OPPOSITE PAGE Figure 55. Vision image: Entrance to the core of the site. Showing an information centre with an orientation space and a view overlooking the reserve (Author 2015).
Figure 56. Vision image: Variety of users moving through the nature reserve via a formal wheelchair friendly walkway (Author 2015).



05

Narrative, concept, and form generation

5.1 Introduction

Many cemeteries disregard the experience of the user, even though cemeteries are for the living and not for the deceased. According to Eggener (2010) cemeteries are not scary and creepy places, but moving, rich, provocative places with the potential to be powerful and meaningful. The argument made in chapter two states that a landscape could become meaningful through a narrative. This chapter discusses the narrative of the burial site, as well as the concept and the form generation.

5.2 Nekrotopio narrative

According to Potteiger & Puttin (1998) a narrative embedded in the landscape first take shape through naming. The burial site is entitled Nekrotopio, this is derived from the Latin phrases *nekro*, which means death, and *topio*, which means landscape or scenery. Naming bestows identity and reveals the character or projected aspirations of a place (Potteiger & Puttin 1998). The name Nekrotopio, *scenery of the death*, already reveals the essence of the site: it is a sacred landscape where the deceased are laid to rest. The name also discloses the climax of the site: a lookout point with a view over the landscape where the deceased are returned to the earth, the user literally looks out onto the scenery of the dead.

The narrative of Nekrotopio forms part of the *memento mori* art genre. The term *memento mori* is Latin and directly translated means: “remember (that you have) to die” (Oxford English Dictionary, Third Edition, June 2001.) It developed with the growth of Christianity, which emphasized Heaven, Hell, and salvation of the soul in the afterlife. The *memento mori* art genre brings viewers to term with their own mortality and the temporality of human life. Similarly, Nekrotopio leads the user through a series of spaces that encourages contemplation regarding their inevitable demise, as well as consideration as to the disposal of their human remains. The landscape becomes a vehicle to understand the place, but also the self. The proposed burial site uses controversial methods to dispose of corpses, these methods are crucial points in the narrative and do not only add to the experience of the user, but also promote sustainable, eco-friendly, and affordable corpse disposal methods.

Nekrotopio is sequenced with the aim of leading users through a series of spaces in a specific order. Sequencing of spaces communicates a strong narrative (Potteiger & Puttin 1998). The spaces juxtapose each other and emphasize the dissimilarities. The first event of the Nekrotopio narrative starts at the composting chambers. In

this space, corpses are individually lowered into chambers where they decompose through the addition of a carbon source. Similar to conventional burial, the corpse is lowered into the chamber; this retains the cultural tradition of lowering a loved one into the soil. However, unlike conventional burial where a grave is dug in the soil, the composting chambers protrude out of it, Figure 57. This stark contrast expresses the controversial idea of composting corpses.

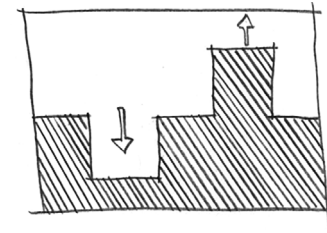


Figure 57. Negative versus positive space of conventional burial and composting chambers (Author 2015).

Corpses are lowered into the chambers on the upper platform, while the walkway below leads the users past them, as illustrated in Figure 58 and Figure 59.



Figure 58. Initial chamber vision: An upper and lower level. Corpses are lowered into the chambers and users can walk past them on the lower level (Author 2015).

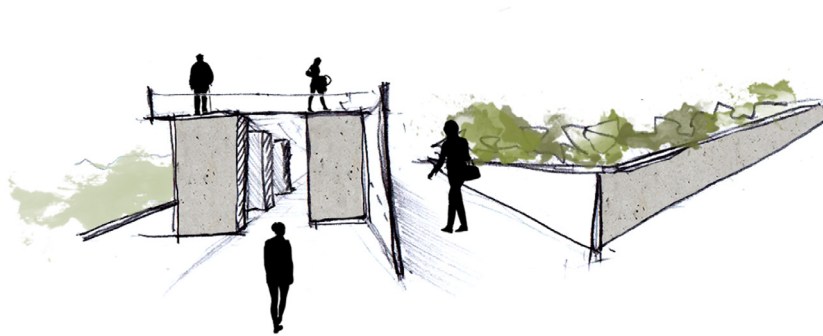


Figure 59. Initial chamber vision: An upper and lower level. Corpses are lowered into the chambers and users can walk past them on the lower level (Author 2015).

The intention of leading users past tall chambers where corpses are composted is to make them aware of their own mortality. Figure 60 illustrates that the user should feel mortal and insignificant. The walkway past the chambers is a confined and dim space with indirect light falling on the memorial wall and direct light entering the walkway in-between the chambers; this creates a serious space, as opposed to a brighter and open space, which feels light-hearted.



Figure 60. The space makes users feel insignificant and confronts them with mortality (Author 2015).

The materiality and detailing of this space is discussed in chapter seven: Detailing.

The second event in the Nekrotopio narrative takes place at the green burial field. Here, unembalmed corpses in woven straw caskets are buried in shallow graves. Unlike conventional graves, green burial graves remain unmarked, because they are reused every ten years. This space in the narrative is a vast open veldt. It is in direct contrast with the composting chambers where the user moves through an extremely enclosed space. From this enclosed space, the user is exposed to a vast veldt. The feeling from moving from event one to event two can be compared to walking through a dense forest and unexpectedly walking into a glade, Figure 61.

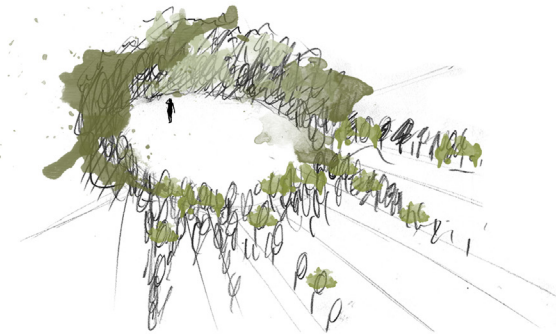


Figure 61. Moving from the first to the second event of the narrative can be compared to moving through a dense forest and unexpectedly walking into a glade (Author 2015).

This contrast should make the user feel exposed and vulnerable. Potteiger & Puttin (1998) describes this as erasing in a narrated landscape; instead of adding onto the landscape, a void or negative space is created. According to Treib (1987), the contrast between positive and negative space draws attention. Upon seeing and then moving through the veldt, the user should realize that the entire veldt is filled with corpses. Figure 62 illustrates that the space is a humbling realization that our bodies are reduced to organic matter once returned to the soil. Nothing of our earthly bodies remains. The absence of tombstones reinforces the notion that we are temporary. Placing a tombstone at the specific point of burial attaches a sense of permanence to the grave, however, within ten years there is no trace left of the deceased. Thus, instead the memorialization of the deceased should happen detached from the specific grave. The user moves through the veld via a walkway. There is an absence of trees and vertical structures in this space; this is done intentionally to not break the vastness



Figure 62. Green burial veldt where the user feels exposed and vulnerable. The user realizes that all bodies are reduced to organic matter and returned to the soil. (Author 2015).

of the veldt and the sky.

The third event in the narrative takes place in the promession forest. Here, the ash remains of the deceased is placed in an eco-urn along with compost and a small tree. The eco-urns are planted to form a forest. The specific forest trees are selected to ensure they attract wildlife. The intention is to have a vibrant forest filled with grassland birds and animals. The dense forest should provide a sense of safety and calmness. There is a single path leading the user through the forest, sunlight filters through the trees, and birds are chirping. Figure 63 illustrates the envisioned genius loci of the promession forest. When moving through the forest, the user should realize that each tree in the forest represents a human life. Each tree was nourished using a deceased's ashes. Even though we are mortal and temporary, even though we are insignificant and our human remains deteriorate, from our death, comes life. This is the notion of holism; human bodies are broken down into basic elements and from these elements something new, like a tree, comes into existence.



Figure 63. Promession forest genius loci: holism and acceptance (Author 2015).

After this realization, the narrative leads the user across the Diepsloot stream to a viewing tower. At the top of this tower, the *scenery of the dead* is revealed in its entirety. Potteiger & Puttin (1998) states that revealing and concealing aspects in a narrated landscape builds suspense and encourages users to engage and be inquisitive.

From the tower the user overlooks the shaped landscape along which the Nekrotopio narrative takes place.

The burial site is a composition, the user observes how the composting chambers, the green burial, and the ash forest fit into the landscape and each other. The user should realize, when observing this landscape, filled with generation upon generation of people, that each human is part of the greater cosmos. Death is not the end, but rather a sense of completion in the composition of the universe. Thus, instead of embalming our loved ones, or trying to create permanence with tombstones at empty graves, people should adapt to these suggested sustainable, yet dignified methods of corpse disposal.

To conclude; the sequence of the narrative is as follow: composting chambers, green burial field, and lastly the viewing tower.

5.3 From follows...

Landscape architects often generate form based on adjacent buildings, existing infrastructure, movement patterns etc. Figure 64 illustrates such an example: the design intervention is a reaction to the existing setup. This strengthens the existing and produces an appropriate harmonious new composition.

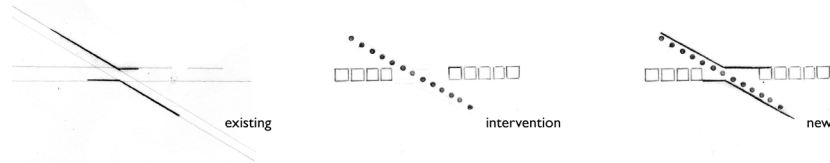


Figure 64. Landscape design interventions are often based on the existing built environment. (Author 2015).

However, what happens when landscape architects are faced with an isolated site? How is form generated? The proposed location for the burial site in the Diepsloot Nature Reserve, is rather isolated. The site, due to its reserve status is virtually undeveloped and has no existing buildings.

According to Ching (2007:195) there are numerous techniques to organize space: centralized, linear, radial, clustered and grid organization. In the event of an isolated site, clustered organization is deemed most appropriate. Clustered organization, Figure 65, relies on the physical proximity of spaces to one another. It usually consists of repetitive spaces, sharing a mutual visual trait, such as shape or orientation.

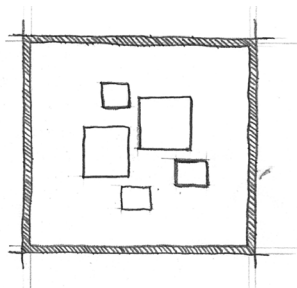


Figure 65. A clustered organization relies on the physical proximity of spaces to one another. (Author 2015).

It is accepted that within a clustered organization, spaces can be dissimilar in size, form, and function, but related to one another by proximity or visual ordering. Clustered organizations are not rigid; they are flexible and accepting of change and growth that does not affect the character. (Ching 2007:222). The design of the burial site is ordered to form a clustered organization. It makes use of three Ching (2007) principles to achieve this: common shape, Figure 66 grouping along a path, Figure 67, and a loop path, Figure 68.

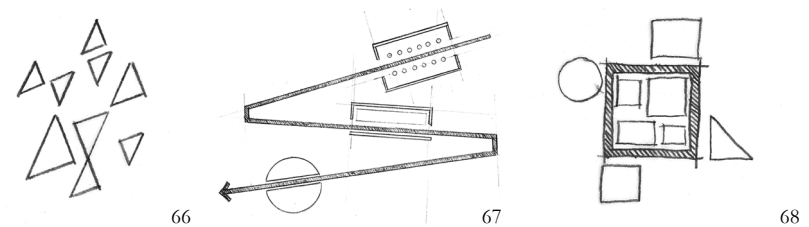


Figure 66. Common shape strengthens a clustered organization (Author 2015).

Figure 67. Grouping along a path tries elements of a clustered organization together (Author 2015).

Figure 68. A looped path assists in structuring a clustered organization (Author 2015).

5.3.1 Common shape

A repetitive shape strengthens the notion of unity in a clustered organization. The idea of juxtaposition was used to determine an appropriate shape for the design. Although there is no existing built form to respond to, the DNR has a very diverse typography, Figure 69, which creates an organic backdrop.

This organic backdrop can be emphasized using clean geometrical lines. Two examples where an organic backdrop is contrasted with strong geometry are the Kaufmann Desert House and the Glass House. The Kaufmann Desert House, in Palm Springs, California, by Richard Neutra, successfully accentuates the mountainous topography, as well as the modernist dwelling. The Desert House was not designed to blend into the site in a Wrightian style, but rather to contrast it (McGrew 2012). The iconic horizontal planes juxtapose the rugged landscape, Figure 70. The Glass House in New Canaan, Connecticut, by Phillip Johnson, effectively contrasts the forest in the background. The foliage of the forest creates an organic silhouette in the background. Although the pillars of the house mimic the verticality of the tree trunks, the major space-defining element of the dwelling, the roof plane, strongly contrasts it, Figure 71. This successfully emphasizes

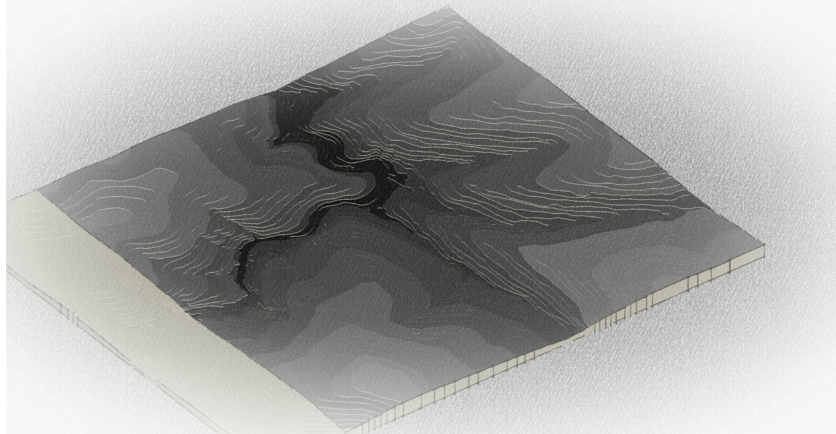


Figure 69. Diverse topography of the Diepsloot Nature Reserve (Author 2015).

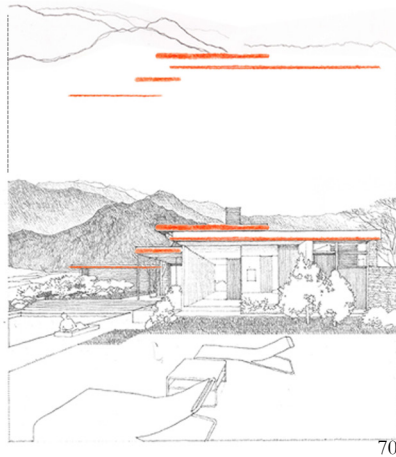


Figure 70. Kaufmann Desert House's strong horizontal planes contrast and emphasize the mountainous topography (Ching 2007 edited by Author 2015).

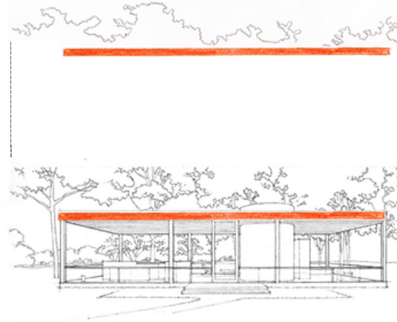


Figure 71. The Glass House's dominating horizontal roof slab juxtaposes the organic forest silhouette (Ching 2007 edited by Author 2015).

both the natural beauty of the forest, as well as the geometry of the dwelling. Similar to these examples, instead of designing an intervention that will blend into the DNR, the intervention should juxtapose it with the intention of placing emphasis on the nature reserve, as well as the design.



Figure 72. Juxtaposing elements emphasize each other (Author 2015).

5.3.2 Grouping along a path

The narrative, as described in 5.2, dictates that the user is led through a sequence of spaces. These spaces are grouped in a predetermined order along the main path of the burial site. Ching (2007) states that the grouping of spaces along a movement route strengthens and helps define a clustered organization.

5.3.3 A looped path

A looped path does not only tie a clustered organization together, it also reinforces the narrative. The looped walkway starts and finishes at the same point; this strengthens the notion of the great circle of life. The looped walkway creates a sense of completion, just like death is the completion of life. Each person is nourished using the earth's resources and once they die, they are returned to the earth, from which a new generation is nourished.

Designing the burial site as a clustered organization will bring unity to the design and strengthen the narrative.

5.4 Concept

Although the intention is to design a *memento mori* in the form of a narrated landscape, this does not give form to the design. It merely explains the type and quality of spaces needed to convey the narrative. A concept should enable a landscape architect to give form to the design. The concept is inspired by the

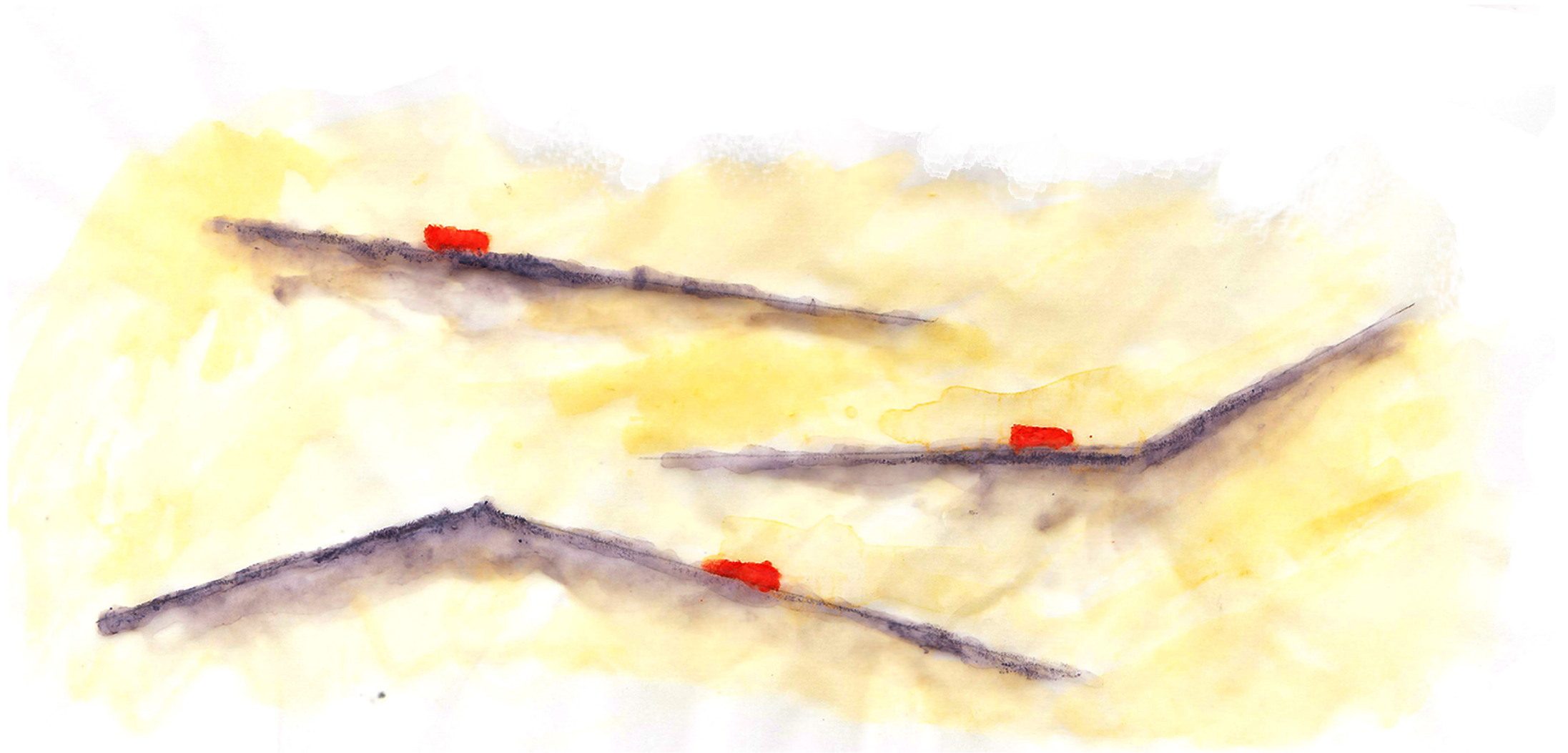


Figure 73. Concept Painting: Shaping the landscape, through cutting, and creating moments of intensity (Author 2015).

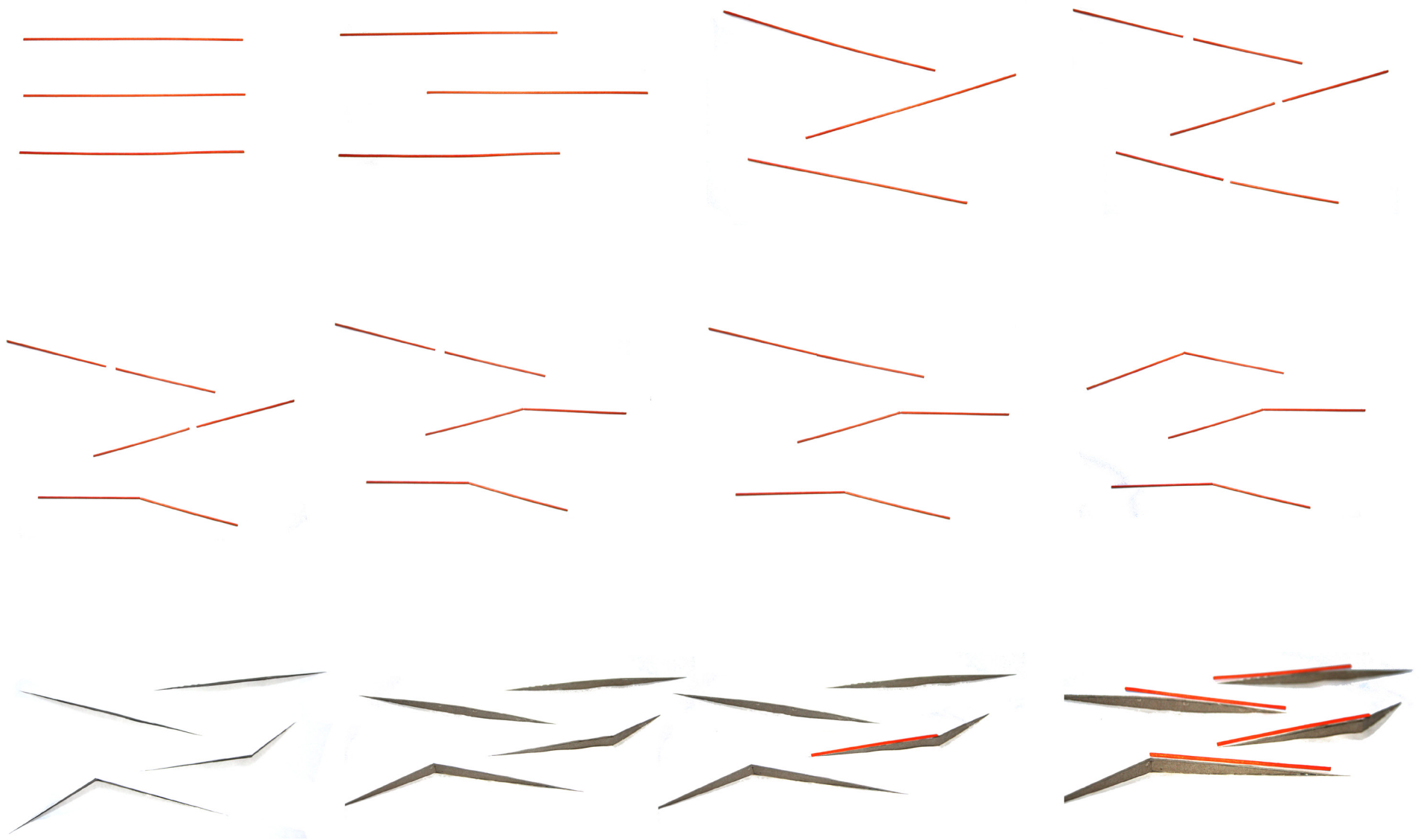


Figure 74. Evolution of conceptual form (Author 2015).

idea of clustered organizations, the narrative, and how the user will experience narrative. The concept is illustrated by the painting in Figure 73: A shaped landscape of common form, with moments of intensity.

5.5 Conceptual Form generation

Figure 74 shows the evolution of the conceptual form generation. As a point of departure the strong horizontal lines, as seen in the example of the Kaufmann Desert House, is used. Through a series of experiments, the lines are moved,

rotated, and cut to form a simple composition of triangular shapes. These two-dimensional shapes are then made three-dimensional to create a conceptual form showing a shaped landscape.

5.6 Conclusion

The next chapter shows how the conceptual form generation led to the actual form generation of cutting into the landscape and adding volume to it in order to shape the landscape. This shaped landscape gives form to the burial site's narrative.

06

Design

6.1 Introduction

Nektropio is a narrated landscape that leads people through different kind of sustainable corpse disposal methods, with the purpose of making them aware of their own mortality and their part in the greater cosmos. The previous chapter discussed this narrative as well as the concept of having a landscape shaped through cutting into it. The conceptual form was generated through juxtaposing the hilly topography of the site. This chapter explores the application of the narrative, concept, and conceptual form on the site to develop the design of Nektropio.

Figure 75 shows the proposed area for the design within the DNR.

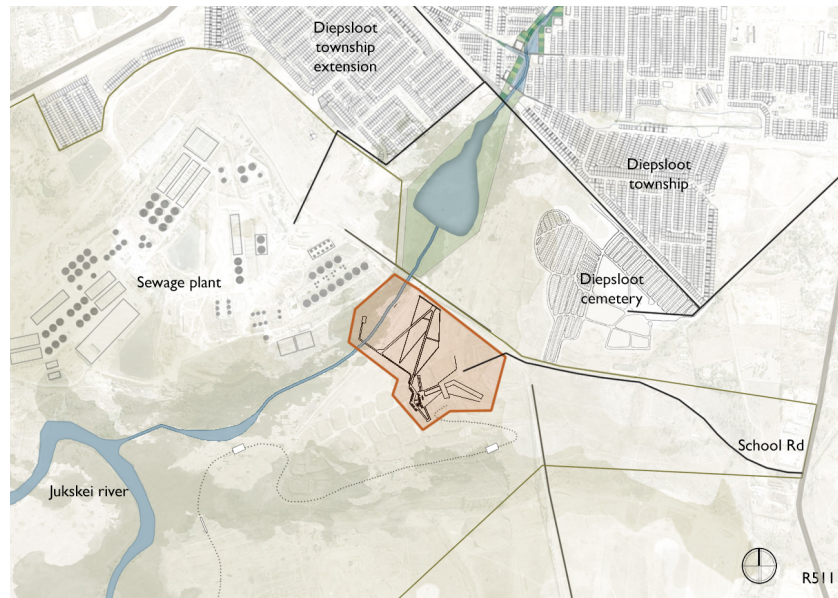


Figure 75. Orange area indicates the place of intervention/ the core of the DNR (Author 2015).

6.2 Conceptual form to physical form

Following the conceptual form model, Figure 76 and concept drawing, it was applied to site. Figure 77 illustrates the first attempt at organizing Nektropio as a clustered organization consisting of repetitive spaces sharing a mutual shape. This first attempt was necessary, but is overcomplicated, goes against the contours of,

and lacks the idea of cutting into the landscape to shape it.

6.3 Development of the core/ activity hub

The activity hub was designed first. The activity hub is the core of the DNR, as discussed in the framework for the reserve in chapter four. The programme of the hub accommodates both the nature reserve as well as the burial site. The programme was divided according to sacredness, refer to table on page 54 in Chapter four. The sacred activities needed a physical separation from the non-sacred activities. The ridge line acted as the point of separation; everything east of the ridge is non-sacred public and everything west of it sacred public, Figure 78. On the ridge itself, the sacred private activities were placed, Figure 79. This basic layout paved the way for a comprehensive functional diagram, Figure 80, circulation diagram, Figure 81, and model, Figure 82.

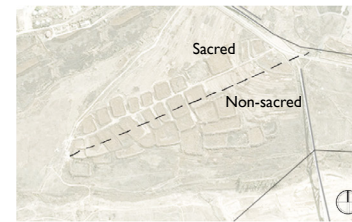


Figure 78. The ridge line separates the sacred from the non-sacred activities (Author 2015).

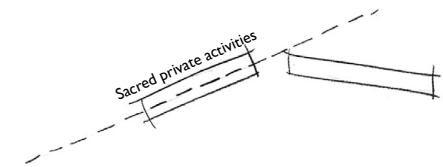


Figure 79. The ridge line separates the sacred from the non-sacred activities (Author 2015).

Figure 83 illustrates a large cut, resembling the repetitive shapes of the conceptual model, was made in the landscape to accommodate two buildings. Between the two buildings, there is an orientation space with a view over the reserve. The building to the east of the ridge contains an information center, a workshop where the caskets are woven, a restaurant, and a venue. The building on the ridge contains the procession facilities, a chamber where the corpse is placed inside of the casket, a room where the deceased's body can be viewed for the last time, and a chapel. Nektropio, which is not part of the hub lies west of the ridge. The circulation of the hub's different users is illustrated in Figure 84, the users include a funeral attendee, a nature reserve visitor, and a corpse. The core allows for a variety of people to use the site at once for different functions without any of them clashing.

Refer to Appendix A for the core's water calculations.

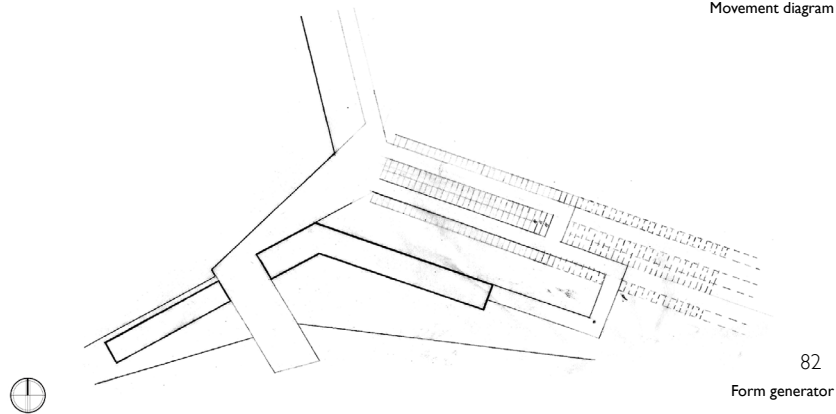
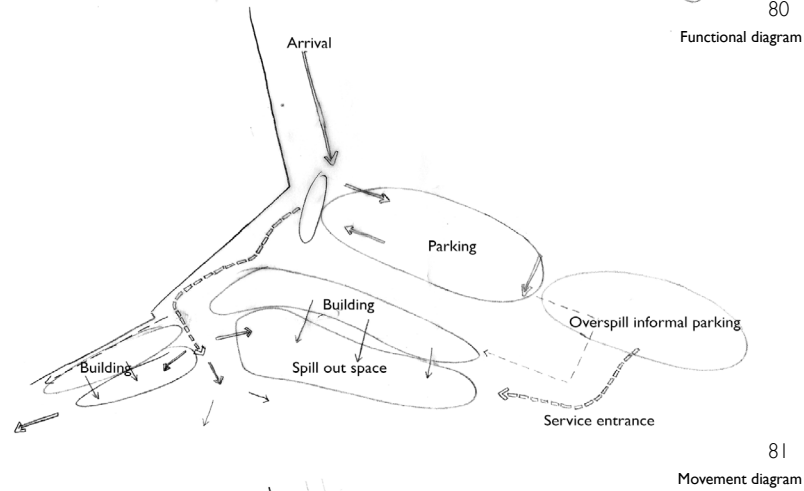
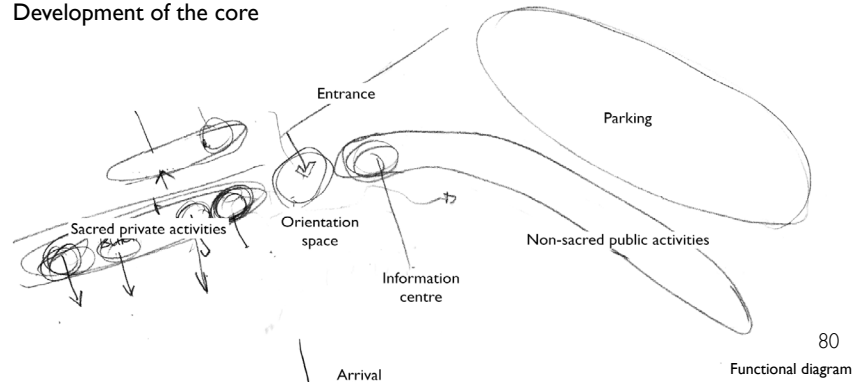


OPPOSITE PAGE Figure 76. Concept mode: A landscape shaped through cutting into it (Author 2015).

Figure 77. Marquette showing a clustered organisation applied to the landscape of the DNR (Author 2015).



Development of the core



TOP Figure 80. Core's functional diagram (Author 2015).

MIDDLE Figure 81. Movement diagram. Showing arrival at core and dispersal (Author 2015).

BOTTOM Figure 82. Design of the core based on the ridge, functional diagram, and movement pattern (Author 2015).

OPPOSITE PAGE Figure 83. Model of core/activity hub showing places of different activities, sacred and non-sacred (Author 2015).

Chapel

Final body viewing by family

Body placed in woven casket/ urn

Promession room

Orientation space with view

Information centre

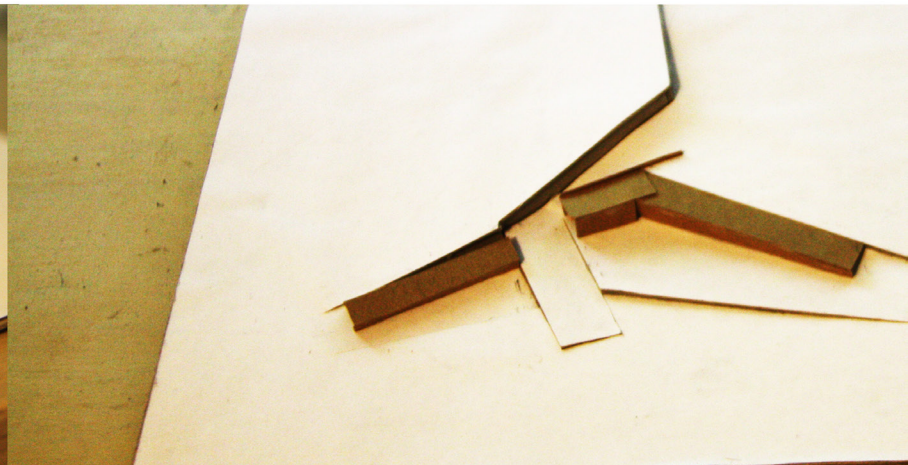
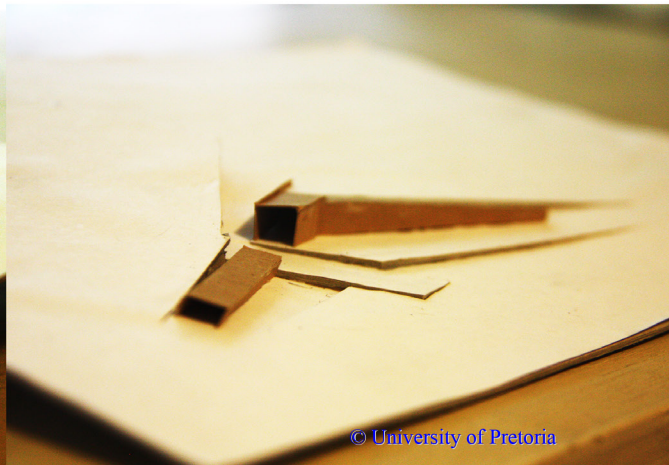
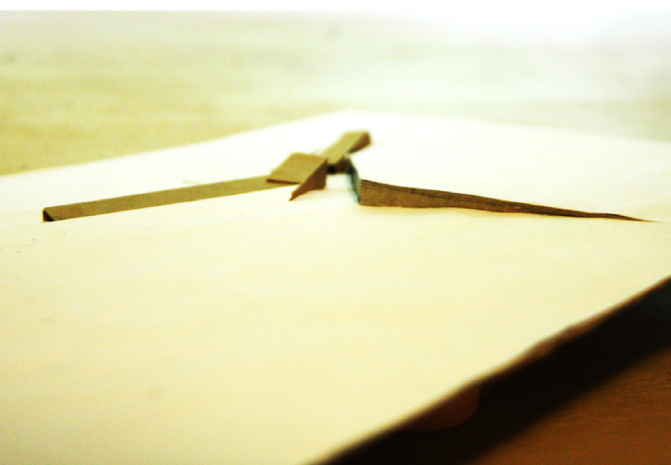
Workshop

Coffee shop

Venue

Lawn picnic area

RECEIVING
SHEET
1-12-50



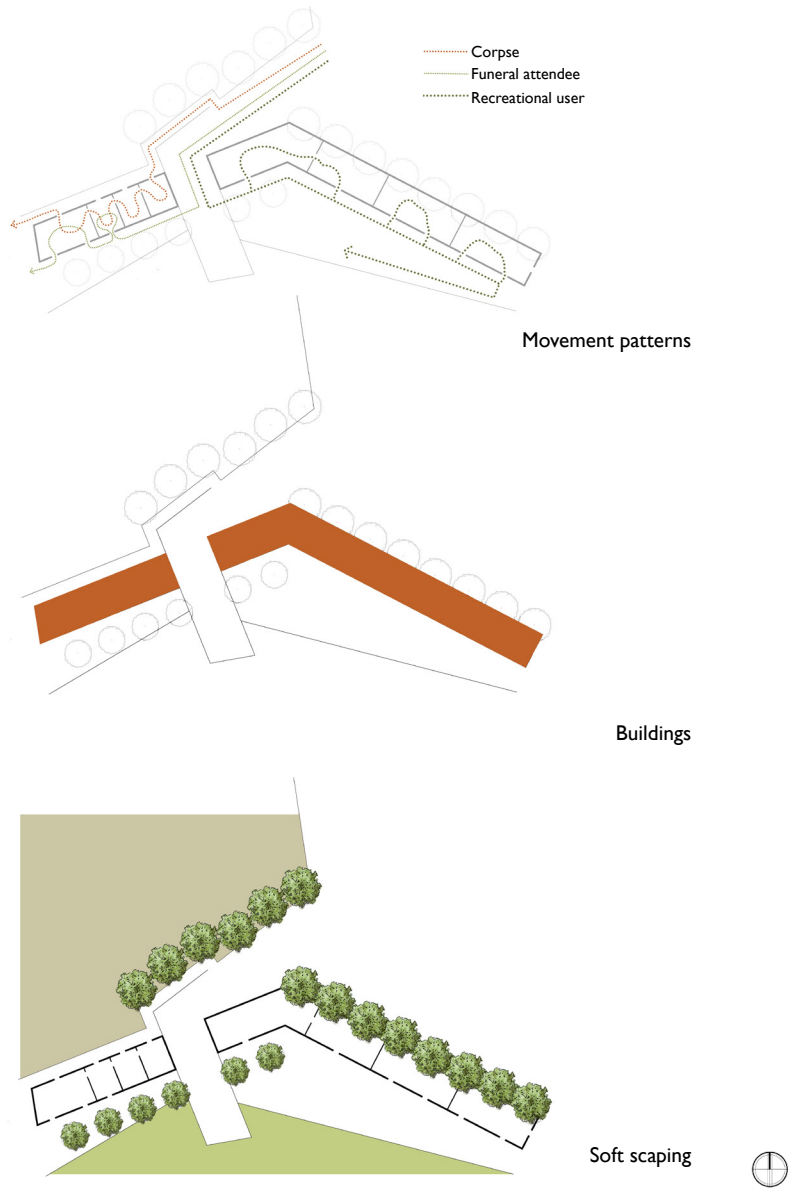


Figure 84. Diagrams illustrating the core's user movement, buildings, and soft-scaping (Author 2015).

6.4 Nekrotopio

Nekrotopio (the burial site) is adjacent to the core of the site. It forms part of the sacred public classified program. The ridge separates the sacred and non-sacred. Nekrotopio is located west of the ridge. The vision for Nekrotopio is a sequence of spaces. These spaces are grouped in a predetermined order along the main path of the burial site. Before designing the path, a functional diagram is required to give an overall layout of the burial site. According to the narrative, the user starts at the composting chambers, then moves through the green burial veldt, and then the promession forest. Lastly, the user crosses the stream and moved to the top of the viewing tower. The burial site's functional diagram illustrates the sequencing of the spaces and the general area for each event of the narrative, Figure 85.

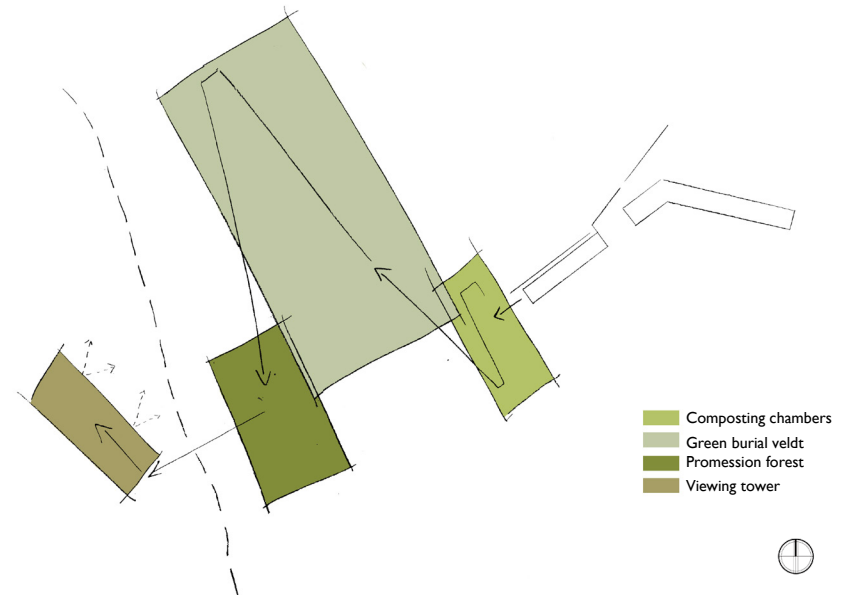


Figure 85. Functional diagram of Nekrotopio burial site. Showing location and sequencing of events of the landscape narrative (Author 2015).

With the functional diagram in place, the walkway/ path, which leads the user through the narrated burial site, was designed. Due to the sloped topography of the site, the walkway is a ramp. In accordance with SANS 10400-S: 2011 (South African National Standard part S: Facilities for persons with disabilities) a ramp may not have a gradient steeper than 1:15, may not be less than 1100mm wide, and

must have a landing every ten meters of at least 1200mm. The ramp and platforms cutting into and protruding from the landscape is shown in Figure 86 and Figure 87. The three platforms form the green burial veldt, which requires a surface with a flat to subtle slope.



TOP Figure 86. Marquette of Nekrotopio showing the ramp and green burial veldt platforms (Author 2015).

BOTTOM Figure 87. Marquette of Nekrotopio showing refined ramp and platforms (Author 2015).



The design of the promession forest, composting chambers, and viewing tower followed. Figure 88 shows the evolution of the Nekrotopio design.

6.5 Master plan

Figure 89 illustrates the final design of Nekrotopio, and Figure 90 indicate and explain the different components.

6.6 Sketch plan

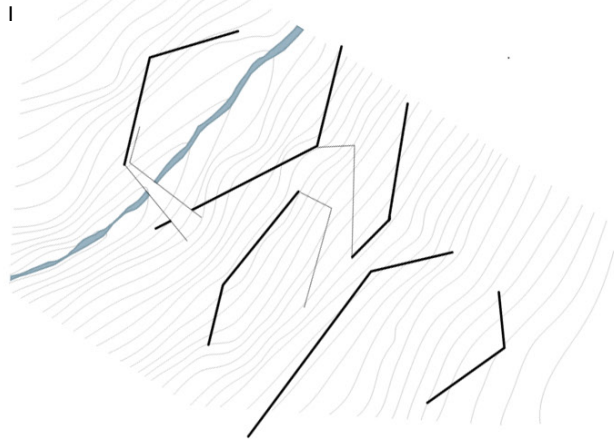
The composting chambers are the focus area. It is fully discussed and detailed in chapter seven. The development of the chambers is illustrated in Figure 93 and Figure 94. Figure 93 is a series of rough drawings exploring the arranging of the chambers around the ridgeline. The form refinement is illustrated in Figure 94

Keeping to the concept of having a shaped landscape, the chambers are designed to appear carved from the landscape. The notion of repetitive shapes and the extension of the walkway through all three of the burial places (composting chambers, green burial veldt, and the promession forest) ties the composting chambers into the rest of the design.

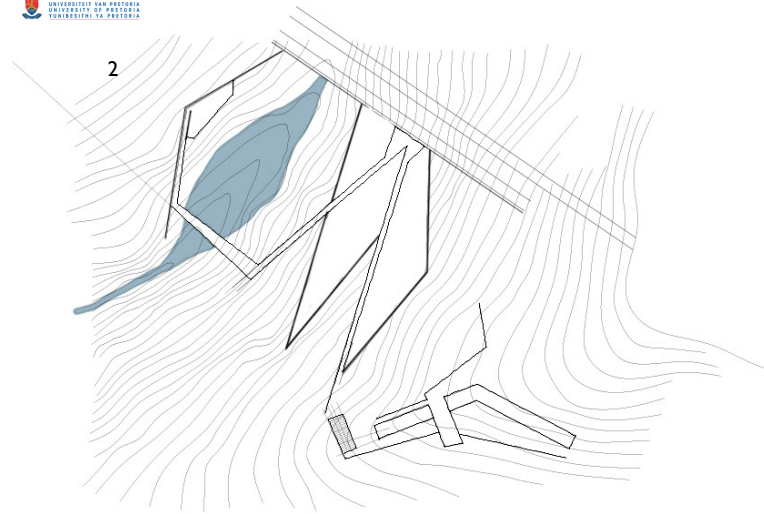
6.6 Conclusion

The landscape was shaped through cutting to create the narrated landscape of Nekrotopio. The main structuring element is the prominent ramp. It leads the user through the composting chambers, the green burial veldt, the promession forest, and to the viewing tower.

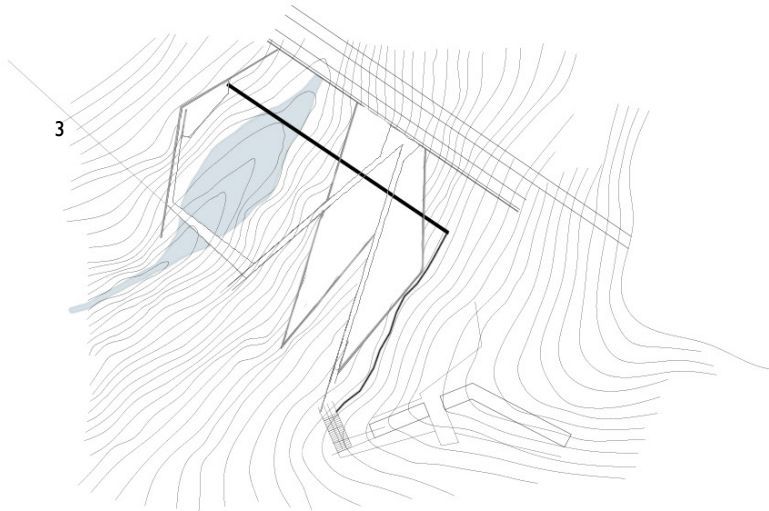
The composting chambers is the area of focus for the next chapter; chapter seven: Technification. Other aspects such as ecology and water systems are also discussed.



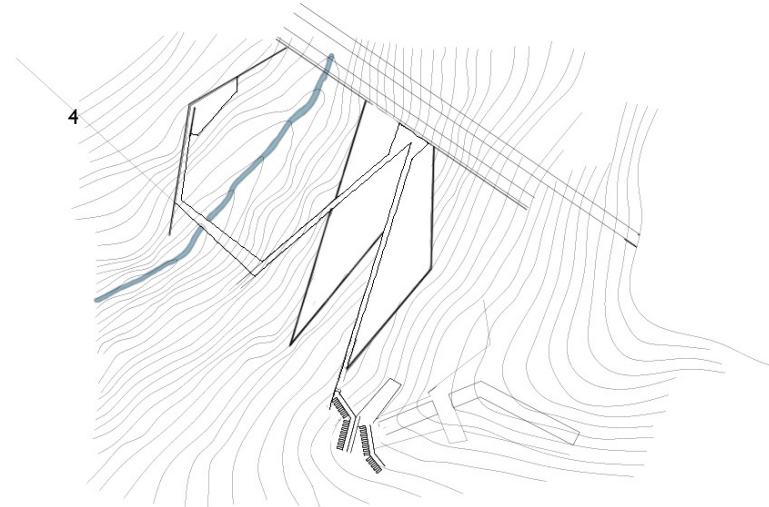
- First attempt to create a clustered organization on site
- Composition lacks structure and logic
- Repetitive shapes works against the contours



- Core/ activity hub is designed
- Ramp is used to structure design
- Platforms are cut from the landscape and protrude from it
- The stream is dammed up to create a reflective pool
- Moses bridge designed to take users through the stream onto a reflective platform overlooking Nekrotopio



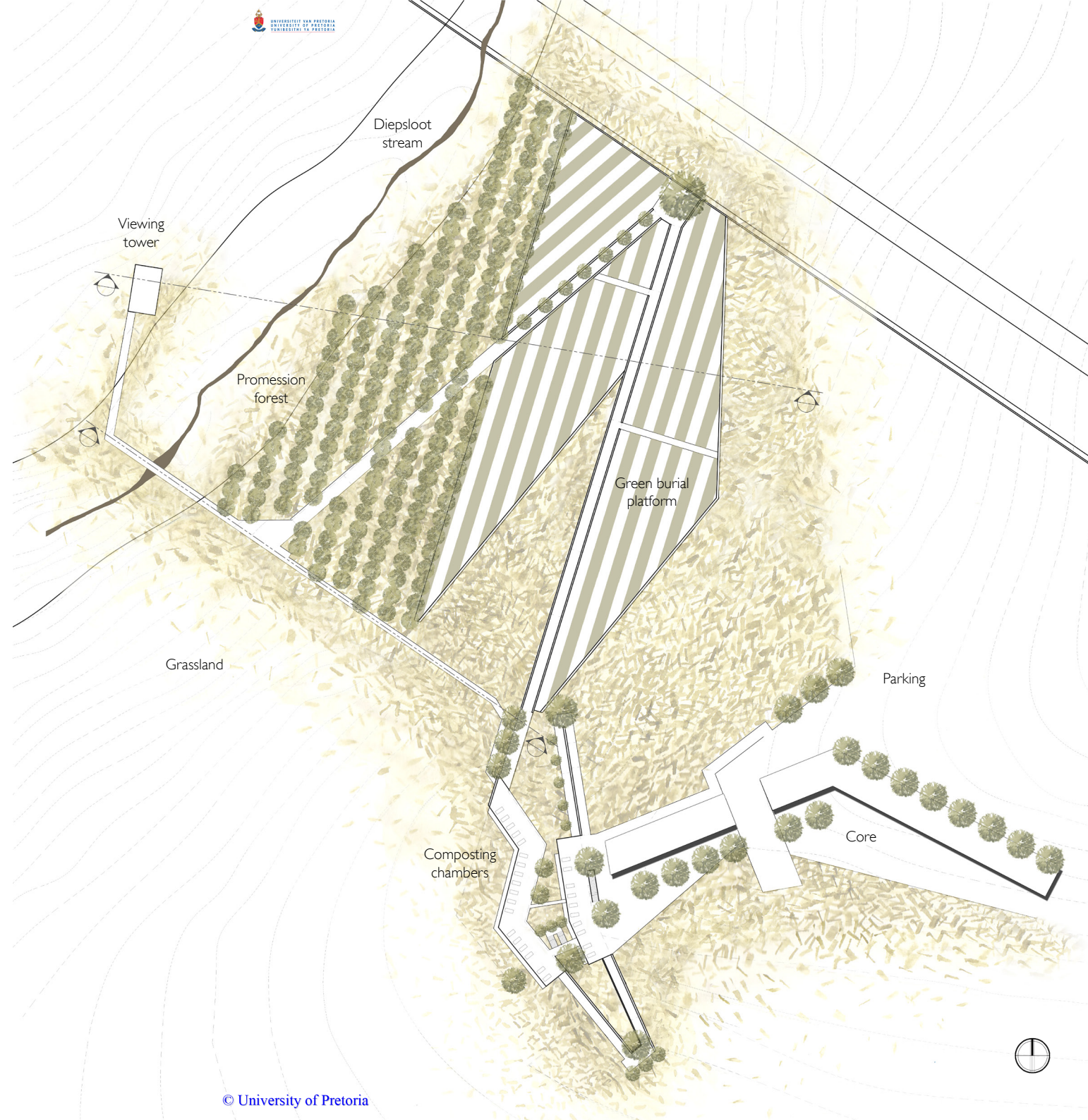
- Viewing tower with bridge added to return users to the start of the narrative.



- Dam removed and Moses bridge removed due to unpredictable flash floods of the Diepsloot stream
- Bridge removed due to unfeasibility
- Composting chambers altered to protrude from the ridge



Figure 88. Design evolution of Nekrotopio's master plan (Author 2015).



Master plan
Nekrotopio
(Figure 89; Author 2015)

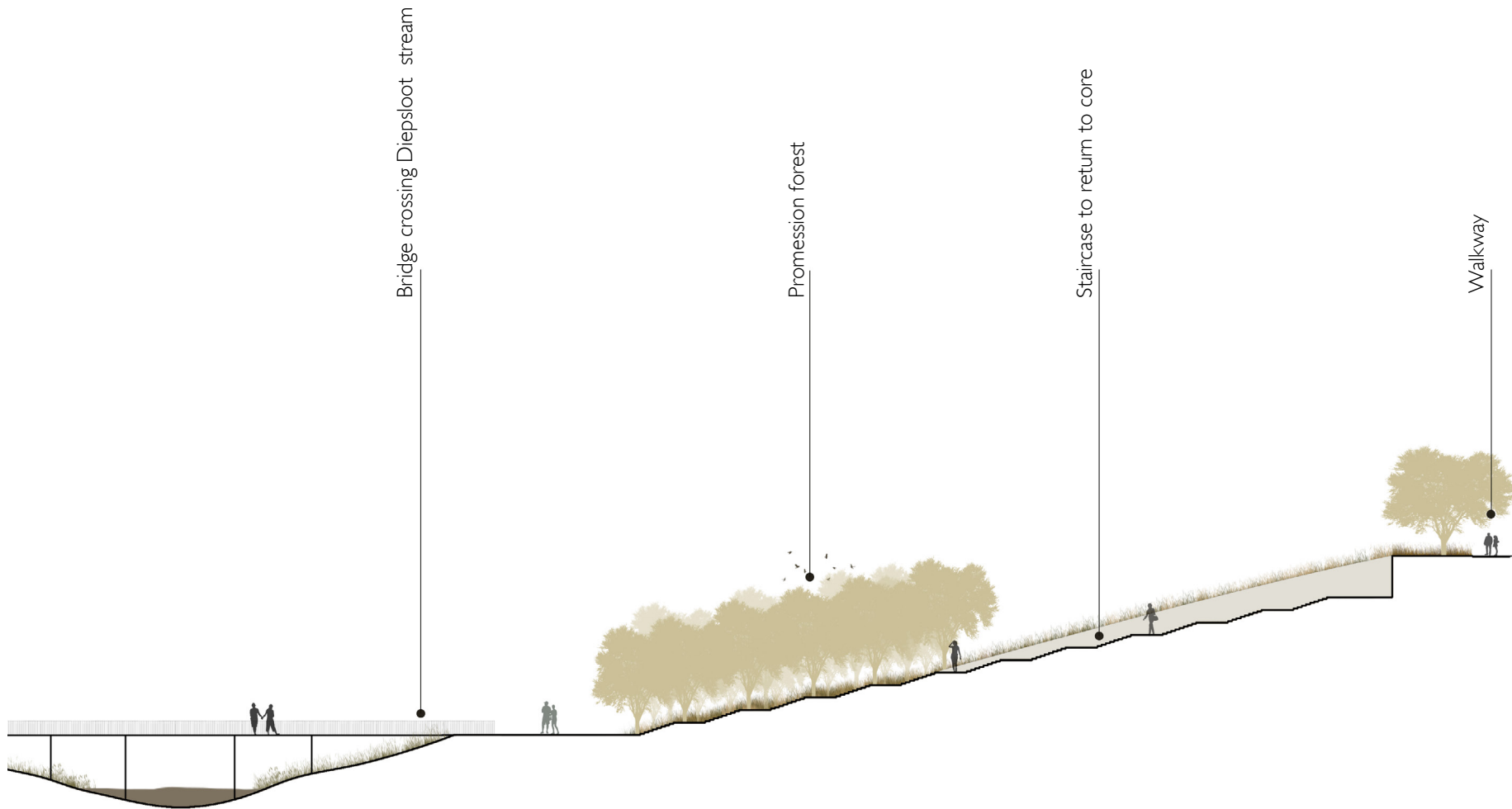


Figure 90. Section A-A showing the bridge crossing Diepsloot stream and the staircase back to the core. (Author 2015).

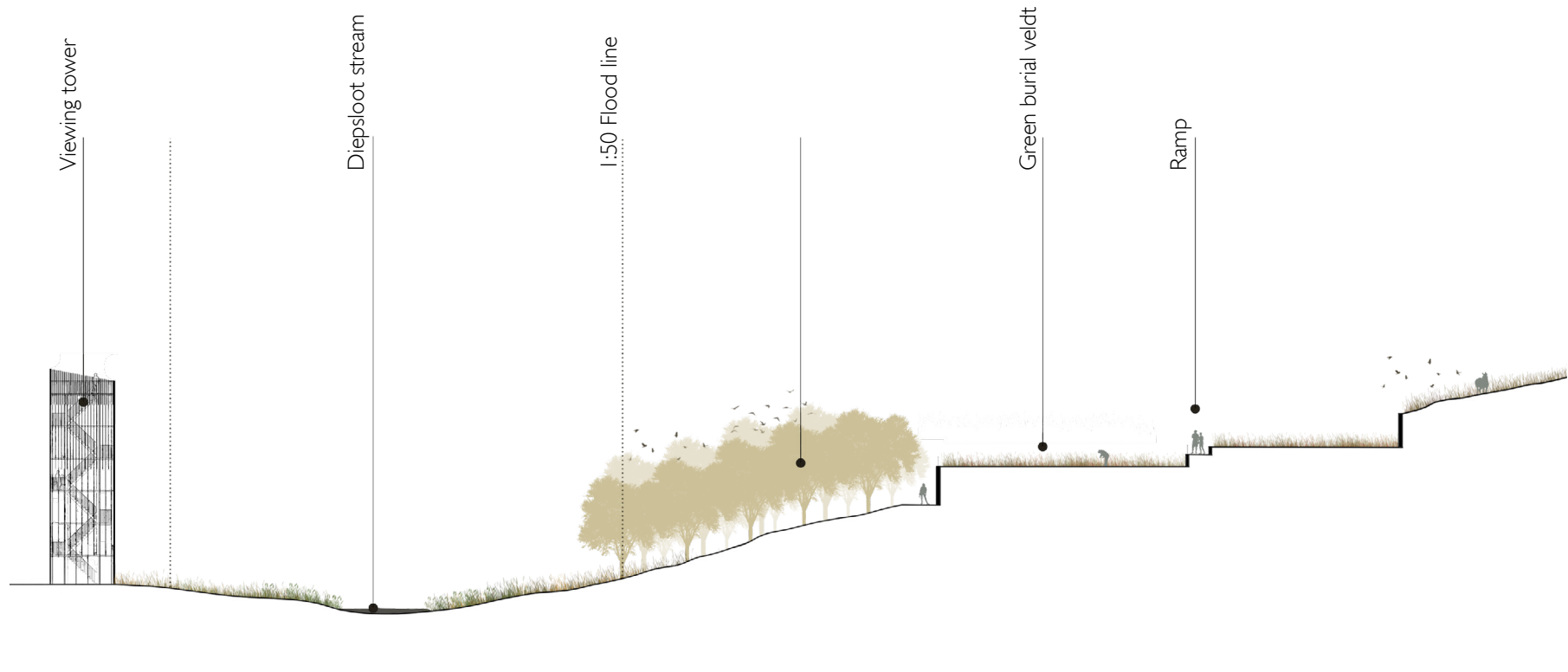
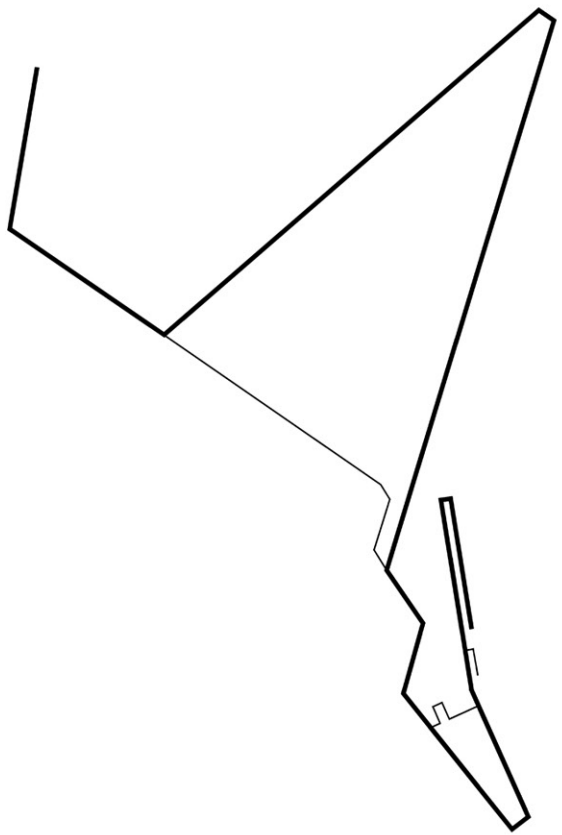
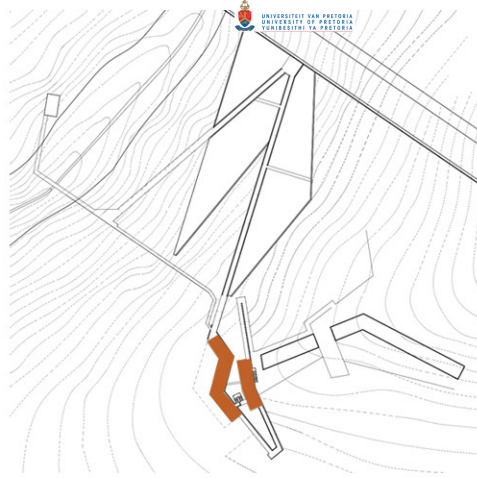


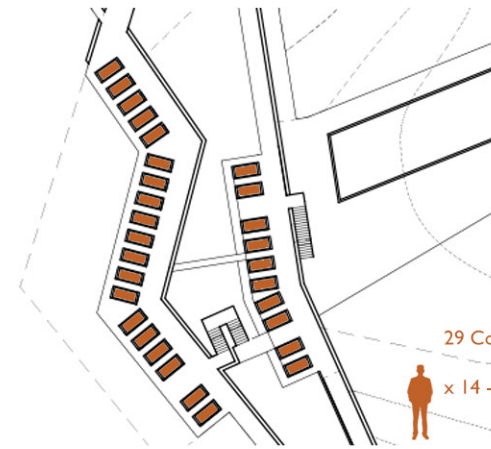
Figure 91. Section B-B showing green burial veldt, procession forest and viewing tower.
(Author 2015).



Main ramped walkway through Nekrotopio

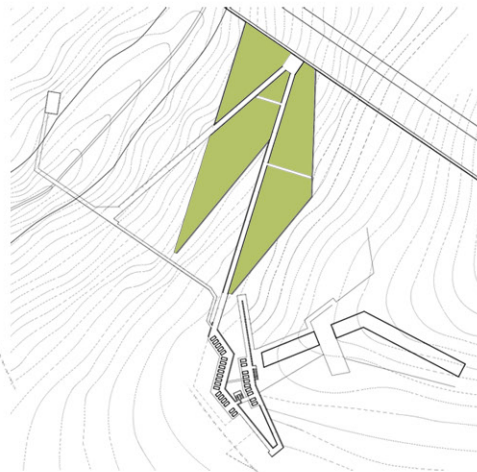


Composting chambers

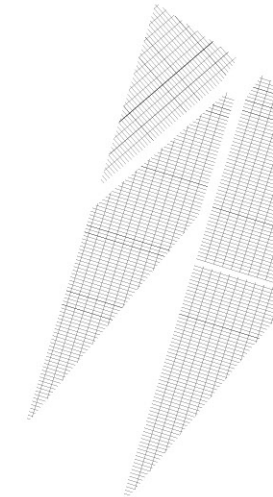


29 Composting chambers

x 14 - 15 per month

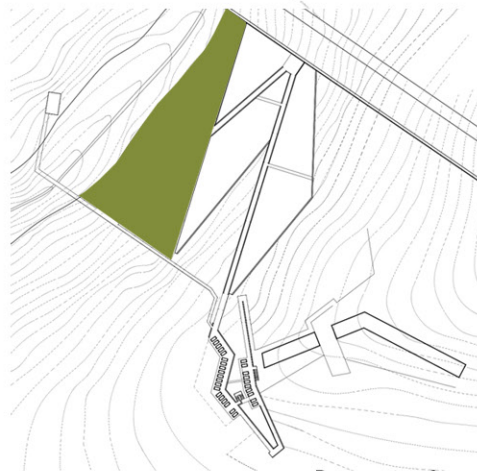


Green burial veld

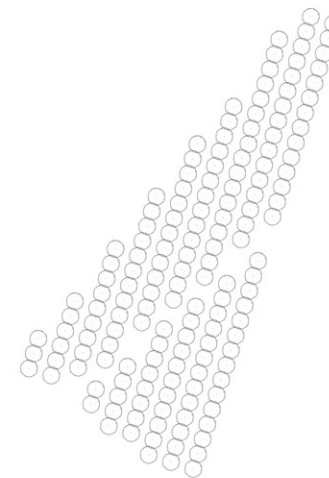


4800 graves

x 40 per month



Promession forest



160 Tree spaces indicated

x 13 per month

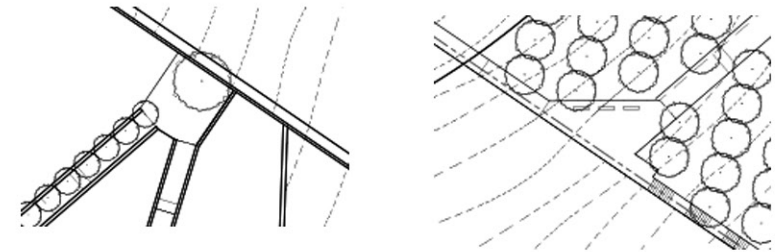
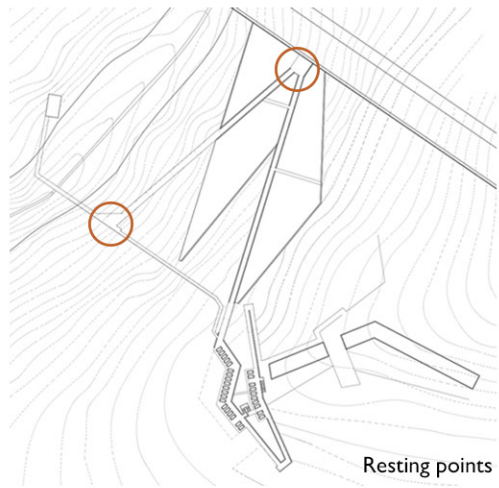
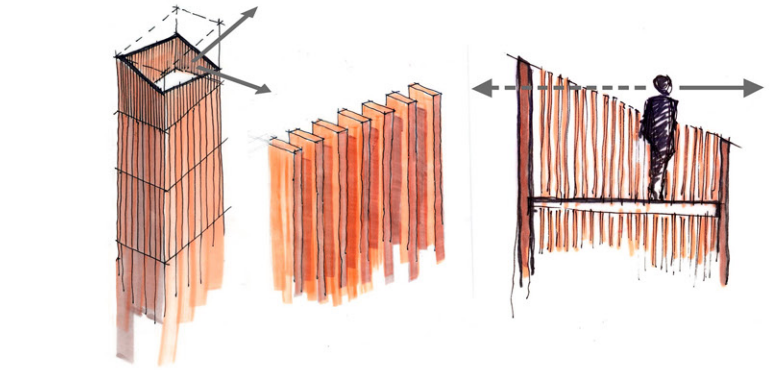
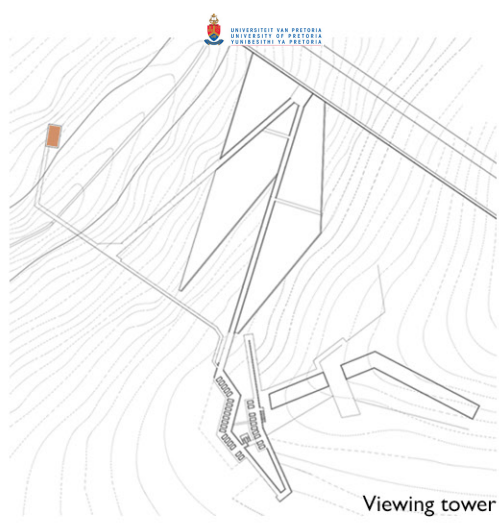


Figure 90. Master plan design explanation (Author 2015).

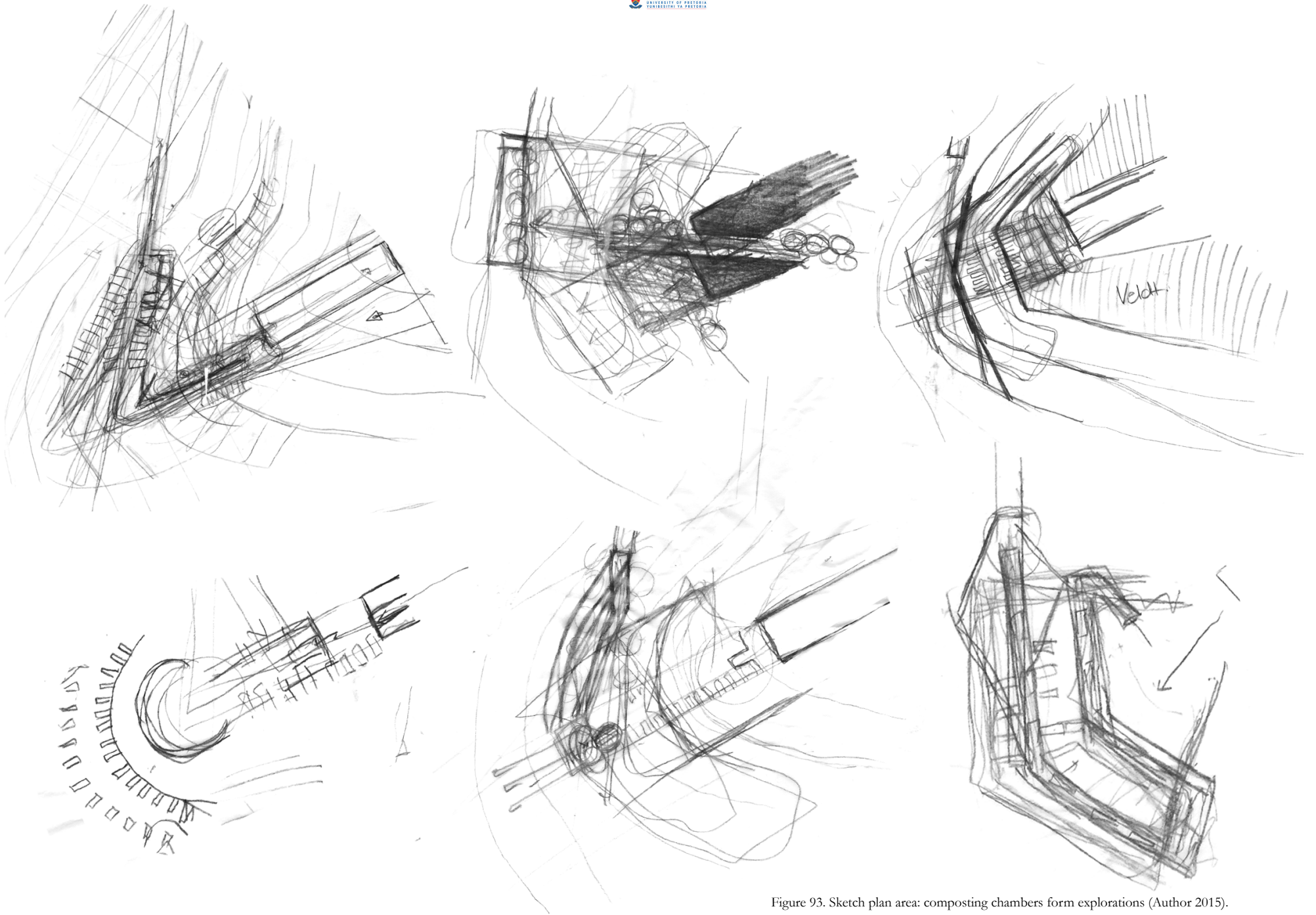


Figure 93. Sketch plan area: composing chambers form explorations (Author 2015).

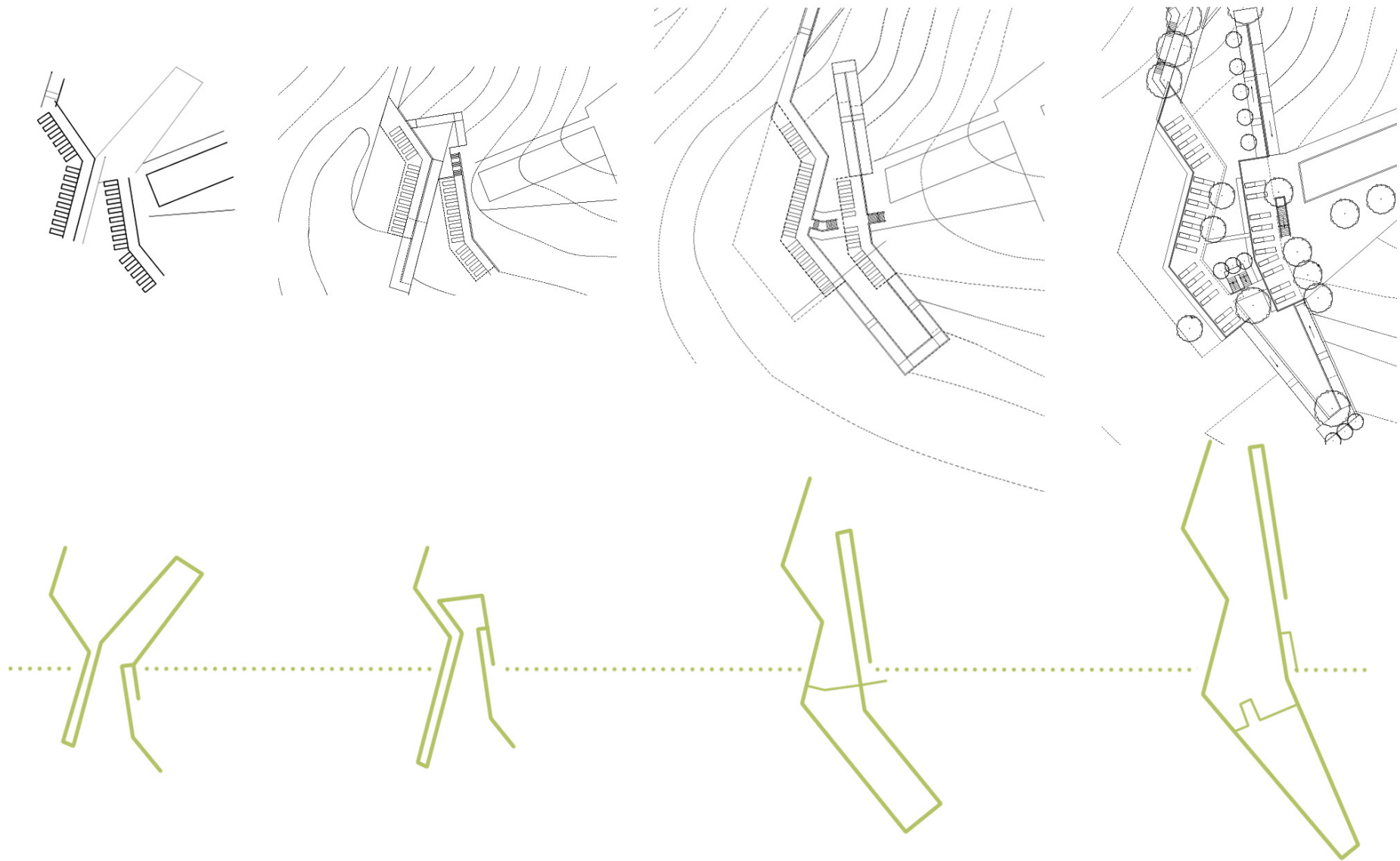


Figure 94. Sketch plan area: composting chambers form development, left to right, into the final design (Author 2015).

07

Technification

7.1 Introduction

The following technical investigation is aimed to give expression to the main concepts of alternative corpse disposal, local grounding, as well as designing spaces that express the narrative told throughout the site.

This chapter addresses water systems, ecology, human compostings, and the technification of the human composting chambers.

7.2 Water systems

7.2.1 Surface water

The overall approach to the water is providing clean water for recreational use and for animal consumption.

The Nekrotopio burial site is located in the southern half of the degraded Diepsloot Nature Reserve. As proposed in the landscape vision in Chapter four, the nature reserve status of the site will be regained through proper site boundaries, rubble removal, grassland rehabilitation, and the addition of game such as antelope and zebras. In order to accommodate the proposed wildlife, water suitable for animal consumption has to be provided. The Diepsloot stream runs through the site, Figure 95, and will be used to provide the animals with fresh water. Unfortunately, the entire Diepsloot township is located in the stream's catchment area, Figure 95. The stream is polluted with silt, floating debris, and other pollutants flushed into the stream from the township. Figure 96 illustrates some of these contaminants. To ensure clean water on site, purification interventions will have to be implemented upstream in the township. Figure 97 shows the proposed water strategy. This water strategy can be divided into two phases.

7.2.1.1 Phase one: Diepsloot township

Diepsloot township is a densely populated informal settlement. Diepsloot's central stream divides the township in two. It is difficult to cross. Figure 98 shows locations of worst rubbish build up. It often correlates with informal circulation paths. Poor connectivity has resulted in the breakdown of the refuse collection system and has made collection of the litter impossible. The existing connectivity of Diepsloot is mapped in Figure 98. There are only two formal crossing points over the stream. Improved connectivity between the west and east of Diepsloot will enable refuse collection. Figure 98 maps the proposed improved connectivity

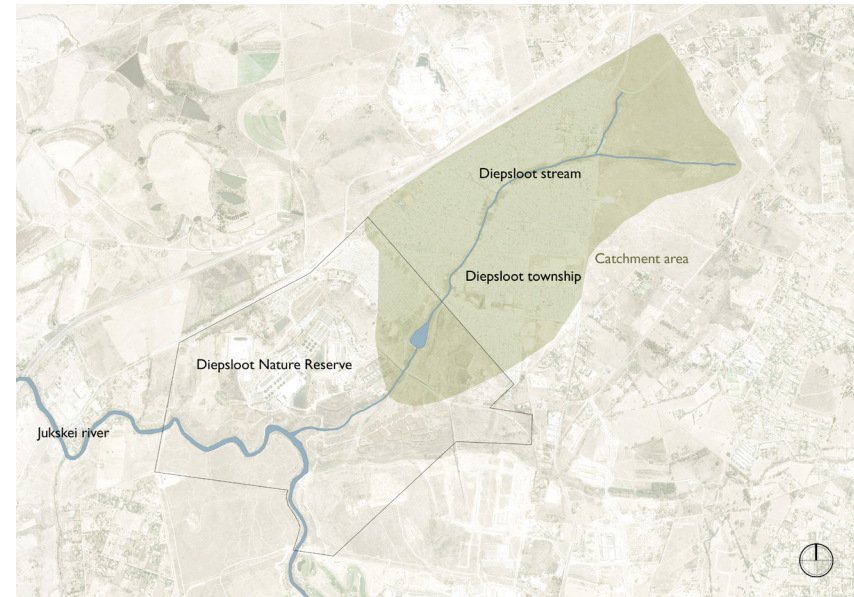


Figure 95. The Diepsloot stream's catchment area consists mainly of the Diepsloot township (Author 2015).



Figure 96. Collage of Diepsloot stream contaminants (Tyrell 2007).

1. Township runoff
2. Phase one: proposed stream intervention
3. Gabion wall silt traps
4. Existing natural detention pond used to irrigate trees (gravity fed)
5. Wetland
6. Clean stream runs through area of intervention
7. Wildlife drinking pond
8. Purified water fed into Jukskei river



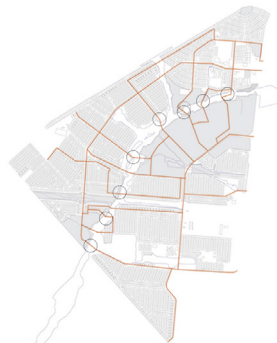
Figure 97. Diepsloot Nature Reserve water strategy (Author 2015).



Areas of extreme litter due to poor connectivity



Existing connectivity



Proposed connectivity

Figure 98. Diepsloot litter and connectivity analysis (Author 2015 adapted from Tyrell 2007).

in the settlement as well as across the stream. The ten points crossing over the stream is a series of vehicle and pedestrian bridges. These bridges form part of the first layer to improve the Diepsloot stream.

Figure 99 illustrates the layered strategy in Diepsloot to improve the stream's water quality.

Layer one: Trash trap bridges

The above-mentioned improved connectivity of Diepsloot involved the addition of bridges over the stream. These do not only connect to eastern and western sides of Diepsloot, they function as trash traps. Although the proposed connectivity should improve the refuse collection system, it is a management solution, not a designed solution. There is not guarantee that the litter will not enter the stream, thus a series of garbage traps are proposed to prevent the floating debris from flowing down stream.

In addition to collecting floating debris, the proposed bridges improve the safety of the informal settlement's residents. The stream often floods during summer due to the large amount of storm water runoff caused by erosion.

Layer two: Water management

The second layer of Figure 99 shows the proposed water management strategy. The dark blue areas form a series of

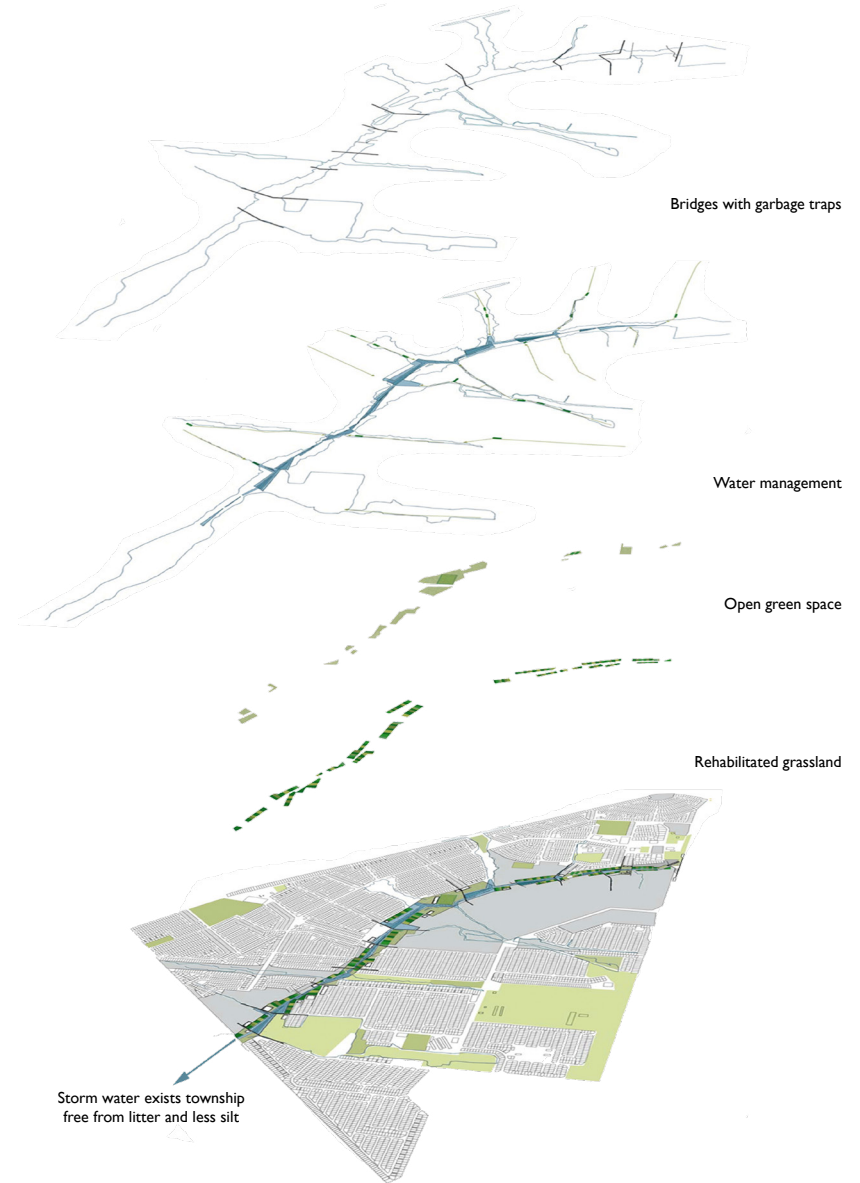


Figure 99. Phase one: Diepsloot stream strategy (Author 2015 adapted from Tyrell 2007).

perennial surface wetlands. Lighter blue areas indicate ephemeral wetlands that will only be inundated during the summer rainfall season. The remainder of the year these areas will be masses of sedges and wetland grasses.

The green arrows indicate the most appropriate locations for bio-swales. These locations are based on the topography as well as the limited open space between the informal dwellings. The bio-swales slow down and treat water before it reaches the wetlands and eventually the stream. They also improve the microclimate within the township and reduce erosion (Tyrrell 2008).

Layer three: Open green spaces

The third layer illustrates proposed parks and public open spaces as illustrated in Figure 99. These spaces relate directly to the proposed bridges and strive to create community nodes at these points.

Included in the open spaces are soccer fields. Not only can the community enjoy this, the fields become detention dams during large rainfall events. Other spaces are large enough for many formal and informal recreational uses. The community would generate such programs (Tyrrell 2008).

Layer four: Rehabilitated grassland

Due to the large amount of storm water runoff during summer as well as the lack of paved walkways large areas next to the stream have been eroded, leaving the soil bare. The fourth layer proposes the reimplementation of grassland vegetation in areas outside the proposed community open spaces. The establishment of grassland vegetation will stabilize the soil, prevent further erosion and reduce the amount of silt in the stream.

Through the implementation of this first phase with its four layers, the water exiting Diepsloot via the stream should be free of floating debris, have low amounts of silt in it, and contain minimal contaminants due to the bio-swales and wetlands.

7.2.1.2 Phase two: Post Diepsloot treatment

Once the water exits Diepsloot, the stream flows through a series of silt traps to catch any remaining silt. From this the water flows into a natural existing retention pond. Water from this pond is gravity fed to the site to irrigate the promession forest. From this pond, the stream continues through a surface wetland into the site. The stream should now be aesthetically clean, contaminant free, and safe for

animals consumption. The stream follows through the site and flows into the Jukskei river.

This two phased water strategy should provide the Nekrotopio with clean water for recreational use and for animal consumption.

7.2.2 Ground water

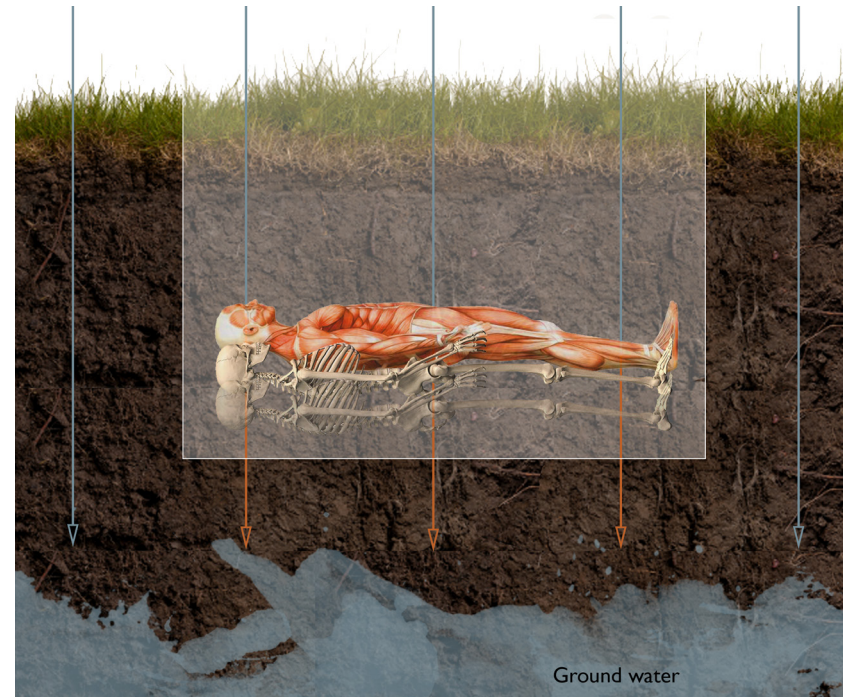


Figure 100. Buried corpses could potentially pollute water (Author 2015).

Nekrotopio is a burial site; in certain areas, corpses are buried in the soil. This raised the question: what impact, if any, does burial sites (cemeteries) have on ground water?

According the Department of Water Affairs and Forestry (DWAf 2007), certain members of the public believe that cemeteries pollute ground water. This perception is incorrect, and the following policy, which have been formulated and

sanctioned by the Minister will clear up the matter:

The risk of pollution posed by cemeteries to the quality of the water resource, especially the quality of drinking water, is regarded as acceptable, and in most instances negligible, for the following reason:

A corpse's disease-causing bacteria cannot survive long outside a living human body. They perish within days from burial, before it comes into contact with groundwater or even surface water. If a corpse is exposed to ground water, it will therefore have a low risk of containing disease-causing bacteria and, although high in nutrients, will be small in volume when compared with waste from improper sewage management, chemical fertilizers, pesticides, illegal disposal of medicine and medical waste, and industrial runoff.

The risk of pollution posed by cemeteries is very low. Notwithstanding the above, the Department of Water Affairs and Forestry do recognise the potential for pollution caused by poorly sited cemeteries. Based on previous assessments funded by DWAF and conducted by specialists, amongst others the CSIR, the following measures have been put in place to address this potential risk:

In accordance with the definitions contained in the National Water Act, No 36 of 1998 (NWA), a cemetery constitutes a water use in terms of s21(g) of the NWA, which need to be authorised. However, due to the low pollution potential from cemeteries, very broad general authorisations are currently under preparation for the purpose of such authorisation.

The table in figure 101 proves that in terms of sections 22(3) and 22(4) of the NWA, that Nekrotopio meets the cemetery placement requirements of the Department of Water Affairs and Forestry.

For the complete Policy refer to Appendix B.

To conclude: The burial of corpses on site will not pollute groundwater. Correct measures were taken to ensure the location of the burial is acceptable and safe with regard to users and the environment.

National water act requirement	Nekrotopio
Located above the 1 in 50 year flood line of a river/ stream	Burial and composting of corpses happen above the 1 in 50 year flood line.
Not situated in unstable areas like fault zones, seismic zones, dolomitic or karst areas where sinkholes and subsidence are likely	The site is underlain by transported sandy and gravel soils overlying strongly cemented residual soils that are underlain by weathered granite belonging to Halfway House Granite Dome of Archaean Age.
Not situated in a ecologically sensitive areas;	Although the burial site is located in the Diepsloot Nature Reserve, it is situated on top of old agricultural fields, a completely disturbed area of the reserve. In addition, the site is rehabilitated using grassland species in the burial site instead of the traditional lawn and exotic trees.
Not situated in areas characterised by steep gradients, or shallow bedrock with little soil cover, where stability of slopes could be a problem	The areas where corpses are buried has been either cut or filled to create a stable surface with a mild slope. The area is slightly sloped to prevent the burial veldt from turning into a detention pond during summer. Corpses submersed in water will not decompose, because composting is an aerobic process.

Figure 101. Nekrotopio meets NWA requirements regarding cemetery placement (Author 2015).

7.3 Ecology (Planting)

The overall approach to the planting is rehabilitation. Areas where rehabilitation is not reasonable, planting is used to strengthen the burial site's narrative. The planting for this thesis can be divided into three sections: Rehabilitation: Most of the site is rehabilitated to enrich the nature reserve.

- Green Burial veldt grasses: Rehabilitation is not feasible where new corpses are buried every ten years. Thus, grasses appropriate to the Egoli Granite Grassland are planted to enrich the narrative.
- Promession Forest: The forest forms part of the site's narrative, as well as a sustainable method of corpse disposal. Indigenous trees were selected for this area. They convey the narrative and aid in the rehabilitation of the nature reserve.

7.3.1 Rehabilitation

The Diepsloot Nature Reserve forms part of the Egoli Granite Grassland region.

The GM 10 Egoli Granite Grassland has moderately undulating plains and low hills with *hyparrhenia hirta* dominant grasslands. Some woody species can be found in rocky outcrops and well as some scattered shrub groups (Mucina & Rutherford 2006).

Due to agricultural activities, sewage drying pans, a motorcycle racetrack, illegal dumping, and the extension of the informal settlement into the reserve, some areas are disturbed, as discussed in chapter three: Site analysis.

The strategy for the larger DNR is to rehabilitate the site. Rehabilitation means to improve the current situation, while restoration means to restore it to its original state. The areas of rehabilitation is indicated in Figure 102. The four rehabilitation phases are as follows:

1. Site clearing: The existing rubble needs to be removed and a proper barrier to demarcate the reserve needs to be erected.

2. Eradicate invasive flora: Alien invasive species need to be removed. The phases of eradication is initial control, follow up control and maintenance control. In the control phase, the smaller plants are hand pulled and larger trees frilled. In the remaining phases, the site is regularly checked for regrow and eradicated again if necessary.

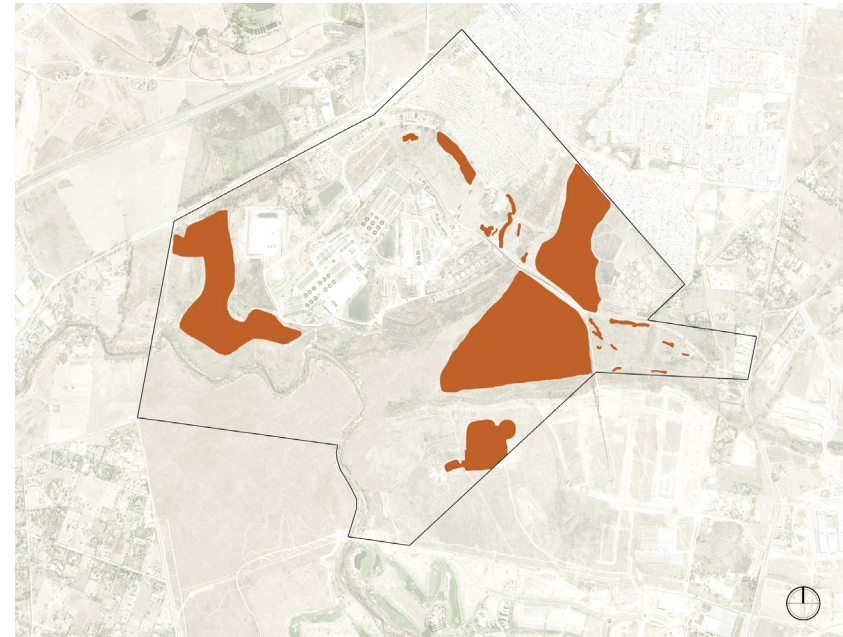


Figure 102. Areas of proposed rehabilitation (Author 2015).

3. Establishment of pioneer species: Following the eradication pioneer species are established. The suggested pioneers are *Eragrostis teff*, *Melinis repens*, and *Sporobolus festivus*.

4. Procession: After the establishment of the pioneers, climax grasses such as *Melinis nervalomus*, *Miscanthus junceas* and *Setaria megabulla*, and herbs and succulent like *Diantis molensis*, *Stagis natalensis*, *Colombaria sp.*, *Dicana sabiri* and *Dicana anomda* can be planted in-between the pioneers (Wentzel 2015).

7.3.2 Green Burial veldt grasses

In the green burial veldt graves are reused every ten years when the corpses have completely decomposed. The soil is thus disturbed every decade. This makes grassland rehabilitation on top of the graves unfeasible. Instead of attempting to make the burial veldt look undisturbed, the veldt is planted in a stripe pattern, highlighting the rows of graves, Figure 103. The selected grasses, figure 104, were

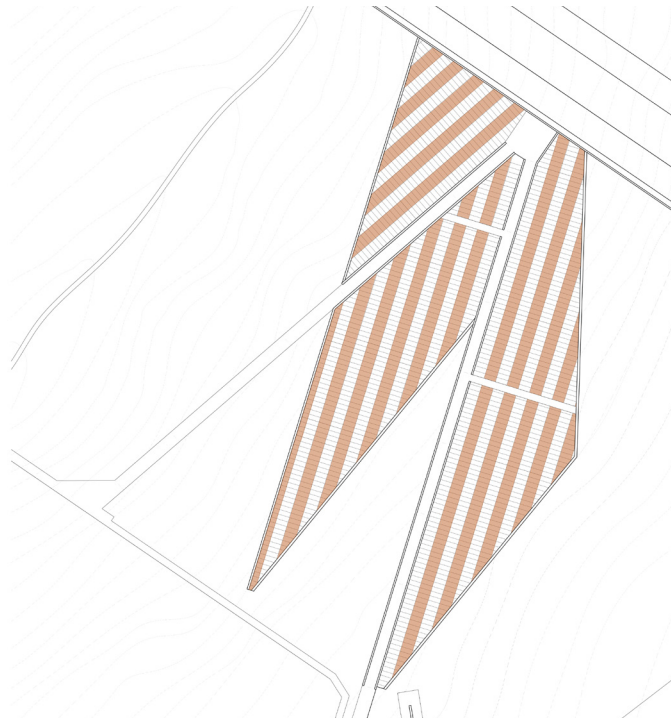


Figure 103. Stripe veldt grass pattern derived from the graves layout (Author 2015).



Figure 105. Different grasses arranged according to height (Author 2015).

selected based on their height, Figure 105, winter foliage, and summer foliage and arranged accordingly. Each grass strip is a different colour in summer and winter, Figure 106. Throughout the year the veldt will always be changing colour. This idea of a dynamic landscape fits into the circle of life theme. According to the Phenomenology of grief, nature teaches people the facts of life and death. Nature provides people with an intellectual frame of reference for death and dying, reminding them that death is a natural phenomenon that they can neither escape nor ignore (Grover 2013). With the grass strips changing colour throughout the year, the user sees the results of the death, decay, and rebirth that is inherent to holism and the cycles of life. It makes intuitive sense that a closer connection to ever-changing nature may help people come to terms with death and the grieving process (Grover 2013). In an article on nature awareness as a healing therapy, Dr. Dyer explains the role nature plays in grief and acceptance:

“Being in nature one becomes aware of the infinite circle of life. There is evidence of decay, destruction, and death; there are also examples of rejuvenation, restoration, and renewal. The never-ending cycle of birth, life, death and rebirth can put life and death into perspective and impart a sense of constancy after experiencing a life changing loss or a death”.

(Dyer 2002)

The green burial veldt is not only a place where corpses are buried or where the user realizes that nothing of the human body remains, it is also a place where the user starts to come to terms with death through nature.

7.3.3 Promession Forest

In the promession forest, a corpse’s ashes are placed in an eco-urn with a tree seedling and compost, and are placed in the promession forest. The deceased’s family has five trees to choose from: *Dombeya rotundifolia* var. *rotundifolia*, *Erythrina humeana*, *Ziziphus mucronata* subsp. *mucronata*, *Vachellia rodusta* subsp. *robusta*, and *Combretum molle*. These trees were selected because they are suitable for the environment: they are all hardy, frost resistant, fast growing, easily cultivated from seed, and have low water requirements. They were also selected for their shape, they all have relatively rounded crown without any low branches or multiple stems, thus the user will be able to walk underneath the crowns. According to the narrative, the forest is the third event. This space is entered into after the user has been made aware of their own morality and the fact that their bodies disintegrate after death. Upon entering the forest, the user should feel safe. Light is filtering

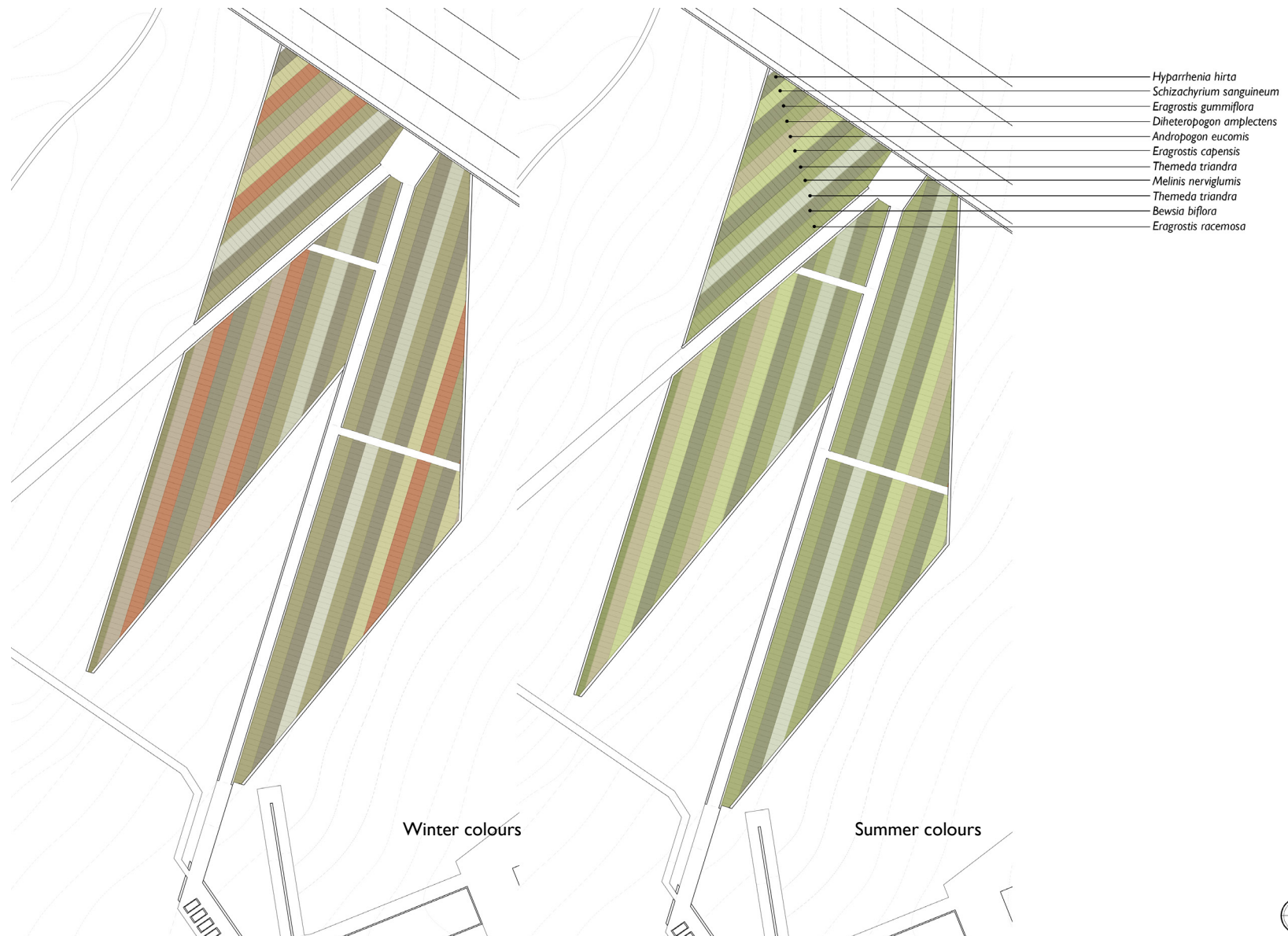


Figure 106. The green burial veld changes colour as the seasons change, creating an ever-changing stripe pattern in the landscape(Author 2015).

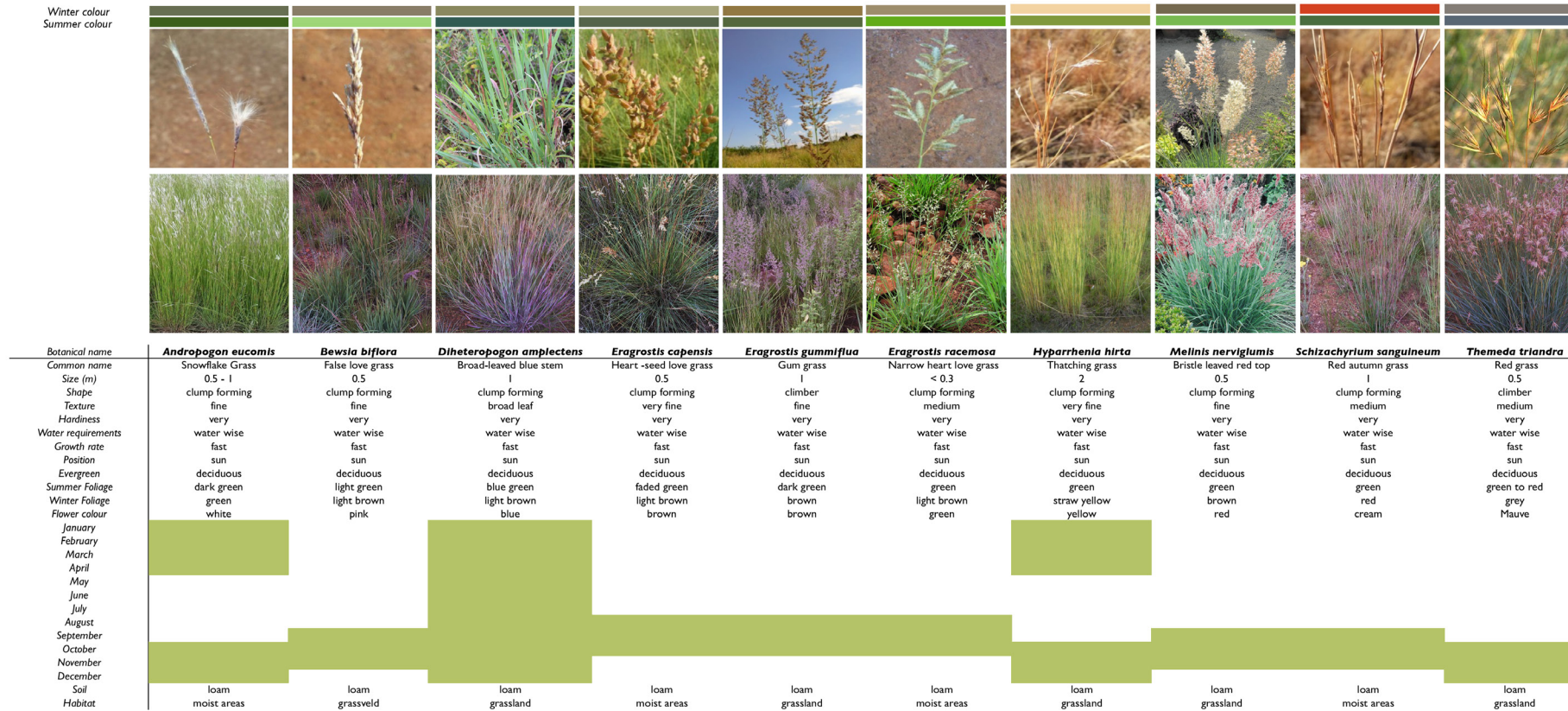
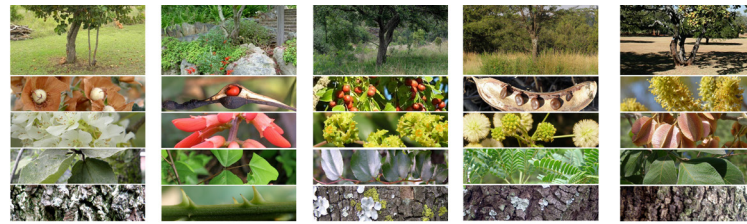


Figure 104. Selected grasses for the green burial veldt (Author 2015).

through the trees, birds are singing and animals can be spotted. In the forest, the user should realize that each tree represents a life. Each tree grew from the remains of a person. So even though people are mortal and their bodies are temporary, from death comes new life. The trees in the forest provide food and shelter to other life forms. In order to have such a dynamic forest, the selected trees attract a lot of insects, birds and animals, Figure 107.

The role of nature in grief is also pulled through into the forest: deciduous tree with attractive changing foliage and interesting fruit or flowers were selected to ensure that the forest is visually dynamic. Like the grass strips, the trees are also planted in a pattern to highlight certain aspects of certain trees during the year.



Botanical name	<i>Dambeya rotundifolia</i> var. <i>rotundifolia</i>	<i>Erythrina humensis</i>	<i>Ziziphus mucronata</i> subsp. <i>Mucronata</i>	<i>Vochelia robusta</i> subsp. <i>Robusta</i>	<i>Combretum melle</i>
Common name	Bushveld bridle	Dwarf Coraltree	Buffalo-thorn	Broadpod Robust Thorn	Velvet Bushwillow
Classification	small tree	medium shrub/ small tree	medium tree	small tree	medium tree
Size (m)	6 x 4	3 x 2.5	9 x 10	7 x 6	9 x 10
Shape	rounded (sparse open texture)	long narrow (sparse open texture)	rounded (sparse open texture)	rounded (dense)	concorded to rounded
Root system	not aggressive	not aggressive	not aggressive	aggressive	not aggressive
Drought resistant	yes	yes	yes	yes	yes
Hardiness	very	half-hardy	very	very	very
Water requirements	low	low	medium	medium	low
Growth rate	fast	fast	moderately fast	fast	moderately fast
Position	sun	sun	sun	sun	sun
Evergreen	deciduous	deciduous	deciduous	deciduous	deciduous to evergreen
Cultivation	easy from seed	easy from seed	easy from seed	from seed	easy from seed
Bark colour	dark brown to black	grey-green	dark brown	blackish brown	dark brown to blackish
Bark texture	very coarse and fissured	prickly with vertical grooves	grooved	rough with deep grooves	rough and fissured
Summer foliage	dark green (appears after flowering)	green (appears with flowering)	dark green (appears with flowering)	dark green (appears with flowering)	green (appears after flowering)
Leaf shape	broadly ovate to round	triangularly-lobed and pointed	ovate or broadly ovate	lanceolate	elliptic to obovate
Leaf texture	thick, rough and hairy	shiny and smooth	leathery	fine	soft, velvety
Autumn foliage	lemon yellow before falling	brown and dies back	golden yellow before falling	brown before falling	yellow to red before falling
Flower colour	creamy-white then golden-brown	red	yellow-green	yellow	yellow
Flowering time:					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Fruit/pod colour	almost round hairy fruit cream	long, stickle-shaped pod, purplish-black pods with orange-red seeds	shiny and leathery round berry ripens to yellow, then dark red or brown, all soils	leathery/woody pods, straight or sickle	attractive, four-winged fruit
Soil	most soils	humus rich soils	all soils	most soils	red-brown moist soils
Habitat	open bushveld	mountainsides in bushveld	variety (bushveld to forest)	dryish bushveld/ grassland	bushveld
Other	Attracts useful insects, game browsers leaves and porcupines are fond of the bark	Sunbirds, white-eyes and bulbuls feed on the nectar produced by the flowers, it also attracts useful insects	Flowers attract bees, butterflies and beetles. Guineafowl and other birds consume fruit. Game browses leaves and fallen fruit. Rock rabbits climb the tree	Flowers, pods and leaves eaten by game. Lures a large number of insects and thus insectivorous birds	Attracts insects and the Guinea-fowl butterfly. Antelopes browse the leaves

Figure 107. Selected trees for the promession forest (Author 2015).

7.4 Composting system

In the selected area of detailing, the composting chambers, corpses are composted in vertical enclosed structures. Each corpse is placed in the chamber with straw. The amount of straw required has to be calculated. In order to do so, the process and mechanics of composting need to be understood.

Haug (1993) defines composting in *The Practical Handbook of Compost Engineering* as:

“The biological decomposition and stabilization of organic substrates, under conditions that allow development of thermophilic temperatures as a result of biologically produced heat, to produce a final product that is stable, free of pathogens, and can be beneficially applied to land.”

Rodale (1960) manages to state it a bit more eloquently when he argued that compost is more than a fertilizer or a healing agent for the soil’s wounds. It is a symbol of continuing life.

Composting is a process that involves the cultivation of microorganisms that degrade and transform organic materials in the presence of oxygen, Figure 108. When properly managed, meaning the compost heap has the correct nitrogen to carbon ratio, the compost becomes heavily populated with thermophilic microorganisms. Microorganisms combine carbon with oxygen through a chemical reaction that produces carbon dioxide and energy in the form of heat. This exothermic reaction kicks off the composting process. Following this, the organic material is converted to humus through a series of stages by micro (invisible) and macro (visible) organisms.

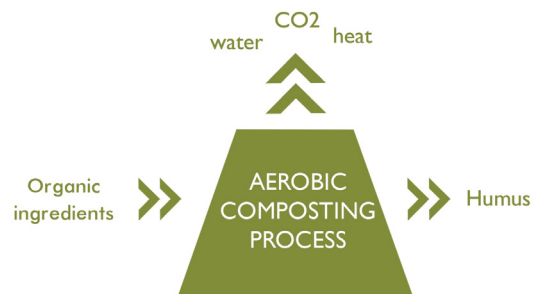


Figure 108. Thermophilic aerobic composting process (Author 2015).

7.5 Return to nature through composting

All organic material contains stored energy. Everything from a leaf to a corpse holds a certain amount of heat and light. According to Sides (1991) in the cycle of light, producers (plants) convert solar energy into food for primary consumers (humans). Through the consumption of the producer, the energy is transferred to the primary consumer. When the primary consumer dies, the energy should be returned to the soil in order to generate new producers. The cycle of solar energy is one of the reasons why composting of corpses is crucial. Corpses should not longer be seen as waste, but as sunlight on the move from one form to another (Sides 1991). This energy is returned to the soil in the form of humus.

Through the composting of a corpse and other organic material, humus is created. Humus is a brown substance resulting from the decay of organic refuse. Humus is a stable product that does not attract insects or nuisance animals. It can be handled and stored without fear of carrying pathogens. Not only does it accelerate plant growth, it also holds moisture, thus increasing the soil’s capacity to absorb and store water. Furthermore humus aerates the soil, balances the soil pH and slow-releases essential plant nutrients, such a Nitrogen, making it less susceptible to leaching than chemical fertilizers (Haug 1993). The humus is added to soil, to restore fertility and create rich topsoil. Without the addition of humus to the soil, building topsoil is a centuries long process.

Through the process of corpse composting, the energy and nutrients in a human body is returned to the soil to complete the circle of life.

7.6 Four necessities for successful corpse composting

1. Balanced ingredients

A proper blend of organic materials (a good nitrogen : carbon balance) is required for a successful, thermophilic, and odor free compost pile. Without a sufficient N:C ratio, the organic materials will not compost. Corpses are nitrogen (N) based (they contain more nitrogen than carbon) thus without the addition of a carbon based material, it will not compost, only rot. A good N:C ratio for a compost pile is between 1:20 and 1:35. The optimum ratio is 1:30, Figure 109. For every 30 parts of carbon there has to be only one part nitrogen (Stoner 1977).

Microorganisms’ main energy source is carbon, but nitrogen is needed for protein, genetic material, and cell structure. A balanced diet for a compost microorganism

is 30 parts carbon for every one part nitrogen they consume. If a compost pile contains too much nitrogen, the microorganisms cannot consume all of it and the excess is lost in the form of foul smelling ammonia gas. Nitrogen is extremely valuable to plants, thus losing it to the atmosphere is wasteful (Rodale 1960).

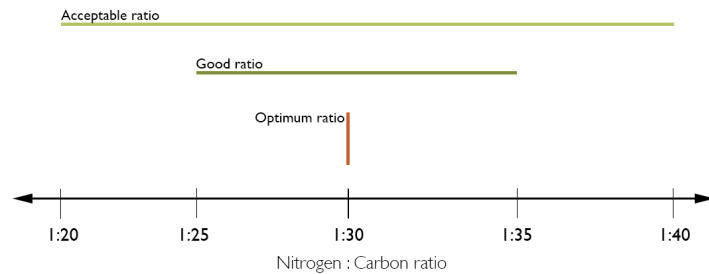


Figure 109. Required Nitrogen: Carbon ratios for successful compost (Author 2015).

The two ingredients of corpse composting are the corpses and straw/dried veldt grass (carbon based material). A human corpse consists of 18.5% carbon and 3.2% nitrogen. Although the percentage of nitrogen might seem low, in comparison to the carbon percentage, a corpse has a N:C ratio of 1:6. This is far from the required 1:30 ratio needed for composting. Straw consists of 40% carbon and 0.288% nitrogen and has a N:C ratio of 1:140. Combining the corpse and straw in the correct proportion will result in a balanced N:C ratio.

2. Moisture

Without sufficient moisture, organic material will not compost. Moisture is required at the initial stage when the exothermic reactions take place. During the composting process a lot of moisture evaporates, causing the pile to shrink with 70%. The lack of moisture will result in a dried out composting and bring the process to a halt (Rynk 1992). In extreme cases, the moisture content of a compost pile can dwindle from 65% to 20% in just a week.

Water does not need to be added as an ingredient. The ingredients (corpse and straw) all contain moisture and if balanced correctly no extra moisture will be necessary.

Both ingredients have a moisture percentage. Carbon based materials like straw, dry

veldt grass, sawdust, etc. consist of 20% H₂O. Corpses vary in moisture content because humans die at different ages. As a human ages, the moisture content of the body decreases. Figure 110 indicates that newborns have a moisture content of 75%, a one year old to a teenager a 65%, an adult 55 - 60% and an elderly person only 50% (Forbes 1987). The moisture content as well as the weight of the corpse will influence how much straw is needed to balance the compost pile.

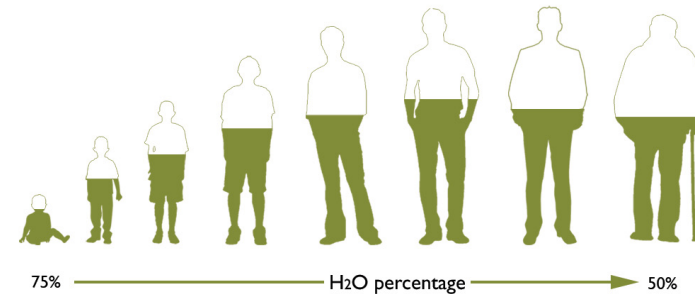


Figure 110. The moisture percentage of a human body decreases with age (Author 2015).

3. Oxygen

Composting is an aerobic process that requires the cultivation of oxygen loving bacteria in order to ensure thermophilic decomposition. Minute interstitial air pockets can be created by adding airy, non-compacted, bulky material (straw) to the corpse (Jenkins 2005).

Bacterial decomposition can take place anaerobically; this however, is much slower, not thermophilic, and releases undesirable odors. Proper healthy aerobic compost does not smell bad; good carbon bulking material, like straw, traps oxygen in the pile and prevents odors.

4. Temperature

Composting is an exothermic chemical reaction. In order to compost the organic materials properly, the pile has to reach a certain temperature. Without a correct N:C ratio, the compost pile is too hot or not hot enough. Figure 111 illustrates that if the N:C ratio is 1:40 the pile will only reach a temperature of 60°C, while a 1:60 ratio only reaches 45°C. With a correct N:C ratio the compost pile should reach temperature between 70 and 77 °C. If this is not reached, the decomposition is less effective and takes a lot longer.

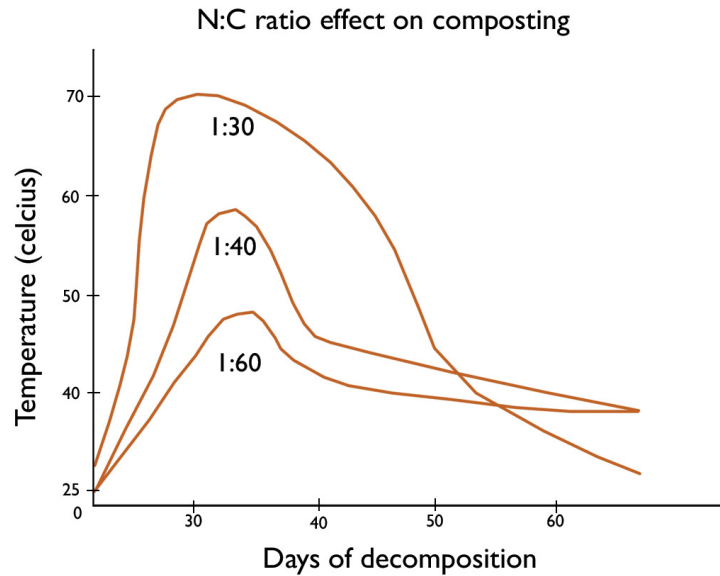


Figure 111. Incorrect N:C ratio will result in insufficient heating of the compost heap (Author 2015).

The person compiling the compost heap can easily manage the above-mentioned necessities. Once these are in place, thermophilic microorganisms can start the composting process.

7.7 The composting process

7.7.1 Preparing the chamber

Prior to composting, the pile needs to be built.

1. The pile should be contained in a constructed chamber instead of just sprawling over the soil; this will reduce the surface area where heat loss happens.
2. The pile needs to stand on top soil to allow macroorganisms, like earthworms, to move from the soil into the pile and back. If the soil underneath the pile were compacted, macroorganisms would not be able to enter the pile, which would bring the process to a halt.
3. The chamber should not be entirely exposed to full sun. Solar heat would externally overheat the pile, killing the micro and macroorganisms and cause the

pile to rot, rather than compost.

4. The materiality of the chamber needs to be considered. Timber or cement/masonry can be used, timber may be preferred as it will insulate the pile and prevent heat loss. If timber is used it should be kiln dried and may not be soaked in toxic chemicals. Kiln drying timber removes the air, which makes it too dense to decompose (Jenkins 2005).

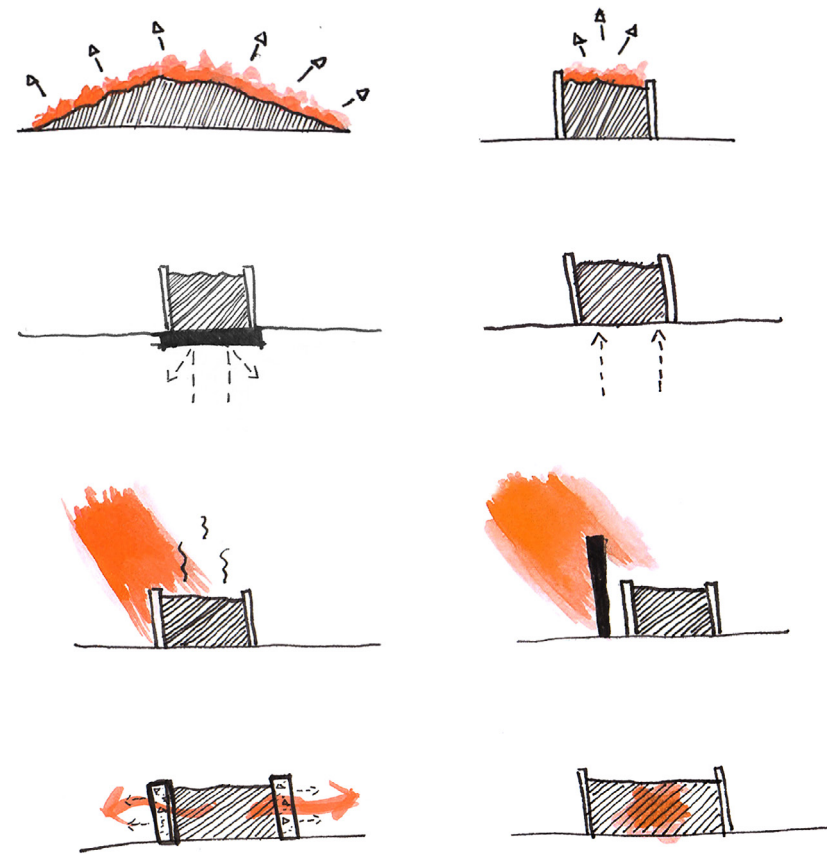


Figure 112. Incorrect vs correct composting pile construction (Author 2015).

CONSTRUCTED CHAMBER

Compost contained in a constructed, versus a sprawling pile, reduces surface heat loss

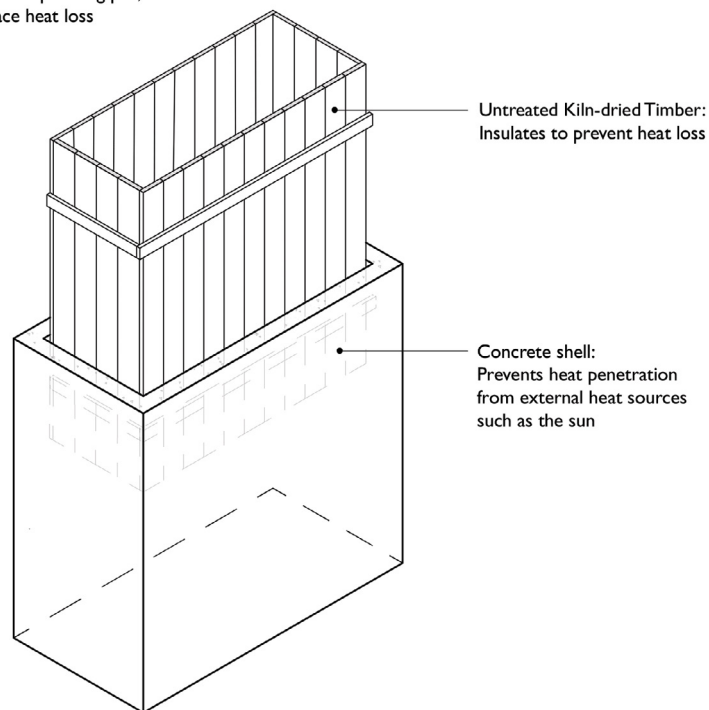


Figure 113. Proposed constructed composting chamber's materiality and shape (Author 2015).

7.7.2 Preparing the corpse

Before placing the corpse in the composting chamber, the corpse has to be prepared, Figure 114, to ensure proper composting. Everything in the human body can decompose; teeth however take exceptionally long due to its high calcium concentration. The decay of teeth can take as soon as 50 to 100 years. The teeth should rather be pulled out and turned to ash through promession, as it will not compost within two months. Next, the corpse may not be embalmed at all. Embalming fluid will prevent decomposition and will poison the compost pile. Lastly, the corpse may not be placed in a wooden or metal coffin. Only decomposable straw woven caskets are allowed. The corpse may also be wrapped in cotton instead of placed in a casket.

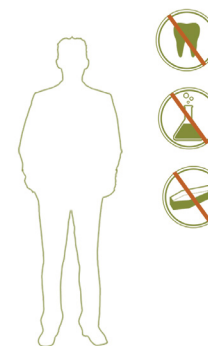


Figure 114. Composted corpses may not be embalmed or be placed in timber caskets. Their teeth are also pulled prior to composting as dental decay takes between 50 - 100 years (Author 2015).

Once the chamber is constructed and the corpse has been prepared, the corpse and straw can be placed inside. The corpse, which is placed in a woven casket or wrapped in cotton, is lowered onto 40% of the straw and then covered with the remaining 60%. It is crucial that the nitrogen-based material is covered with the carbon-based material; it prevents foul corpse odors.

7.7.3 Four phases of composting

When the corpse and straw is placed in the chamber, Figure 115, the four stages of composting commence. Figure 116 illustrates the four phases of composting.

7.8 Calculating the N:C ratio

Efficient and pathogen destroying thermophilic composting only takes place if the nitrogen-based and carbon-based organic materials are balanced. The perfect N:C ratio is 1:30. In order to calculate the N:C ratio, the nitrogen, carbon, and water percentage of each material is needed. Whilst calculating the ratio, it is also crucial to calculate the size of the pile. This is done in cubic meter and will determine the size of the compost chamber.

7.9 Composting calculation example

Each corpse will require its own N:C ratio calculation. The age of the person who died, as well as their weight influences the amount of sawdust needed. As an example the calculation will be done for a 45 year old male who weighed a 100kg.

Day 1

1 MESOPHILIC PHASE
 44 - 50°C
 - CO₂ + O₂ + Compost bacteria = O₂ + Energy (heat)
 - Heat = Reproduction & growth of bacteria
 - Temperature rises & thermophilic bacteria takes over

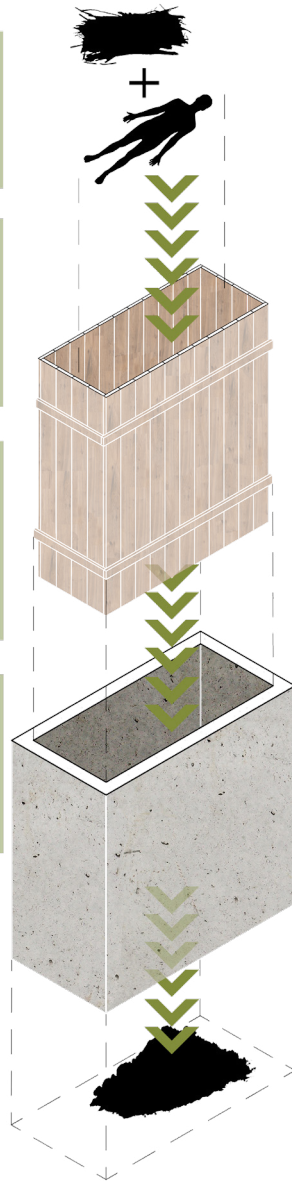
2 THERMOPHILIC PHASE
 50 - 70°C
 - Thermophilic bacteria generate more heat
 - Heat localizes around corpse
 - Micro-organisms digest corpse and straw
 - Phase lasts a couple of days to weeks

3 COOLING PHASE
 20 - 40°C
 - Corpse and straw appear digested, but coarser material remains
 - Thermophobic microorganisms, Fungi and macroorganisms (earthworms & sawbugs) migrate to compost to digest remaining matter to humus

Day 20 - 30

4 CURING PHASE
 0 - 20°C
 - Remaining organic material is broken down and pathogens killed
 - Uncured compost causes Phytotoxins, which is toxic to plants as it robs the soil of oxygen

Day 45 - 60



LEFT Figure 116. Four phases of composting (Author 2015).
 RIGHT Figure 115. Ingredients are placed into the chamber and reduced to humus through composting (Author).

Temperatures reached during composting process

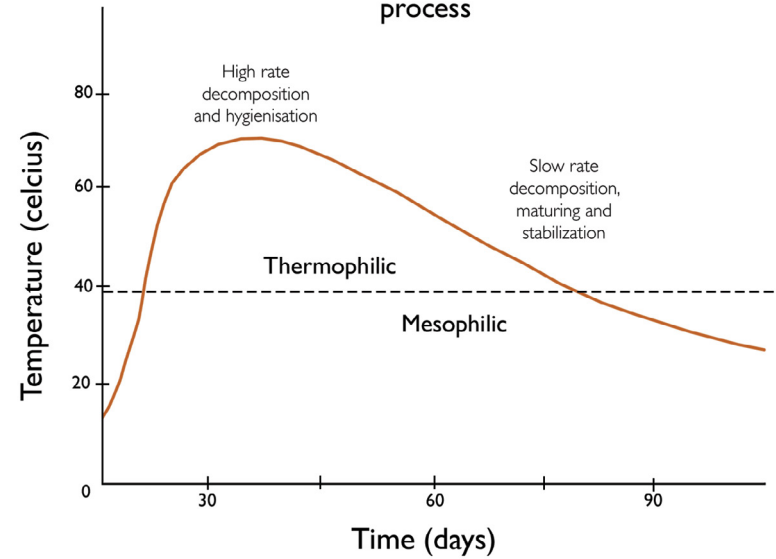


Figure 117. Temperatures reached during composting process (Author 2015).

Figure 118 illustrates his, and the straw's biological statistics. The information in is translated into a table.

NON EMBALMED CORPSE	STRAW/ DRIED GRASS
% H ₂ O	20% H ₂ O
18.5% Carbon	42% Carbon
18.5% Nitrogen	0.288% Nitrogen
100kg/m ³ Bulking density	18kg/m ³ Bulking density

Figure 118. Biological and chemical statistics of a corpse and straw (Author 2015).

Organic material	Weight (kg)	Volume (m ³)	% H2O	% Carbon	Carbon average	% Nitrogen	Nitrogen average	N:C ratio
Corpse	100	0.1	60	18.5	7.4	3.2	1.28	1:6

The volume of the corpse is calculated as such:

$$\text{volume (m}^3\text{)} = \text{weight (kg)} / \text{density (kg per m}^3\text{)}$$

(Greenwood & Earnshaw 1997)

The density of a human corpse is 1000kg per m³ and the corpse in this example weighs 100kg. Thus, the volume of the corpse would be 0.1.

$$v = w/p$$

$$v = 100 / 1000$$

$$v = 0.1 \text{ m}^3$$

Following this calculation, the amount of carbon needed to balance the nitrogen-based corpse has to be calculated. The chemical statistics of straw is illustrated in Figure 118. This information is translated into the table.

Organic material	Weight (kg)	Volume (m ³)	% H2O	% Carbon	Carbon average	% Nitrogen	Nitrogen average	N:C ratio
Corpse	100	0.1	60	18.5	7.4	3.2	1.28	1:6
Straw	120	5	20	42	40.32	0.288	0.276	1:122
Total	220	5.01			47.72		1.556	1:30

With the information in the table, the weight and volume can be calculated. For a deceased person of 45 years and 100kg, 120kg (five cubic meter) of straw is needed to compost the corpse. Also indicated in the table is the total volume of the compost pile; to compost this corpse the chamber will need to be at least 5.01 cubic meter.

7.10 Timing and final product

Human corpse composting is not practiced anywhere in the world. The author designed the system based on the biological properties of the organic elements and chemical processes of composting. Although humans are not composted, the composting of livestock carcasses on farms has become popular amongst farmers. The increase of composting large animal carcasses is due to the high cost to dispose of the carcasses through incineration, bio-digestion, or chemical digestion (Auvermann *et al* 2006).

According to Auvermann *et al* (2006), the cattle carcasses are covered with sawdust, Figure 119, to ensure a N:C ratio of about 1:30. Phase one to three takes about two months for a 250kg calf. For human corpse composting, the Author has divided this time in half, due to corpses being smaller and lacking a thick coarse skin, and fur.

After the first three phases, all soft tissue has degraded, only the carcass bones have not fully composted. The pile is left for another two months for allow phase four to take place (Auvermann *et al* 2006). Once again this time can be reduced for human corpses. After all four phases are completed, some larger bone fragments remain, Figure 120, but they are hollow and brittle and will easily degrade once applied to the land (Auvermann *et al* 2006). If larger bone fragments are undesired, it can be turned to ashes using an industrial blender.

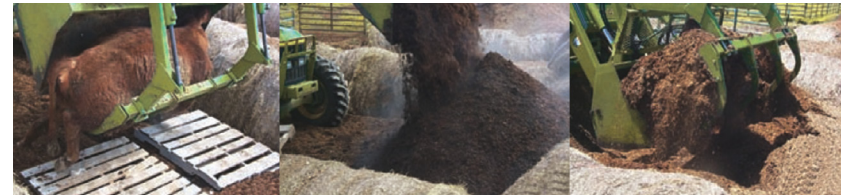


Figure 119. Nitrogen-based cattle carcass is placed in and over with sawdust (Author 2015).



Figure 120. After the Curing phase brittle bone fragments remain (Author 2015).

To conclude, the composting of a human corpse takes about one and a half to two months. The mass of the organic materials is reduced to about 30% of the original volume within the first 20 to 30 days. The final product of composting is a nutrient rich, safe to handle humus, which may contain some bone fragments.

7.11 Focus area: Human composting chambers

The area selected for detailing, figure 121, is the first event of the burial site's narrative: the composting chambers.

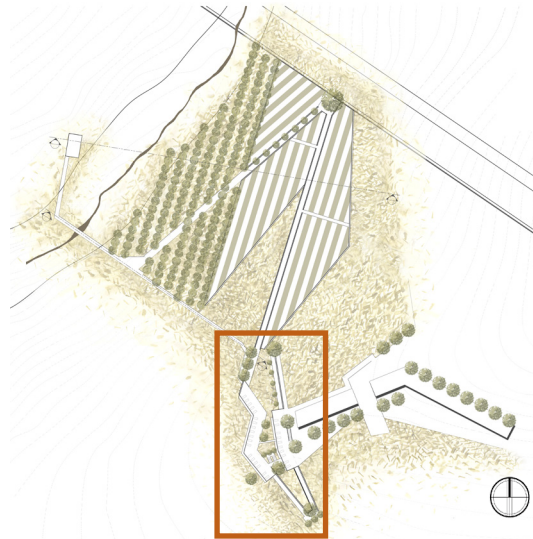


Figure 121. Sketch plan/ focus area for technification (Author 2015).

7.12 Approach to technification of the composting chambers

The area was selected because it is important to the site's narrative and demonstrates a unique alternative method to sustainably dispose of corpses through composting. At the composting chambers, the user is made aware of his own morality. On the upper level of the chambers, the user witnesses the corpses being lowered into chambers. This makes the burial feel very traditional up to this point. However, once the user is on the lower level moving past the composting chambers, it goes from tradition to unconventional. On the upper level the experience is about the user bidding farewell to a loved one, while on the lower level it is about the user's own mortality. On the lower level the user realizes that they, like the person composting in the chamber next to them, is mortal. Although the corpses cannot be seen or smelled, the idea of it makes one very aware of the temporality of human life, and of your own mortality. This is a powerful, serious, formal and important space; not only is it a place where someone says goodbye to a loved one, it is also a space where the user is confronted with death. The design and materiality of the space should reveal this.

The space should not feel informal, cheerful, or lighthearted, so the architecture should not either. Tectonic structures often feel light and relaxed. An example of such is the viewing tower at the end of the narrative. After the user moved through the narrative the *genus loci* changes from serious to lighthearted. The architecture reflects this change in atmosphere by also being light, open, and tectonic like the viewing tower at Vecht riverbank in Dalfsen, Figure 122.



Figure 122. Tectonic viewing tower at Vecht riverbank in Dalfsen (Author 2015).

In juxtapose, the architecture of the composting chambers needs to be solid, strong, and formal. The architecture has to reveal a place of importance. It is place where the body of a person is returned to the greater cosmos. It is a place where a person watches as their loved one is lowered into a chamber. It is a place where people are confronted with death.

To achieve this the architecture has to be heavy and powerful. An example of such a place is the Voortrekker monument, Figure 123. This iconic granite building is extremely powerful, it conveys the message that it is a place of importance and permanence. If the Voortrekker Monument were instead a light steel frame with glass panels, it would not have conveyed the same message. If the sarcophagus and interior of the monument had not been polished granite, but timber, the space would not have felt as sacred. The composting chambers needs to have a similar stature to it. The place has to be stereotomic: a solid shape with spaces carved into it. Peter Zumthor's Thermal Baths in Switzerland, Figure 124, is a great stereotomic example of how spaces are created through voids or negative space. The success of this project also lies in the simplistic material choice: granite is used on the exterior and interior walls as cladding and as large tiles on the floor. This enables the space to read as a single mass from which has been cut. Like the Voortrekker Monument, the Thermal Baths is also a strong granite structure (even though it is cladding), which makes the space read as a mighty sanctuary. The intention of Zumthor was to create a space that felt like a cave with natural hot springs (Betsky



Figure 123. Voortrekker monument, Pretoria, is a strong stereotomic structure. The architecture reveals that it is a place of permanence and importance (Aspeling 2013 & Author 2015).



Figure 124. Thermal baths, Switzerland, by Peter Zumthor. Spaces are created through carving it from a solid structure (Betsky 2002).

Figure 125. Tidal swimming pool, Portugal, by Alvaro Siza feel like the architecture was carved out of the natural rock (Balters 2011).



2002). Finally, the composing chambers need to sit in the landscape, although stereotomic, it should not feel like a box stuck onto the landscape. Where the natural site ends and where the constructed chambers start should not be visible. A highly successful example of this is the Tidal swimming pool in Portugal by Alvaro Siza, Figure 125.

7.13 Material selection

To achieve all of the above-mentioned, the material selection for the composting chambers needs to be powerful, yet simplistic.

Granite

Granite is the main material, it is used in the form of tiles and cladding to, as the for-mentioned examples, give stature to the space and read as one volume. Even though granite is a non-renewable resource, the mining amount is restricted to avoid depletion of the resource. Unlike most quarried or mined materials, natural stone has a relatively low impact on our environment. The extraction process does not require the use of any chemicals. Only water is used at quarry sites to cool and lubricate diamond abrasives to cut the stone. Natural stone quarries do not produce toxic waste piles that can pollute the surrounding environment.

Granite also has a memory connection. Granite and marble is used for tombstones and cremation wall plaque without exception all over South Africa. It is tradition to engrave a person's name on a precious stone. It gives their memory a sense of permanence (Moodley 2007). Even in the poorest of settlements, loved ones buy the most expensive granite slab they can afford; it is a sign of respect and love towards the deceased. An example of this is seen in an illegal cemetery just outside the Diepsloot township. Even though the family of the deceased could not afford a grave in a municipal cemetery, every grave is marked with a granite tombstone, Figure 126.

This thesis is not about changing people's culture or traditional beliefs regarding death or burial. The aim is to preserve and respect the traditions, but deal with corpses in a sustainable and ecologically friendly manner within these beliefs. Thus, the tradition of using granite in a place where people are laid to rest and remembered is retained.

The selected granite colour is Niagara Gold, Figure 127. This stone, crystalline in



Figure 126. Illegal cemetery in an open field next to Diepsloot township. Each grave is marked with a granite slab or tombstone (Author 2015).



Niagara gold granite

Diepsloot Nature Reserve

Figure 127. Niagara gold granite will fit in the DNR seamlessly to strengthen the notion of cutting into the landscape and carving out of it (Author 2015).

formation, is a combination of vibrant bordeaux reds, creams, golds, and greys that resembles the colour of the Diepsloot Nature Reserve soil and landscape, Figure 127.

Corten (weathering) steel

Weathering steel is used for lighter elements such as balustrades. It is used instead of stainless steel or galvanized steel because of its earthy texture and colour. Stainless steel has an undesirable clinical quality; while weathering steel has a

warmer quality and blends in with the natural landscape. To prevent rust residue from the weathering steel it is treated and sealed. The steel is sand blasted and oxidised to activate rust. The rusting is brought to a halt and the steel is sealed with marine.

Concrete

Smooth finish concrete is used sparsely to not compete with the granite; it is used in service areas and on the ceilings. The colour and texture blends well with the Nigara Gold granite.



Figure 128. Selected material: concrete, granite, and weathering steel (Author 2015).

7.14 Sketch plans

The composting chambers are terraced into the landscape of the Diepsloot Nature Reserve. The design consists of three levels, as illustrated in Figure 129.

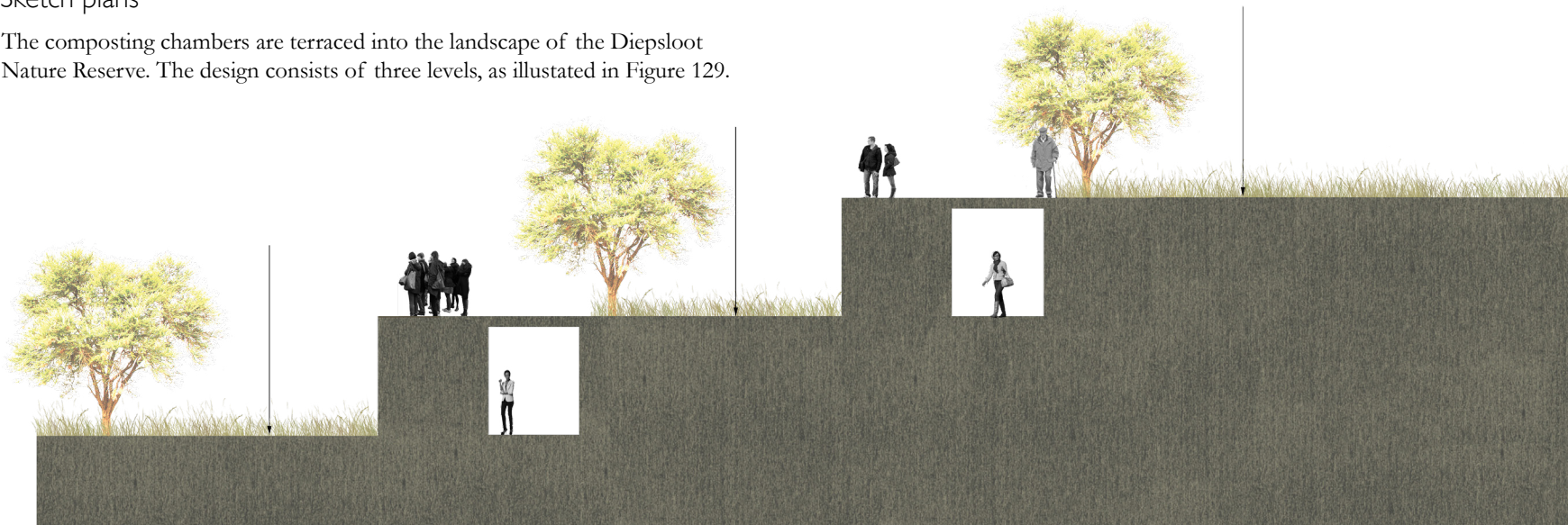
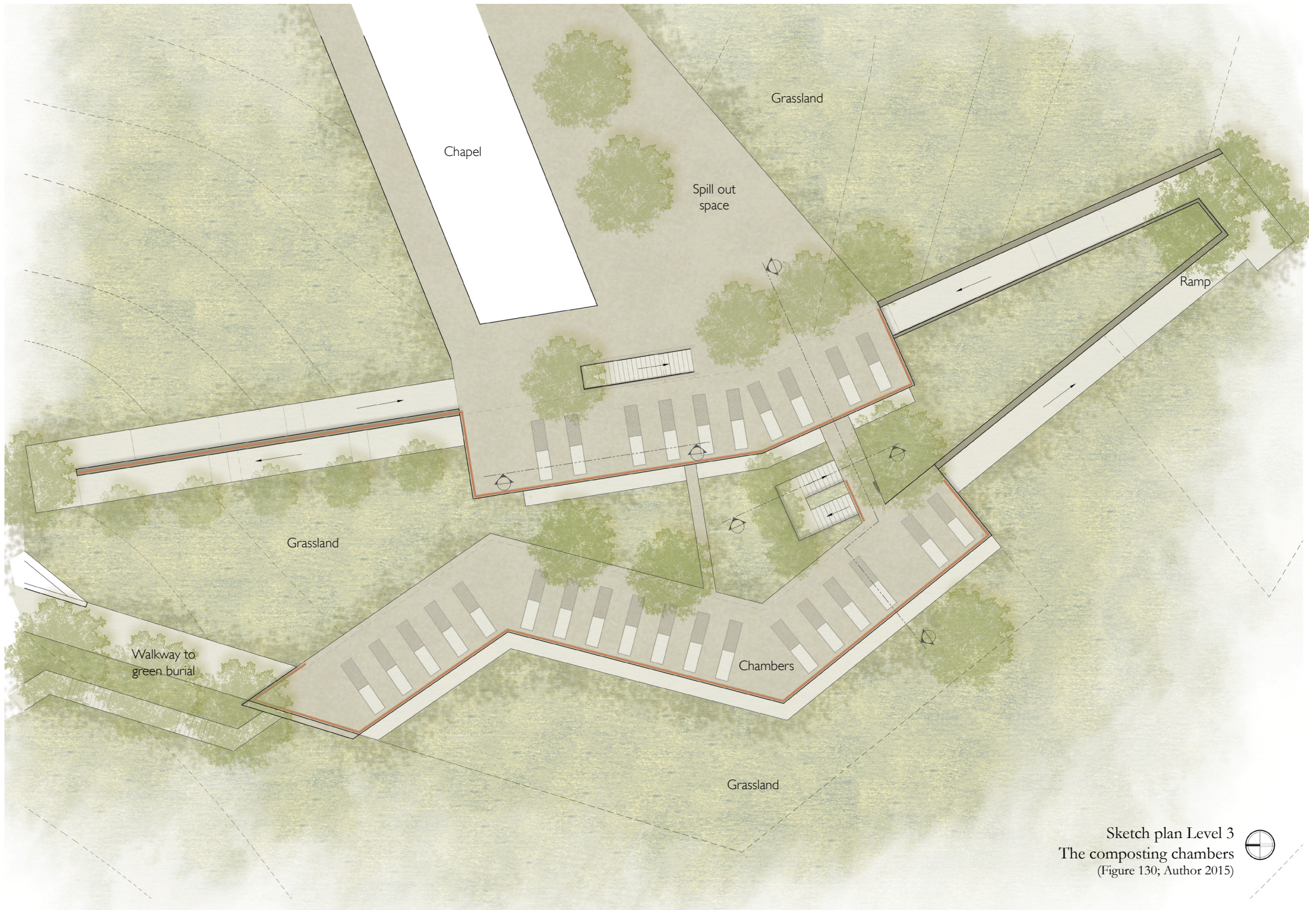
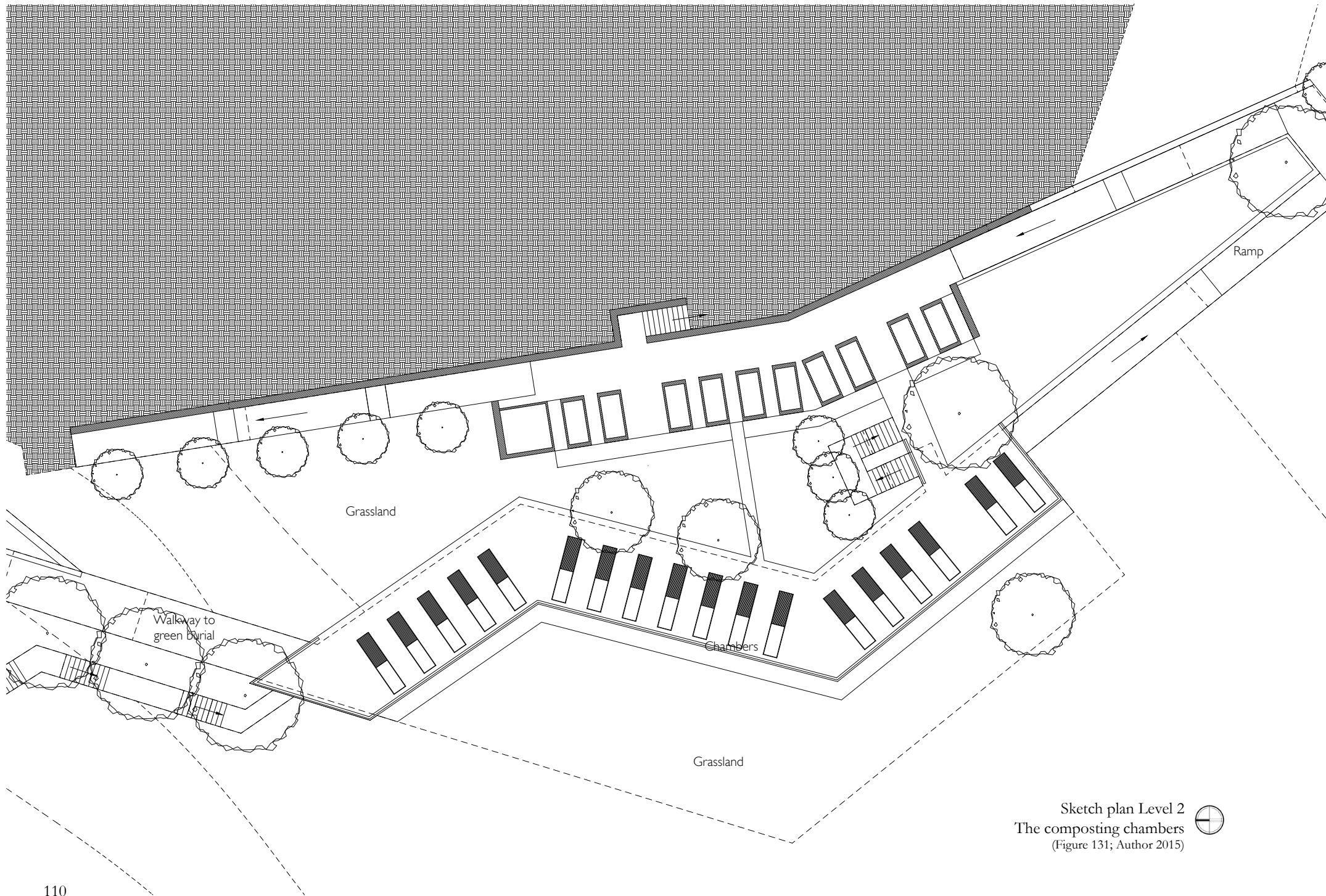


Figure 129. The three levels of the terraced composting chambers (Author 2015).

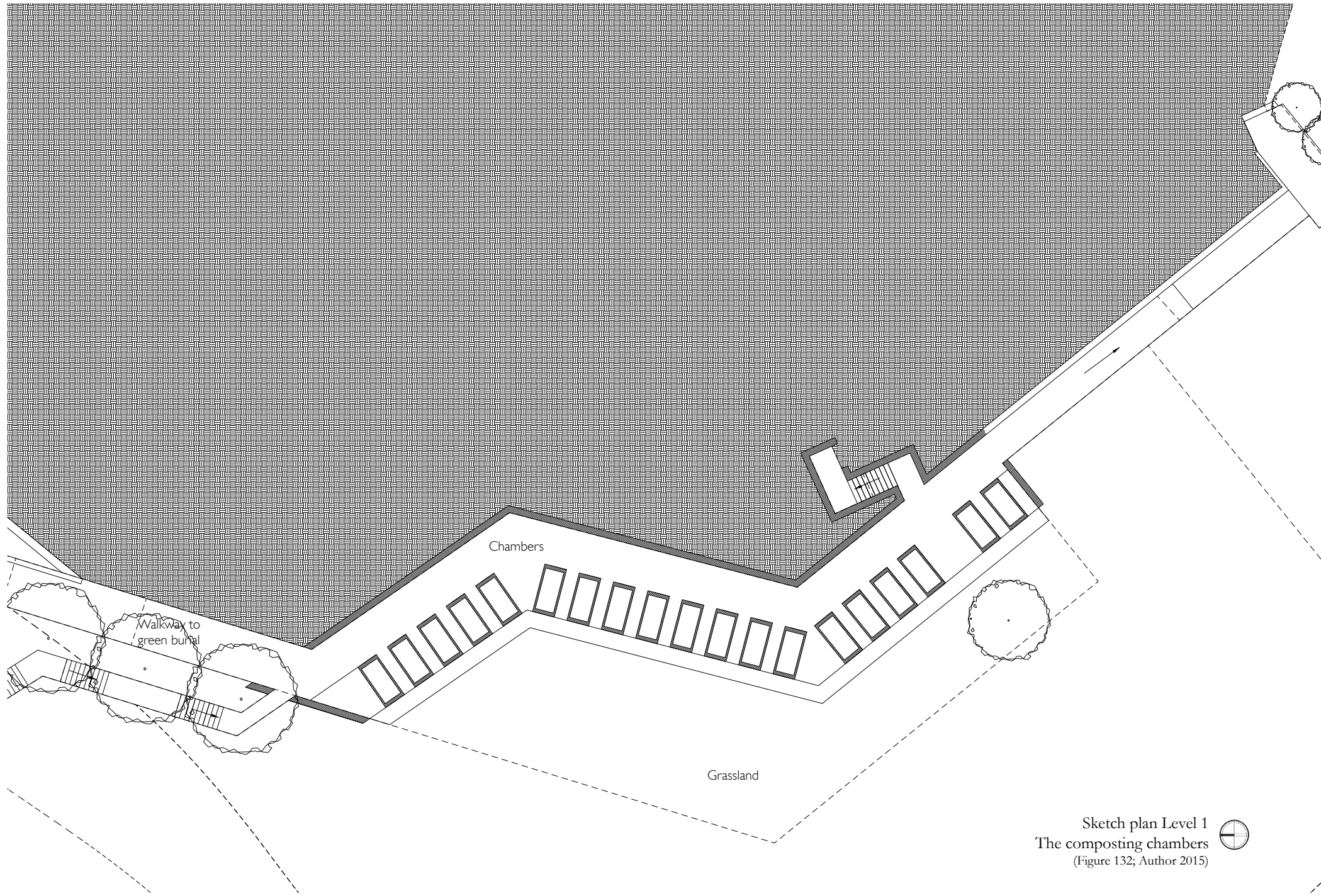


Sketch plan Level 3
The composting chambers
(Figure 130; Author 2015)



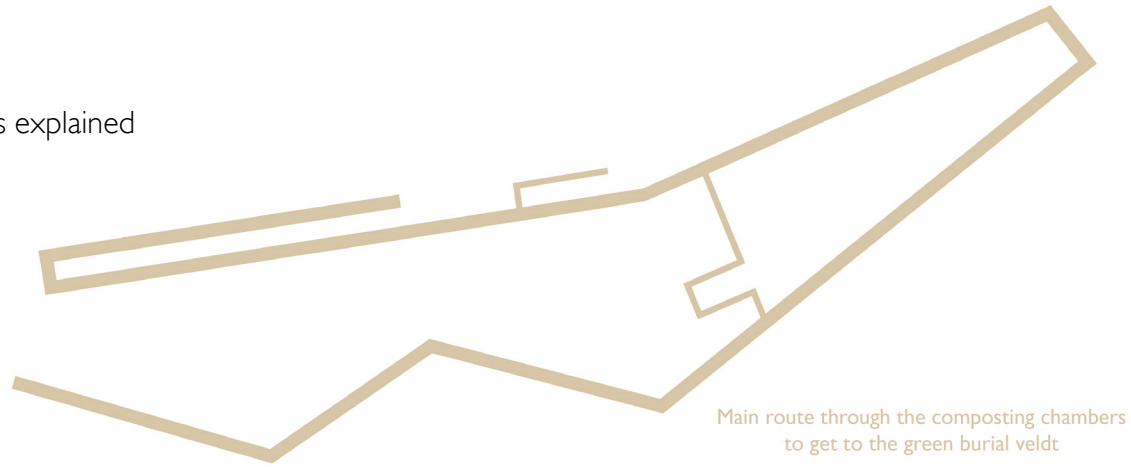


Sketch plan Level 2
The composting chambers
(Figure 131; Author 2015)

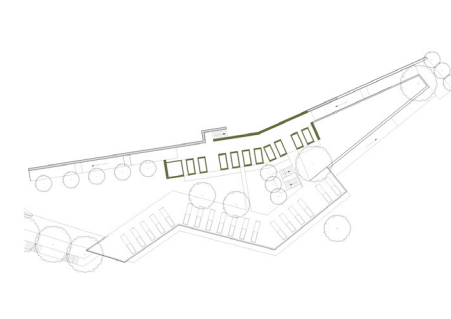
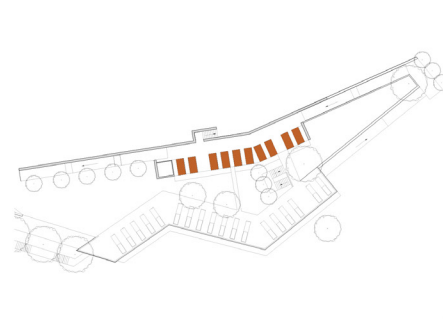
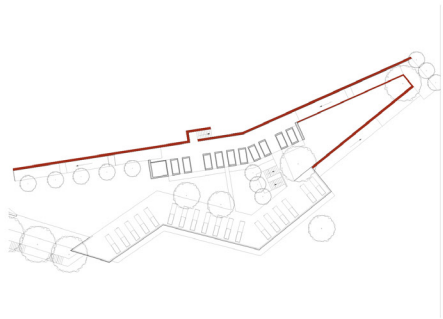


Sketch plan Level 1
The composting chambers
(Figure 132; Author 2015)

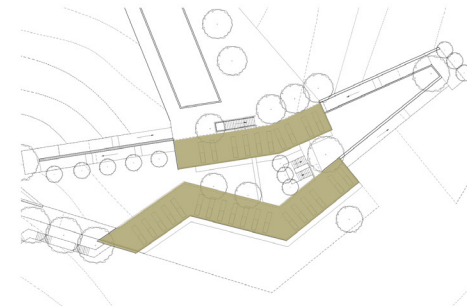
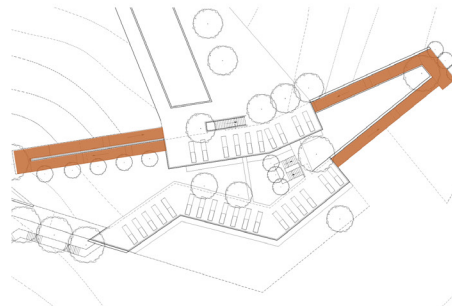
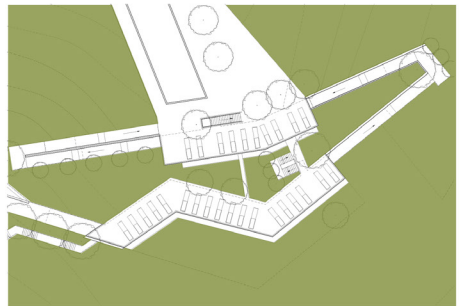
7.15 Composting chambers explained



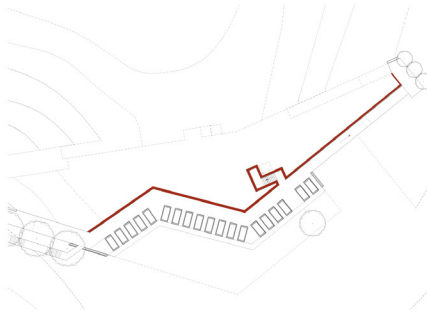
Level 2



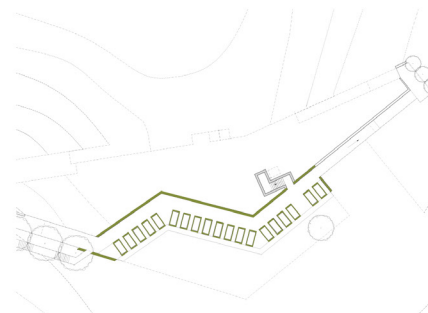
Level 3



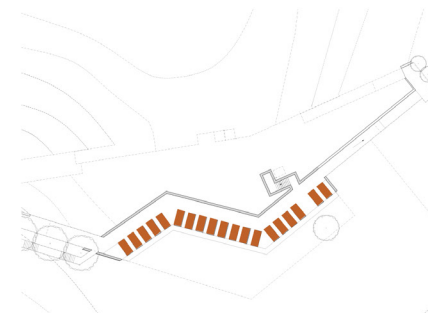
Level I



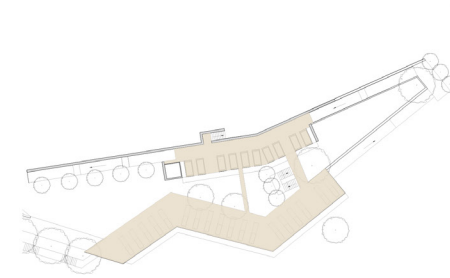
Retaining wall creating terracing of composting chambers



Walls supporting upper platform



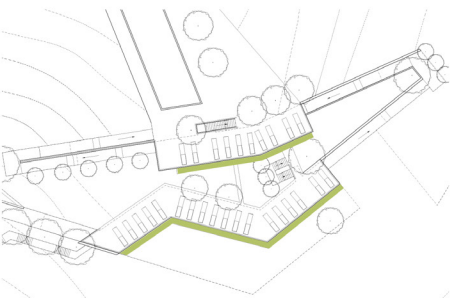
Composting chambers



Hard surface



Grassland



Service alleys where humus is collected once it is removed from the chamber



Trees size and placement at the composting chambers

Figure 133. Composting chamber design deconstructed (Author 2015).

7.16 Perspectives



Figure 134. Users descend a ramp to get to the second series of composting chambers. Catherine Dee's refuge and prospect theory was applied by having a high retaining wall on the right and a vast view of the landscape on the left. (Author 2015).

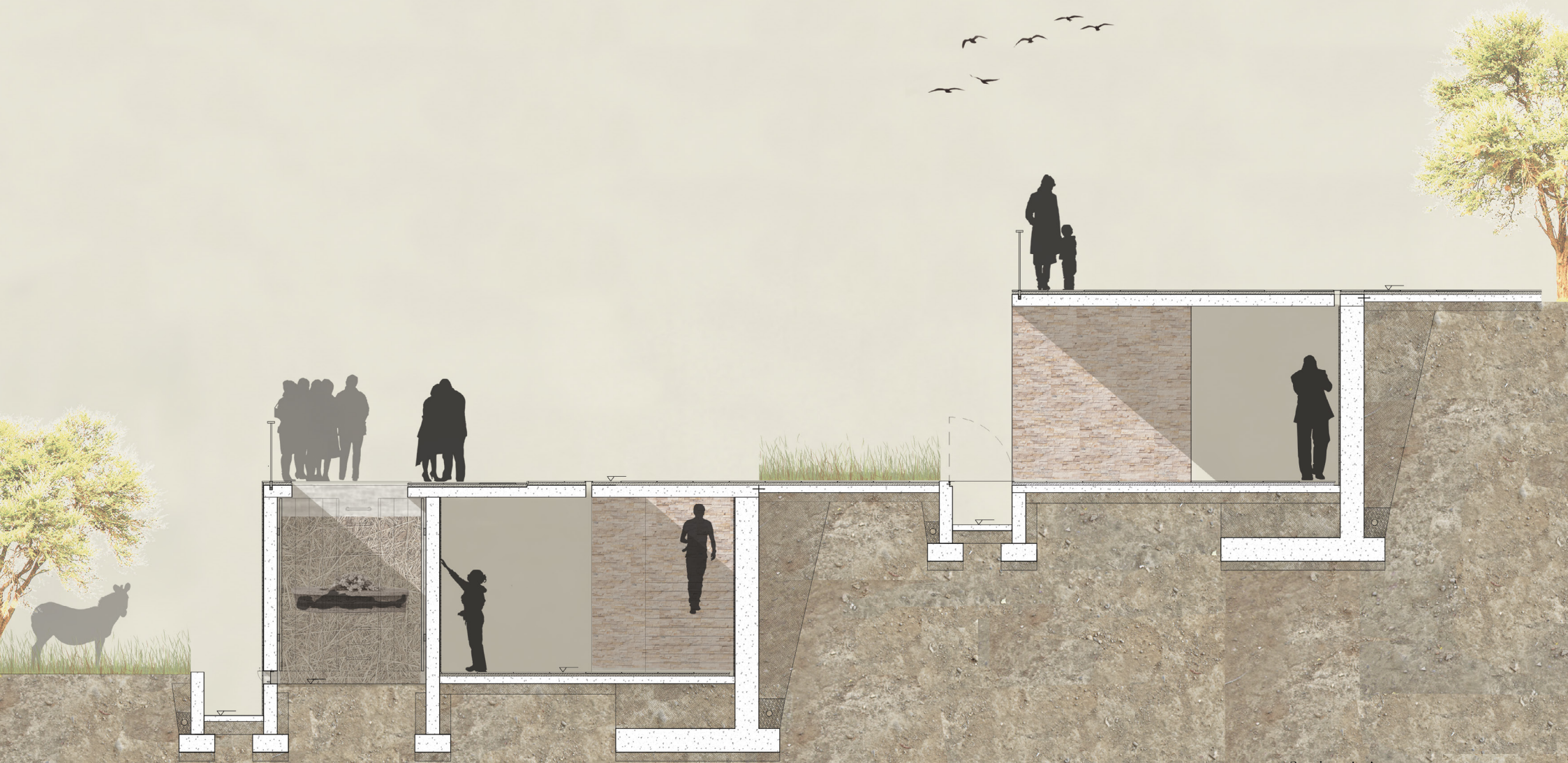


Figure 135. The names of the deceased is engraved on the chamber in which their human remains were reduced to compost. The slits between the chambers allow light to filter into the space. This balance between light and dark is a metaphor for two other contrasting elements of the thesis: Life and Death. (Author 2015).

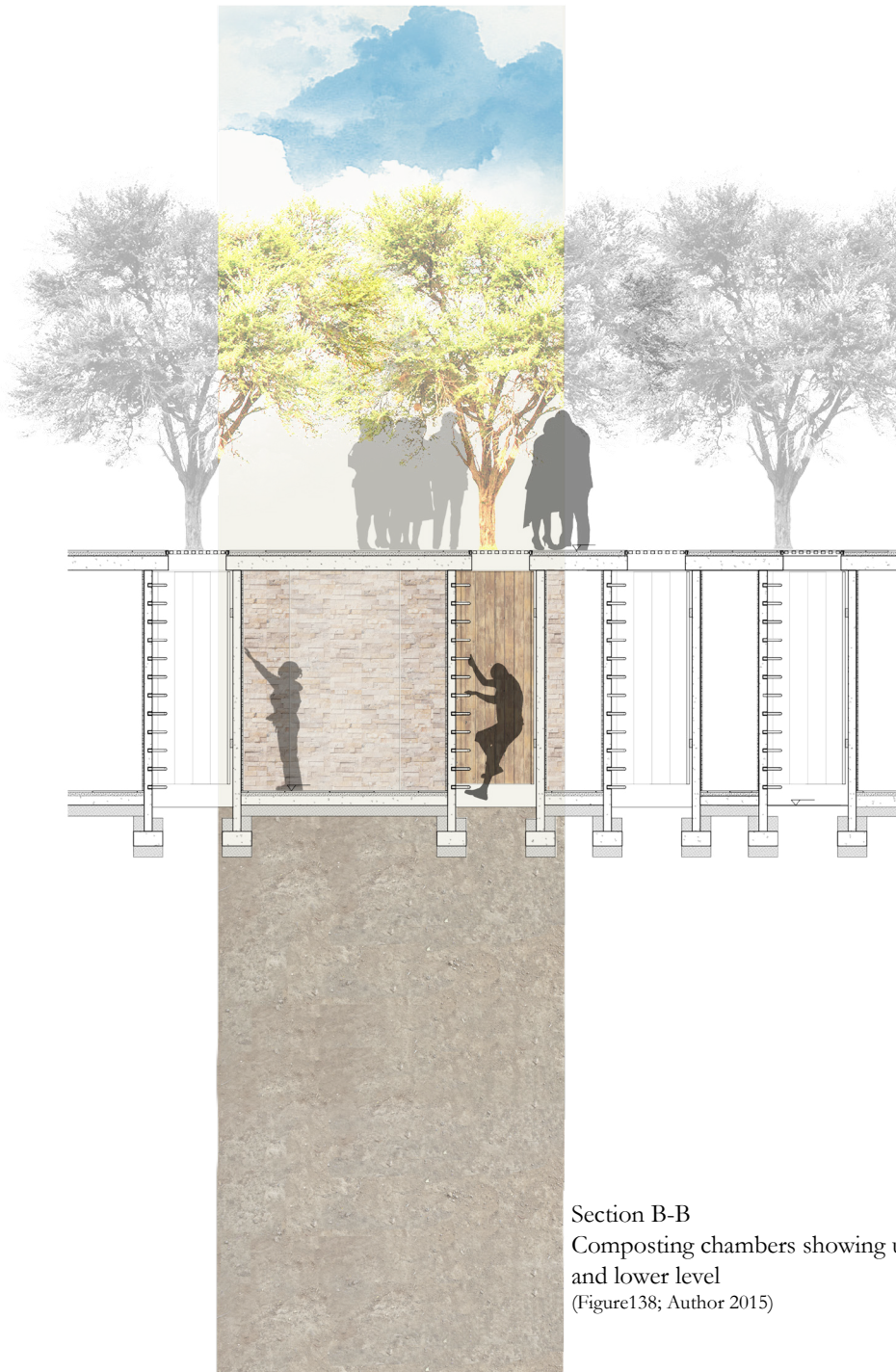


Figure 136. Some slits between chambers are larger to create a moment of intensity. The view is framed and the space is recessed to allow for user contemplation. (Author 2015).

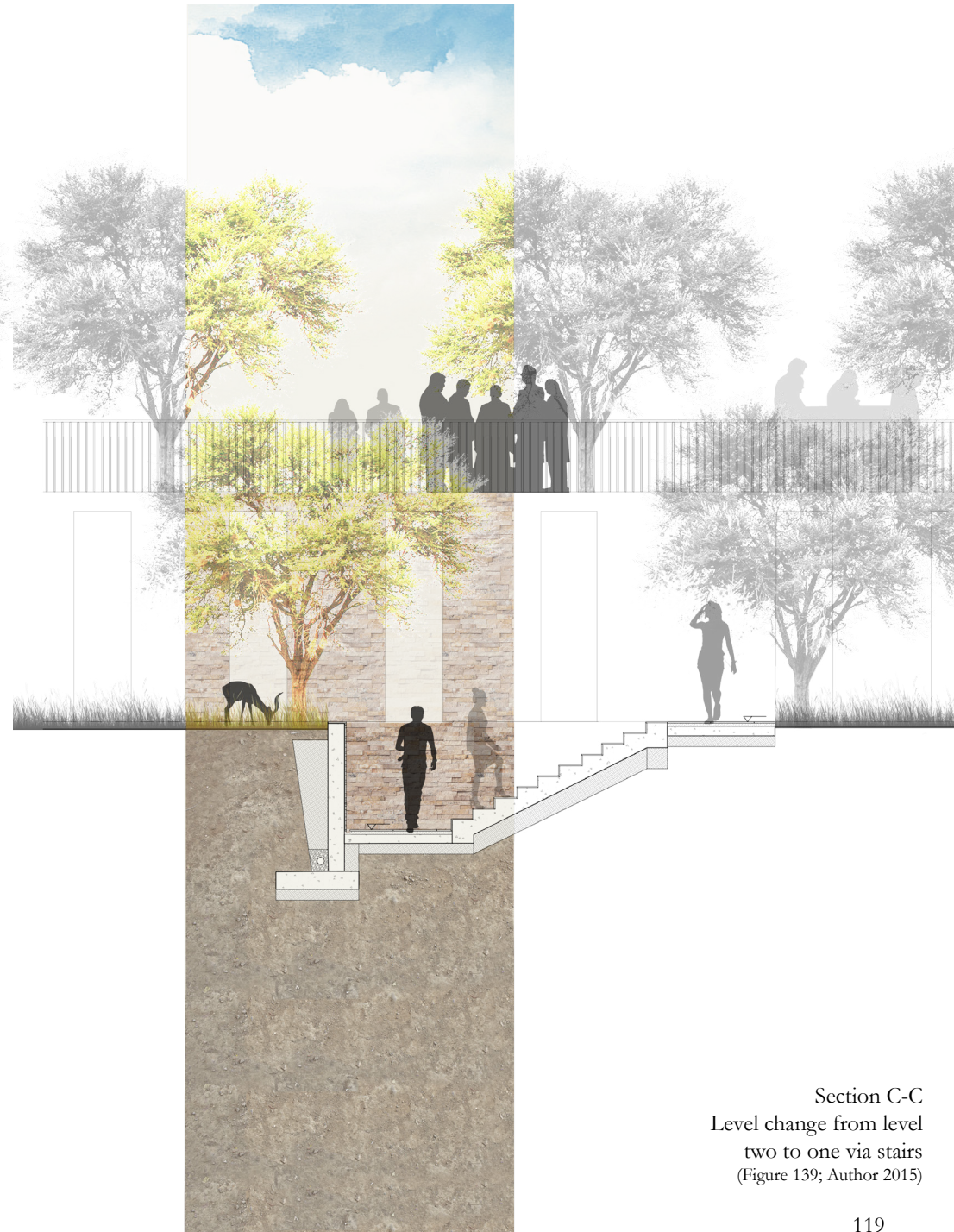
7.18 Sections



Section A-A
Terraced composting chambers
(Figure 137; Author 2015)



Section B-B
Composting chambers showing upper
and lower level
(Figure 138; Author 2015)



Section C-C
Level change from level
two to one via stairs
(Figure 139; Author 2015)

7.18 Chamber isometric

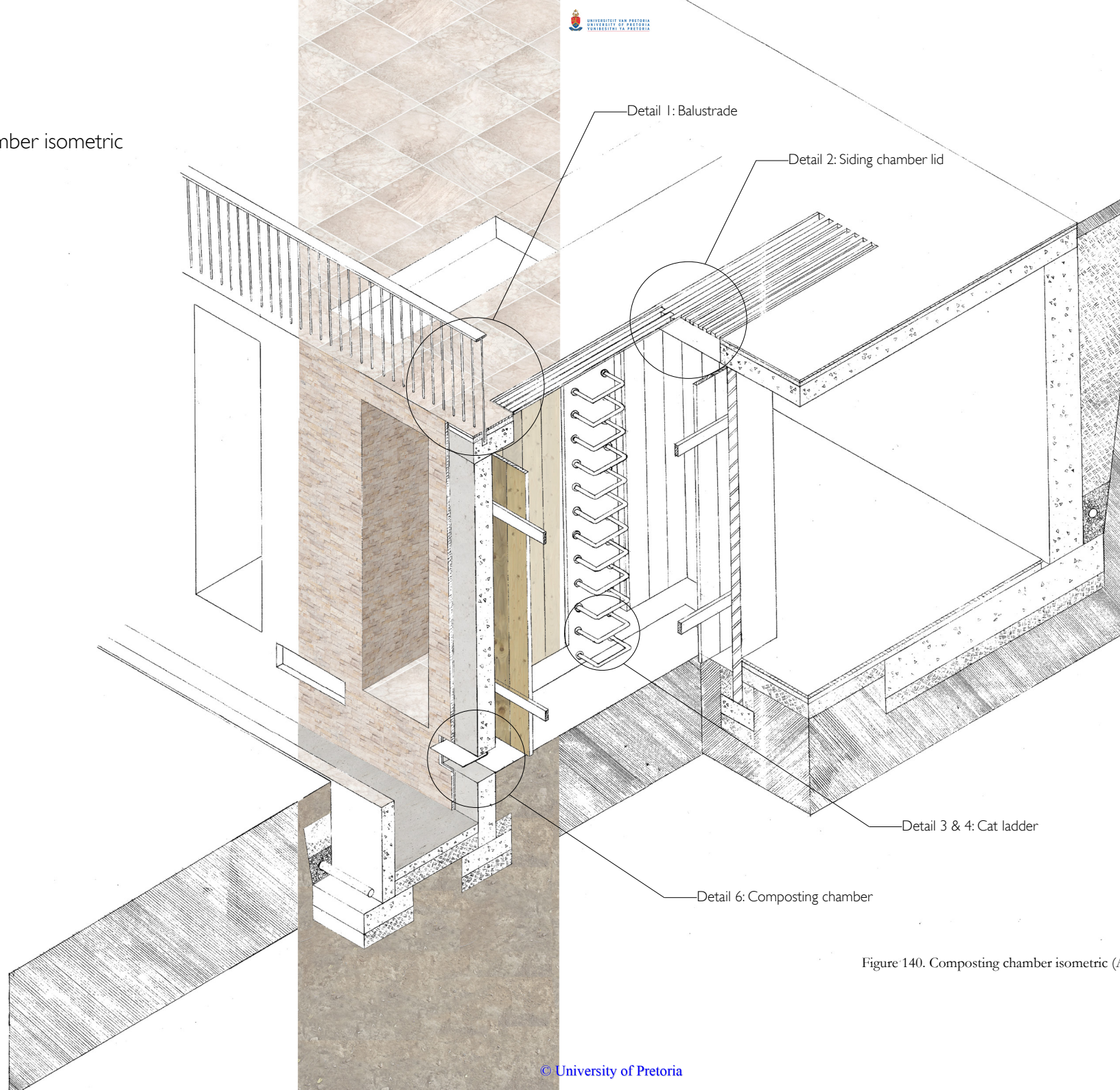


Figure 140. Composting chamber isometric (Author 2015).

7.18 Details

7.18.1 Detail 1: Balustrade

The balustrade strongly resembles the one by Peter Zumthor at the Thermals Baths. The thin corten balustrade juxtaposes the heavy stereotomic structures and emphasizes it. The balustrade is elegantly fixed to the platform without exposed bolts.

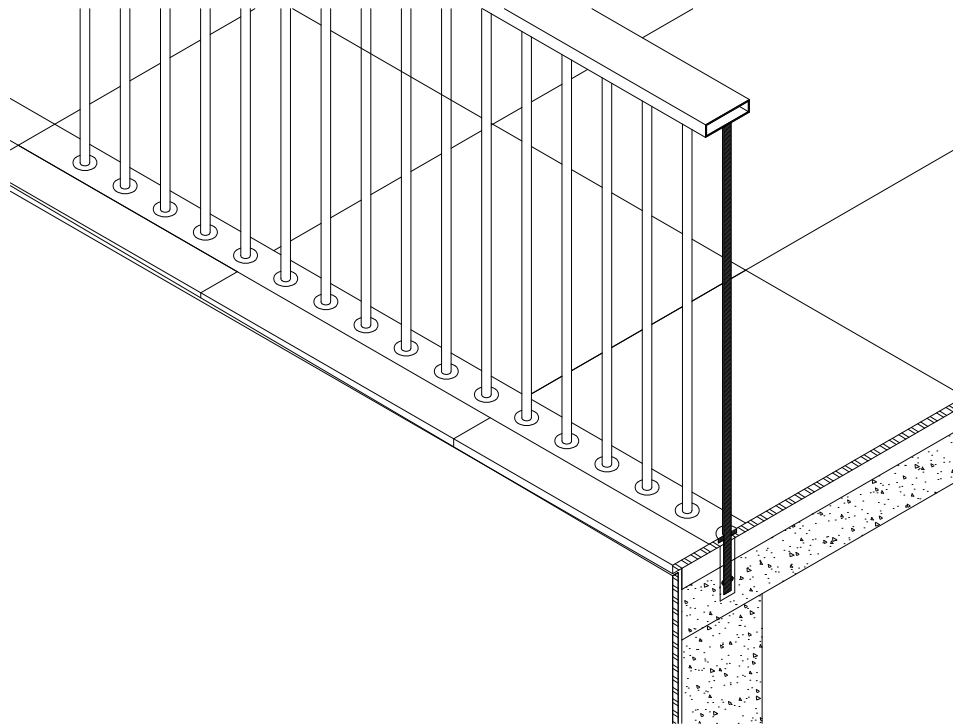


Figure 141. Balustrade isometric (Author 2015).

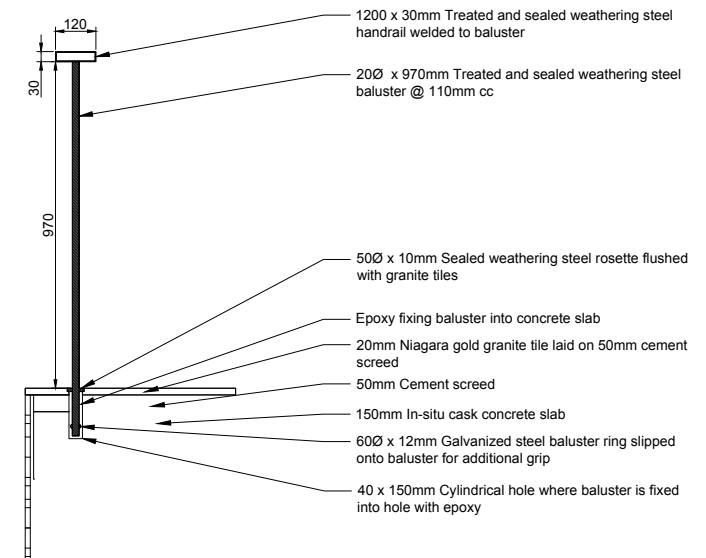
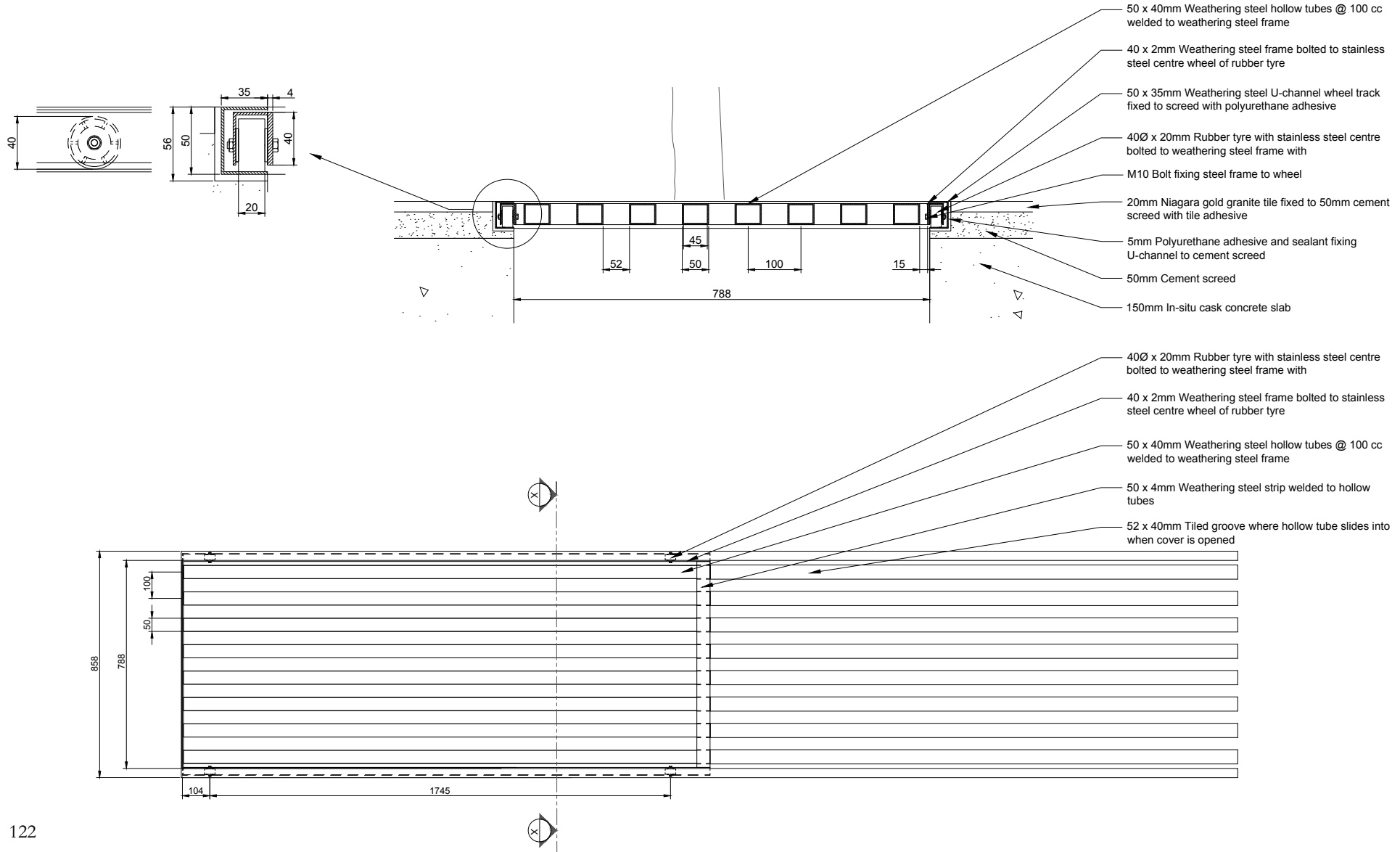


Figure 142. Detail 2: Balustrade technical detail (Author 2015).

7.18.2 Detail 2: Sliding chamber lid

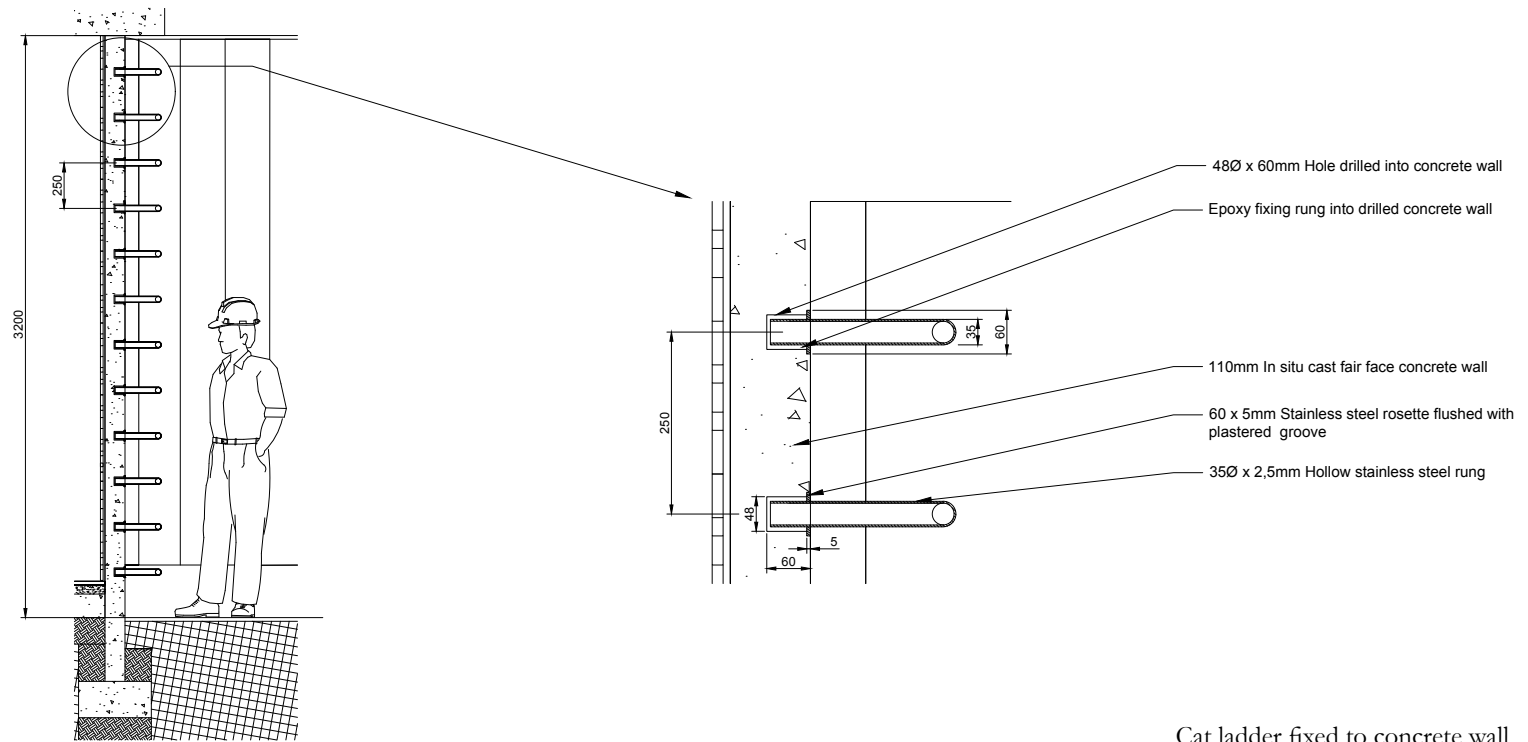
The composting chamber requires a suitable lid: it has to be permeable enough to allow for ventilation and rain during summer, but also closed to prevent a user on the upper level from falling into the chamber. The initial idea was a removable lid, however this felt too industrial and resembled a manhole cover. The final lid

designed is a weathering steel (corten) frame with steel bars that slide on wheels into the paving when open and slides closed once the corpse has been placed inside. It opens and closes easily, allows for ventilation and users can walk over it when it is closed.



7.18.3 Detail 3 & 4: Cat ladder

The cat ladder on the inside of the chamber provides the employees access to the humus. The material for the ladder is stainless steel to keep it as hygienic as possible for the person climbing into the chamber and to simplify cleaning. It is fixed to the concrete wall with epoxy



OPPOSITE PAGE Figure 143. Detail 2: Sliding chamber lid technical detail (Author 2015).

Figure 144. Detail 3: Cat ladder inside of composting chamber (Author 2015).

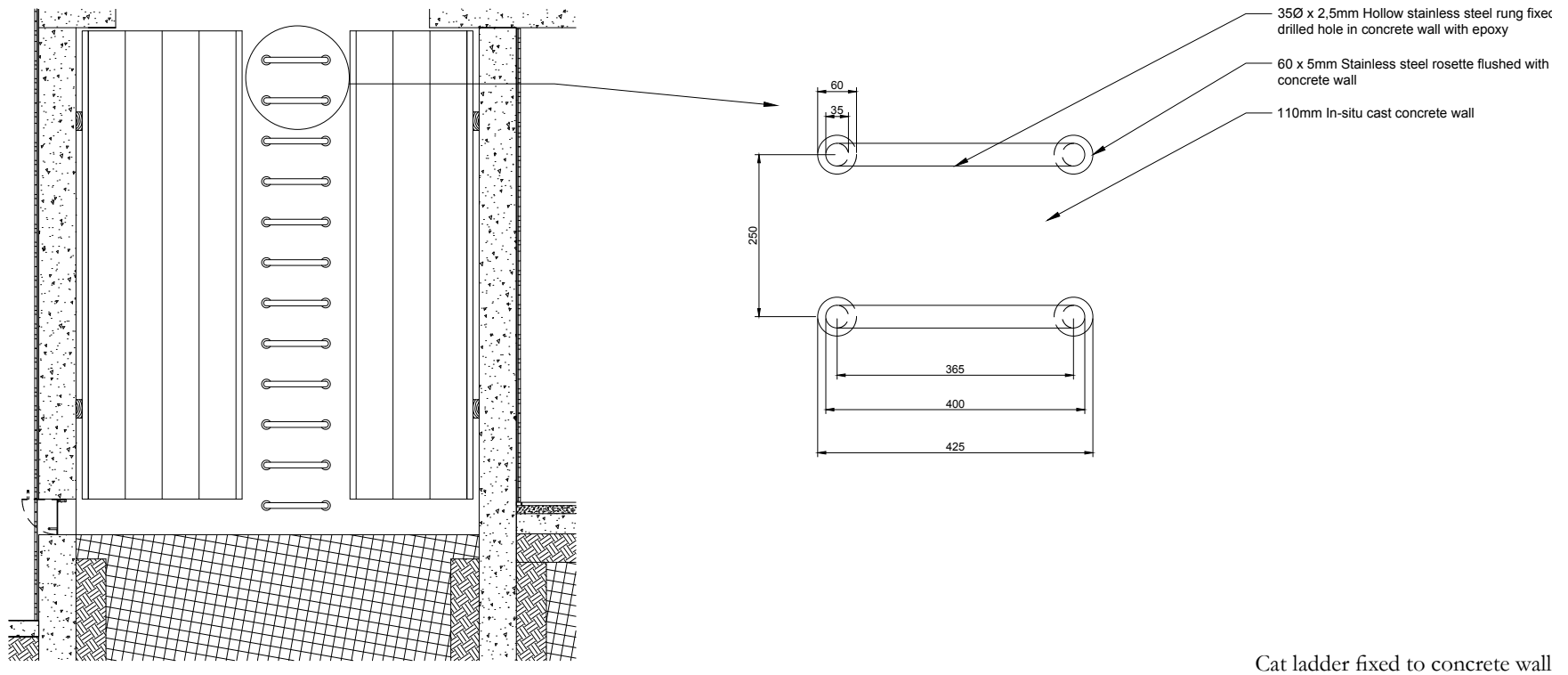


Figure 145. Detail 4: Cat ladder inside of composting chamber (Author 2015).

7.18.4 Detail 5: Service alley

After the corpse and straw have been reduced to humus, the humus is swept out of the chamber through a cavity in the outer wall into the wheelbarrow in the service alley. The service alley is designed like a haia; it is at a lower level than the walkway and vegetation, visually hiding it from the users. At some points users can walk over the service alley on a steel platform. When humus is being collected, the steel platform hinges up to allow the wheelbarrow to pass.

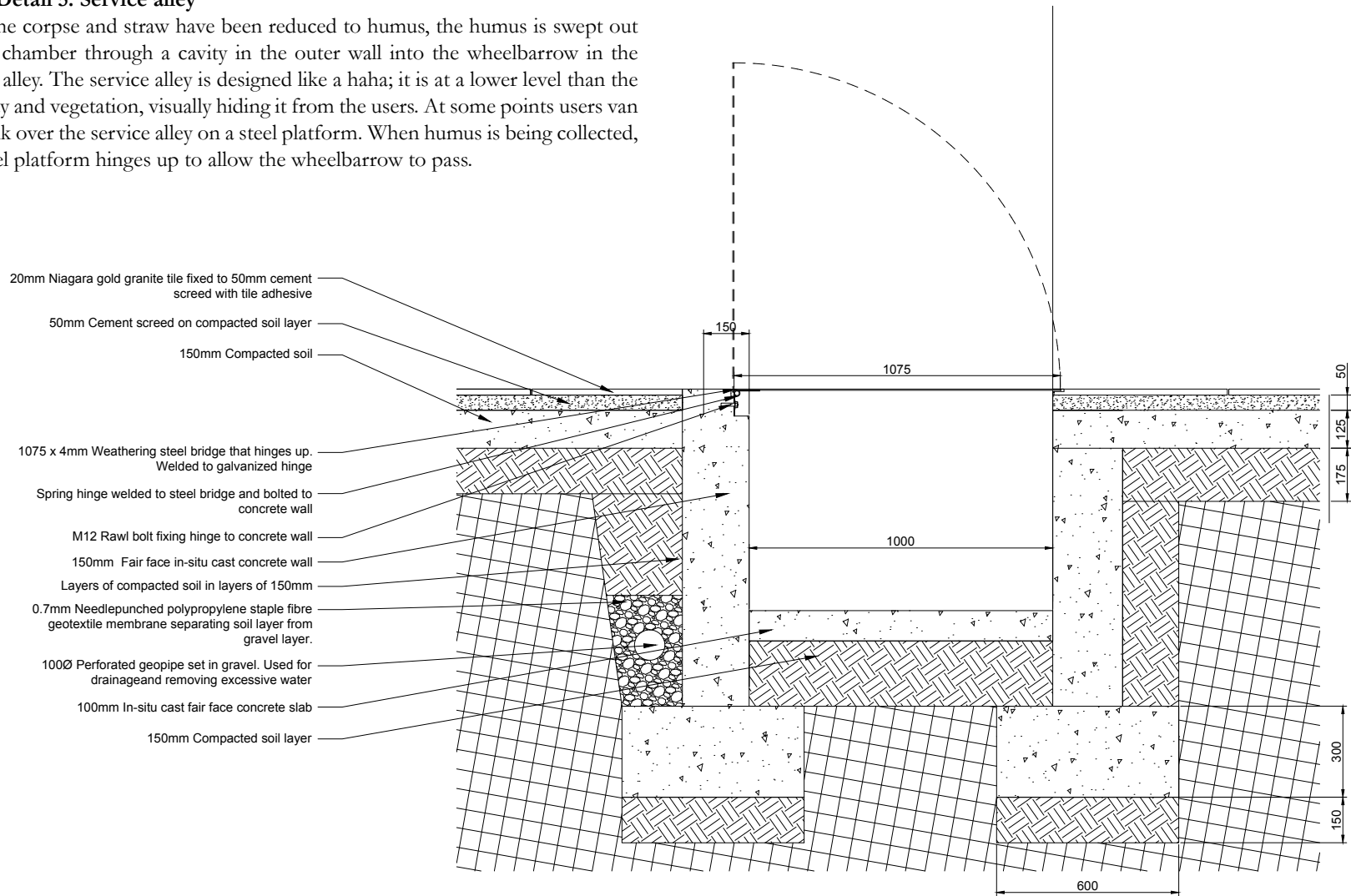


Figure 146. Detail 5: Service alley for removal of humus after the composting process is complete (Author 2015).

7.18.5 Composting chamber

The chamber has a concrete shell and timber cladding on the inside. The timber prevents heat loss and has to be kiln dried and may not be treated with any chemicals. The floor of the chamber is aerated top soil so micro and macro organisms can transfer between the soil and the compost pile during the process. The composting chamber is designed with an input at the top, and an output at

the bottom. The corpse and straw/dry grass is placed into the chamber at the upper level. After two months, all that remains is the humus at the bottom of the chamber. This is access via a cat ladder. Once inside the employee sweeps and rakes the humus into a pile and pushes it through a cavity in the wall (which is covered with a steel lid during composting) into the service alley.

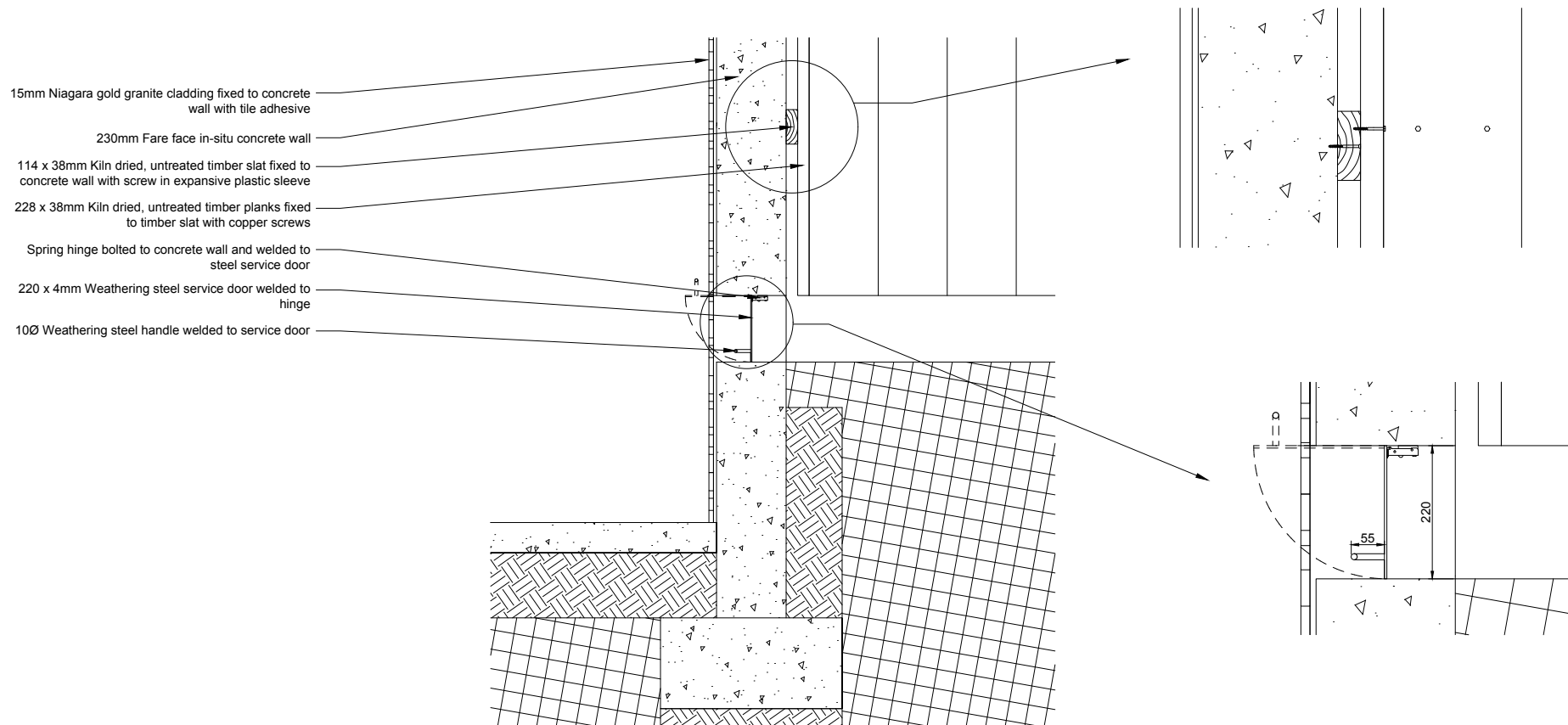


Figure 147. Detail 6: Composting chamber exterior wall detail (Author 2015).

OPPOSITE PAGE Figure 148. Perspective showing materiality (Author 2015).

7.18 Materiality perspective



7.19 Sustainability rating

The SITES (Sustainable land design and development rating for initial design) sustainability rating system was used to evaluate Nekrotopio and the rest of the Diepsloot Nature Reserve. Due to the unique nature of the thesis it is difficult to evaluate it based on a formula developed to assess general landscape interventions.

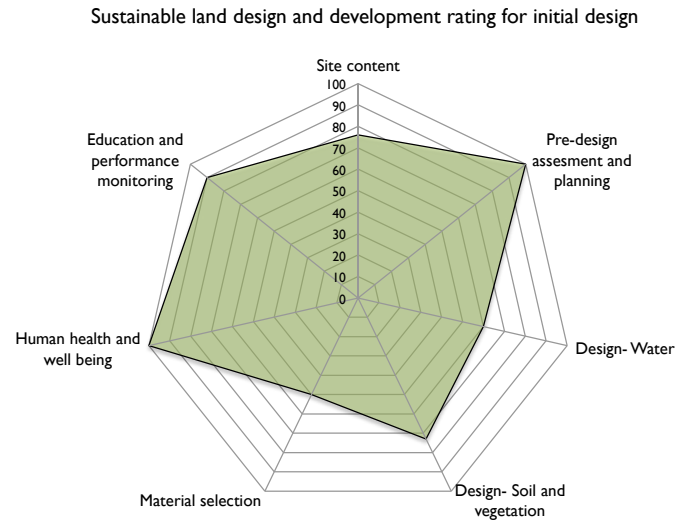


Figure 149. SITES sustainability rating (Author 2015).

Figure 145 indicates that the proposed design is overall sustainable. Material selection appears less sustainable due to the use of granite. Water is also less sustainable due to the fact that the site is not urban and does not require the same type of intensive storm water management systems.

The SITES rating is a good guideline for sustainability, but it is flawed. This thesis focused on sustainable corpse disposal and the impact it has on the environment, yet this part of the sustainability of the thesis is not accounted for in the SITES rating.

08

Presentation



Figure 150. Final crit presentation posters pinned up in 2-7 of Boukunde (Marike Franklin 2015).



Figure 151. Marquettes and Models forming part of the design process (Marike Franklin 2015).



Figure 152. Marquette of Nekrotopio (Marike Franklin 2015).

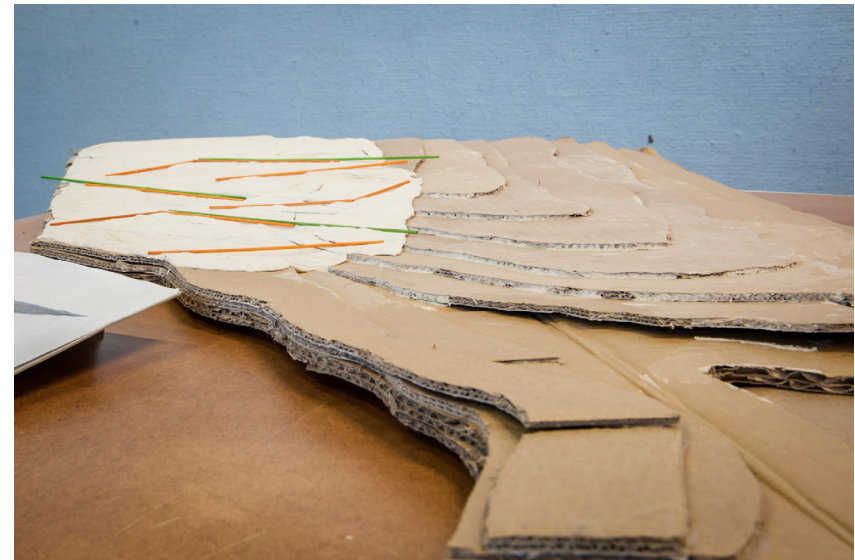


Figure 153. Marquette of a first attempt at creating a clustered organization (Marike Franklin 2015).





OPPOSITE PAGE Figure 154. Graham Young having a closer look at the Composting chambers model during the verbal presentation (Marike Franklin 2015).

TOP Figure 155. External and internal examiners listening to the verbal presentation (Marike Franklin 2015).

MIDDLE Figure 156. External and internal examiners listening to the detailing of the composting chambers (Marike Franklin 2015).

BOTTOM Figure 157. Author explaining design decisions regarding the composting chambers (Marike Franklin 2015).



Figure 158. Author with model of the composting chambers (Marike Franklin 2015).



Figure 159. Model of composting chambers (Marike Franklin 2015).



Figure 160. Model of composting chambers (Marike Franklin 2015).

RIGHT Figure 161. Three level of the composting chambers model (Marike Franklin 2015).

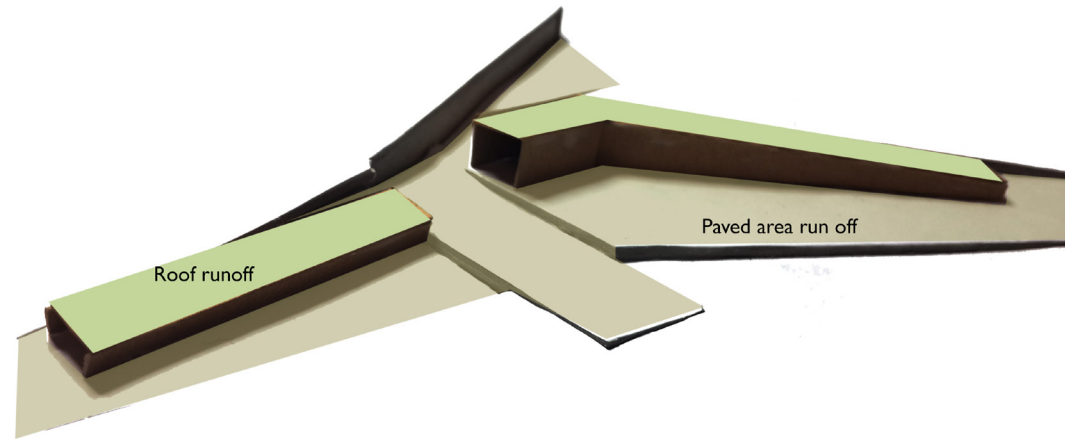


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Appendix A - Water calculations for the core/ activity hub of the Diepsloot Nature Reserve



Yield																									
Month	Precipitation (m)	Roof catchment area (m ²)	Run-off coefficient	Roof catchment (m ³)	Paved area m ²)	Run off coefficient	Paved area catchment (m ³)	Total catchment area (m ³)	Total yield (m ³)	Lawn area	Irrigation per week (m)	Irrigation per month (m)	Lawn Irrigation demand (m ³)	WC flushed per month	WC water demand (l)	WC water demand (m ³)	HWB water demand (l)	HWB water demand (m ³)	Total demand(m ³)	Water balance	Month	Total yield (m ³)	Total Demand(m ³)	Monthly balance (m ³)	Volume in tank (m ³)
January	0.122	645	0.9	70.82	1831	0.8	178.7	2476	226.08	600	0.04	0.16	96	4500	18000	18	6000	6	120	January	226.08	120	106.08	348.09	
February	0.106	645	0.9	61.53	1831	0.8	155.26	2476	216.79	600	0.04	0.16	96	4500	18000	18	6000	6	120	February	216.79	120	96.79	444.88	
March	0.091	645	0.9	52.83	1831	0.8	133.3	2476	186.13	600	0.04	0.16	96	4500	18000	18	6000	6	120	March	186.13	120	66.13	511.01	
April	0.033	645	0.9	19.16	1831	0.8	48.34	2476	67.49	600	0.035	0.14	84	4500	18000	18	6000	6	108	April	67.49	108	-40.51	470.5	
May	0.022	645	0.9	12.77	1831	0.8	32.23	2476	51.39	600	0.031	0.125	72	4500	18000	18	6000	6	96	May	51.39	96	-44.61	425.89	
June	0.007	645	0.9	4.06	1831	0.8	14.65	2476	18.68	600	0.031	0.125	72	4500	18000	18	6000	6	96	June	18.68	96	-77.32	348.57	
July	0.01	645	0.9	5.81	1831	0.8	14.65	2476	20.46	600	0.031	0.125	72	4500	18000	18	6000	6	96	July	20.46	96	-75.54	273.03	
August	0.01	645	0.9	5.81	1831	0.8	14.65	2476	20.46	600	0.031	0.125	72	4500	18000	18	6000	6	96	August	20.46	96	-75.54	197.49	
September	0.021	645	0.9	12.19	1831	0.8	30.76	2476	42.95	600	0.035	0.14	84	4500	18000	18	6000	6	108	September	42.95	108	-65.05	132.44	
October	0.06	645	0.9	34.83	1831	0.8	87.89	2476	122.72	600	0.04	0.16	96	4500	18000	18	6000	6	120	October	122.72	120	2.72	0 START 2.72 END	
November	0.117	645	0.9	67.92	1831	0.8	171.38	2476	239.3	600	0.04	0.16	96	4500	18000	18	6000	6	120	November	239.3	120	119.3	122.01	
December	0.117	645	0.9	67.92	1831	0.8	171.38	2476	239.3	600	0.04	0.16	96	4500	18000	18	6000	6	120	December	239.3	120	119.3	242.01	
Total	0.715			415.59			1058.19		1451.75			1.74	1032	54000	216000	216		72	1320	Total	1451.75	1320			

required tank size

Appendix B - Water Quality management policy with regard to the management of and control over cemeteries as a source of water pollution

Several requests, including Ministerial enquiries, received by this office pertaining to the impacts from cemeteries on the water resource, refers.

There appears to be a perception among certain members of the public that cemeteries is a source of pollution which is neglected by the Department of Water Affairs and Forestry (DWAF), and that water supplies are being polluted because of being in the vicinity of cemeteries. This perception is incorrect, and the following policy, which have been formulated and were sanctioned by the Minister (see attached letter), should be brought to the attention of those approaching your officials in this regard:

The risk of pollution posed by cemeteries to the quality of the water resource, especially the quality of drinking water, is regarded as acceptable, and in most instances negligible, for the following reasons:

1. The process of decay of human bodies is much slower than, for example, the degradation of waste in a waste disposal site, and most disease-causing bacteria usually do not survive long outside a living human body, and will expire within days from burial, before it comes into contact with groundwater or even surface water. When degradation products of decaying bodies does come in contact with water, it will therefore have a low risk of containing disease-causing bacteria and, although high in nutrients, will be small in volume when compared with waste from, for example, a leaking sewerage pipeline.

2. The risk of pollution posed by cemeteries is an issue that is of low priority when compared with the pollution caused by activities resulting from other sources in municipal areas. Examples of this include the improper siting and inadequate operation of waste disposal sites, the use of pesticides in municipal gardens and parks, the illegal disposal of medical waste by amongst others general practitioners and hospitals, and improper management of sewage. The biggest threat of pollution in municipal areas originate from inadequate service delivery of local authorities regarding the management of sewage, and such pollution problems are exacerbated by inter alia the poor operation of sewage treatment works, incorrect siting of areas for the disposal of sewage sludge, leaking sewerage pipelines, stormwater contaminated with sewage due to blocked sewerage pipelines and drains, overflowing sewerage pumping stations, etc.

3. Within municipal areas, there are many factors that could therefore influence the quality of ground- and surface water. For this reason, local authorities are responsible to supply potable water for household use in residential areas through a reticulation system, originating from a facility where water is purified up to SABS Specifications.

4. The use of poorer quality groundwater (which may have been affected by any of the above- mentioned factors, including cemeteries) for purposes of, for example, gardening, would therefore constitute a low risk in relation to other environmental factors that can contribute to potential health problems.

Notwithstanding the above, the Department of Water Affairs and Forestry do recognise the potential for pollution caused by poorly sited cemeteries. Based on previous assessments funded by DWAF and conducted by specialists, amongst others the CSIR, the following measures have been put in place to address this potential risk:

1. In accordance with the definitions contained in the National Water Act, No 36 of 1998 (NWA), a cemetery constitutes a water use in terms of s21(g) of the NWA, which need to be authorised. However, due to the low pollution potential from cemeteries, very broad general authorisations are currently under preparation for the purpose of such authorisation. This would only apply to new cemeteries, as old cemeteries (some of which had been in existence for more than a century), are existing lawful uses in terms of section 33 of the Act, and should be addressed as set out in point 3 below.

2. Local authorities are responsible for the implementation of legislation governing land development objectives, and are therefore responsible for land use planning within areas of their jurisdiction, and the appropriate zoning of land, taking full cognisance of the environment. As co- operative governance must be promoted for water use authorisations, in terms of sections 22(3)2 and 22(4) of the NWA, the Department of Water Affairs and Forestry (DWAF) could dispense with the requirements for such authorisation if local authorities would take cognisance of the requirements of DWAF in their planning ordinances as it relates to the siting of cemeteries. These requirements of DWAF are that graveyards should not be:

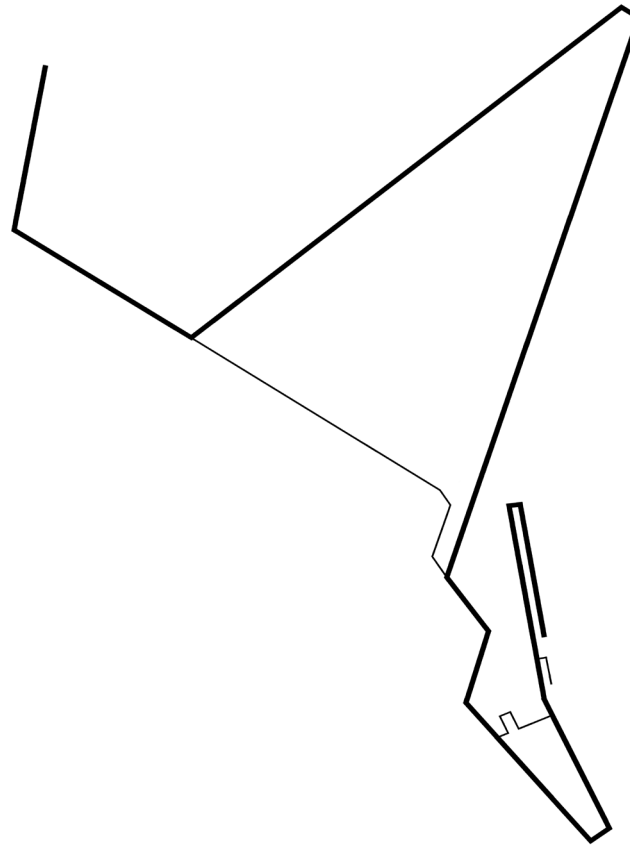
- located below the 1 in 50 year floodline of a river;
- in close proximity to water bodies such as wetlands, vleis, pans, estuaries and floodplains;

- situated on unstable areas, like fault zones, seismic zones, dolomitic or karst areas where sinkholes and subsidence are likely;
- situated in or near sensitive ecological areas;
- situated in or on areas characterised by flat gradients, shallow or emergent groundwater;
- situated in areas characterised by steep gradients, or shallow bedrock with little soil cover, where stability of slopes could be a problem;
- situated in areas of ground water recharge on account of topography and/or highly permeable soils; and
- situated on areas overlaying or adjacent to important or potentially important aquifers (Parsons aquifer classification), where such aquifers are to be use for water supply purposes.

3. In cases where cemeteries are poorly sited, and are indeed causing an elevated risk to the users of ground- and/or surface water, this is mainly due to poor planning by local authorities, which implies that these local authorities did not take their responsibilities in terms of planning seriously. In such cases, as in other instances where we become aware of water pollution, action should be taken by DWAF Regional WQM officials in terms of the provisions contained in the National Water Act to ensure that the parties responsible for the pollution address and correct the situation accordingly.

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