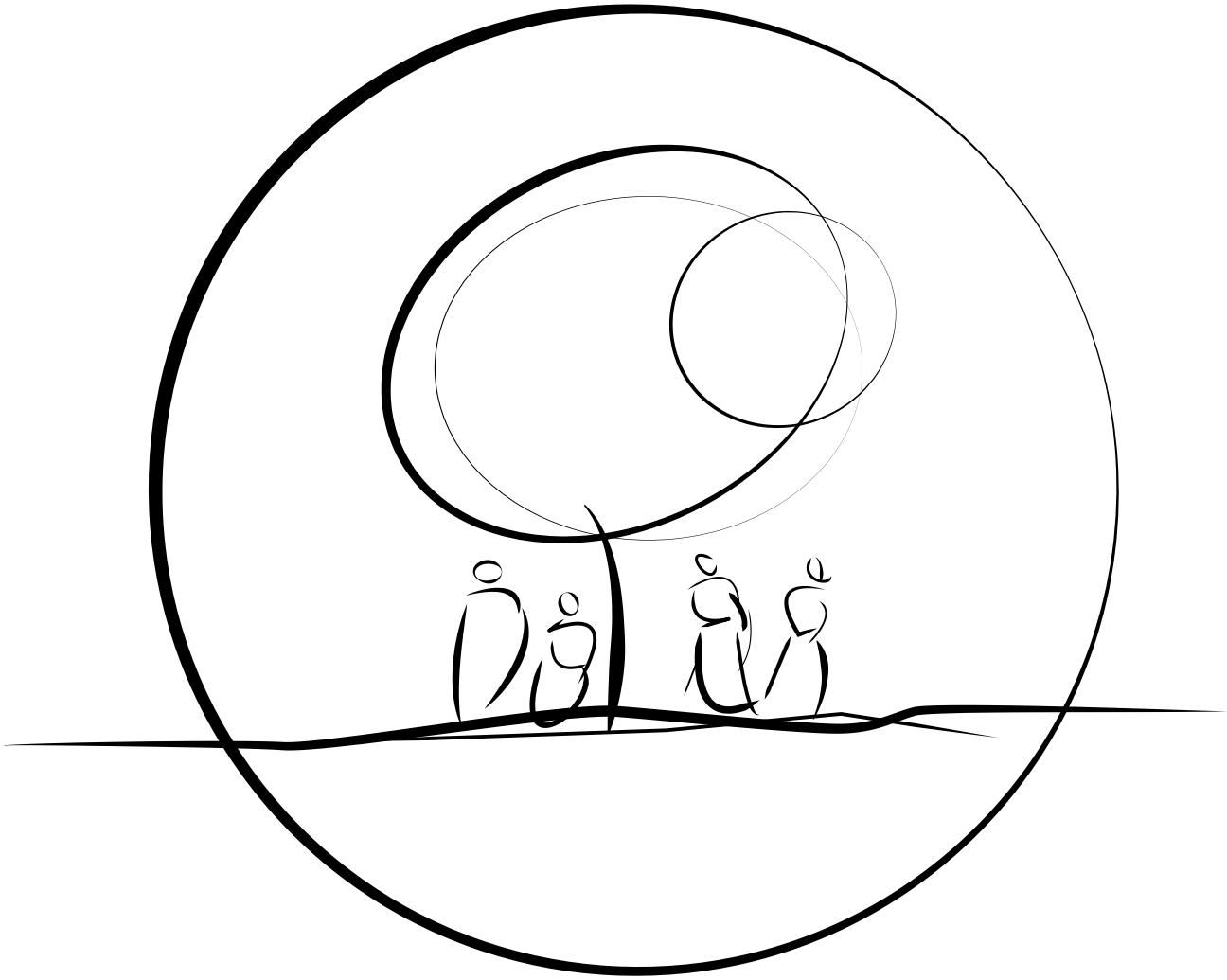

# HUMAN | NATURE

## IN DIALOGUE WITH NATURE IN THE CITY

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Submitted in fulfilment of part of the requirements for the degree of Magister in Architecture (Professional) of the Department of Architecture, Landscape Architecture and Interior Architecture, for the Faculty of Engineering, Built Environment and Information Technology.

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## PROJECT SUMMARY

**Programme:** Well-being Centre

**Site description:** Fort Wonderboompoort, Wonderboom Nature Reserve

**Site Location:** Wonderboom 302 JR

**Address:** Lavender Road, Wonderboom, Pretoria, 0182

**GPS Coordinates:** 25 41'S 28 11'E

**Research Field:** Environmental Potential

**Keywords:** Urban protected area, Earth architecture, Experiential architecture

# ABSTRACT

Natural areas in proximity to urban environments are constantly under pressure from development. Conservation is not high on the list of priorities, mostly because the general public do not experience the benefits of nature first hand. In Pretoria, South Africa, this is not due to a lack of open space, but rather due to the fact that conservation areas are under-utilised. The International Union for the Conservation of Nature (IUCN) recommends that some areas be made more accessible to the benefit of greater conservation efforts. The dissertation considers the potential contribution of sensitive developments in urban conservation areas and how they should be approached. What is an architecture that supports and introduces human activities yet respects a sensitive environment? How does architecture place Man in relation with Nature?

The investigation is centred at Wonderboom nature reserve in the north of Pretoria. This municipal reserve is a place of natural and historical significance: it forms part of the Magaliesberg and has remnants from the Stone Age, Iron Age and ZAR periods within its boundaries. The proposed development focuses on illustrating how nature has a significant impact on human well-being. A health practice which focuses on rehabilitation that makes use of the natural environment as primary stimulant, is introduced. The centre includes a cafeteria and is designed to support other recreational activities and occasional events too. The project looks to precedents of programme, form, materiality and similar experience for guidance. Mark DeKay's interpretation of Integral Theory's application to sustainable architecture is applied as criteria for architectural decisions.

Design is the primary means of inquiry. Various conceptual approaches were considered before a concept was finalised which was then further iterated. The nonlinear process has been documented. The final design proposes three volumes each offering a different perspective of the environment. The exterior spaces and routes in between are carefully considered for their experiential value. The building is drawn from the environment; constructed with materials from site as far as possible. Low-tech, passive solutions favour processes which are labour intensive and can employ unskilled labourers. The construction process narrates an understanding of place and is in itself a means of engaging with the landscape. The dissertation concludes that an architectural solution best suited to an urban protected area is one with a holistic approach. In addition to performing well in terms of sustainability and being seamlessly integrated into natural systems, architecture should delight. Individual experience and collective meaning are just as important when designing to place humans in relation with nature.

# CONTENTS

# 1. INTRODUCTION

## 1.1 Background

Future Pretoria is envisioned as the "*African Capital City of excellence*" (City of Tshwane 2013:6). The 2055 vision[1] opens up discussions on the identity and uniqueness of our city. Two characteristics stand out: When we look to the past, a layered, yet contested heritage is clear; the landscape of Pretoria is strewn with the relics of the various groups of people who have lived in the area, from the Stone Age to the present. The second unique aspect is the proximity of nature within the urban environment (figure 1.1). The urban fabric is interspersed with natural areas and undeveloped ridges (City of Tshwane 2013:43). These characteristics contribute to the identity of the city. Future plans will do well to consider how the existing attributes can be enhanced and celebrated.

## 1.2 Problem statement

Globally, city planners are investigating the important role of green spaces in urban areas. In addition to the ecological benefits, their impacts on the well-being of the society have become clear. Lee et al. (2015) notes that urban green areas provide residents with "*spaces for physical activity and social interaction, and allow psychological restoration to take place*". The availability of natural environments in cities are on the decrease worldwide. Pretoria's abundant natural areas should therefore be to our advantage. To protect natural and cultural heritage assets from the intensification of urban development, their value and place within the city should be clear. Stories, places and landscapes are forgotten when they are no longer of relevance to society. To the benefit of greater conservation efforts, development in some areas may be necessary to attract visitors and illustrate the 'usefulness' of these places (Trzyna 2014). The dissertation offers an approach to the convergence of protected environments and cities.

## 1.3 Proposed context

The theory will be applied to the elected site, Wonderboom Nature Reserve, which is located on the Magaliesberg ridge and situated between two main arteries linking the northern suburbs with Pretoria CBD (figure 1.2). The 200ha reserve is of ecological and heritage importance. The Magaliesberg, which stretches from Bronkhortspruit in the east to Rustenburg in the west, was proclaimed a protected area in 1977. It forms a natural boundary north of the nucleus of Pretoria. Ecologically, the mountain "*lies at the interface of two great African biomes – the central grassland plateaux and the sub-Saharan savannah*" (Magaliesberg Biosphere Initiative Group n.d.). The fauna and flora of the region is extremely diverse. On the western boundary of Wonderboom Nature Reserve, the Apies river cuts through the ridge, forming a natural portal. A unique specimen of *Ficus salicifolia vahl* (the Wonderboom) grows at the base of the hill. It is an atypical fig tree complex which lends a mystical aura to the area.

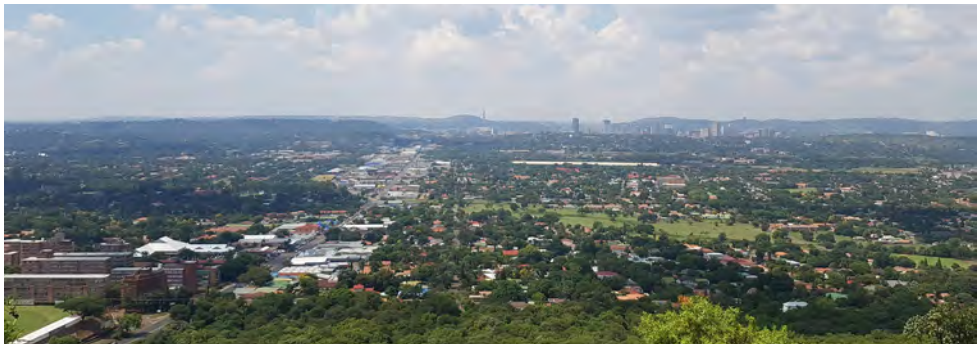


*FIGURE 1.1_When viewing the CBD from Fort Wonderboom the abundant greenery of the city is evident (Photo by A. Visagie 2017)*

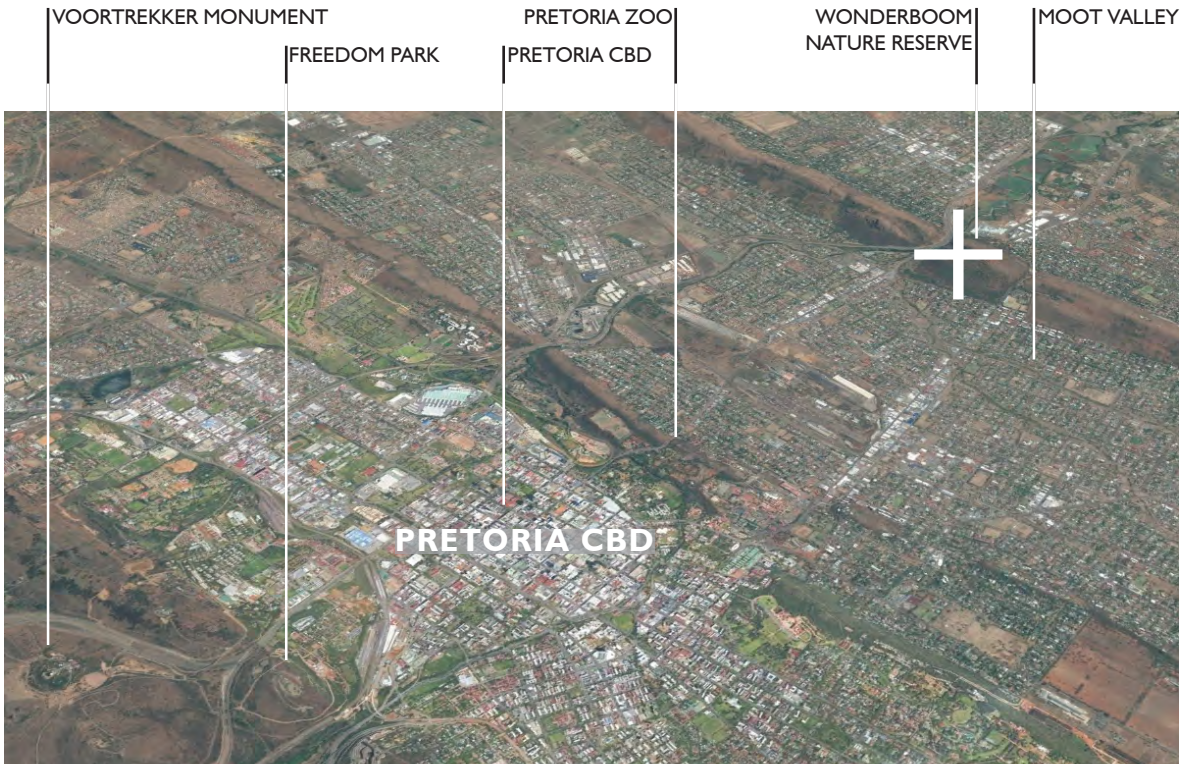



*FIGURE 1.2_The location of the site (indicated by the red cross) in reference to Pretoria CBD (Aerial photograph from Google Earth 2017; adapted by Author 2017)*

The site's natural features have made it a favourable location for various groups of settlers over the years. Many groups have inhabited the area including Stone and Iron Age civilizations, the Tswana, Nguni, Ndebele and Voortrekkers (Carruthers 1990:232-256). A fort (figure 1.3) was constructed during the South African War and was subsequently destroyed during the Second World War (Gallow 2009:13). The area was proclaimed a nature reserve in 1954, and a national heritage site in 1980 (Van Vollenhoven 2008:23). Currently, it is mainly used as a picnic area.

The surrounding area is a gateway to the city and as such it has undergone large developments in recent years. The Tshwane Spatial Development Framework proposes two development nodes, one north and one south of Wonderboom Nature Reserve (figure 1.4) (City of Tshwane 2012). Line 2 of the BRT system has recently been completed and forms part of this endeavour. First phases of the Rainbow Junction mixed-use precinct, the northern node, will soon be underway (Rainbow Junction 2015).

## 1.4 Research questions

From the problem statement and brief introduction to the context, the following research questions are formulated:

[1] How do we integrate quasi-pristine green spaces in our urban fabric so that they become more accessible to the public, yet remain protected to the level required?

[2] What can (or what does) the site contribute to the city and how does one illustrate the value of the natural and cultural landscape to city inhabitants?

[3] In order to implement conservation strategies, funding is required. What activities does the site lend itself to that could generate the revenue that will allow it to sustain itself?

[4] What is an appropriate way of creating places for humans that maintains an attentive dialogue with nature?

[5] In what manner do we respond to past human interventions that have impacted on the environment in the past, yet today are an integral part of the environment that supports life?

## 1.5 Intentions

The proposed developments in the area open an opportunity to rediscover and reinvent the Wonderboom Nature Reserve as important green urban space. Although the focus is on the specific attributes of the reserve and the dissertation aims to illustrate how its unique aspects may be employed as response to challenges that it faces,

the purpose is also to contribute a general understanding of an approach to urban nature reserves. The project will test how, using architecture as the tool, we can frame the landscape and history so that it gains importance. On an urban level, the relationship between the urban and natural realms is investigated. By renewing interest in the site (as a natural and cultural landscape) and highlighting the importance thereof for the city, it can be a valuable destination for citizens of Pretoria. By doing so, we may add value, allow it to generate its own revenue and thereby protect it from potentially insensitive developments in the future.

Ecologically, the site is a sanctuary for urbanized ecosystems, metaphorically, it could serve a similar purpose by providing an escape for citizens. Associated 'escapism' activities are primarily recreational in nature, and may include conversation, observation, reflection, exercise and creative production amongst others.

## 1.6 Research methodology

The dissertation approaches research from within the paradigm of critical theory and is specifically concerned with an inquiry into three fields of interests, as formulated by Habermas in Dash (2015):

[1] "*A technical interest concerned with...the physical environment, which generates empirical and analytical knowledge. [2] A practical interest concerned with understanding the meaning of situation, which generates hermeneutic and historical knowledge. [3] An emancipating interest concerned with the provision for growth and advancement, which generates critical knowledge*".

The dissertation focuses on how a reading of the site can inform and guide the making of architecture. Integral Sustainable Design (DeKay 2011), a concept which applies American philosopher Ken Wilber's Integral Theory framework to the field of architecture, guides the investigation. The project also draws on ideas related to regionalism, cultural landscape theory and phenomenology amongst others.

## 1.7 Delimitations

This dissertation is an enquiry into the relationship between the urban and natural environments. It focuses on how architecture can be a tool which brings urban inhabitants into contact with nature. In the second instance, the focus is on creating experiential spaces which allow for a personal interpretation of a variety of the dimensions of this environment. Fort Wonderboompoort is not the focus of the project, although it will be considered as part of the contextual informants. The research activities do not focus on heritage approaches, conservation and preservation strategies or adaptive reuse.

The design caters for rehabilitative therapy and recreational activities. The idea is that these activities take place within the natural environment as far as possible and that the environment is a stimulant for therapeutic activities. The interior spaces of the building are auxiliary spaces and services which support the activities taking place outside. The intention is to create an architecture of the environment. As far as possible materials will be drawn from the site.



*FIGURE 1.3_Fort Wonderboompoort (Author 2016)*

*FIGURE 1.4_Tshwane Spatial Development Framework for the area around Wonderboom Nature Reserve (City of Tshwane 2012)*

## 1.8 Assumptions

[1] The nodes and development corridors to the north and south of Wonderboom Nature Reserve will develop as set out in the Tshwane Spatial Development Framework (City of Tshwane 2012). These developments will result in an increase of activities in the vicinity of Wonderboom Nature Reserve.

[2] The proposed Rainbow Junction mixed use precinct situated along the Apies River to the north of the reserve will be constructed in the near future.

[3] The Tshwane Rapid Bus transit system will improve access to Wonderboom Nature Reserve, making it an easily accessible recreational facility for city dwellers.

[4] Wonderboom Airport will increase in importance as a regional airport and public transport to the airport will be improved.

[5] A full environmental impact assessment has been completed and the proposed developments, approved.

## 1.9 Definitions

**Conservation Area**: "*Areas of special natural, ecological, architectural or historic interest, the essence of character or appearance of which it is desirable to preserve and /or enhance*" (City of Tshwane 2012:3).

**Environment:** The sum total of the "*circumstances, objects, or conditions by which one is surrounded*"; including "*the complex of physical, chemical, and biotic factors that act upon an organism or an ecological community*" and the "*social and cultural conditions*" (Merriam-Webster 2017).

**Healing:** To restore to an improved state.

**Health Practice:** A privately managed setting (separate from hospital institutions) in which a group of health professionals may treat the public.

**Landscape**: Landscape is both "*a social product and a visual experience*" (Calcatinge 2012:31). Most modern day landscapes have been formed by the interaction between humans and nature [space] and our understanding thereof is always influenced by the current context. For this reason landscape is "*a text, a social and cultural document*" (Calcatinge 2012:37).

**Rehabilitation:** (1) "*To restore to a former capacity*"; to reinstate (Merriam-Webster 2017).

**Recreation (as in recreational activities):** "*A means of refreshment or diversion*" (Merriam-Webster 2017).

**Seminatural:** "*Modified by human influence but retaining many natural features, i.e a seminatural park*" (Merriam-Webster 2017).

**Technology:** "*A manner of accomplishing a task ... using technical processes, methods, or knowledge*". From the Greek *technologia*, which refers to the "*systematic treatment of an art*": from *technē* (art, skill) + *logia* (Merriam-Webster 2017).

**Therapeutic:** (1) "*Of or relating to the treatment of disease or disorders by remedial agents or methods*" (2) "*having a beneficial effect on the body or mind*" (Merriam-Webster 2017).

**Urban Protected Area (as defined by the International Union for the Conservation of Nature)**: "*Urban protected areas are protected areas situated in or at the edge of larger population centres. A protected area is a clearly defined geographical space, recognised, dedicated and managed...to achieve the long term conservation of nature with associated ecosystem services and cultural values*" (Trzyna 2014).

**Well-being:** "*The state of being happy, healthy, or prosperous*" (Merriam-Webster 2017).

# 2. ARTICLE

The article synthesizes the argument. It draws all the informants - context, programme, theory and precedent - together and explains how these form the base of the architectural design which is to follow. The specifics of the programme and factual information regarding the context are given in chapter three.

## 2.1 Introduction: A divide between man and nature

Urban centres grow increasingly. As more people move to cities, the divide between humans and the natural environment expands exponentially. If in the past there existed an active, responsive relationship, today we statically regard nature as the 'other'. We have removed ourselves from the systems of which we are naturally a part. This is reflected in our tendency to compartmentalise cities: natural areas within the boundaries of urban areas are fenced off - contained - to prohibit humans from partaking in an attempt to conserve natural systems. This has put a stop to the age-old dynamic dialogue between human collectives and their environments.

Over the centuries, humankind's primary means of engaging with the natural landscape has been to transform it. We manipulate our environment, not necessarily to destroy it, but rather to come to terms with it and to "*say what is significant about our being in the world... about how we belong in nature*" (DeKay 2011:99). Architecture, in this sense, is a "*system of reference*" (Gregotti 1996:342) which contextualises a collectives' place in the world and the relations between the concrete and the imagined. It is a tool, a metaphor, to know and meet the context.

The post-modern sustainable movement in architecture has brought the issue of our relation to nature to the fore by questioning whether humanity can truly live separate from the environment. The same concern is rising in a multitude of other disciplines too. The International Union for the Conservation of Nature (IUCN) argues that separating natural areas from human inhabited areas might not be the best conservation strategy, stating that it would be beneficial to the larger body of conservation efforts if urban protected areas are made easily accessible, affordable places in which urban inhabitants can truly interact with nature (Trzyna 2015:xii). This dissertation delves into the issue and investigates the possibility of establishing connections in the Wonderboom Nature Reserve, located seven kilometers to the north of Pretoria's CBD. The reserve encompasses part of the Magaliesberg ridge which extends east and west through the city's northern suburbs. This specific area is engraved with traces of the natural and human history of the area and is important as natural and socio-historical landscape.

The project investigates how we can engage more productively with the semi-natural areas in our cities. It accepts that these reserves need to generate income to support conservation efforts, and it believes that their contribution need not be limited to tourism and leisure. The architectural intervention proposed will build upon the existing recreational facilities and introduce a secondary programme of healing in order to create a destination that will introduce citizens to the reserve on a more regular basis. The purpose is to renew interest in the site, to showcase its qualities, to add to its value and in so doing contribute to its protection. The project's main intention is to imagine a place in which a confrontation between the natural world and the purposely created material space "*provokes reflection*" and inspires (Nesbitt 1996:456).

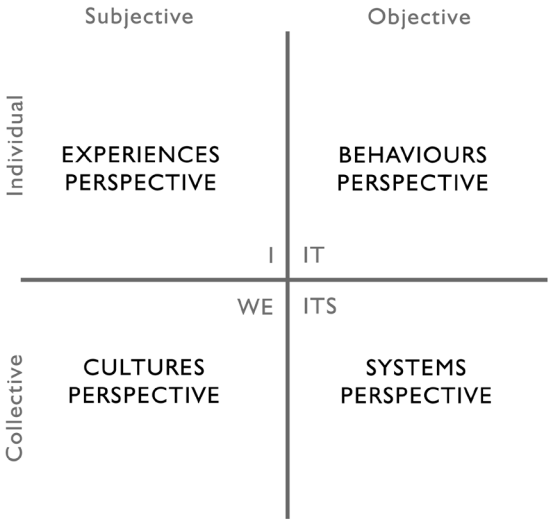



*FIGURE 2.1_The four quadrants of Integral Theory (DeKay 2011)*

*FIGURE 2.2_The Origin of Architecture (Laugier 1755)*

## 2.2 A theoretical lens

The purpose of theory in architecture is to "*pose alternative solutions based on observations of the current state of the discipline*" (Nesbitt 1996:16). The theoretical position assumed taints the lens through which the physical context is viewed and the programme understood. The dissertation considers issues of sustainability and aligns itself with Integral Sustainable Theory. Integral theory aims to find a method that achieves "*ecological performance while embracing the complexities of ecological processes and the messy subjective interiors of people and culture*" (DeKay 2011:7). It is an all-encompassing standpoint which recognizes the multitude of viewpoints in contemporary theory and establishes a matrix by which the various perspectives may be aligned. It proposes a system of viewing design challenges from four perspectives. The perspectives (figure 2.1) are broadly classified as the Experience perspective (the self and consciousness); the Behaviours perspective (science, mechanics and performance); the Cultures perspective (meaning, worldviews and symbolism); and the Symbols perspective (social and natural ecologies and contexts). They are not separate phenomena, but rather "*simultaneous perspectives on any event*" (DeKay 211:xxv). Within this framework, the project also then draws on ideas related to regionalism, cultural landscape theory and phenomenology amongst others. These ideas are explained in more detail throughout the essay where they are applicable to a reading of the context, interpretation of the role of architecture, or an understanding of the programme for example.

*FIGURE 2.3_An architectural landscape folly: The Temple of Ancient Virtue, Kent & Gibbs (photo credit: The National Trust Picture Library)*

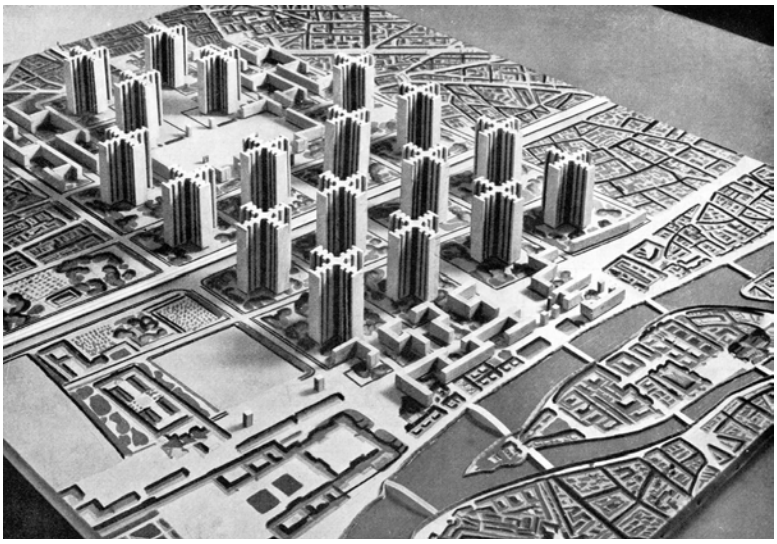


*FIGURE 2.4_The Modern approach to the environment: Ville Radieuse, Le Corbusier, 1924 (Le Corbusier 1924)*

## 2.3 The continuum of thought on architecture and nature

Architecture has investigated the relationship between the man made environment and nature through a variety of theoretical approaches which have developed through attitudes to the construction of the site. Historically, these attitudes have "*fluctuated from sympathy, harmony, and integration with nature, to hostility and exploitation*" (Nesbitt 1996:20).

Laugier's illustration (figure 2.2) of the primitive hut as symbol of the origin of architecture depicts the environment as both source and context of architecture. Contrariwise, the English landscape tradition introduced the notion of architecture as anchoring point for landscape. Architectural follies (figure 2.3) in English landscapes are a reference point in the landscape and a threshold between man-made and natural space. The Modern Movement was revolutionary in this regard as in others: a universal design language was applied to a clean slate (figure 2.4). Post-Modern paradigms in general, in spite of their far-lying ideas, oppose unsympathetically erasing the landscape, stating that architecture should find its meaning in its specific context (Nesbitt 1996:16). Some advocate that we "*touch the earth lightly*" (figure 2.5) (Murcutt in Drew 2000); others believe that architecture is man's way of participating in the environment and that making architecture implies "*making contact with the earth, with the idea of nature as a totality*" (Gregotti 1996:342).

When considered from the perspective of Integral Theory, the change in human attitude to Nature over time is the result of increased levels of complexity within all four quadrants. As a society becomes more complex, it's world view, individual perceptions and its means of exploiting technology, also changes (DeKay 2011:xxx). Architecture, according to DeKay (2011:8) is "*one of the most enduring manifestations of culture that exists*". What then, do contemporary trends, and specifically sustainable design, say about our relation to the environment and what our culture believes?

*FIGURE 2.5_Touching the earth lightly: Ball-Eastaway House; Glenn Murcutt (Photograph by Hunter 2016)*

## 2.4 Contextual overview

Integral theory's hypothesis that cultures grow in complexity in all aspects simultaneously, can be used to dissect the changes over time in the relations between man and nature, as manifested on the site. Throughout history, human ecology and natural ecology have influenced one another continuously. Much attention is given to the impact of human activities on the environment, yet we tend to forget that "*the city is existentially, fundamentally dependent on Nature*" and that "*the cultural city is built on and encompasses the biological city, which is built on and encompasses the physical city*" (DeKay 2011:91). It is through this lens that the context is read.

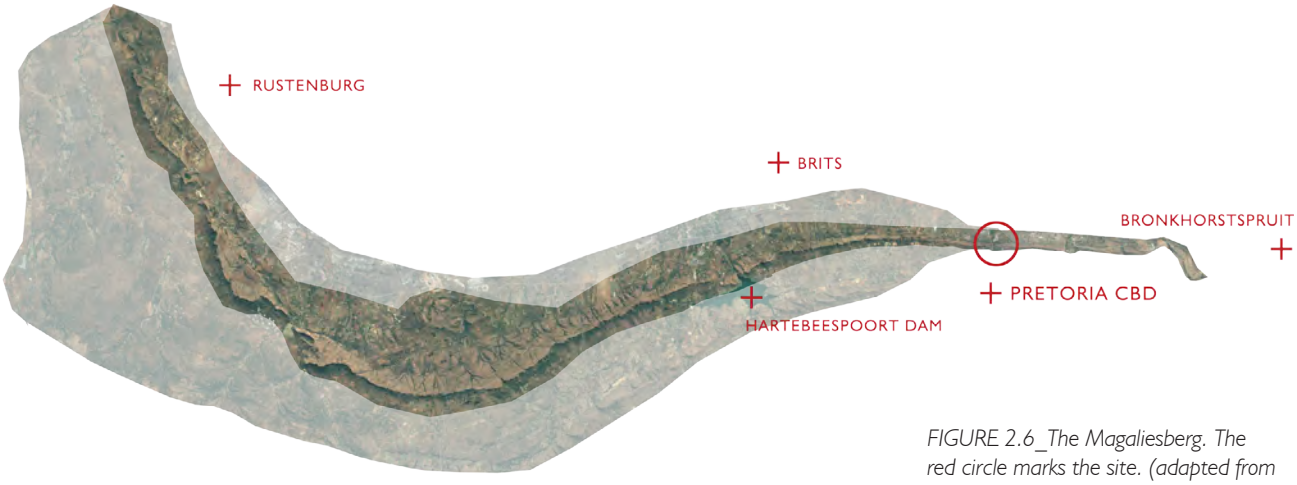



*FIGURE 2.6_The Magaliesberg. The red circle marks the site. (adapted from Google Earth 2017 by Author 2017)*

### 2.4.1 Natural history

At 2000 million years, the Magaliesberg is one of the oldest geological formations in the world. The linear ridge extends from Rustenburg in the west to Mamelodi in the east (figure 2.6) (Carruthers 1990:6). Faults and alluvial forces have created narrow valleys which cut through the ridge. The site is located directly east of Wonderboompoort where the Apies River, which flows through Pretoria, transects the Magaliesberg (Carruthers 1990:30). The cliffs in the poort form the western boundary of the reserve, while on the eastern side the land gently slopes down to a 'nek' in the ridge. Natural terracing occurs on the southern and northern slopes; the northern terraces feature distinct perpendicular red-brown rock faces which retain level areas with shrubs, grasses and small trees. The crest is relatively flat with shallow soils (Van Vollenhoven 2008:12).

The geology has given rise to "*distinctly different types of habitat*" (Carruthers 1990:3). The Magaliesberg forms the boundary between two biomes: the central grasslands plateau and the sub-saharan savannah. Consequently, the fauna and flora of the region is extremely diverse (Magaliesberg Biosphere 2015). The area is named after an atypical specimen of a wild fig tree (figure 2.7 & 2.8) (*ficus salicifolia*) which grows within the reserve boundaries. The fig tree complex is believed to be over 1000 years old and was dubbed the 'Wonderboom' (Tree of Wonder) by the first Afrikaans settlers in the area. The Wonderboom is a source of mystical folklore (Van Vollenhoven 2008:18). The first European visitors who came to the area described it as a wilderness teeming with birds, insects and large mammals.

### 2.4.2 Human history

Together with the Apies river as reliable source of water, the area was a prime spot to settle. The mountain and specifically the caves in the cliff face would provide shelter for people and livestock (Van Vollenhoven 2008:13).

One of the most extensive Early Stone Age sites was discovered at Wonderboompoort and partially excavated in 1955. The artefacts found indicate that it was a tool manufacturing centre and hunter settlement (Carruthers

1990:215-216). The earliest Iron Age people inhabited the Moot valley to the south of the mountain. They lived in villages of conical or domed huts (Carruthers 1990:221-222). From the 1600's, late Iron Age settlers moved into the region. A number of sites with ancient stone walls have been identified on the Magaliesberg: one on the northern slope within the boundaries of the reserve (figure 2.10 & 2.11) (Van Vollenhoven 2008:16).

At the beginning of the nineteenth century two Tswana groups occupied this area (Bergh in Van Vollenhoven 2008:17). These first groups fled the area when Mzilikazi invaded in 1827 during the Difaqane. He destroyed their villages and established his own settlements. Particular mention is made of Mzilikazi's capital, a town called Kungwini, located in the vicinity of the Wonderboom (Carruthers 1990:245). European explorers who followed soon after Mzilikazi were the first to document some of the area's oral histories (Carruthers 1990:225). Mention is made of a large tree in which a group driven from their homes had constructed a village of tree houses (figure 2.9)! It is most likely that this tree is located close to present day Rustenberg (Carruthers 1990:250) but it is possible that the Wonderboom also provided shelter to large groups. Mzilikazi was driven from the area a decade after he arrived by advancing groups of Voortrekkers. The first European settlers established themselves in Pretoria in 1839. The farm Wonderboom was established as early as 1841 (Van Vollenhoven 2008:17).

The discovery of gold in the Witwatersrand attracted attention to the Zuid Afrikaanse Republiek. Soon the British were laying claim on the Afrikaner Republic. To protect their capital, a fortification plan was drawn up. In 1897 Fort Wonderboompoort (figure 2.12) was constructed by German contractors on the Magaliesberg.

*FIGURE 2.7_The Wonderboom early 1900's (photographer unknown)*

*FIGURE 2.8_The Wonderboom today (photographer unknown)*

*FIGURE 2.9_Inhabited tree described by Moffat (sketched by A. Steedman 1835; Carruthers 1990)*

*FIGURE 2.10_Wonderboom Iron Age ruins (photograph by A.C. Van Vollenhoven 2008)*

*FIGURE 2.11_Wonderboom Iron Age ruins (photograph by A.C. Van Vollenhoven 2008)*

This fort was one of five forts (figure 2.13) constructed during this time (Van Vollenhoven 2008:140). The forts were armed with the best weaponry Europe had to offer and each equipped with dynamos, steam powered pump stations and lightning conductors. Fort Wonderboom-poort also had a telephone. The other forts were never equipped with cables as initially planned, therefore the forts communicated mainly by sending messages in morse code via heliograph (Fordred 1997:64-65). The fort's water supply was pumped up from the Apies River to a reservoir below the ammunition store. There was also a kitchen, stables, officers' quarters, a store room and the garrison where the troops lived, ate and were schooled. These rooms surrounded a courtyard which faced a large stone wall with rifle loopholes. Above the structure rose embankments with emplacements for cannons. The steep slopes would have been protected by a wall of sandbags (Gallow 2009). For all the planning that went into the construction of the forts, they did not play an important role during the South African War that ensued (Van Vollenhoven 2008:23). Pretoria was very soon seized by the British as the Boer forces assumed guerrilla tactics.

### 2.4.3 A series of proclamations

In the years following the war, the land was sold and developed piece by piece as residential neighbourhoods

*FIGURE 2.12_Fort Wonderboompoort during the South African War (1899 - 1902) (photographer unknown; Van Vollenhoven 1995)*

(Van Vollenhoven 2008:18-23). The Wonderboom tree remained a place of gathering for *Geloftedag* (Day of the Vow) commemorations. The efforts of the *Geloftedag* Committee led to the continued communal use and protection of the Wonderboom (Van Vollenhoven 2008:24).

In 1936 the City Council of Pretoria obtained the land including the tree and the fort. In March 1937 the area was proclaimed a nature reserve (Van Vollenhoven 2008:24). There were some proposals for the possible use of the fort, including that it be converted into a prison, but none of them were ever realised. The fort was destroyed by the government of Jan Smuts during the Second World War to prevent rebel groups from using the fort as base from which to attack the city (Gallow 2009). The ruins of the pre-European civilizations lay forgotten.

In 1960, a waterfall was installed on the west facing cliffs to commemorate 50 years of the Union of South Africa (Van Vollenhoven 2008:24). The artificial waterfall became a landmark of the northern gateway to the city. Presently the pumps have been switched off. The tree was declared a national monument in 1980 and the fort proclaimed a national monument in 1988 under the former National Monuments Act of 1969. Fort Wonderboompoort was preserved in its ruined state. In 1983 the Wonderboom was attacked by a parasite. It was placed under quarantine for twenty years before visitors were allowed once again in 2003 (Van Vollenhoven 2008:24).

### 2.4.4 Wonderboom Nature Reserve today

Over the years the reserve has remained a popular picnic spot for citizens. Presently, Wonderboom Nature Reserve is owned and managed by the City of Tshwane. At the base of the mountain on the northern boundary lies a resort area with picnic sites, parking, a playground for children, ablutions and a small entrance structure. An 'interpretive trail' has been established surrounding the tree which consists of explanatory plaques relating to the geology, history, fauna and flora of the reserve. Stone footpaths meander up the mountain to the fort and cave. The reserve is home to zebra, impala and some other small mammals, reptiles, birds and insects.

Wonderboom Nature Reserve is but one of the many conservation areas in the Tshwane Metropole which forms a network of green spaces in the city (figure 2.14). They are vital to the support of the remainder of the natural ecosystems in Pretoria. The reserve forms part of the larger 'Magaliesberg Protected Area'. In 2015, UNESCO declared the 'Magaliesberg Biosphere', thereby giving support to environmentalists who have lobbied for the improved conservation of the area (Magaliesberg Biosphere Initiative Group n.d.). The Monuments Act under which the Fort and Tree were proclaimed has been replaced by the National Heritage Resources Act (25 of 1999) which downgraded all previously declared heritage sites to grade II sites (Van Vollenhoven 2008:24). The fort and tree thus do not enjoy the status previously endowed upon them.

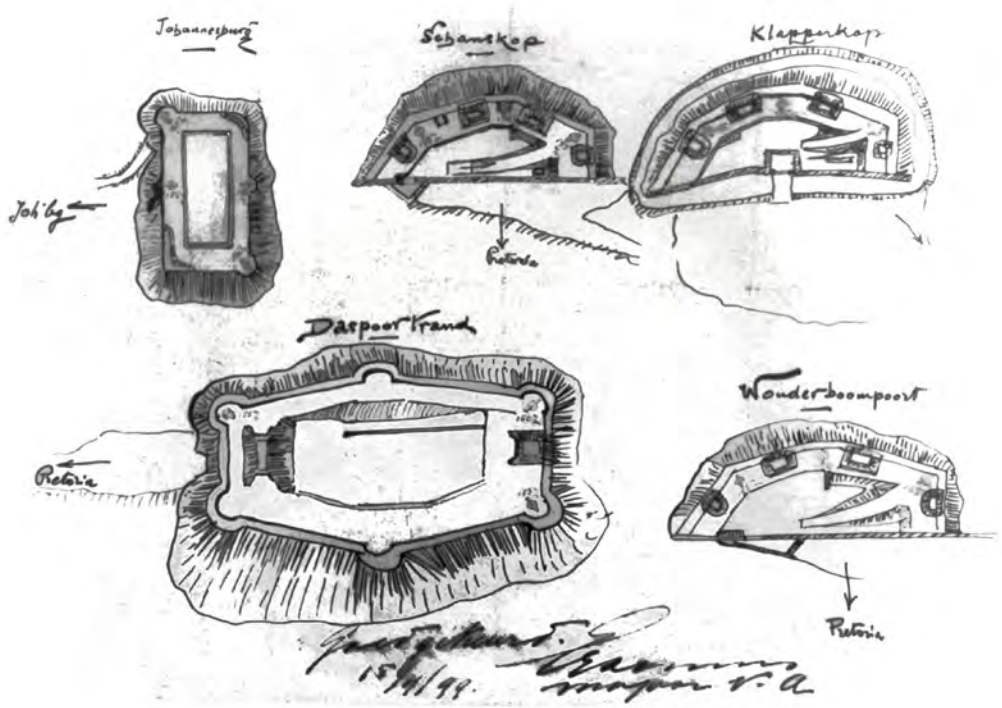



*FIGURE 2.13_Five forts of the Transvaal Republic: Johannesburg, Schanskop, Klapperkop, Daspoortrand (Wesfort) and Wonderboompoort (drawn by Major P.E. Erasmus; Van Vollenhoven 1995)*

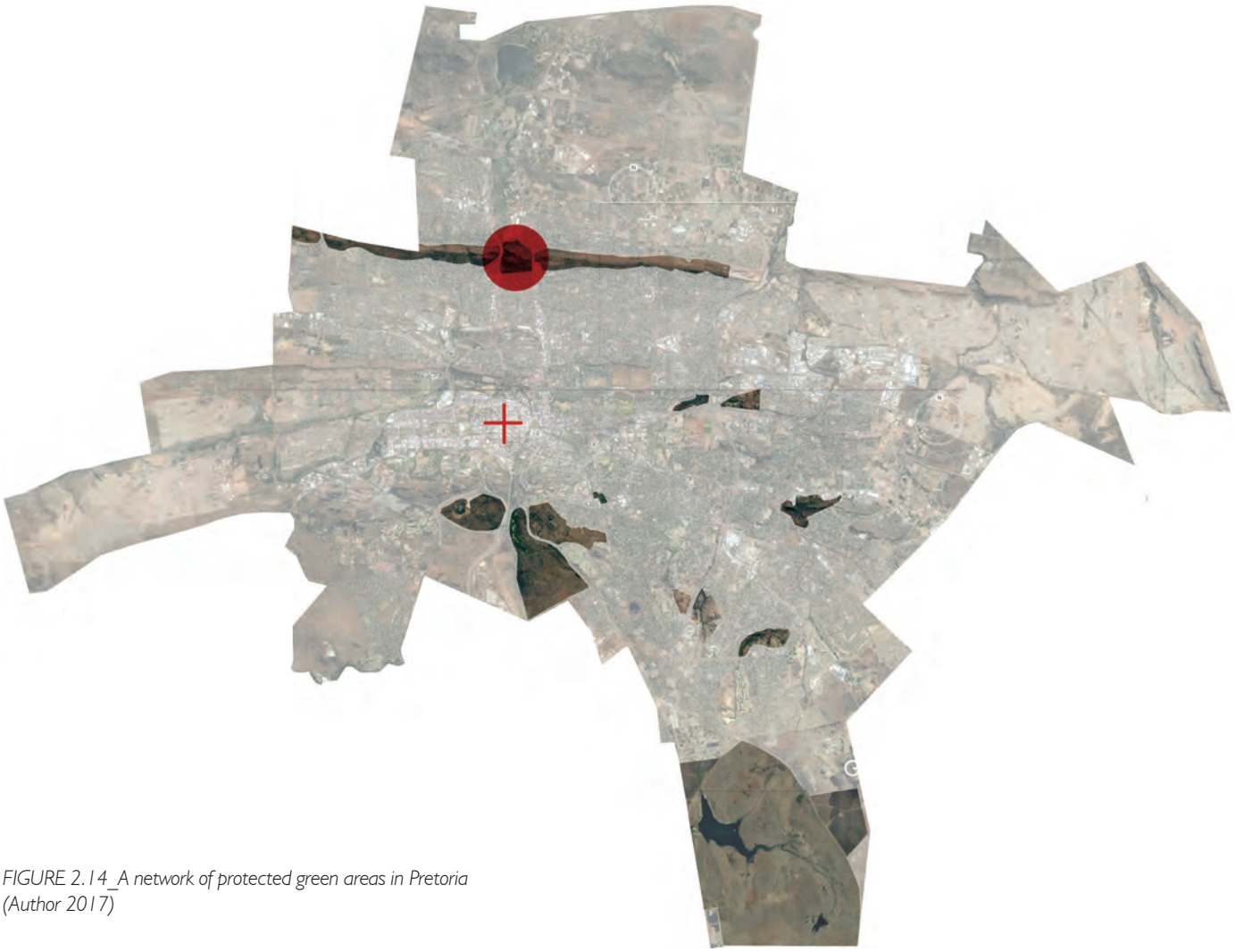


*FIGURE 2.14_A network of protected green areas in Pretoria (Author 2017)*

**[theoretical lens: heritage in flux]**

If we consider objects and places of the past as humanity's contribution to the totality of a landscape (which in itself is responsive), we should question our obsession with the preservation of artefacts. Based on his analysis of indigenous building typologies in South Africa, Frescura (1985:41) remarks: "*the South African rural dweller does not appear to have shared his European counterparts' preoccupation with permanence*". Calcatinge (2012:32) cites Longhatti & Dalang who share this critique of viewing cultural landscapes as "*an inheritance that must be protected*" at all costs. This stigma robs landscape of its identity as "*an important and basic element of interhuman relations*" (Calcatinge 2012:32) and it risks becoming a commodity.

The purpose of intervening on this site is to focus the attention anew on the various relationships between man and nature that this site has witnessed. The physical traces of an Iron Age settlement, the Boer fort and rituals of bygone eras are part of that which characterizes the Wonderboom Nature Reserve. Although initially alien, today these structures are part of the geography and a system of habitats. The circumstances which formed the structures are no longer, therefore attempting to reconstruct them would be nonsensical. Rather, a new dialogue that will rekindle the relationship between human being and his environment should commence. Parallel to this objective of writing a new chapter, the architectural intervention should reveal stories from the past and explain how they have all contributed to our understanding of the current whole.

### 2.4.5 The foreseeable future

The surrounding area north of the reserve is developing rapidly and there are additional proposals on the table. The Tshwane Spatial Development Framework suggests two development nodes, one north and one south of Wonderboom Nature Reserve (Municipality of Tshwane, 2012). The intention is to develop strong urban cores which can guide the establishment of "*positive performing settlements*" as opposed to the current haphazard development which lacks a guiding structure (Jordaan 2008:32). The development of the northern node is driven by the Rainbow Junction group who envision an urban core integrated with public transport, road infrastructure and upgrade of the Apies River (figure 2.15) (Rainbow Junction, 2015). The proposed mixed use development will conserve the Apies River and flood-plain as green belt connecting the Magaliesberg with the Bon Accord Dam to the north. A public transport intermodal facility, integrated with an upgrade of the existing Pretoria North train station, is also planned (Jordaan 2008:32-33). Line 2 of the BRT system will terminate here and will connect the future urban core with the CBD. The area south of the reserve indicate much slower economic growth. It is characterised by a boulevard of second hand motor dealers. In addition to the development of the surrounding areas, the Pretoria North Rekord reported that the Gauteng Department of Sports, Recreation, Arts and Culture had commissioned an environmental impact assessment to consider the "*possibility of doing some developments in the Wonderboom Nature Reserve*" (Bothma 2016). Their proposals have yet to be confirmed. In view of the developmental pressures there is now an opportunity to rediscover and reinvent the Wonderboom Nature Reserve as important green urban space. Alternatives which investigate the larger significance and potential of the reserve to contribute economically and socially in addition to its primarily ecological role should be put on the table.

*FIGURE 2.15_Rainbow Junction proposed development plan (Rainbow Junction n.d.)*

**2.4.6 Man and Environment - what changed?**

Over the course of history, the inhabitants and activities in the Wonderboom area have fluctuated constantly. Lines can be drawn between significant changes in history and developments in society (refer to figure 2.16) (DeKay 2011:xxx). Prehistoric societies lived in close proximity to the environment, living in natural shelters and off seasonal abundance. The minimum was done to adapt the environment for human comfort. As societies grew in complexity, they engaged more actively with the environment to shape it to meet their needs for shelter, protection and food. Population increases and the arrival of new groups, specifically from Europe, led to conflict. The geography of the Magaliesberg and its potential to provide surveillance and protection became its greatest asset. Contemporary society does not live with a daily awareness of dependence on the immediate environment. This is reflected in the state of the nature reserve and the fact that it is used sporadically for leisure activities, not to meet daily needs.

The quadrant diagramme hypothesizes that society will develop from a pluralistic post modern culture to a holistic and then to an integral society (DeKay 2011:xxx). Social systems and engagement with the environment will become informational to support holistic commons and an integral world view. Norberg-Schulz states that "*the primary purpose of architecture is to make a world visible*" (Nesbitt 1996:29). Architecture imagines and gives expression to what developing worldviews may entail. The dissertation pictures how the expression of a holistic worldview will write the next chapter of Wonderboom's story.

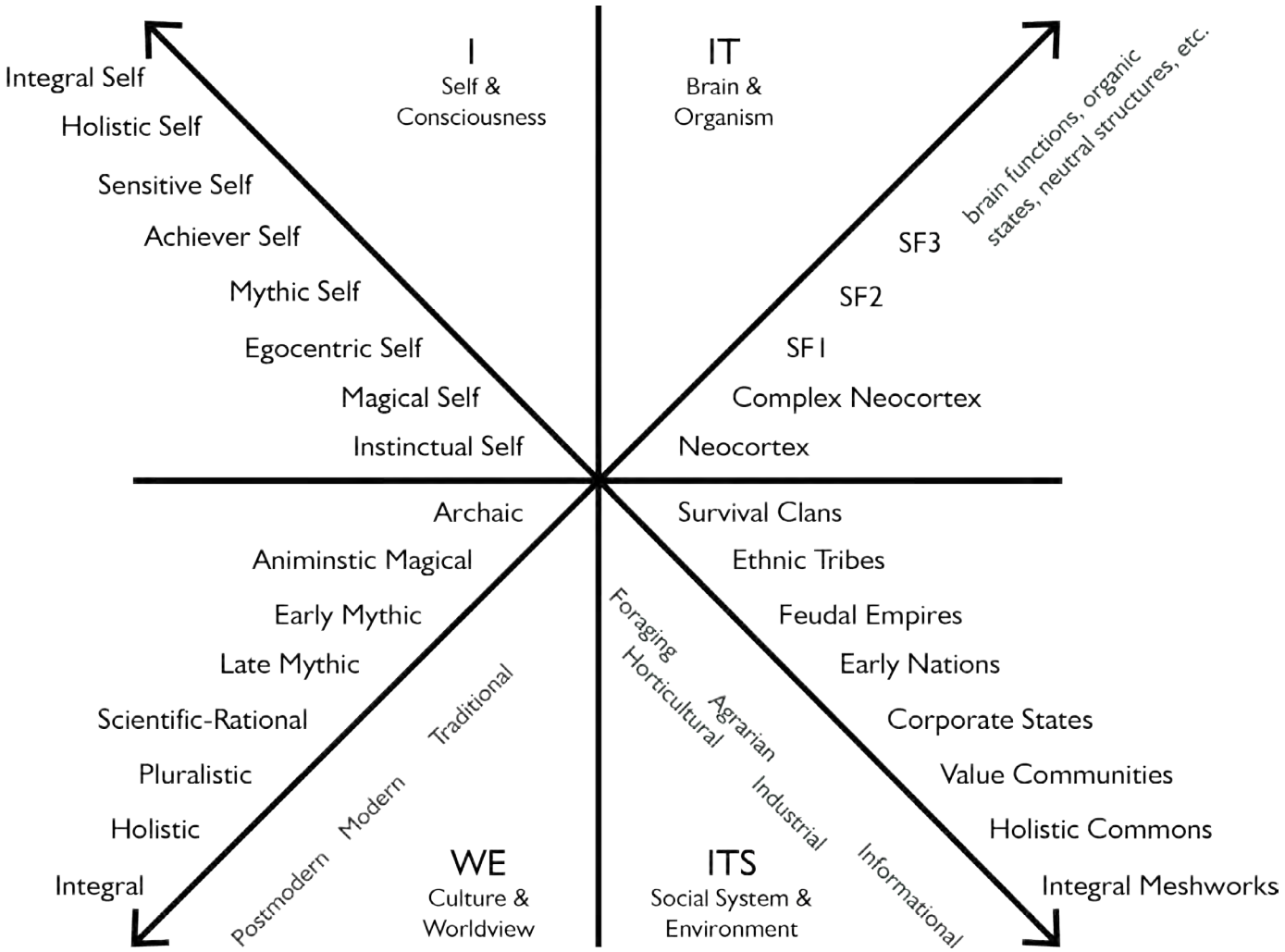



*FIGURE 2.16_Development in one sphere of society results in changes and increased complexity in others (DeKay 2011)*

## 2.5 The natural environment's potential to heal

**[theoretical lens: architecture should gather meaning]**

The ecological thinker sees the world in terms of "*dynamic systems*" (DeKay 2011:60). Everything can be understood as part of a larger whole where individual organisms are "*linked together in social systems* [and] *organisms and the physical environment are linked through their relationships into ecosystems*" (DeKay 2011:61). The functions of Nature and of Society are interrelated when viewed as a complex, yet unified system. The dissertation conceptualizes spaces that bring urban inhabitants in contact with the natural environment to bring home the notion of being part of this unified whole. Functionally, the building asks what it means to be well in contemporary natural and social environments. It should place the individual and collective in very specific relations to the earth. Phenomenological theory argues that architecture which creates engaging experiences instils a subconscious realisation of one's place in the world (Pallasmaa 1996:450). For architecture to make the world (as society understands it) visible, it should fuse with place "*by gathering the meaning of a situation*"; only then can architecture transcend its "*physical and functional requirements*" (Holl 1989:9). The intentions of the building are collected in its unique situation and the role of the architect is to find the tension point that triggers a confrontation between the natural world and the purposely created material space (Nesbitt 1996:456) (Holl 1989:9).

### 2.5.1 A place to be well: Programme

In Western traditions, buildings constructed for human well-being can be considered a typology in own right that has its origin in the ancient world. In the Greek temples of Asklepios and Kos, dating from around 500 BC, faith was placed in "*the power of sacred settings and ritual*" (Prasad 2012). Contemporary literature indicates a growing interest in the impact that the quality of place on well-being with the beneficial impacts of natural environments increasingly cited (Bragg, Wood, Barton & Pretty 2015:5). In spite of corroboration, to thus far the importance of green spaces for well-being and general health is "*largely underestimated by policy makers and the public*" (Bragg, Wood, Barton & Pretty 2015:13). Natural environments improve human health by reducing stress and anxiety, improving psychological well-being, attention and concentration and have a positive impact on physical health by promoting physical activity. Proximity to nature is also beneficial to cognitive restoration. While other dense urban contexts are faced with the challenge of developing and enhancing green infrastructure to provide citizens with access to nature, Pretoria is blessed with an abundance of preserved natural places within the urban boundaries and need only appropriate them to encourage public access.

The dissertation proposes that, in addition to the reserve's recreational facilities, a second programme that introduces activities during the week, be introduced. The programme is a driver with which to test the theoretical approach to the context; a facilitator which brings man to nature. Drawing on the notion of hampered relations as core theme for the project, the programme looks to people whose ability to engage with their physical and social environment has been negatively affected. A therapeutic centre providing for physiotherapy, occupational therapy, speech pathology, cognitive therapy and counselling is proposed. Educational programmes can be included to equip family members and educate the general public (Schnall 2016). The public interface of the scheme offers amenities on a daily basis for the occasional hiker and tourist which visit the reserve. Other communal spaces are designed in such a way as to accommodate the therapy programmes during the week as well as public events, such as a 'Secret Sunrise' yoga gathering for example, over weekends.

On a programmatic level, the scheme investigates how nature can contribute to a person's well-being; to a person's ability to participate fully in the systems of which he/she is an integral part. The overall intent is to cast light on the relations with the self, with society and with the environment. The programme ties in to this goal by literally focusing on re-establishing connections within the individual, in order for the individual to restore relations with the physical environment and social context.

*refer to Chapter 3.3 for more information regarding programmatic requirements.

## 2.6 Making form from informants

Now that the informants have been laid out, the second part of the essay explains how they come together to guide design decisions. Architecture is made, in the first instance, as a response to the understanding of the context; the programme is applied as driver to test the presumption that architecture can stimulate a connection between man and nature; and the ideal of sustainability drives the method of creating architecture.

DeKay's 'Integral Sustainable Design' applies the principles of Integral Theory to sustainable architecture. We

are already familiar with the four perspectives of integral theory (figure 2.1). The right-quadrant perspectives are what we would typically associate with sustainable design. The top-right, the Behaviours Perspective, is concerned with performance. Reducing consumption, creating better internal loops in the building economy for non-renewable resources and reducing waste and pollutants are the main design considerations. This is the basic approach to sustainability most are familiar with. The bottom-right quadrant takes it one step further: from a Systems Perspective the environment is a living system. Architecture impacts on these systems and human settlements should therefore be designed to fit their ecological contexts. Architecture can be analysed according to its patterns. This approach is often called eco-design (DeKay 2011:7).

Mainstream sustainable design practice is critiqued as concerning itself only with these external perspectives and negating the human aspect. From the Experience and Cultures perspectives, we can add to these practical considerations that architecture should [1] look at design not only as the physical world (exteriors), but also with a sense of ecologically connected aesthetics and [2] transcend "*the whole systems view to embrace the cultural context of the building community and the cultures at large*" (DeKay 2011:7-8).

### 2.6.1 Nature and culture manifested in architecture

Contemporary South African society has multi-faceted and layered cultural perspectives. It is a global culture interlaced with regional identities. This is probably one of the most challenging aspects architecture in South Africa is faced with. The essay does not discuss the issue of identity in detail, it merely identifies one cultural understanding of nature as the perspective which informs the architectural project.

The site is significant culturally as a place of spiritual rituals and social gatherings. Our cultural meaning of nature in general is not intellectual or scientific. It is mystical - as a place which instils a sense of being connected through rituals to an exterior realm and to the past. It is also social and recreational - people gather in natural environments to braai, for festivals and to engage in outdoor sport activities (refer to figure 2.17 and chapter 3 pp. 34-36: the significance of the site). The architecture therefore, should encourage these cultural activities by creating a multitude of spaces which accommodate communal social activities as well as individual rituals. Trees are protected as places of gathering and sites of ritual. The exterior spaces formed by the buildings are more important in a sense than the interior spaces as they each offer unique experiences and perspectives of the environment.

Architecture reveals nature through metaphors which are culturally applicable. Nature can be understood through the "*tangible transactions*" between nature as empirical force and the building interface; or be presented as "*the embodiment of mythic interpretations via ritual and the support of ritual*" (Dekay 2011: 94). Alternatively, in constructing something, intellectual ideas and abstractions about what nature may be, emerge through our design and technological resolutions. Norberg-Schulz (in Nesbitt 1996:29) believes it is the tectonic realisation of a work of architecture has the potential to "*explain the environment and make its character manifest*". A fourth way of understanding nature is by engaging it in the "*act of building*" (DeKay 2011:96). What we know of nature


*The Wonderboom was popular amongst white settlers as a place to have a picnic*


*Today, a diverse community makes use of the braai facilities*

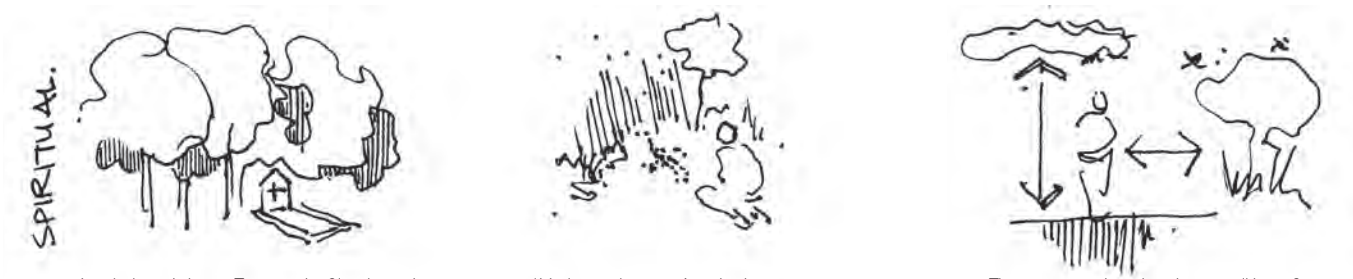
is recorded in our works - like a farmer that knows the seasons and therefore farms the way he does. The design should express an understanding of our coexistence with nature. It must advocate that human inhabited spaces should not erase or replace existing ecosystems, rather create place that supports the livelihood of a multitude of species.

The building is a product of the practices and perceptions embedded in the building culture. It's orientation on site corresponds to the east-west linearity of Pretoria's geography and built fabric. The architecture of the region is characterized by solidity and the pattern languages of a rich masonry tradition in stone, brick and blocks. The base of the building is a mass structure which blends into the stone faces of the mountain but is contrasted by tectonic elements. The architecture encourages connections to the landscape. Horizontality is favoured over verticality.

The programme, a rehabilitative health centre, is ordered to fit the cultural context. Rather than having a single internalised building, a complex of smaller structures are organized around exterior spaces. The hierarchy of the exterior spaces form routes through the site which act as a layered interface respecting the levels of privacy required by programmes. Interior and exterior spaces are permeable and natural elements and forces are celebrated as opposed to a typical healthcare building which is a sealed, sterile, interior environment. The challenges that the site and natural environment offer are used to the fullest extent to provide a stimulating healing environment. Instead of opposing or controlling nature, it is drawn into "*an intimate association*" (Ando 1996:460) with the built environment. Physical boundaries are downplayed and a new landscape which transforms "*nature through abstraction*" (Ando 1996:460) is created. The centre functions differently to accommodate both weekend and week schedules and activities. Flexible spaces with varying degrees of privacy accommodate the activities which cater for both individuals and groups. The ruin of the fort is appropriated (without diminishing the open air experience) as sanctuary accommodating small groups and occasional events. Through landscape interventions the scale of the fort courtyard is made more intimate. By considering landscape and building as a single design, "*there is no clear demarcation between outside and inside, but rather a mutual permeation*" (Ando 1996:460).

### 2.6.2 Human experience

The human connection to the earth is explored and applied metaphorically to different aspects of the process of healing. Each position offers a different vantage point and thus a different understanding of the environment and a person's place within it. Intersecting pedestrian paths which meander up, down and around the hill or transect the fort's berm, organise the site as a coherent whole. The route as main organisational element is imagined as an experiential journey which leads the visitor from the city and gradually submerges them in nature. The pathways' implicit purpose is to encourage physical activity and bring people in contact with the environment. The route reveals the landscape in segments. Architecture manipulates how the landscape is understood through the senses by revealing it at different scales and distances. The fort is valuable as a heritage artefact as the fabric has not been altered (Van Vollenhoven 2008:24). Through landscape design

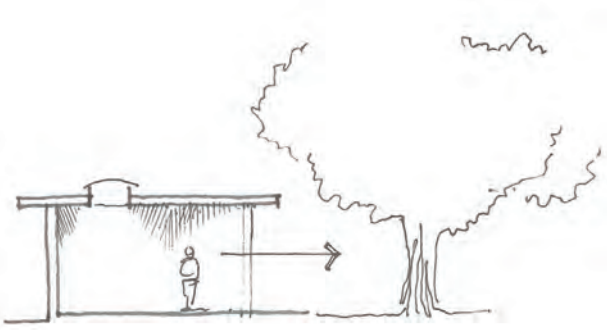



*It is believed that a Tswana chief lies buried beneath the Wonderboom*

*'Mieliemeal crosses' and other temporary markings indicate contemporary places of prayer*

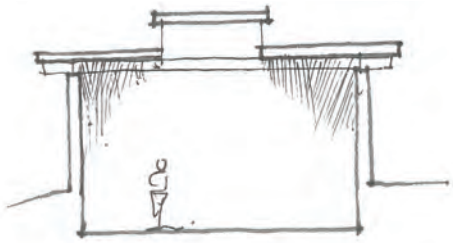
*The project predicts that the site will have future significance as a place where man can connect with nature*

*FIGURE 2.17_ The site is significant culturally as a place of spiritual rituals and social gatherings It has been used and interpreted from various perspectives in the past and present (Author 2017)*



*Directional views*

*Multiple views*



*Submerged*

interventions, prominence is given to the fort while maintaining its quality as a ruin.

Informal spaces to pause, or engage in conversation are provided throughout. By framing, hiding or revealing different views the visitor is confronted with a changing perception of both natural and historical features throughout his/her visit. Seasonal and diurnal changes, as well as the individual's perspective at a given time will allow the inhabitant to uncover more aspects of their environment as they move through it. These principles have been applied in Jørgen Bo and Vilhelm Wohlert's original 1955 design for the Louisiana Museum of Modern Art in which the elements of the architectural route frames the landscape as an ever changing artwork (figure 2.18) (Radford, Morkoc & Srivasta 2014:54-61).

Buildings designed with the experiential qualities in mind have "'*the capacity to awaken the sense, memories and minds of their occupants and inspire productive energies' (Jacobson et al. 1990)*" (DeKay 2011;105). They consider the visual aesthetics; the aesthetic of process - patterns and systems in the buildings; the aesthetic of ecological health and how place changes over time. Ecological patterns can be a language for architecture which complements more traditional design approaches (DeKay 2011:67). The range of spatial qualities give each space a different value. The "*discontinuities become the experiences*" of place (Gregotti 1996:342).

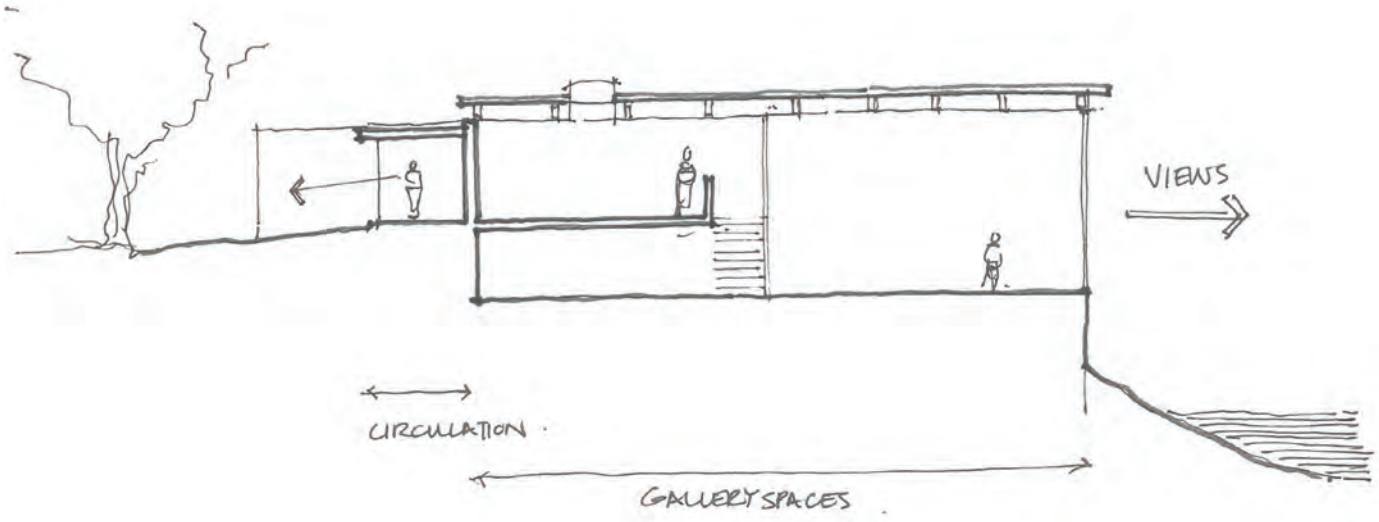



*FIGURE 2.18_A route through the landscape: The Louisiana Museum of Modern Art (Adapted from Radford, Morkoc & Srivasta 2014:54-61 by Author 2017)*

### 2.6.3 Part of a larger system

> "*Anything we design creates or modifies a system of ecological relationship. Anything we design places humans into an inhabited system in which our relationships to natural forces and processes are tightly bound.*" (DeKay 2011:82)

Function, from a Modern perspective, can be seen as the "*content*" of architecture (Nesbitt 1996:45) and the main generator of form. Yet function need not only refer to the rational programme of the building: works of architecture can also be understood as elements which impact the performance of natural systems and tools which shape society. The systems perspective considers how the work of architecture contributes to both human and natural ecology of its context. As a driver, this perspective reaches it's full potential in the technological resolution of a project. Frescura (1985:57) describes a process of construction that understands its place in the system when he summarises pre-colonial African vernacular construction as "*a process of creation, function and decay*" in which buildings are "*drawn and moulded from nature, live out* [their] *given life span and once the function has gone, decay back into* [their] *natural components*". This perspective allows us to consider "*construction as a process of "becoming"* [which] *develops as a material narrative*" (Nesbitt 1996:494). The narrative continues beyond the actual period of construction to include the context's response to the insertion over time, the continued functioning of both insertion and context, and the structure's eventual demise.

The architectural resolution, as response to the specifics of this site, should be very aware of its impact. As previously noted, the architecture is not only concerned with human shelter. It creates a place that supports the livelihood of a multitude of species. The intervention restructures the fort's eroded berm. It manages the stormwater of the site to prevent further erosion and protect the ruin of the fort from water damage and debris in the runoff. It creates new habitat for small herbaceous species on the roof of the structure which mimics the naturally occurring rocky outcrops. The plants in turn attract insects. The building footprint does not threaten existing trees. The new activity that the health centre brings provides safety for other recreational hikers through increased passive surveillance. Increased surveillance is also of benefit for the protection of the fort and iron age ruins which are given new importance through improved accessibility. As a self-sufficient structure it generates the energy required and manages waste so that it can be ploughed back into landscaping. The detailed resolution of the architecture and landscape in unison should "*demonstrate the attributes of materials*" and raise "*the issue of hierarchy, in suggesting a relationship between part and whole*"(Nesbitt 1996:494).

### 2.6.4 Performance

Sustainable practice determines the success of a building based on its ability to perform optimally within its context. "*Green design is place-sensitive*", responsive to "*the clues of a specific climate and site*" and where possible, uses sustainable local materials (Brophy & Owen Lewis 2011: Foreword). The performance of the building as an entity, as well as all the elements which constitute it, are examined. Environmental implications associated with design, construction and operation should all be taken into account. As buildings are physical assets with a long potential lifespan, short-sighted attempts to minimise initial costs should be avoided. Rather, sustainable design will "*seek to prolong the life*" of structures and the materials with which they are constructed (Brophy & Owen Lewis 2011:1).

As a whole, the structure should perform well in terms of thermal comfort, energy and water consumption, acoustic comfort and visual comfort. The form and footprint of the building is often a direct reaction to issues and opportunities identified in the site analysis. The structure should be flexible enough to allow for the required amount and size of openings, while maintaining its integrity. In the context, it is important to shade the building adequately to prevent overheating. The principle concern is the cooling strategy. Deep spaces are avoided as they are difficult to light and ventilate naturally.

Building elements are considered with regard to embodied energy, toxicity and the optimisation of renewable resources (Brophy & Owen Lewis 2011:Foreword). Function and spatial intention are other determining factors. In the dissertation project, the therapeutic activities determine material choices for interior and exterior surfaces. They should ideally create a stimulating and varied environment that contributes to the healing process (Schnall 2016). In the given context, the physical condition of the site is also important: it is difficult to provide access for large trucks and machinery due the sensitivity of the natural environment and historical structures. It is for this reason that excavated material will be the first choice of construction material. Where possible, other structures will be light weight, possibly prefabricated and easy to assemble on site.

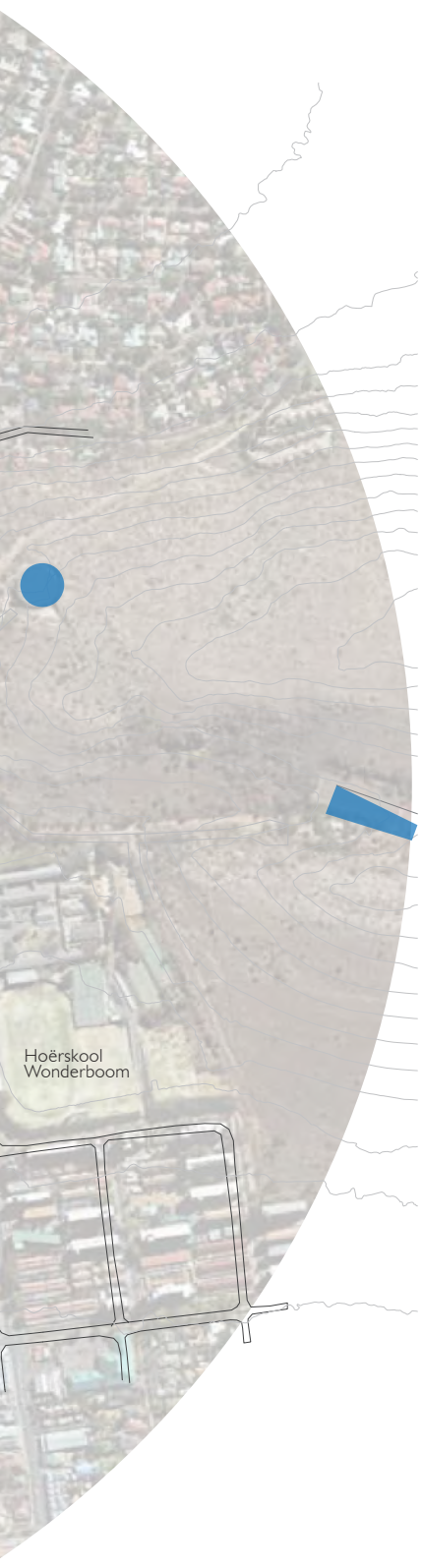
The technical resolution and the performance of the design are presented fully in chapter seven. From the guidelines set out under the performance perspective, it is clear what Gregotti (1996:496) means when he explains that materials are taken from and inspired by the project location; building form in turn is influenced by the restraints of the environment and of those materials; and subsequently details are derived from an understanding of the properties of the chosen materials.

## 2.7 Conclusion

Humankind's means of engaging with the environment - the totality of the natural, social, historical and economic context - is through transformation and manipulation of the given context. We call this architecture. Throughout the ages, man and nature have been in dialogue - both reacting and responding to one another. The spatial divide in cities between that which is man made and that which is natural, negate this interaction.

Wonderboom Nature Reserve is a prime example of the history of human engagement with the environment in the Pretoria region. The traces of these past relations have transformed the landscape to what it is presently. The dissertation's scheme would like to continue the conversation on this site in order to bring people into contact with the environment and demonstrate nature's important contribution to the city, specifically in terms of human well-being. The project will engender an attitude which nurtures nature and therefore contribute to conservation efforts.

At the core of the architectural response, is the acknowledgement that the purpose of the intervention is not merely to shelter humans, but to accommodate and protect other species too. Internationally, this consideration has grown in importance with the development of sustainable design theory. The dissertation considers sustainability from the four perspectives of Integral theory which encourages spatial designers to consider design challenges from the behaviour's, system's, culture's and experience perspectives. These determinants, together with the analysis of the site and the programme, inform and test the design.




# 3. INFORMANTS

## 3.1 CONTEXT AND VISION

The urban vision group investigated the larger precinct (figure 3.1) from a quantitative and qualitative perspective before attempting to construct a vision for Wonderboom Nature Reserve. Understanding the continual relationship between man and nature lay at the core of the group's investigation.

*FIGURE 3.1_Site map of Wonderboom Nature Reserve indicating all existing features, boundaries and surrounding roads (Author 2017)*

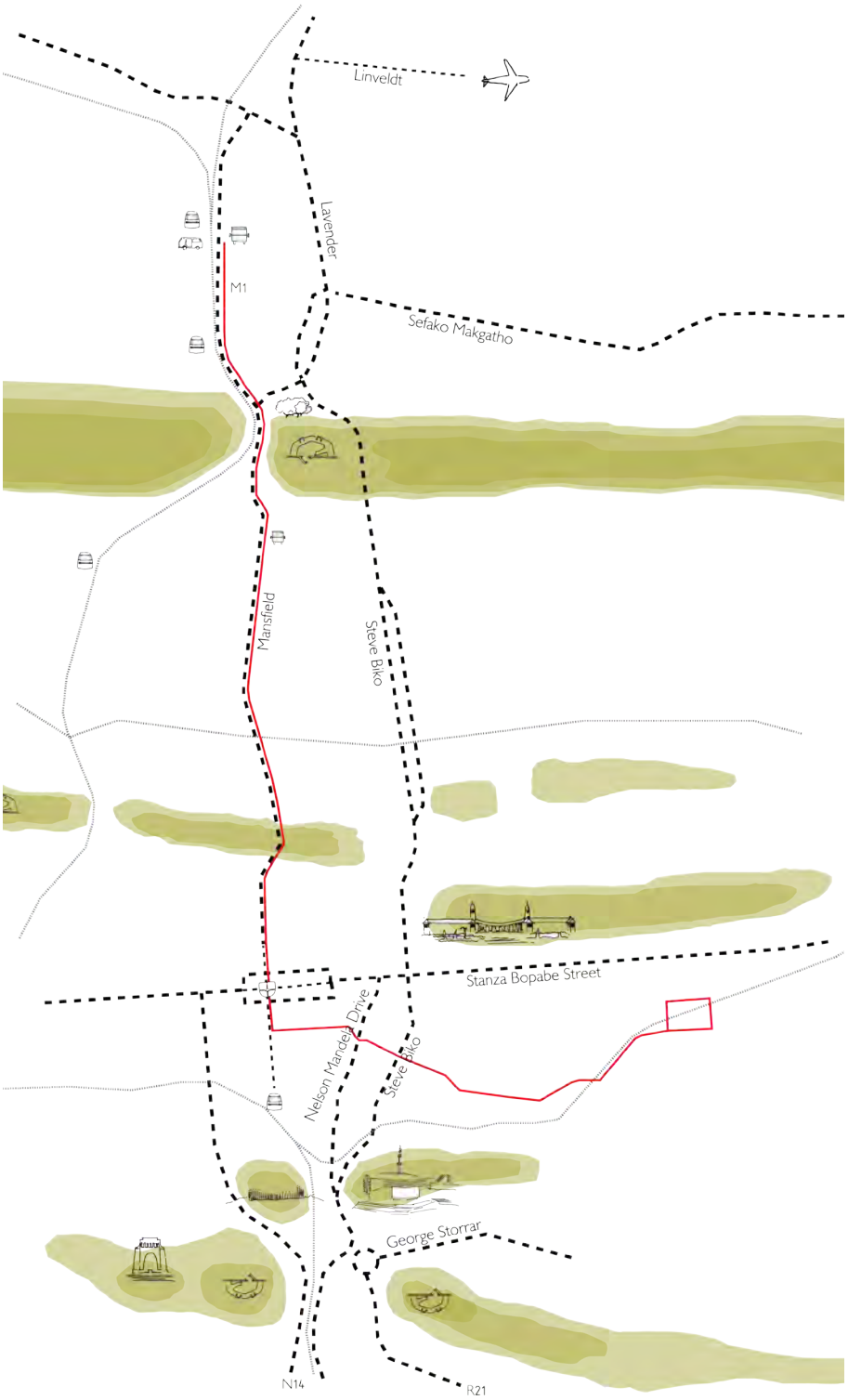



*FIGURE 3.2_Access to the site [macro scale] (Urban Group 2017)*

## 3.1.1 Access

**Road**

Large motorways surround the nature reserve on three sides. The entrance to Wonderboom Nature Reserve is situated in Lavender Road opposite the entrance to the Wonderboom Junction Mall. A service road which gives access to the fort is accessible from Steve Biko Road (figure 3.3).

**Bus**

The newly implemented line two of Tshwane's Rapid Bus Transit System terminates at the Rainbow Junction Transport Interchange north of the site. This route connects the precinct with Pretoria CBD and Hatfield. A bus stop is situated south-west of the reserve in Mansfield Rd (figure 3.2).

**Rail**

The metrorail line headed north passes through the poort. The closest station is Wonderboom Station (figure 3.2).

**Airport**

Domestic and charter flights land at Wonderboom Airport (figure 3.2).

**Footpaths**

Footpaths lead day hikers up to the fort and to the cave (figure 3.3).

**Internal Vehicular Access**

There are internal roads which give access to the picnic site and other service routes which lead to the fort, telecommunication tower and southern part of the site (figure 3.3).

Road

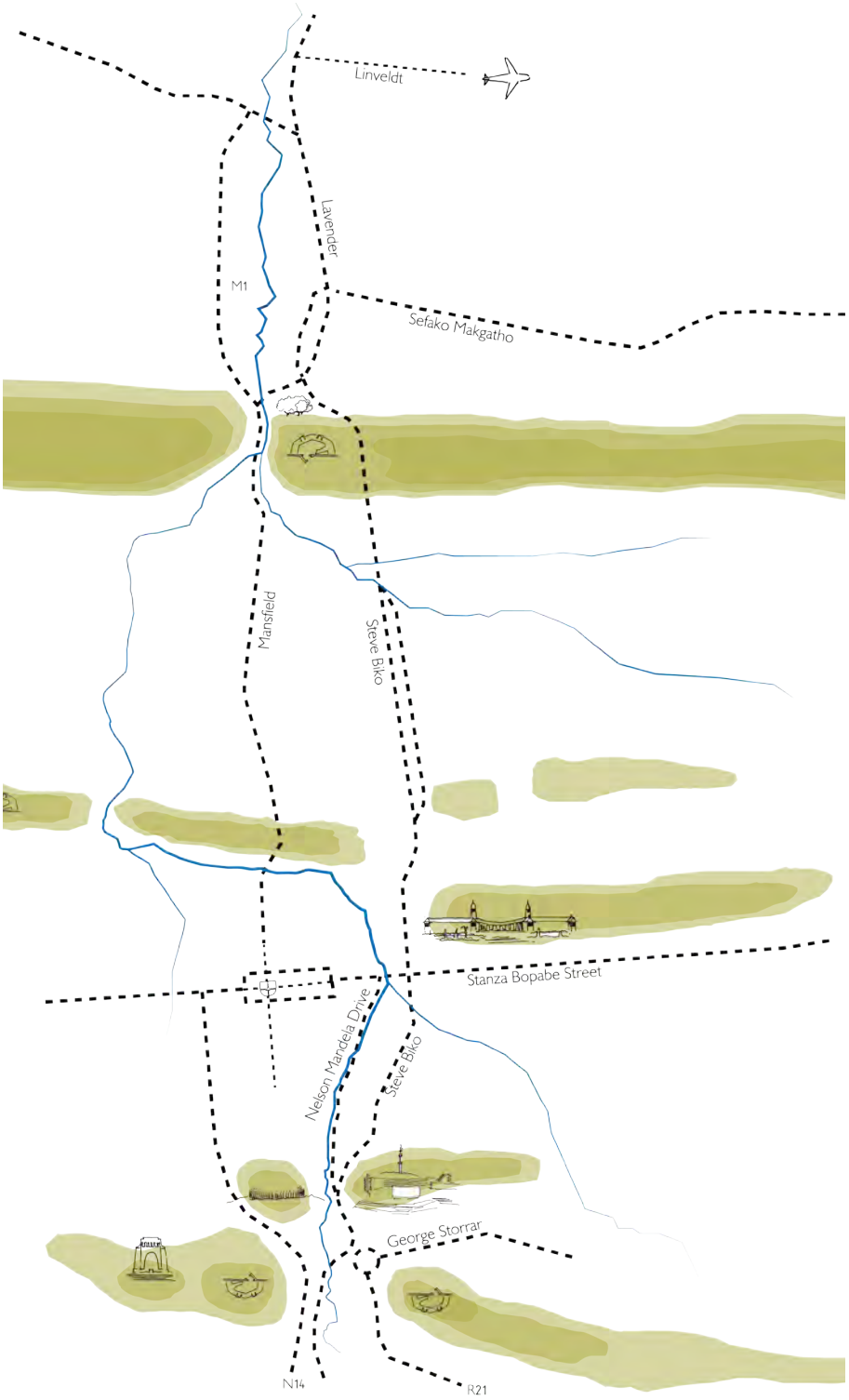
BRT bus

Rail

Footpaths

Internal Vehicular Access


*FIGURE 3.3_Access to the site [micro scale] (Urban Group 2017)*




## 3.1.2 Water courses and reservoirs

The macro map (figure 3.4) indicates the large number of tributaries running into the Apies River before it transects the Magaliesberg at Wonderboompoort.

The ridge's elevated position above the city makes it an ideal location for reservoirs. Four reservoirs are located on the hills next to the reserve (figure 3.5).

A small reservoir was constructed beneath the ammunition room in the fort. Water was pumped from the Apies River. This system is no longer functioning (figure 3.5).

A drinking hole for the animals was constructed on the southern slope (figure 3.5).

Road

Water Course + Reservoirs

Footpaths

Internal Vehicular Access

*FIGURE 3.4_Water courses & reservoirs [macro scale] (Urban Group 2017)*


*FIGURE 3.5_Water courses and reservoirs [micro scale] (Urban Group 2017)*

*FIGURE 3.6_Edge conditions (Google Earth 2017; adapted by Urban Group 2017)*

*FIGURE 3.7_Edge Condition: Lavender Road (Google Earth 2017)*

*FIGURE 3.8_Edge Condition: Wonderboompoort (Google Earth 2017)*

## 3.1.3 Edge conditions

Figure 3.6 indicates the built up areas versus the open spaces. The Magaliesberg ridge stretches from east to west. Flood-plains surrounding the Apies River and its tributaries constitute the other main undeveloped area.

North of the reserve there have been numerous commercial developments, while the southern boundary is a quiet residential area (figure 3.9).

Large roads sever the nature reserve from its surroundings. The road reserves do not create pleasant environments for pedes-trians and cyclists (figures 3.7 - 3.8).

Commercial

Residential

Recreation

School

High Density Residential


*FIGURE 3.9_Nolli-map of the area indicating surrounding occupancies - refer to key (Urban Group 2017)*

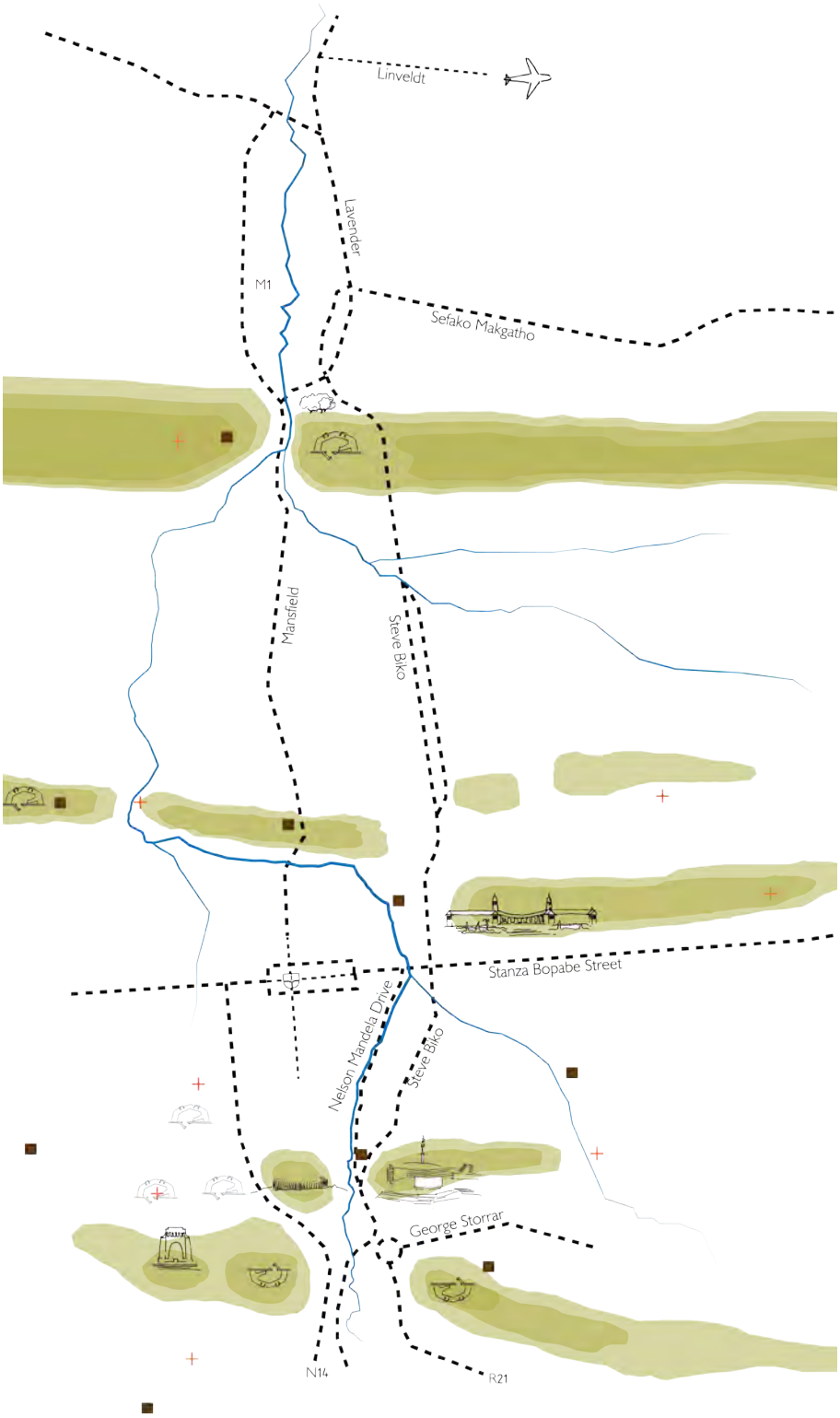



*FIGURE 3.10_Block houses, redoubts and forts of the South African War (Urban Group 2017)*

## 3.1.4 Heritage sites

Stone Age remnants have been discovered in a cave in the cliffs on the western boundary (figure 3.11 - B). Some pottery shards and tools have been discovered. The cave has been fenced of and does not seem to be a major attraction given the state of the footpath which leads to it.

A large site dating from the Late Iron Age is located on a natural terrace on the northern slope (figure 3.11 - A). Stone wall enclosures are remnants of a village up on the hill.

The fort was constructed by German contractors in 1897 for the Zuid Afrikaanse Republiek. It is currently preserved in its ruined state (figure 3.11).

The Wonderboom tree has been used by various groups through the ages as gathering space. It holds a mystical aura (figure 3.11).

Other points of significance include a Day of the Vow podium, various fortification walls associated with the fort and some old farm posts reminiscent of previous boundaries (figure 3.11).

The fort should be understood within the context of other fortifications constructed during the same period. The map on the right indicates the position of other forts, blockhouses and redoubts (figure 3.10). Pretoria has a series of landmarks on the ridges and hills. This fort can also be understood as one of these elements.

**A** Iron Age Ruins

**B** Stone Age Remains

**C** Fortifications

**D** Other

**E** Day of the vow podium

**F** Farm posts

■ Block house

\+ Redoubt

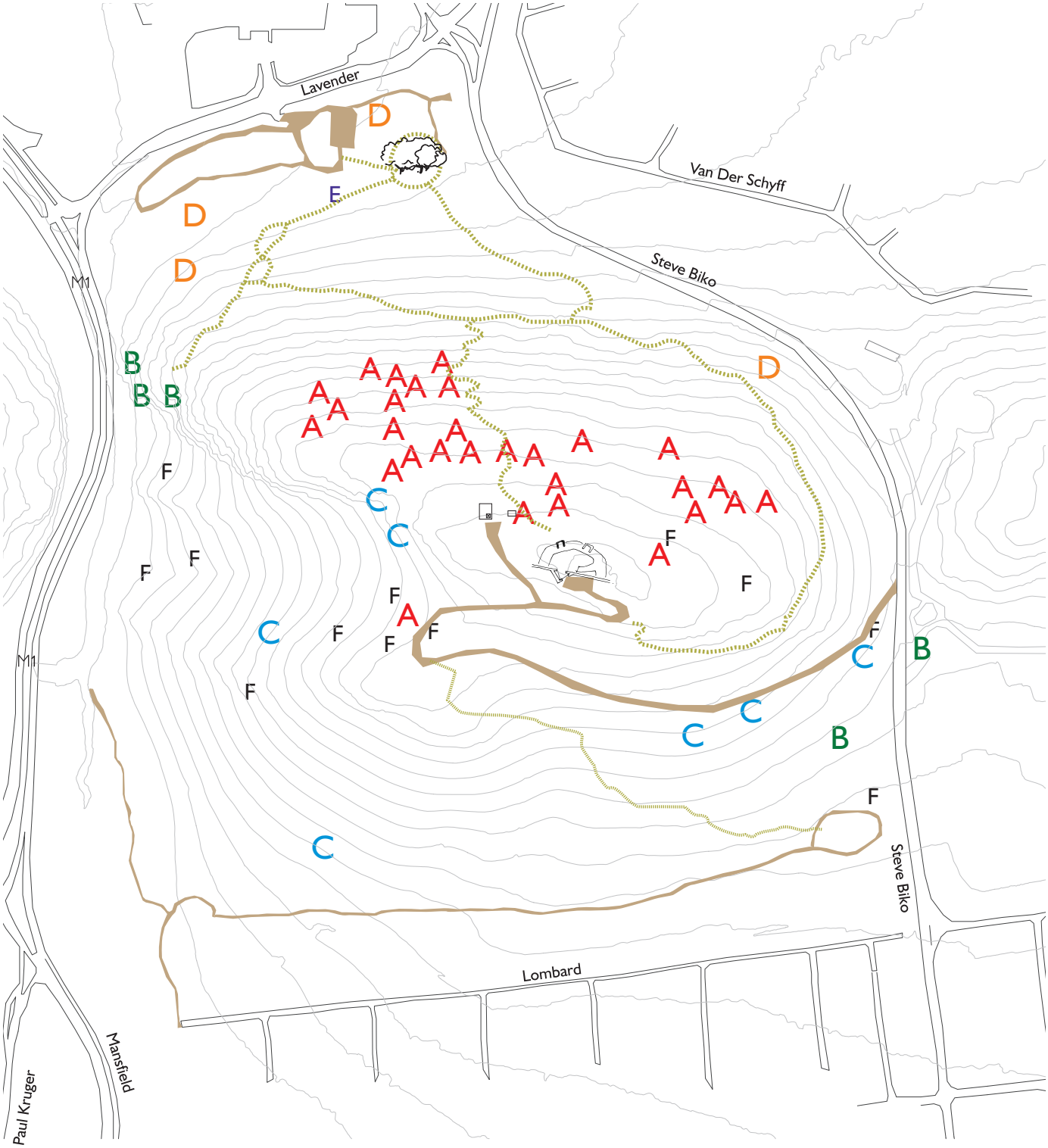



*FIGURE 3.11_Heritage sites and artefacts in Wonderboom Nature Reserve (Van Vollenhoven 2008; adapted by Urban Group 2017)*

## 3.1.5 Management guidelines

In 2008 a heritage conservation plan was drawn up in order to assess the heritage assets of the Wonderboom Nature Reserve and make recommendations for the protection and development of the site.

As a brief overview, the following was recommended:

**3.1.5.1 Fort Wonderboompoort**

Fort Wonderboompoort (figure 3.12 & 3.13) is the only fort constructed by the Germans that can be studied in its original form. The fact that it has not been restored or altered makes it a valuable artefact from the period of the South African War.

Management Guidelines state that only developments which enhance the historical features should be considered. The site should be interpreted within the context of the other forts and the "*fort does not need to be restored*". The excellent condition of the original fabric is makes this fort valuable. Visitors to the site should be monitored and it is suggested that guides are employed (Van Vollenhoven 2008:128-129).

**3.1.5.2 Iron age ruins**

This is a site of substantial size and may contain archeological evidence of Mzilikazi's time in the area although "*no archaeological proof for this has ever been presented*" (Van Vollenhoven 2008:45).

The guidelines suggest that the vegetation be cleared in order to draw a map of the ruins (figure 2.10 & 2.11). Archaeological investigation should also be considered. The site should be kept clean and included in the interpretation of the reserve (Van Vollenhoven 2008:45).

**3.1.5.3 Magaliesberg ridge**

Provision is made for the protection of the ridge as part of a natural system in the Gauteng Development Guideline for Ridges. The Magaliesberg is identified as a Class 2 ridge. This implies a no-go development policy, with the exception of certain low-impact developments (e.g. tourism) which will be considered after the completion of a full Environmental Impact Assessment (Department of Agriculture, Conservation, Environment and Land Affairs 2001:20).

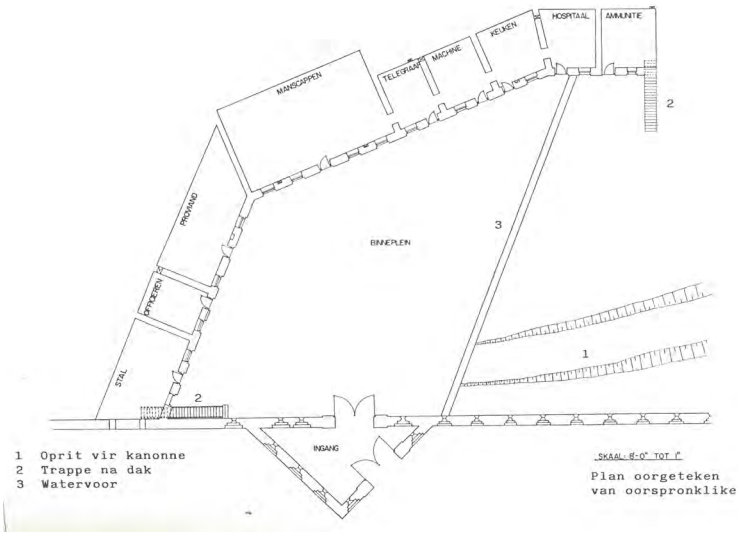
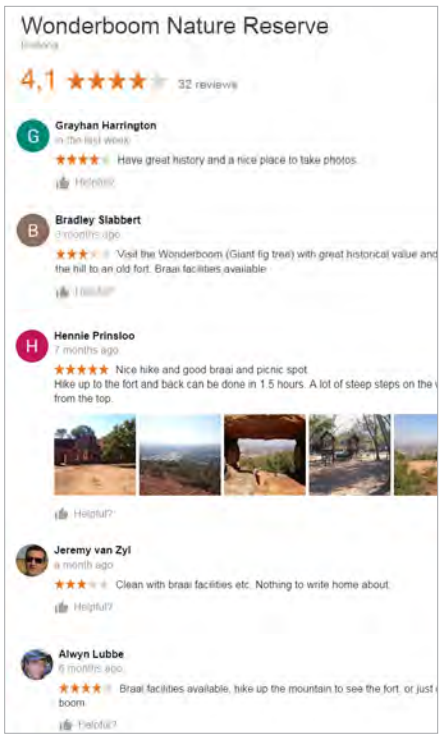
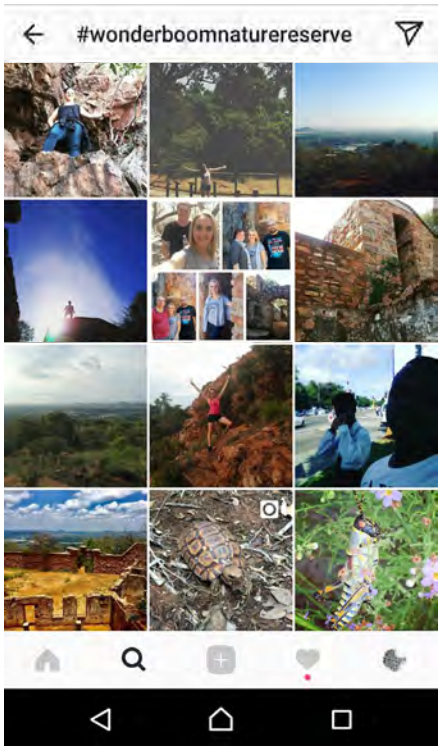



*FIGURE 3.12_Plan of the German Forts: Wonderboompoort, Schanskop and Klapperkop (Van Vollenhoven 1995)*

*FIGURE 3.13_The ruin of Fort Wonderboompoort (Author 2017)*




## 3.1.6 Public perceptions

Social media is an easy way of accessing the general public's thoughts and feelings.

Wonderboom Nature Reserve has received good reviews on Google (figure 3.14), scoring an average of 4.1 out of 5. From the comments it was deduced that most people used the picnic facilities and some made use of the walking trails. Google images corroborate that the braai facilities are popular - most uploaded pictures featured the picnic area (Google Reviews 2017).

The fort is a popular amongst Instagram users (Figure 3.15). Photos and videos of the fauna and flora have also been uploaded on Instagram indicating that some visitors take an interest therein (Instagram).

One Facebook reviewer expressed her dismay at the amount of litter in the reserve (Facebook 2017).

*FIGURE 3.14_Google reviews of Wonderboom Nature Reserve (Google 2017)*

*FIGURE 3.15_Screenshot: Photos of Wonderboom Nature Reserve on Instagram (Instagram 2017)*

### 3.1.7 Past, present and future significance

The information gathered about Wonderboom Nature Reserve and its immediate surrounds have been interpreted in figures 3.16 to 3.22. The drawings illustrate the past, present and potential future significance of the site as a synthesis of the context analysis. Three characterising identities emerge: Wonderboom as an urban wilderness, Wonderboom as a site of heritage significance and Wonderboom as a place for recreation (refer to figures 3.23-3.25 on page 36).

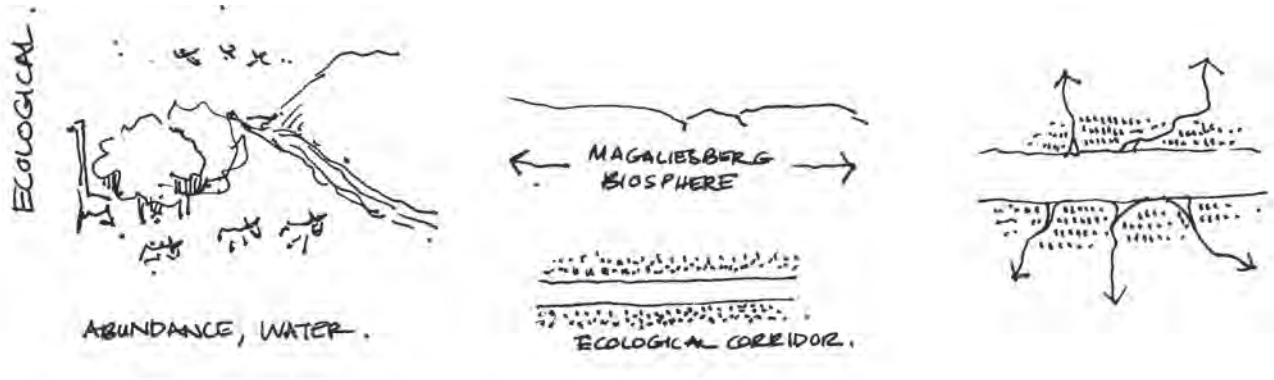



*FIGURE 3.16_Ecological Significance (Author 2017)*

Past: This was a place of abundance: water, wildlife, grazing for herds and agricultural fields.

Present: The Magaliesberg is an ecological corridor which supports life in the city.

Future: Existing natural systems can be better integrated with the city for harmonious co-existence.

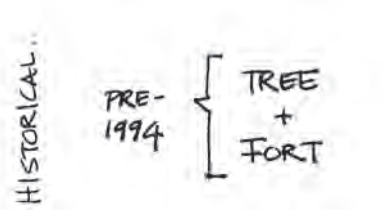



*FIGURE 3.17_Historical Significance (Author 2017)*

Past: Fort Wonderboompoort and the Wonderboom were proclaimed national monuments by the previous government.

Present: Presently not much is done to promote the site as historical site.

Future: New developments hope to restore relationship with place to continue the rich tradition of history.


*FIGURE 3.18_Social and Community Significance (Author 2017)*

Past: Wonderboom was a popular picnic place amongst the white settlers.

Present: Today people meet at the picnic area for a braai.

Future: In the future Wonderboom Nature Reserve will be a retreat for urban inhabitants.

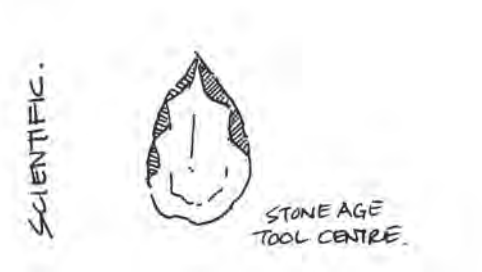



*FIGURE 3.19_Scientific Significance (Author 2017)*

Past: The Stone Age tool making centre played an important role in the scientific progress of the area at the time.

Present: The geology, fauna and flora of the Magaliesberg is of interest to contemporary researchers.

Future: The future scientific contribution may entail 'relearning' how to live in harmony with nature.


*FIGURE 3.20_Aesthetic Significance (Author 2017)*

Past: The natural environment, and especially the wondrous tree, was aesthetically pleasing in the past.

Present: The Magaliesberg is a backdrop to Pretoria's skyline. It's visual continuity should be preserved.

Future: The site will be valuable as a preserved yet accessible natural landscape in the city.


*FIGURE 3.21_Spiritual Significance (Author 2017)*

Past: The Wonderboom was viewed as a holy place. It is believed that a Tswana chief lies buried there.

Present: Today there are various places of prayer along the hiking routes.

Future: In the future the site may be a place where people experience a connection with nature.


*FIGURE 3.22_Political Significance (Author 2017)*

Past: As the site of Mzilikazi's capital, Kungwini, the area was very important politically. It was also a superb point of defence for the Boer capital, Pretoria.

Present: Political focus has shifted to other hills in Pretoria (e.g. Freedom Park, Voortrekker Monument, Union Buildings).

Future: The political future may be influenced by developments and economic growth in the area.

## URBAN WILDERNESS

*FIGURE 3.23_Wonderboom as **Urban Wilderness** (Author 2017)*

## HERITAGE SITE

*FIGURE 3.24_Wonderboom as **Heritage Site** (Van Vollenhoven 1995)*

## RECREATIONAL AREA

*FIGURE 3.25_Wonderboom as **Place for Recreation** (Baloyi 2016)*


*FIGURE 3.26_Conceptual site map (Author 2017)*

## 3.1.8 Urban strategies

Within the urban group, the following strategies were identified as guidelines for the future development of the larger site (figures 3.27 - 3.31).

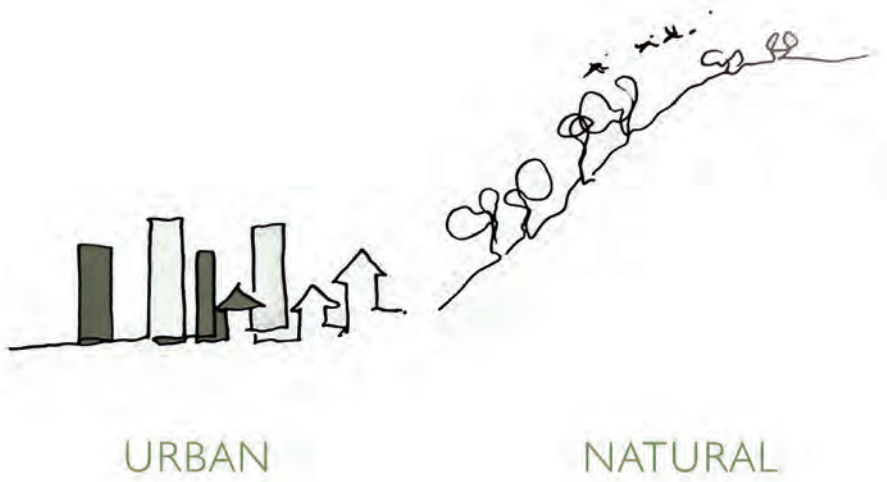
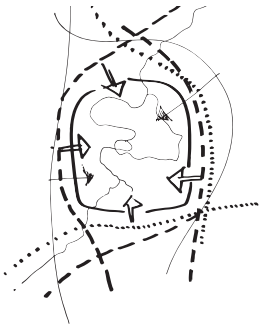


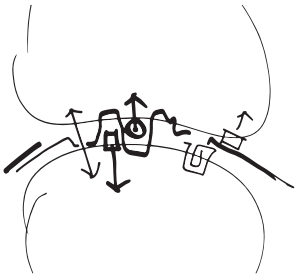

*FIGURE 3.27_Urban Strategy (Urban Group 2017)*



**3.1.8.1 Access**

- Focus on alternative modes of transport - bus, train, cyclists, pedestrians, etc.
- Increase the number of access points [physical access points, but also visual access in general].
- Use architecture as way-finding tool that draws attention to the paths and features in the landscape.

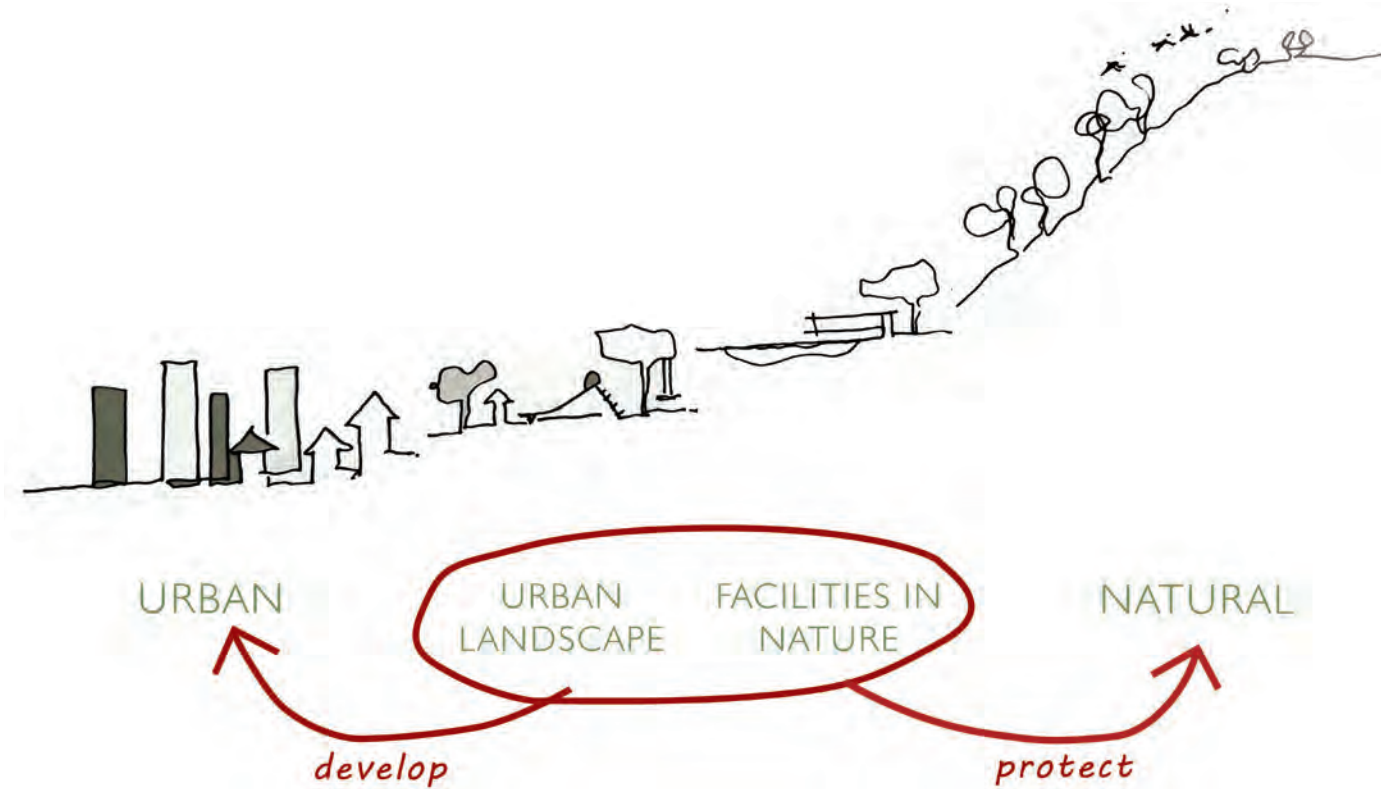
*FIGURE 3.28_Access (Urban Group 2017)*



**3.1.8.2 Edges**

- Improve visual access and awareness of the site.
- Define boundaries and celebrate entrances.
- 'Lend' natural environments to residential areas by recessing boundaries or facilitating visual access.
- Programmes on the edge of the site should serve both natural and urban areas.

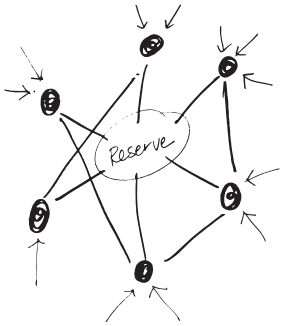
*FIGURE 3.29_Edges (Urban Group 2017)*




**3.1.8.3 Connections**

- Bring People to Nature and Nature to People.
- Rehabilitate green areas [floodplains & road reserves] as recreational facilities that increase the value of surrounding neighbourhoods.
- Create a network of green spaces that facilitate movement.
- Improve passive surveillance of these green routes by adapting buildings & site interfaces and creating new roads at strategic places.

*FIGURE 3.30_Connections (Urban Group 2017)*




**3.1.8.4 Facilities**

- Introduce new programmes that make the site a daily destination [work] as well as a weekend destination [recreational].
- Promote urban natural spaces as easily accessible, important natural recreation areas for urban inhabitants [including lower class].
- Facilities and programmes should be mixed-use, attracting a variety of stakeholders and users to the site.

*FIGURE 3.31_Facilities (Urban Group 2017)*

## 3.1.9 Vision

The Urban Vision (figure 3.32) accepts that the areas to the north and south of the Wonderboom Nature Reserve will develop as proposed in the Tshwane Spatial Development Framework (Municipality of Tshwane, 2012). Line 2 of the BRT system which has recently been completed will make the site easily accessible for city inhabitants. The Rainbow Junction mixed use precinct will be constructed north of the Magaliesberg ridge alongside the Apies River bringing many more people into the area. Within this framework, Wonderboom Nature Reserve is envisioned as a place that contributes to the city and demonstrates a healthy relationship between urban inhabitants and the natural environment. It supports productive activities (project by A. Visagie 2017), recreational and tourist activities and programmes which contribute to the holistic well-being of citizens (project by Author 2017).

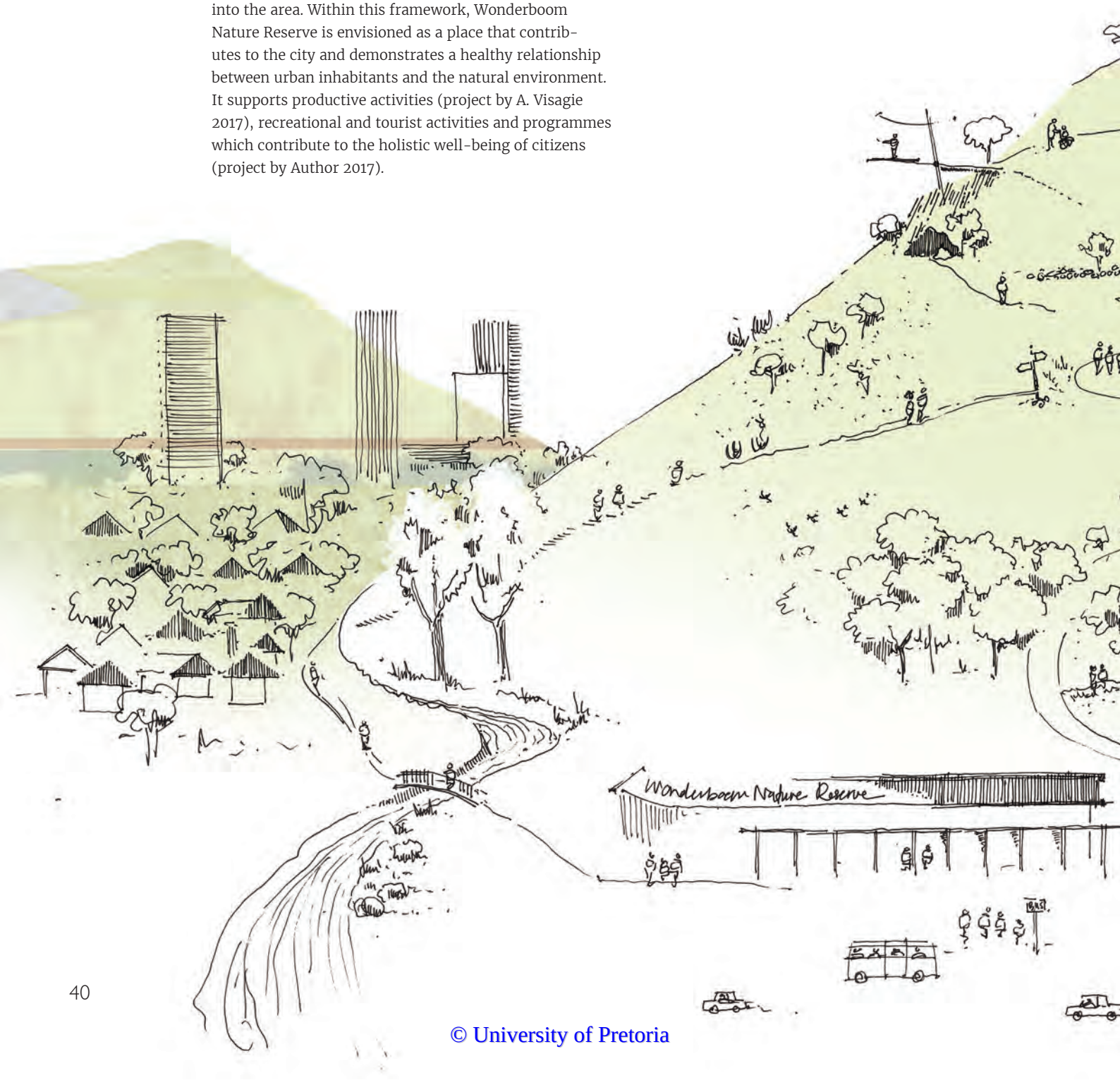
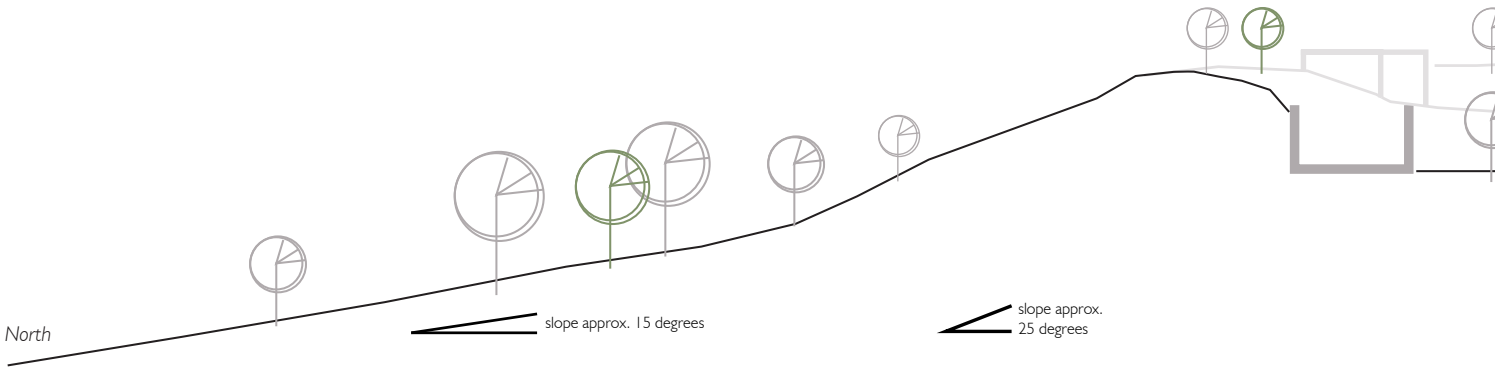


*FIGURE 3.32_Wonderboom Nature Reserve is envisioned as a place that contributes to the city and demonstrates a healthy relationship between urban inhabitants and nature (Author 2017)*




## 3.2 SITE ANALYSIS

The site analysis zooms into the place of investigation, the area around Fort Wonderboom. The specific site has been chosen for the following reasons: [1] it is immersed in the natural environment, yet maintains a link to the city through views; [2] within this pristine area, this is the site most disturbed through previous interventions; [3] it is in close proximity to the Iron Age ruins and Fort Wonderboompoort; [4] the existing service road provides access. This section adapts Brophy & Owen Lewis's site selection checklist (2011:51) as first point of inquiry. Thereafter, the specific site information to which the design should respond is documented.

### 3.2.1 Site selection checklist

| | | |
|---|---|---|
| *Is the land suitable for the intended purpose (does it have cultural, historical, archaeological or scientific significance?) and for development?* | Yes | Historical, cultural, archaeological and natural significance that can be highlighted through development. |
| *Can it be developed without being destroyed?* | Yes | - if approached sensitively. |
| *Are there better uses for the land, such as agriculture?* | No | No other uses that will generate revenue. |
| *Is public transport available nearby?* | | |
| *Is there any potential for renewable energies or district heating?* | Yes | Solar power. |
| *Does the site have daylight availability and solar access?* | Yes | |
| *Are there lakes, ponds or streams, or wetlands? Can groundwater be tapped?* | No | |
| *Is the site vulnerable to flooding, contamination risks?* | No | |
| *What is the condition of air, water and soil? What about noise?* | Good | Noise from the road is a problem lower down on the slopes of the hill. |
| *Is there a pre-existing infrastructure of power, water supply, communications, waste handling, and drainage?* | Yes | Power & water supply that serviced the telecommunication tower can be reconnected. |
| *Depending on the intended use, are there appropriate commercial or community services nearby?* | Yes | Various hospitals within 5km radius from the site. |
| *Can existing structures be re-used?* | Yes | The ruin of the fort and two telecommunication buildings. |
| *How might future developments on adjacent land affect the project?* | None | The ridge policy prohibits large developments. |

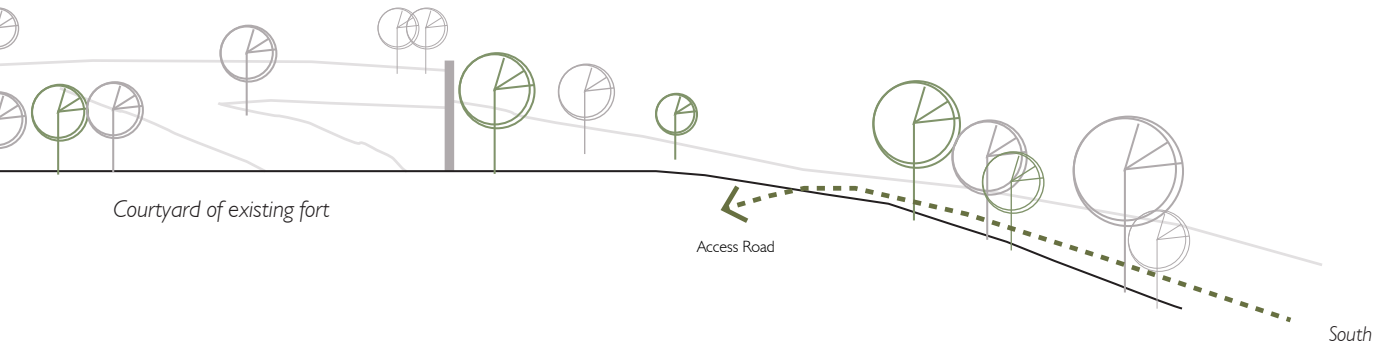



*FIGURE 3.33_North - south section through the fort (Author 2017)*

## 3.2.2 Solar orientation

The Magaliesberg ridge stretches east-west. Views to the city are to the south, yet the optimal solar orientation (figure 3.34) is +15° East and -10° West for Pretoria (SANS 204, 2008). The north facing slope is better located in this regard and refraining from developing the southern slope will keep the ridge line as viewed from the CBD.

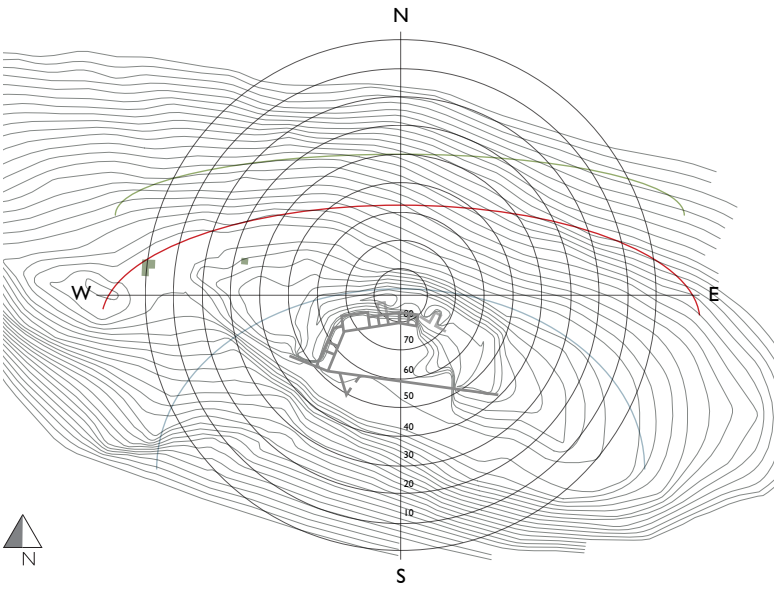



*FIGURE 3.34_Solar orientation and ideal location for building (Meteoblue 2017; adapted by Author 2017)*

## 3.2.3 Geology

The Magaliesberg is predominantly a quartzite ridge. It is assumed that the fort's berm consists of material from previous excavations and therefore a large portion is sand and loose stones of various sizes. The natural rock bed at the top of the ridge is quite shallow (Carruthers 1990:6). The north-south section through the fort indicates the slope of the hill and man made berm (figure 3.33). The berm is badly eroded (figure 3.35).

*FIGURE 3.35_Eroded berm of Fort Wonderboompoort (Google Earth 2017; adapted by Author 2017)*

## 3.2.4 Winds

Pretoria is not a windy city, but the top of the hill is slightly more susceptible to drafts. The wind rose indicates that the predominant wind direction is from the east (figure 3.36).

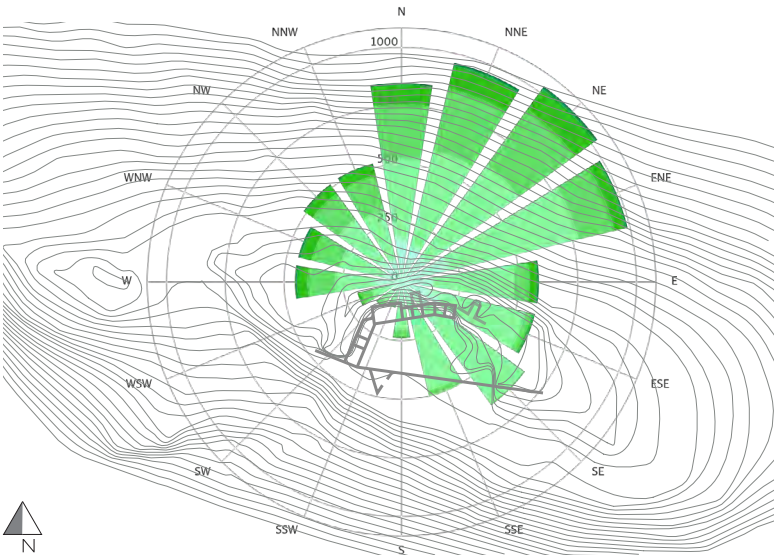



*FIGURE 3.36_Pretoria Wind Rose (Meteoblue 2017; adapted by Author 2017)*

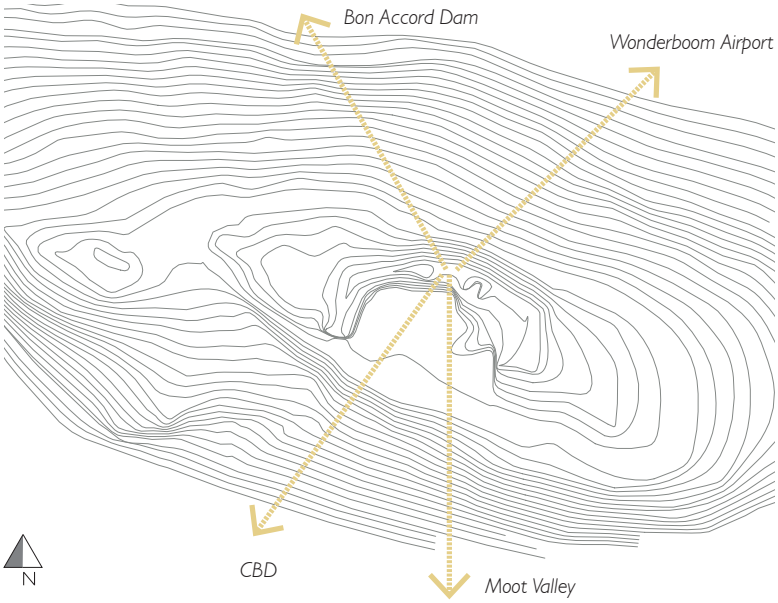



*FIGURE 3.37_Views from the top of the hill (Author 2017)*

## 3.2.5 Views

Looking south from the top of the hill (figure 3.37), one has a view towards the CBD and the Moot Valley. To the north lies the Bon Accord Dam, Wonderboom Airport and the koppies surrounding Brits (figure 3.38).

## 3.2.6 Existing plant species and microclimates

Mucina & Rutherford (2006:466) identify the specific vegetation type of the Magaliesberg as belonging to the Gold Reef Mountain Bushveld sub-biome which is typical of the rocky hills and ridges of Gauteng. The herbaceous layer is dominated by grasses which grow in the shallow soils. Trees and shrubs establish roots in cracks in the rocky sublayer.

A built intervention on this site should respect and protect existing trees. The design can accommodate endemic plants which are adapted to shallow soils and rock crevices (figure 3.39) in roof gardens and planters.

***Bottom Left***
*FIGURE 3.38_The view to the north (Author 2017)*

***Below***
*FIGURE 3.39_Plants grow in the crannies of rocky outcrops (photograph by A. Visagie 2017)*

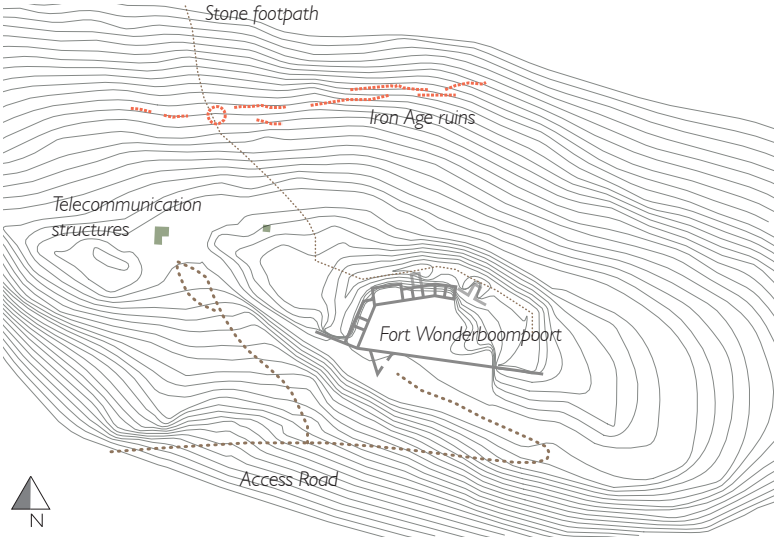
## 3.2.7 Existing structures

Existing man made structures on the site include the paved access road, the telecommunication tower, two small brick buildings, the fort, the iron age walls and the stone footpath (figure 3.40).

The iron age walls have mostly disappeared under a layer of vegetation, but are visible if the visitor is aware of their presence. The fort is the most prominent structure. It is in a ruined state, but structurally sound. Graffiti has been carved into the plastered walls (figure 3.41). The fort has created a cool, moist microclimate on its south characterised by many trees, vines and mosses.

The telecommunication tower and two associated buildings are in disuse (figure 3.42-3.43). The buildings have been stripped. The remaining shells are structurally sound and can therefore be reappropriated. Water and electricity was provided to the buildings in the past. The ground cover surrounding these structures is sparse.

The service road is in good condition although slightly overgrown. The stone paved footpaths of the reserve are the principal route to the fort at present. Van Vollenhoven (2008:45) assumes that stones from the iron age walls may have been used for the paving.




***Above***
*FIGURE 3.40_Existing built features (Author 2017)*

***Bottom Left***
*FIGURE 3.41_Graffiti in the fort (photograph A. Visagie 2017)*

***Bottom Centre***
*FIGURE 3.42_The telecommunication tower (photograph A. Visagie 2017)*

***Bottom Right***
*FIGURE 3.43_Telecommunication infrastructure (photograph A. Visagie 2017)*

## 3.3 PROGRAMME REQUIREMENTS: HEALTH PRACTICE

The programme and the spaces catering for the various needs of the recreation and health centre are unpacked. In addition to the proposed function, the new buildings support recreational activities taking place in the reserve and create the opportunity for more gatherings to be held in the ruin. The diagrammatic sections (figures 3.44 - 3.52) were an initial exploration of the experiential qualities of spaces and their relation to the earth. The icons illustrate the building services that need to be included in the detailed design. Each space is also analysed according to the number of people to be accommodated (Neufert 2000) at any given time and the SANS 10400-XA recommendations for occupancy times and potential heat gains. The colour of the room title indicates whether the space is exclusively for the **private** use of the health practice; whether it can accommodate both **private and public activities** or whether it is a **public** facility.

### Cafeteria

Cafeteria + Bar with seating area

±60m² (Neufert 2000:457)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 18 hours/7days
Design population for Internal Heat Gain: 1 person/m²
Max. annual energy consumption: 400kWh/m²

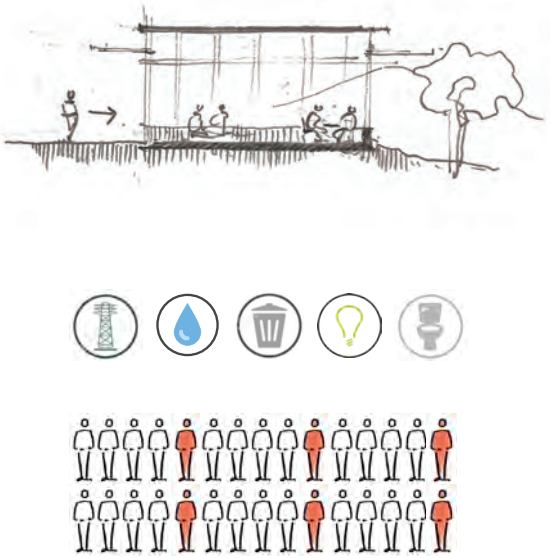


*FIGURE 3.44_ Cafeteria (Author 2017)*

### Kitchen

Cafeteria Kitchen; should also cater for events

±15m² (Neufert 2000:457)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 18 hours/7days
Design population for Internal Heat Gain: 1 person/m²
Max. annual energy consumption: 400kWh/m²

**DESIGN ASSUMPTIONS (SANS 10252-1:2012):**
Daily water demand [full meal prep]: 8-10 litre/meal
Daily hot water demand: 30-40 litre/meal

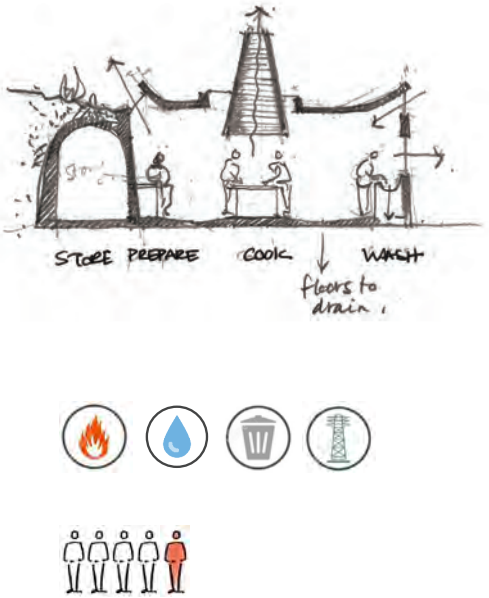



*FIGURE 3.45_ Kitchen (Author 2017)*

## Reception & Administration

Waiting Area; Reception Counter; Filing & Administration

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 12 hours/5 days
Design population for Internal Heat Gain: 1 person/15m²
Max. annual energy consumption: 190kWh/m²
Internal Heat Gain for appliances: 15W/m²

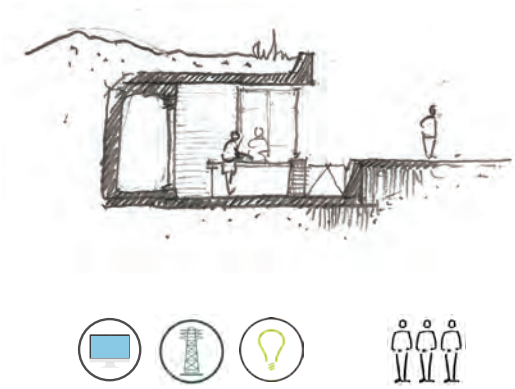


*FIGURE 3.46_ Reception and Administration (Author 2017)*

## Offices

Shared open plan office space with storage

±72m² (Neufert 2000:346)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 12 hours/5 days
Design population for Internal Heat Gain: 1 person/15m²
Max. annual energy consumption: 190kWh/m²
Internal Heat Gain for appliances: 15W/m²

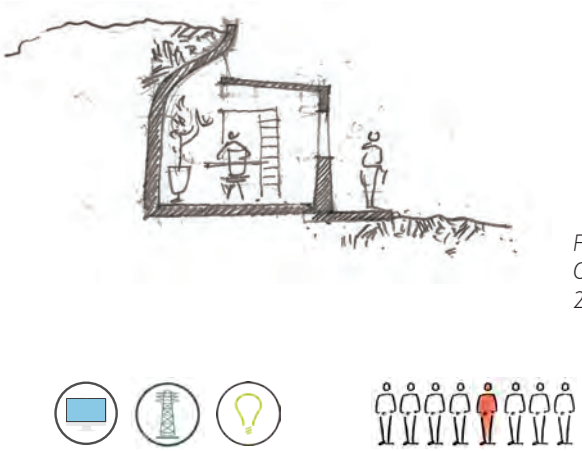


*FIGURE 3.47_ Offices (Author 2017)*

## Ablutions

Ablution facilities for max. no of public visitors during peak times = 50pax.

Showers for gym users = approx. 30 showers p/day

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 18 hours/7days

**DESIGN ASSUMPTIONS (SANS 10252-1:2012):**
Daily water demand [office and consultation]: 7-10 litre/floor area

Daily hot water demand [sports participants]: 30-40litre/capita/day

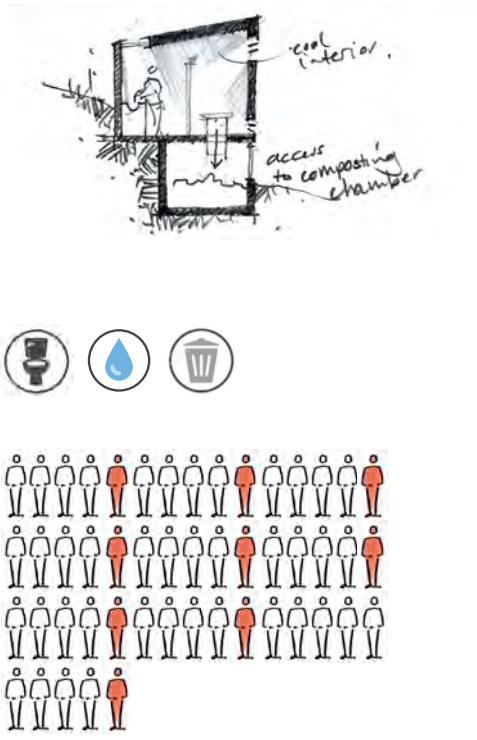



*FIGURE 3.48_ Ablutions (Author 2017)*

## Consultation (x2)

Private Consultation / Examination

±10m² (Neufert 2000:541)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 12 hours/5 days
Design population for Internal Heat Gain: 1 person/15m²
Max. annual energy consumption: 190kWh/m²

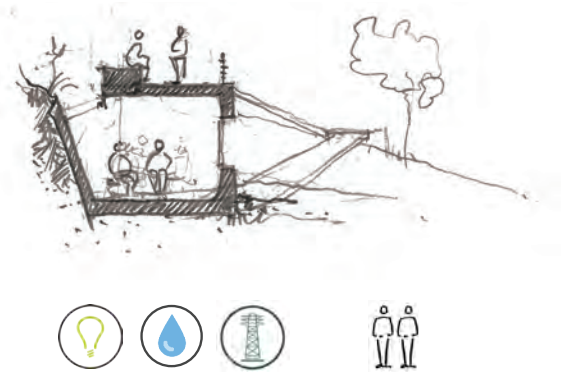


*FIGURE 3.49_ Consultation (Author 2017)*

## Multi-Purpose Venues (x2)

Group Therapy; Seminars & workshops.

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 18 hours/7days
Design population for Internal Heat Gain: 1 person/m²
Max. annual energy consumption: 400kWh/m²

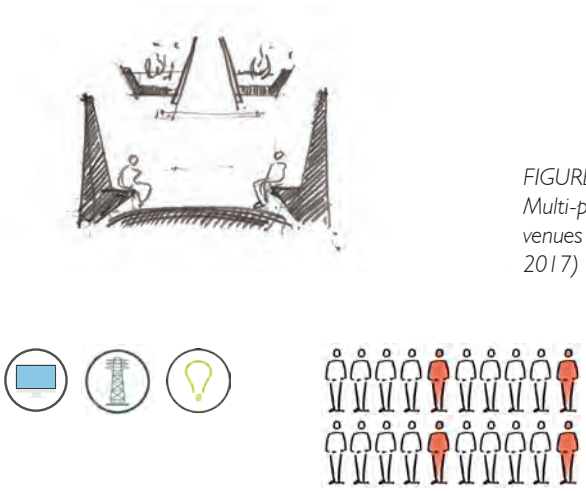


*FIGURE 3.50_ Multi-purpose venues (Author 2017)*

## Individual Therapy Rooms (x2)

Physiotherapy; Massage therapy; Speech therapy; Counselling

±10m² (Neufert 2000:541)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 12 hours/5 days
Design population for Internal Heat Gain: 1 person/15m²
Max. annual energy consumption: 190kWh/m²

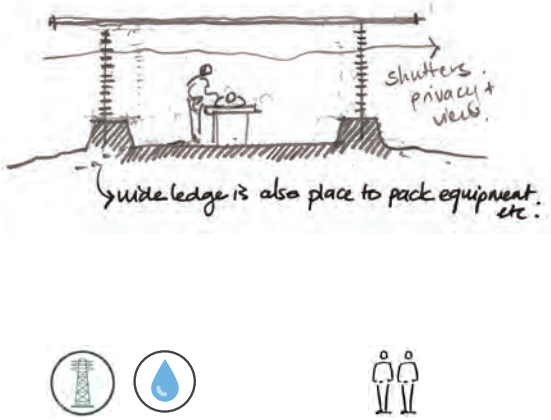



*FIGURE 3.51_ Individual Therapy Rooms (Author 2017)*

## Gymnasium

Occupational therapy; Biokinetics

min 40m² for 12 users (Neufert 2000:534)

**DESIGN ASSUMPTIONS (SANS 10400-XA:2011):**
Design occupancy times: 18 hours/7days
Design population for Internal Heat Gain: 1 person/m²
Max. annual energy consumption: 400kWh/m²

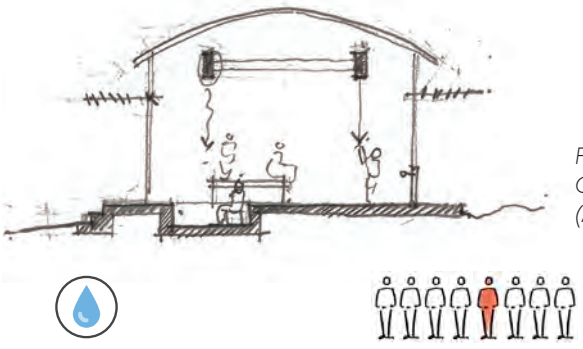


*FIGURE 3.52_ Gymnasium (Author 2017)*

# 4. INITIAL PERSPECTIVES

## INVESTIGATING CONCEPTUAL APPROACHES TO THE SITE

The architectural project has not developed linearly. Although the intent of the project, namely to introduce people to the beautiful natural and historical environment, has remained throughout, the approach to the site has changed drastically during the course of the year. The design was not conceived after all the informants had been investigated. Rather, the opposite is true: a multitude of conceptual investigations guided the process of exploring and understanding the informants. The following chapter delves into the main concepts which explored [1] a number of follies on the hill; [2] a reinterpretation of the *kraal* typology in reference to the Iron Age settlement; [3] an organic interpretation of the forms of the Magaliesberg and [4] the idea of routes through the landscape.

## 4.1 Follies on the hill

From the onset the intention was to preserve the existing natural environment as far possible while still creating opportunities for spaces which could place people within nature. The first scheme was a conglomeration of architectural follies centred around the existing telecommunication infrastructure. The central building would house a cable car station which would connect the heritage sites at the top of the hill with the existing nature reserve entrance and resort area below. No clear programmatic intentions had been identified at this stage. The photograph of the model (figure 4.3) features viewing platforms situated at various locations to provide different views (figures 4.1 & 4.2) of the surroundings and highlight the different types of vegetation present even in this small geographic area.

This approach was discarded as its parts were too disparate.

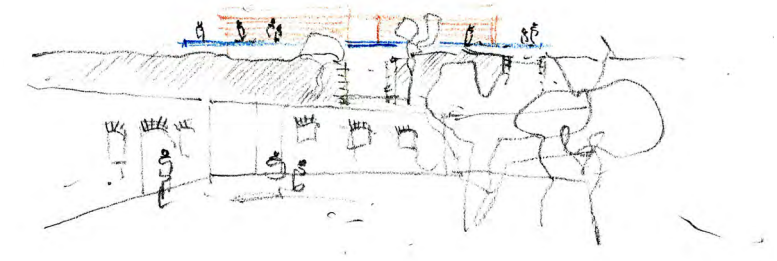
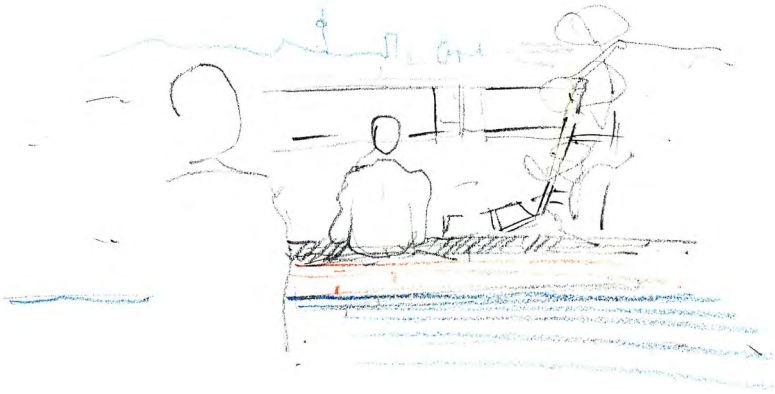
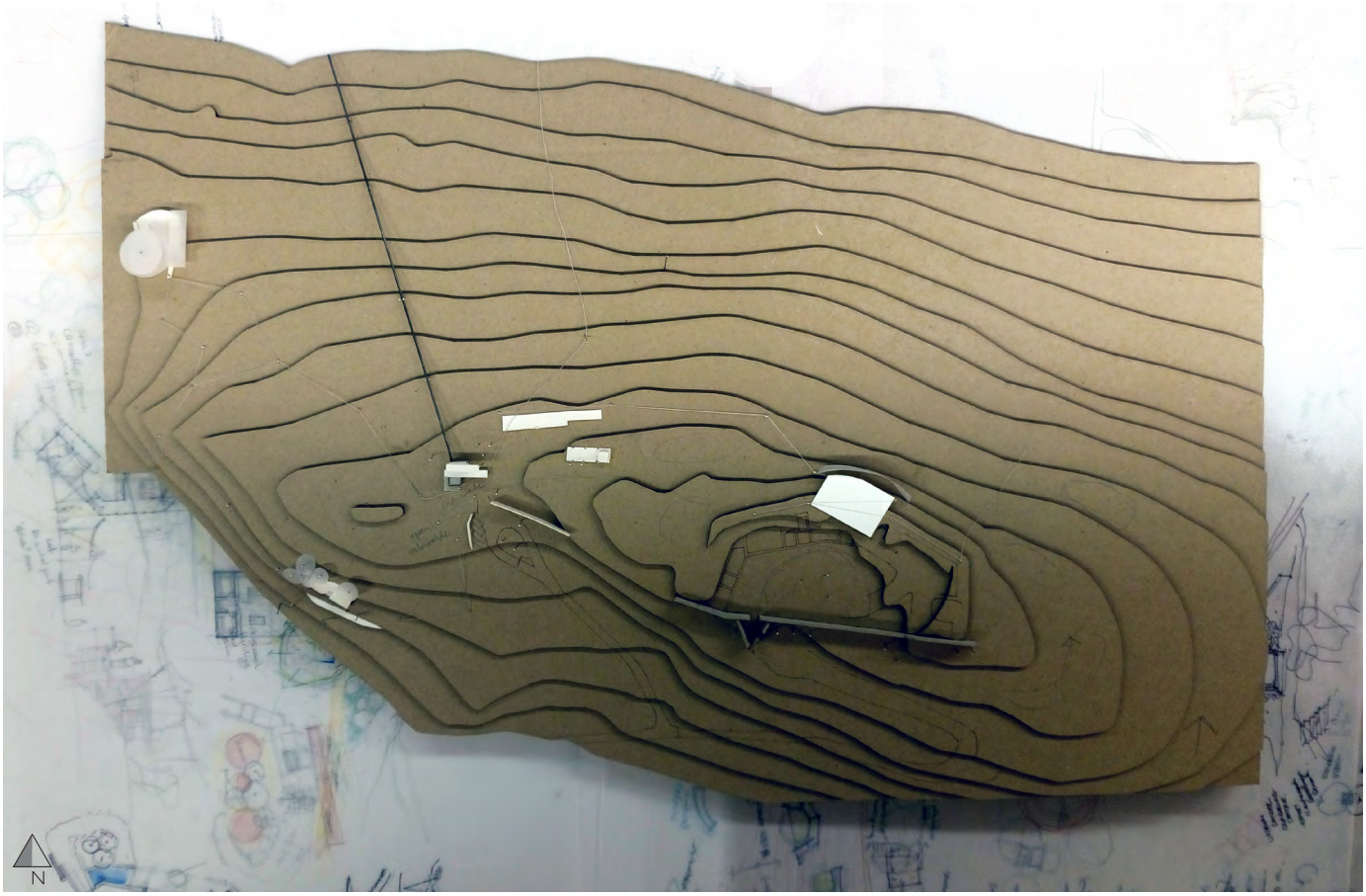


*FIGURE 4.1_A viewing platform above the fort (Author 2017)*



***Left***
*FIGURE 4.2_A view across the Fort towards Pretoria CBD (Author 2017)*

***Below***
*FIGURE 4.3_Concept model: Follies on the Hill (Author 2017)*



## 4.2 A series of *kraals*

The second investigation went hand in hand with research into the post-colonial vernaculars of the region. Franco Frescura (1985) documented the development of Southern African vernaculars and provides a hypothesis of what the Iron Age ruins found on the Wonderboom Hill could have resembled (Frescura 1985:72). Characteristic of these settlements, in spite of the fact that different material palettes may have been used, are rigid spatial constructs. The settlements consist of bi-lobial enclosures with a dwelling in the centre. The entrance is always located at opposite ends to the point of approach (figure 4.4).

In the conceptual design, the courtyard typology is reconstructed, focusing on these specific patterns of approach and threshold (figures 4.5 & 4.6). This approach was critiqued as being very formalistic and excluding of the Boer fort and existing topography of the landscape.

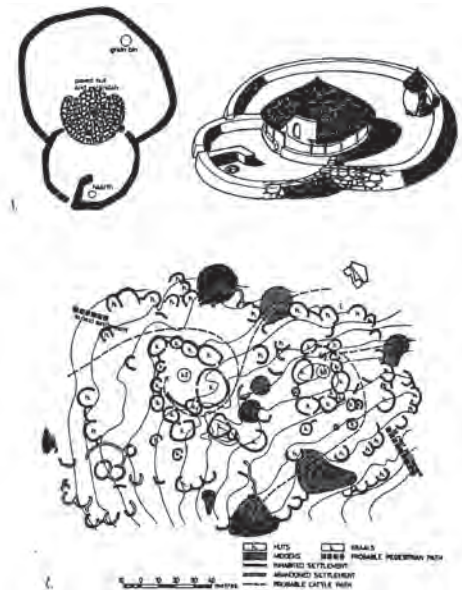


*FIGURE 4.4_Bilobial settlements of the Iron Age (Frescura 1985)*

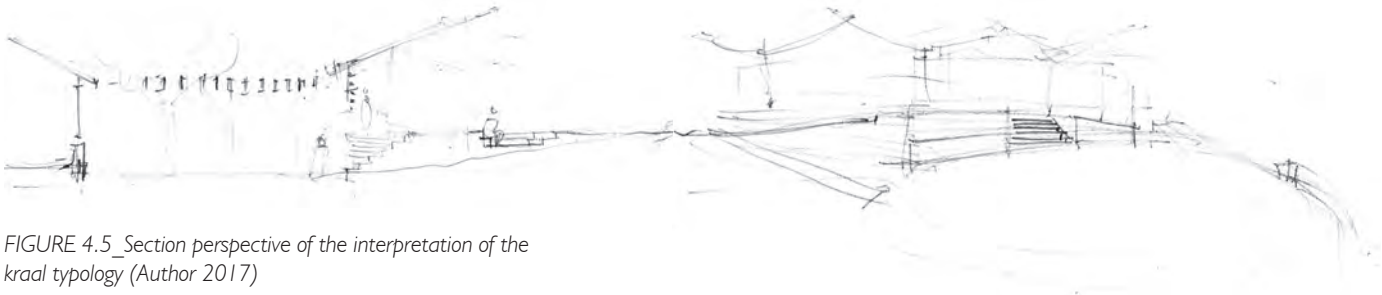


*FIGURE 4.5_Section perspective of the interpretation of the kraal typology (Author 2017)*

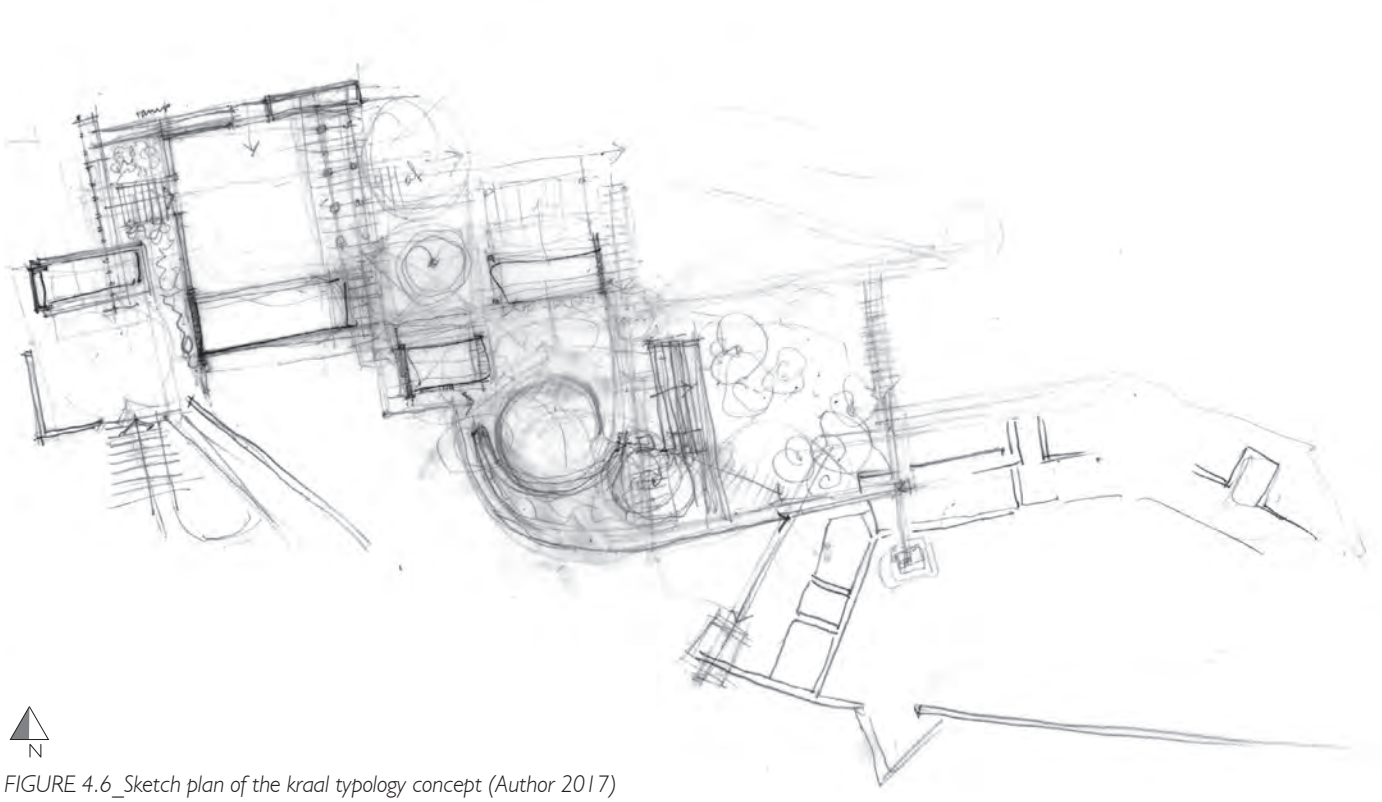
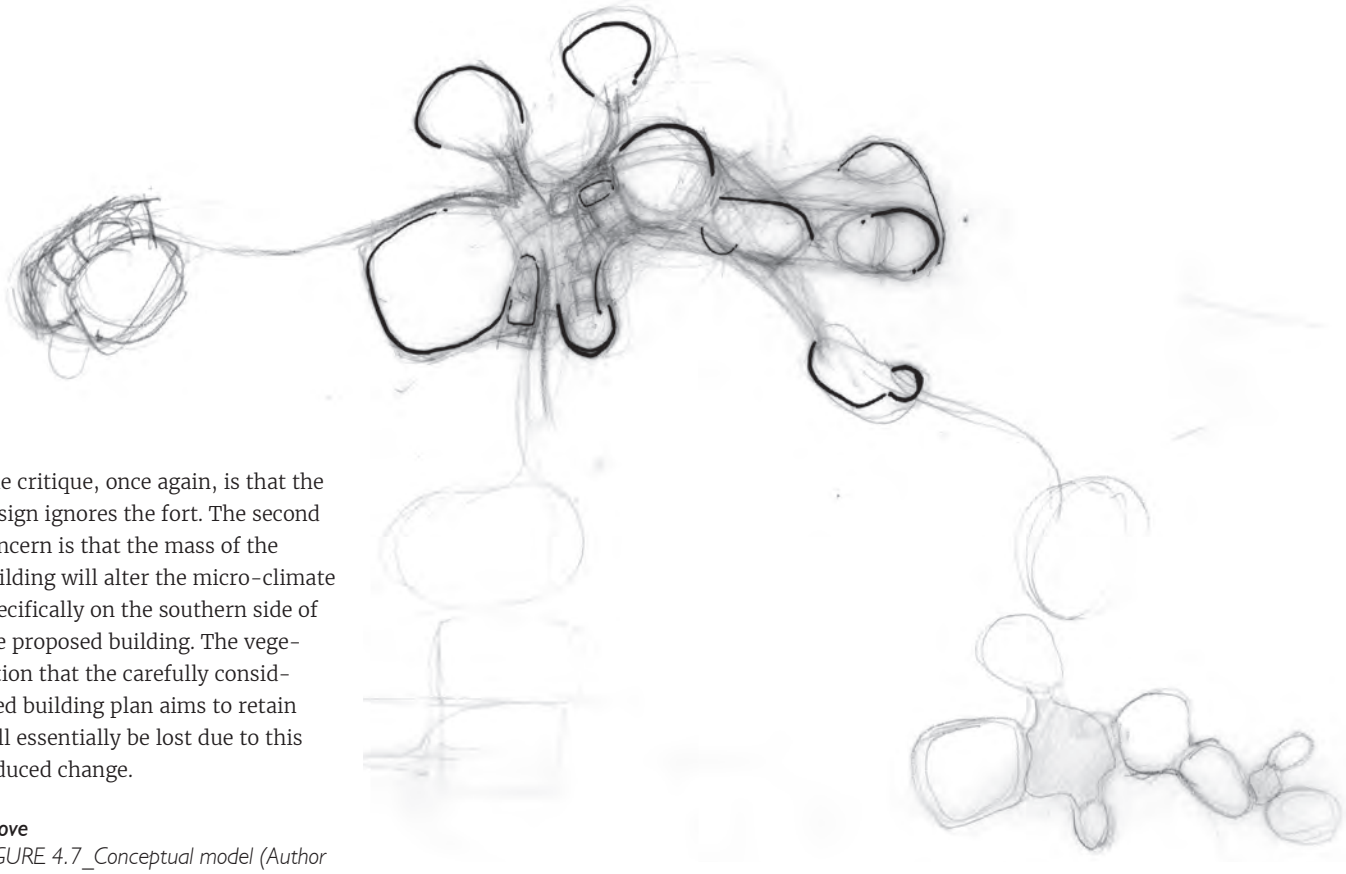



*FIGURE 4.6_Sketch plan of the kraal typology concept (Author 2017)*

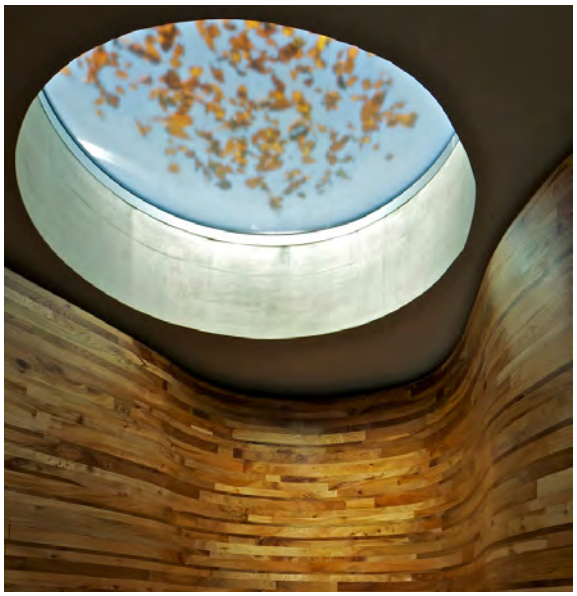
## 4.3 Mimicking the ridge

Having discarded translations of the iron age ruins as design informant, the author turned to the geography of the landscape as inspiration. The third investigation considers organic, parametric forms which mimic the shape of the mountain (figures 4.7 & 4.9). On plan, interior spaces are intersected with small courtyards bringing the environment into the interior (figure 4.8).



The critique, once again, is that the design ignores the fort. The second concern is that the mass of the building will alter the micro-climate specifically on the southern side of the proposed building. The vegetation that the carefully considered building plan aims to retain will essentially be lost due to this induced change.

***Above***
*FIGURE 4.7_Conceptual model (Author 2017)*
***Centre***
*FIGURE 4.8_Sketch plan (Author 2017)*
***Below***
*FIGURE 4.9_Sketch elevation of the building in relation to horizon (Author 2017)*



## 4.3.1 Precedent:

At this stage of the exploration, the programme was considered in more depth. Maggie's Centres, a series of walk in cancer support centres, are designed with the belief that well designed spaces can contribute to our well-being (Medina 2014). The foundation was founded by Maggie Keswick Jencks, late wife of Charles Jencks. According to Jencks, the buildings are "*defined by inarguably positive qualities: light, space, openness, intimacy, views, connectedness to nature* (figures 4.10 & 4.11) – *the opposite of a standard-issue hospital environment. They are domestic in scale, centred around the kitchen, a place where you can make yourself a cup of tea and have an informal conversation*" (Rose 2010).

### MAGGIE'S CENTRE GARTNAVEL
**OMA | REM KOOLHAAS**
2011 | GLASCOW, UNITED KINGDOM

The Maggie's Centre in Glascow (figure 4.12) is set in a grove of trees some distance from the Gartnavel Hospital. Interlocking L-shaped spaces are set around an internal courtyard. In contrast to an institutional building, the spaces are open and flow into one another. Private nooks are set in corners. Throughout the building there is a sense of intimacy and a connection to nature (OMA 2011).

*FIGURE 4.10_A connection with the exterior (Designboom 2011)*
*FIGURE 4.11_Views to the courtyard (Dezeen 2011)*

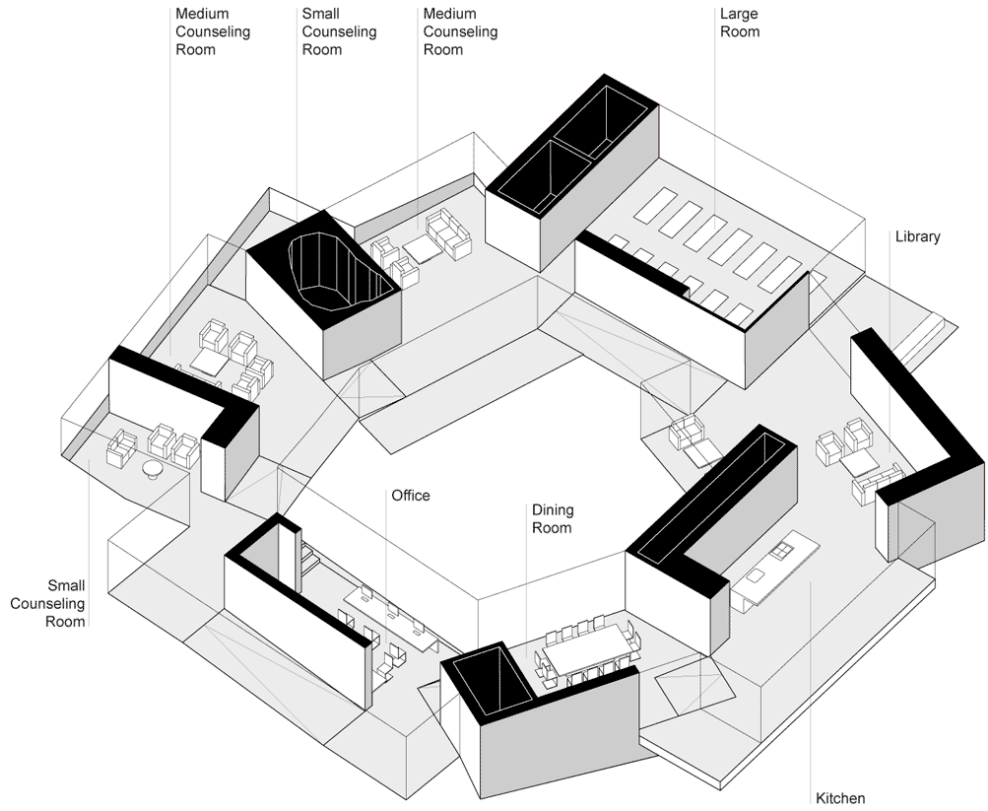
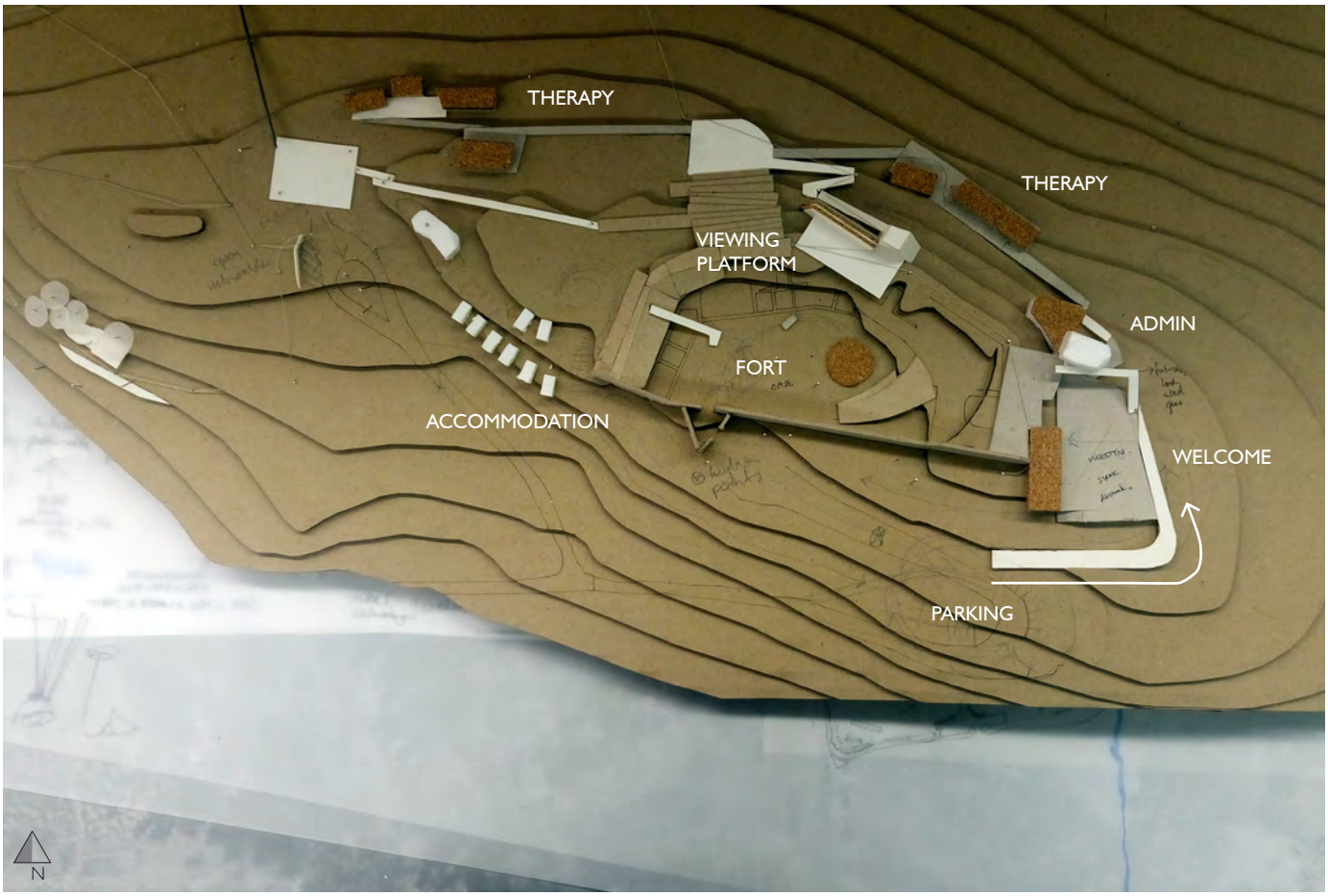



*FIGURE 4.12_Maggie's Centre Gartnavel 3D sketch (OMA 2011)*




## 4.4 Routes

The fourth approach unifies the intentions and ideas of the three previous concepts to a certain extent: The programme is considered as an experiential journey. Healing commences when an individual decides to open themselves to the process. The point of approach is thus to the east of the fort, where the vegetation is sparse and the visitor is exposed to the elements. The reception courtyard (figure 4.14) is approached as one would a traditional *kraal*. From there the fort can be accessed by day visitors and a subtle path leads patients of the well-being centre to the more private functions. Routes between structures are designed to reveal and at times hide aspects of the environment in order to focus the attention on details and the whole (figure 4.13). The Louisiana Museum of Modern Art (refer to section 4.4.1) was studied as an example of architecture which uses the route as main design element.

***Above***
*FIGURE 4.13_Model and explanation of the 'route' concept (Author 2017)*
***Below***
*FIGURE 4.14_Section and elevation of the reception (Author 2017)*


*Welcome Courtyard and Reception*

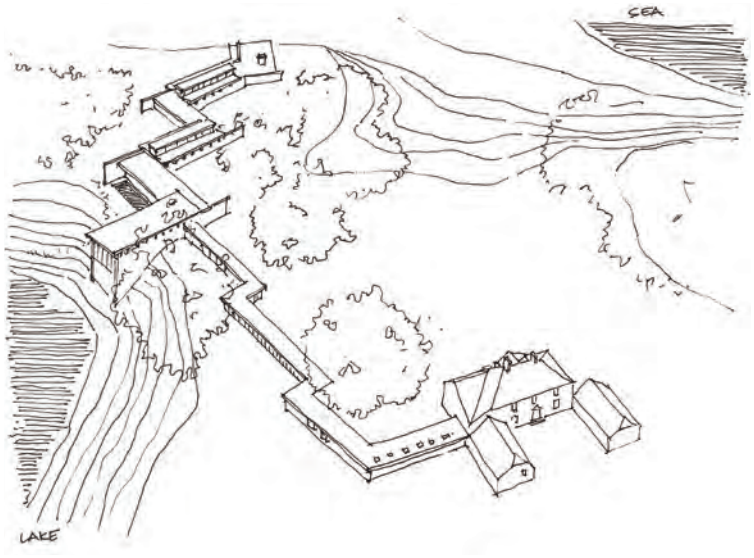



*FIGURE 4.15_Bird's eye view of the Louisiana Museum (Adapted from Radford, Morkoc and Srivasta 2014 by Author 2017)*

## 4.4.1 Precedent

### LOUISIANA MUSEUM OF MODERN ART
**JORGEN BO AND WILHELM WOHLERT**
1956 - 58 | HUMBLEBAEK, DENMARK

The original 1958 design, an addition to a 19th century manor house, was conceived as a path with a series of 'platforms', each offering the visitor a unique experience or view of the landscape (figure 4.16). The building skirts the edge of the site (figure 4.15). Works of art are on display both in the building and in the gardens. Special attention is given to how light enters the spaces and the various sections of the building direct the visitor's gaze at times to the artworks, at times to the landscape. A neutral material palette is applied throughout. The interior space is extended beyond the room perimeter by continuing the brick floors and ceilings on the exterior (Radford, Morkoc and Srivasta 2014: 54-61).



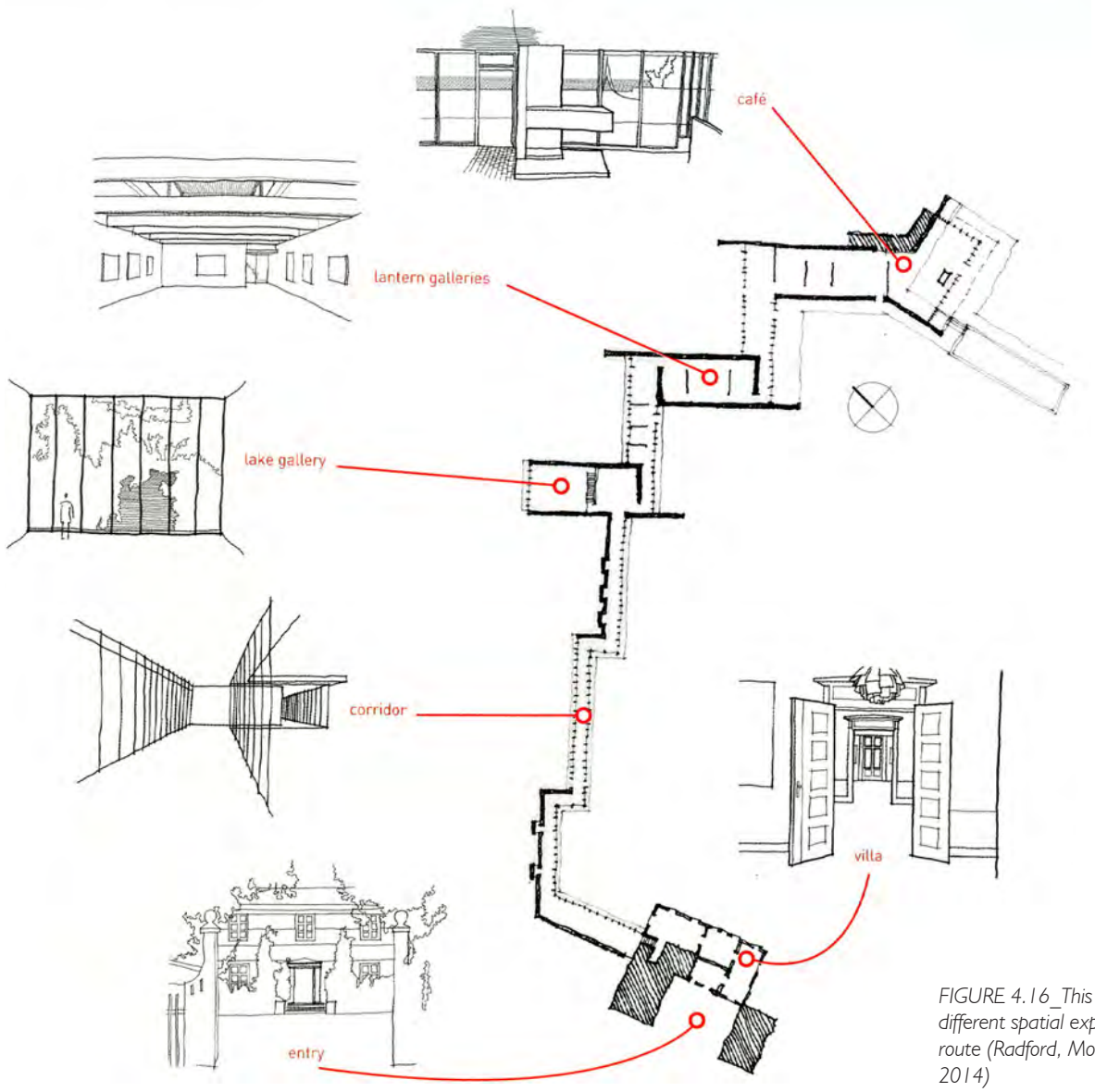
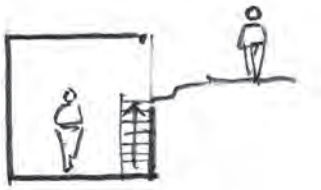



*FIGURE 4.16_This drawing depicts the different spatial experiences along the route (Radford, Morkoc and Srivasta 2014)*

IN
the earth

MIND
Solitary
Cognitive
Private



## 4.5 Relationships to the ground plane

In addition to the idea of a route which links podiums in the landscape, parameters were established to guide the design of interior spaces. These parameters illustrate different relationships to the exterior and to the ground plane. A position in the ground was associated with programmes which focus on cognitive activities and methods of healing. Being on the ground is synonymous with physical activities which support the wellbeing of the body. Lastly, being elevated above the ground plane is regarded as ephemeral and ritualistic. Each type of place has different spatial and structural qualities as explained in the adjacent diagrammes (figure 4.17).

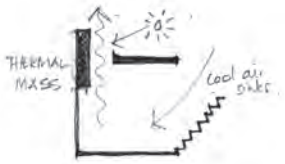
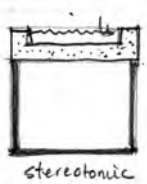
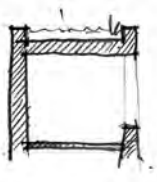
| Views to exterior | Ventilation |
|---|---|
|  |  |
| Natural Light | Artificial light |
|  |  |
| Audio | Services |
|  |  |
| Roof | Structure |
|  |  |

*FIGURE 4.17_Relationships to the Ground Plane (Author 2017)*

# ON

the earth

BODY

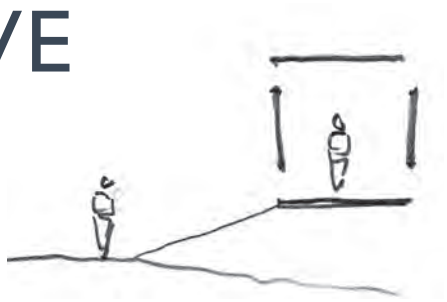
Direct connection to
the environment
Physical activity

# ABOVE

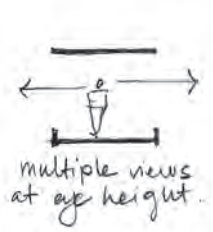
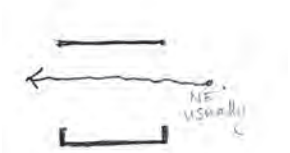
the earth

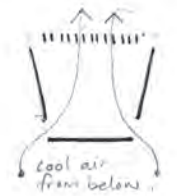
SOUL

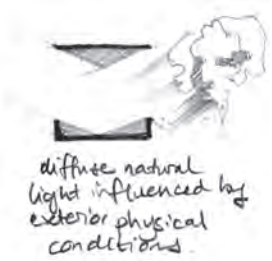
Group activity
Ritual
Connection to outer
realm

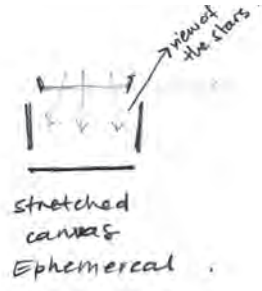


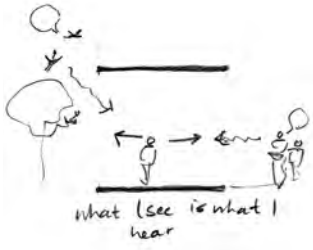


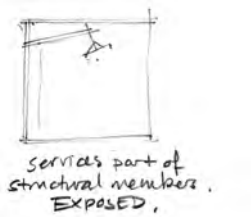
| Views to exterior | Ventilation |
|---|---|
|  |  |

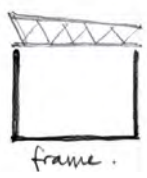
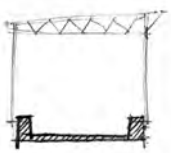
| Views to exterior | Ventilation |
|---|---|
|  |  |

| Natural Light | Artificial light |
|---|---|
|  |  |

| Natural Light | Artificial light |
|---|---|
|  |  |

| Audio | Services |
|---|---|
|  |  |

| Audio | Services |
|---|---|
|  |  |

| Roof | Structure |
|---|---|
|  |  |

| Roof | Structure |
|---|---|
|  |  |

# 5. DESIGN DEVELOPMENT



This chapter explains the conceptual thought processes and development of the design up to the technical phase. Throughout the year, the formulation of the design intentions have developed. A deeper understanding of their implications have resulted in major changes to the design. The idea of the centre as a series of acupuncture points along routes in the landscape, was the principal idea that was developed for the June crit. It was met with much criticism. In the weeks following, the design was completely altered and consolidated to be less intrusive. This design has been iterated over the course of the second semester.

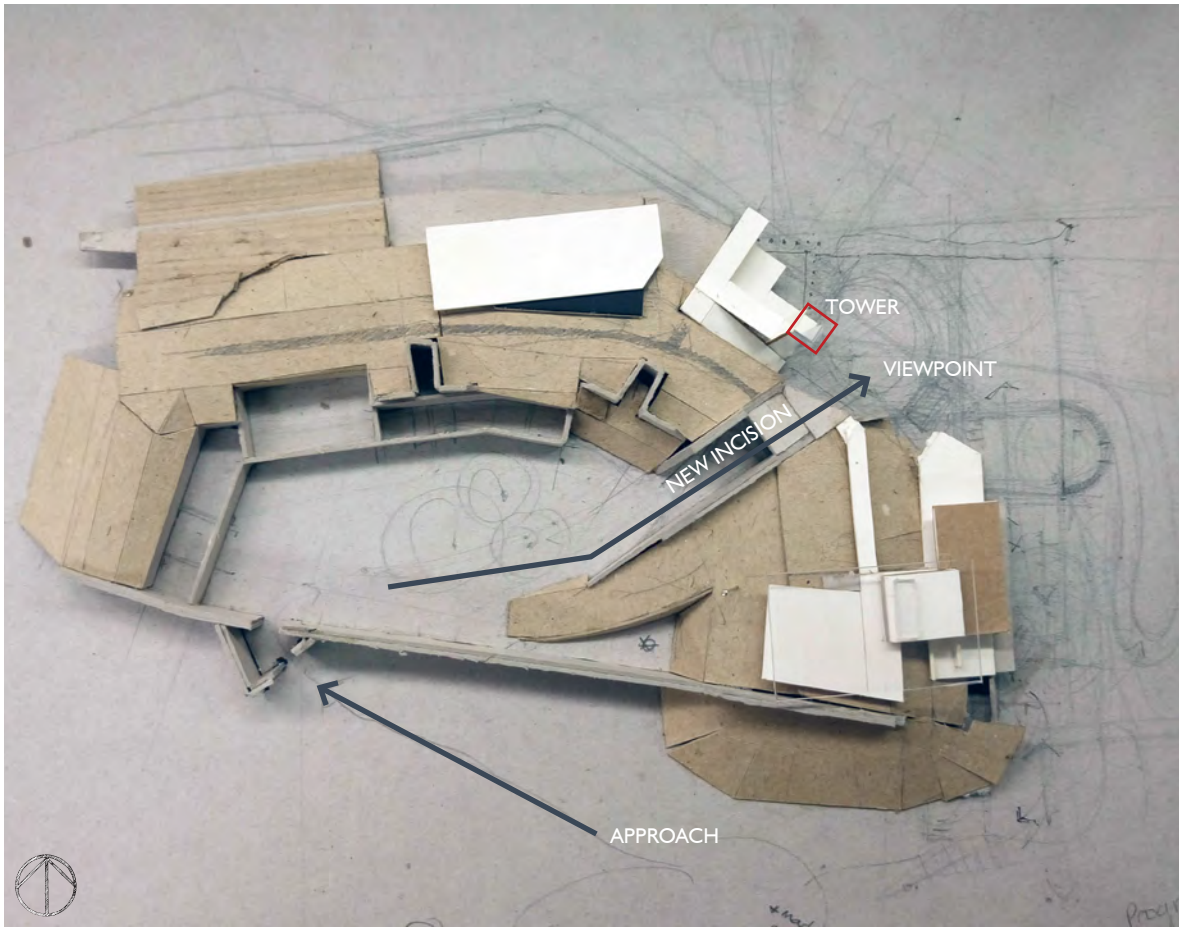



*FIGURE 5.1_Conceptual model: structures holding the fort (Author 2017)*

## 5.1 Holding the fort

By mid-year, a clear understanding of the way architecture could use routes and views to place users within the landscape, had been formed. In addition, a link to the existing heritage structure was required as acknowledgement of these human additions to our understanding of the landscape.

The conceptual model (figure 5.1 & 5.2) explored the possibility of slicing through the fort's berm; creating a new link between the existing structure and its landscape. New structures which 'hold' the fort in a protective manner, while fronting the landscape, are envisioned. A circulation tower orders the whole and serves as point of reference.

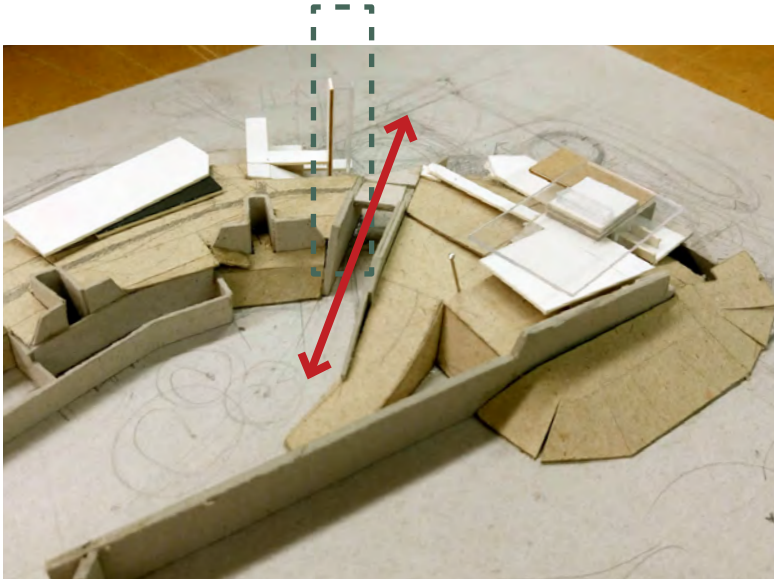


*FIGURE 5.2_Conceptual model indicating the glazed tower as reference point (Author 2017)*

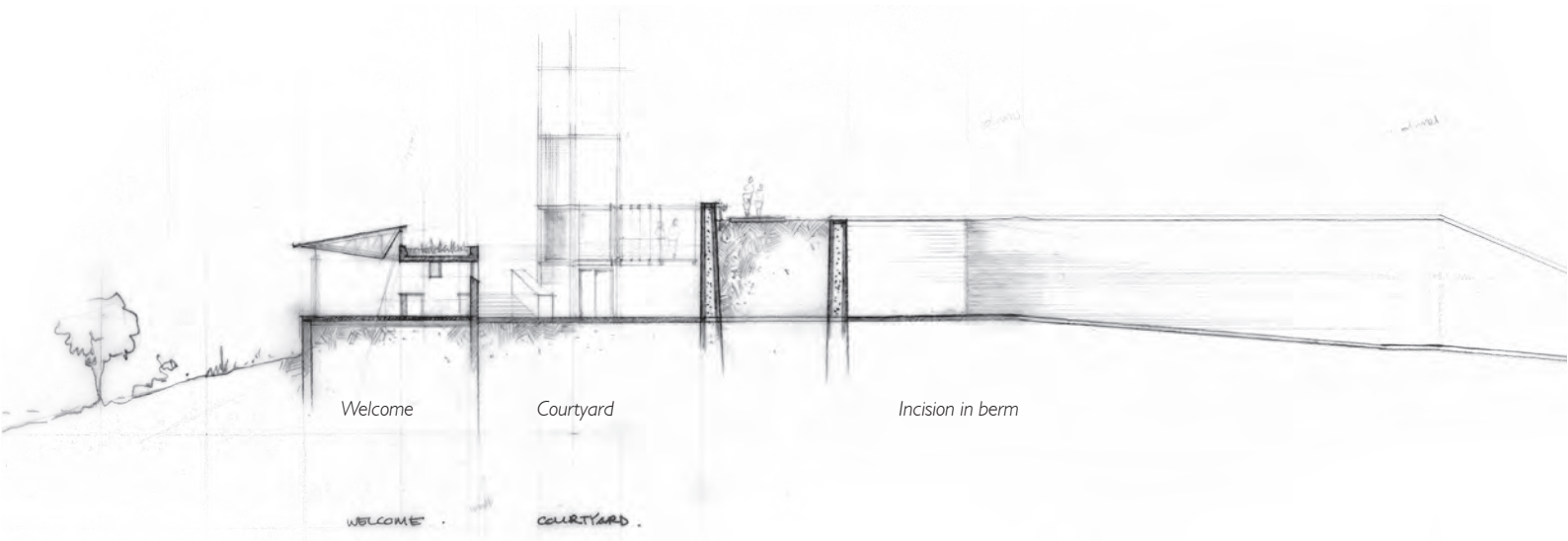
## 5.2 Paths and platforms
### Design - June Crit

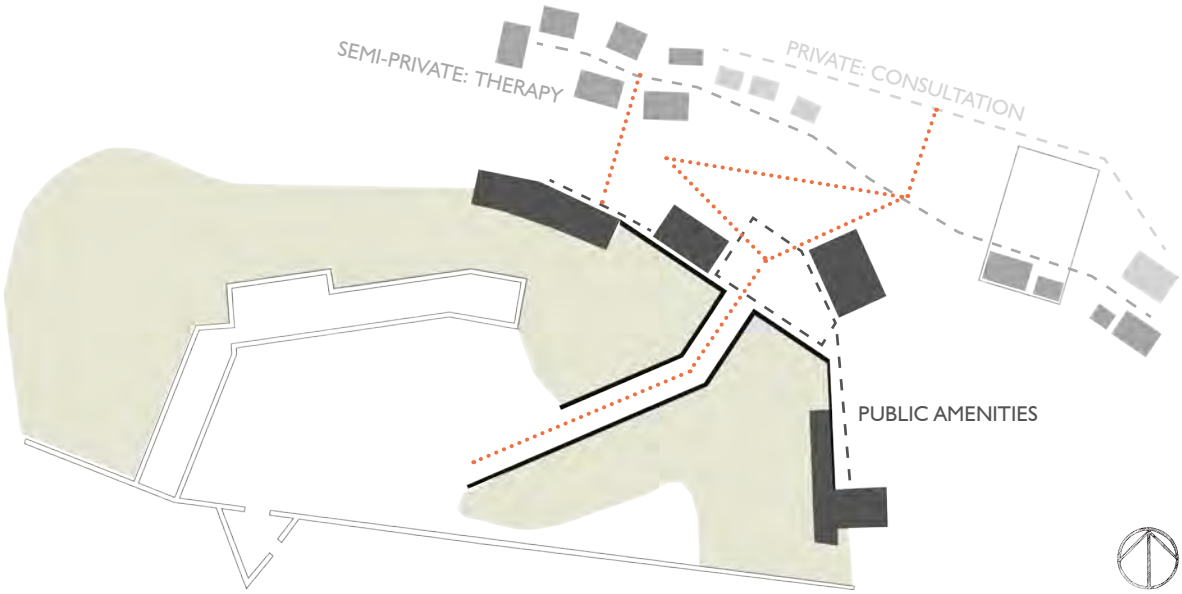
The conceptual model discussed in section 5.1 was further developed in plan and section (figure 5.3) for the June crit. The conceptual model only accommodated the public interface of the programme. Additional spaces were needed for the private functions, specifically accommodating counselling and therapies. A second and third path, parallel to the row of buildings embracing the fort, was created (figure 5.4 and 5.6) along which pavilions accommodating different therapies were placed (figure 5.5).

This design was critiqued as being too intrusive, overwhelming the existing fort and not reflective of the nature of the programme. The proposal included a new parking lot to the south of the fort and the entrance through the fort's old gateway. The examiners proposed that the fort be considered as reception area for the well-being centre and all the other programmes be consolidated.

After some consideration, it was concluded that a previous iteration (section 4.4) in which the approach was around the outskirts of the fort was more appropriate as the scale of the courtyard of the fort is too intimidating to serve as arrival point.

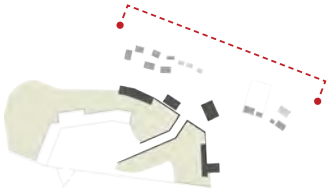
*FIGURE 5.3_The section through the courtyard and welcome area portrays the circulation tower (Author 2017)*

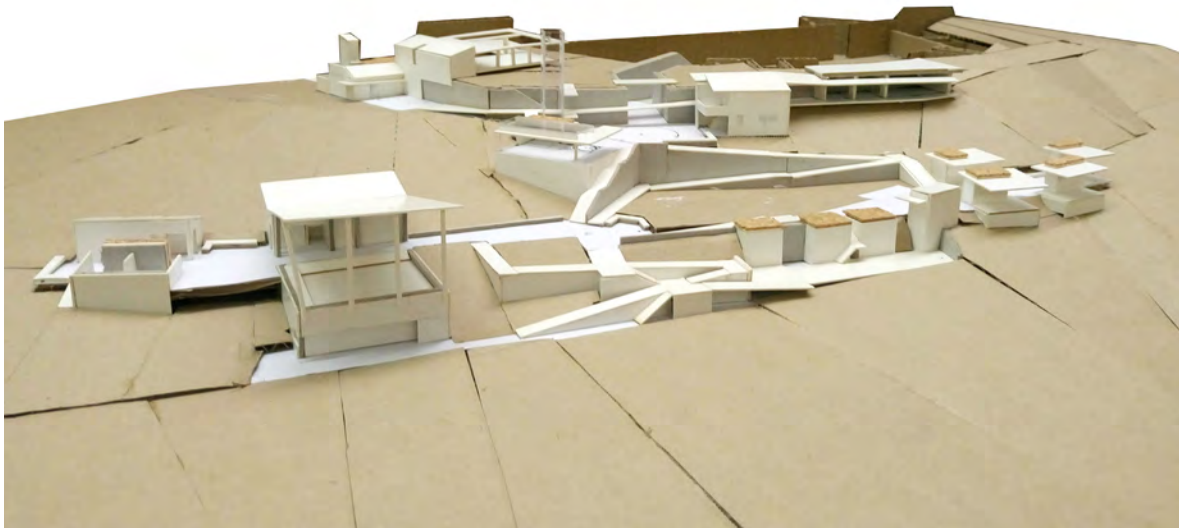





***Above***
*FIGURE 5.4_Diagramme of the three-tiered plan (figure 5.6) presented during the June crit. Programmes are organised on three levels with the dark grey being on the same level as the fort and the lightest grey lowest down the ridge (Author 2017)*

***Below***
*FIGURE 5.5_Conceptual model of the scheme with the consultation and therapy units in the foreground (Author 2017)*





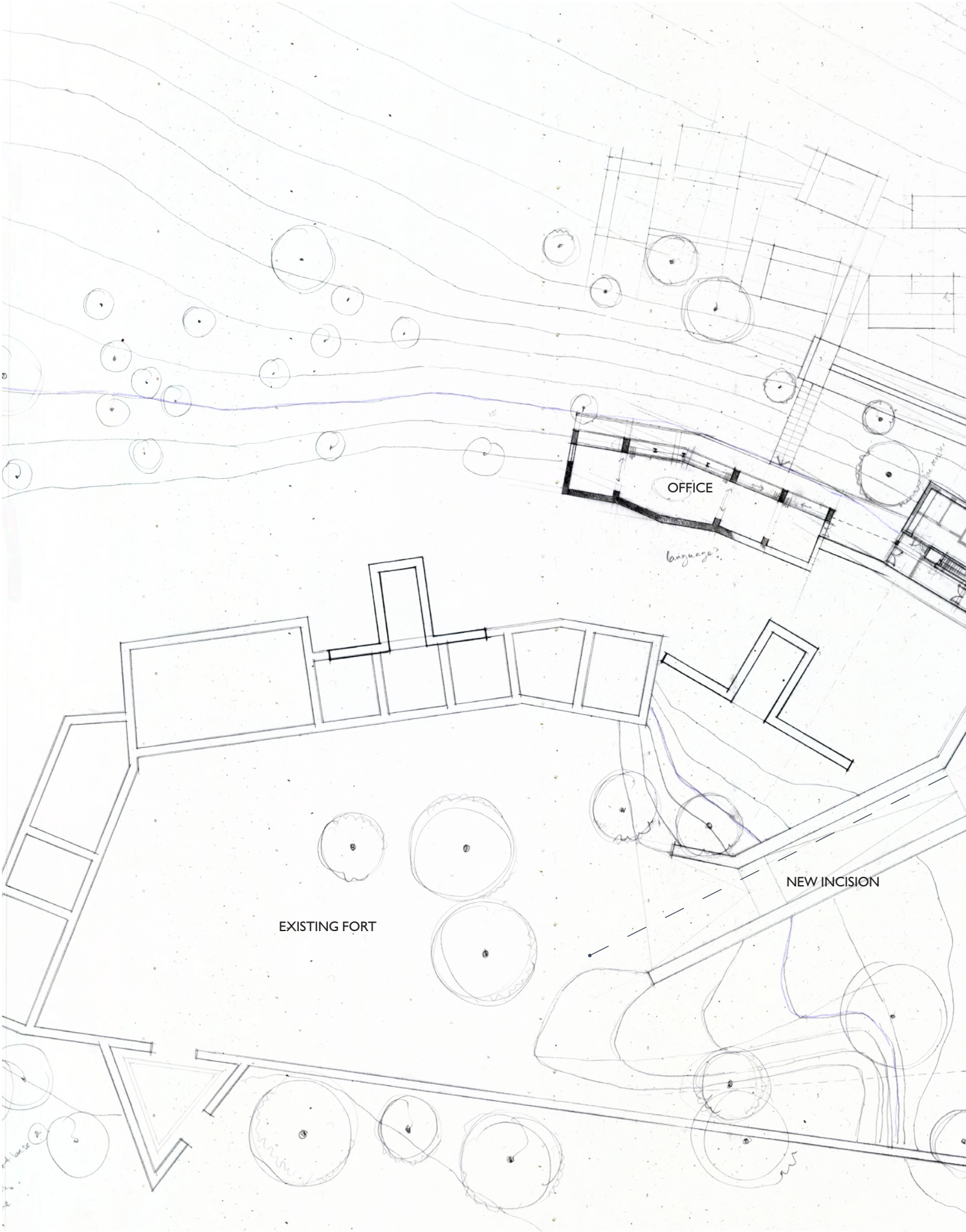
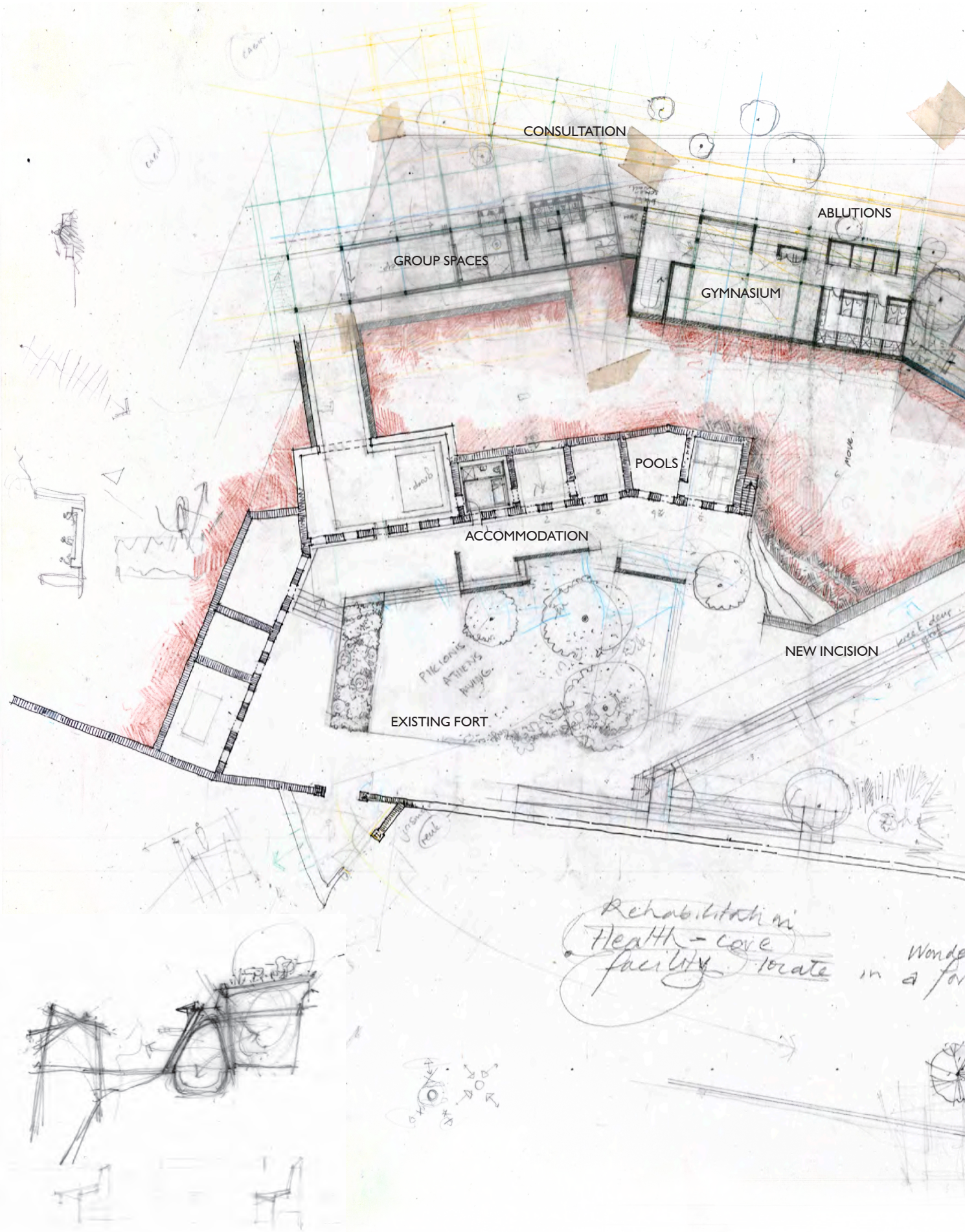



*FIGURE 5.6_Combined plan of scheme (Author 2017)*




## 5.3 Consolidating and protecting

As mentioned in the introduction to this chapter, a different approach was attempted following the June crit. The programmes were consolidated into a linear structure that wraps around the north facing berm of the fort. Better integration of the fort was sought through landscape interventions that appropriate the spaces of the fort as gathering places. For the first time a comprehensive concept was formulated in conjunction with the design development.

### 5.3.1 Iteration 1

The point of entry was reverted to the north-east of the fort. Visitors would park to the south of the fort and walk over the ridge alongside the berm towards the first structure where the administration building would receive them.

Descending into a courtyard centred around an existing tree, they had the option either to walk into the fort through the new incision or take refreshments at the cafeteria which frames the courtyard. The large structure at the opposite end of the courtyard was placed within the berm and acts as buttress to control erosion. It housed the gymnasium and ablutions which would also serve the public. The last structure breaks away from the berm and into the vegetation and housed individual therapy spaces. Through sensitive landscape and surface interventions, the fort would be appropriated to host informal group activities and counselling in the open air. These changes would also encourage general visitors to linger (figure 5.7).

The design was successful in consolidating the programmes and in creating a more intimate, protected entrance to the proposed scheme. It also responded intentionally to the fort which has a strong presence on site. The organisation of the programmes and definition of the public and the private realms were less successful however. It was yet unclear how the concept could guide the structure and organisation of space within the interior.

*FIGURE 5.7_Ground floor plan - Iteration 1 (Author 2017)*

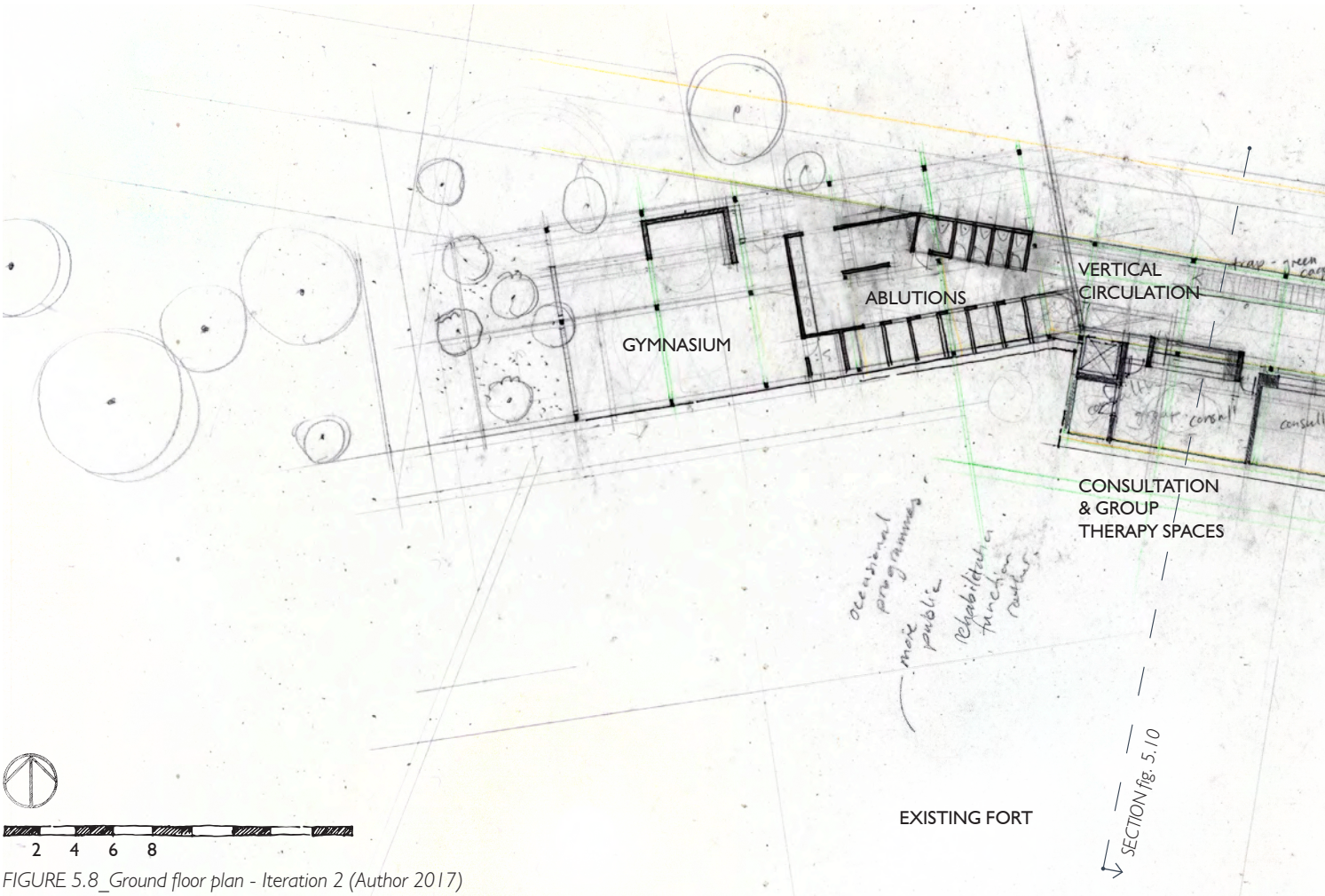



*FIGURE 5.8_Ground floor plan - Iteration 2 (Author 2017)*

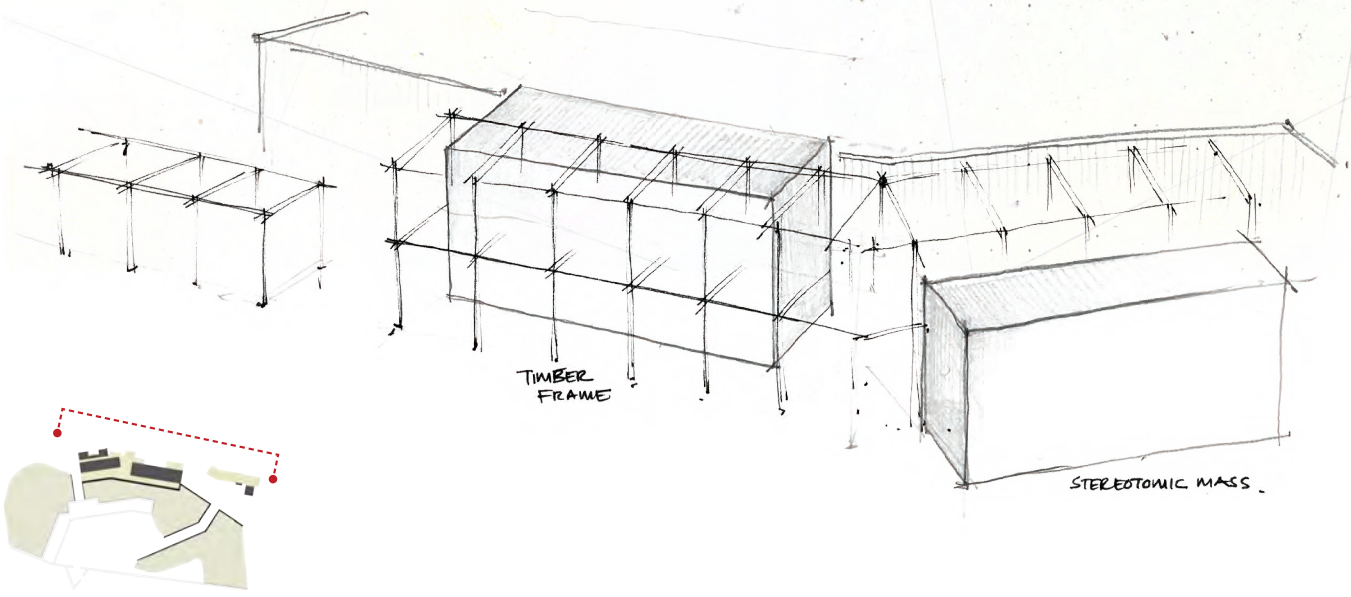
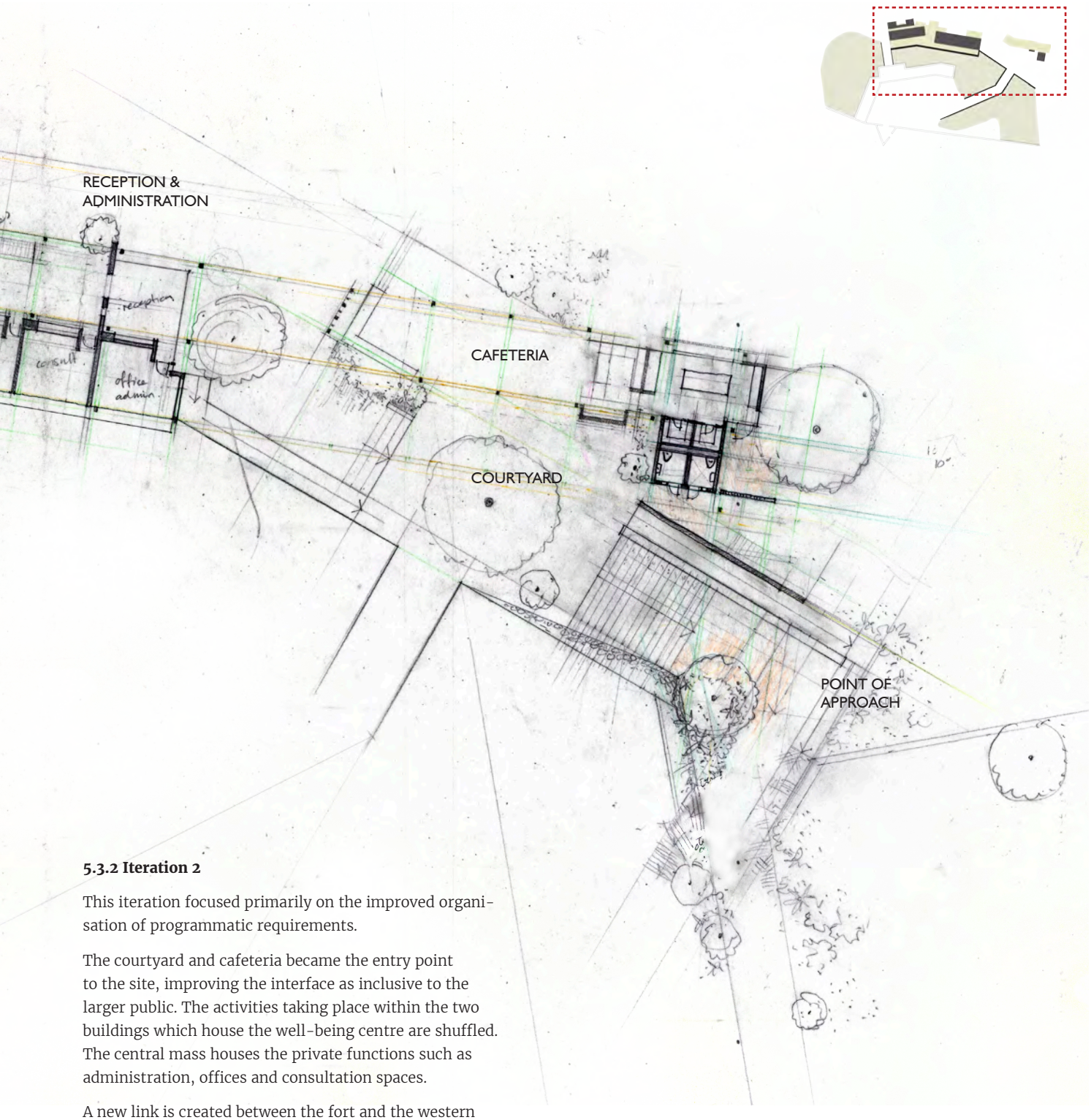



*FIGURE 5.9_Diagramme of the building as a structure which consists of interwoven tectonic and stereotomic elements (Author 2017)*




### 5.3.2 Iteration 2

This iteration focused primarily on the improved organisation of programmatic requirements.

The courtyard and cafeteria became the entry point to the site, improving the interface as inclusive to the larger public. The activities taking place within the two buildings which house the well-being centre are shuffled. The central mass houses the private functions such as administration, offices and consultation spaces.

A new link is created between the fort and the western mass. This structure houses the gymnasium, therapy and group spaces and ablutions. In order to better integrate the well-being centre with the public nature of the reserve, the design investigates how these facilities can serve a larger community instead of being for the exclusive use of the centre (figure 5.8). Formalistically, the whole is envisioned as two spines, one a mass structure, the other a tectonic structure, which intersects to create spaces which relate to the fort and natural vegetation in different ways (figure 5.9). The plan had yet to be explored volumetrically.

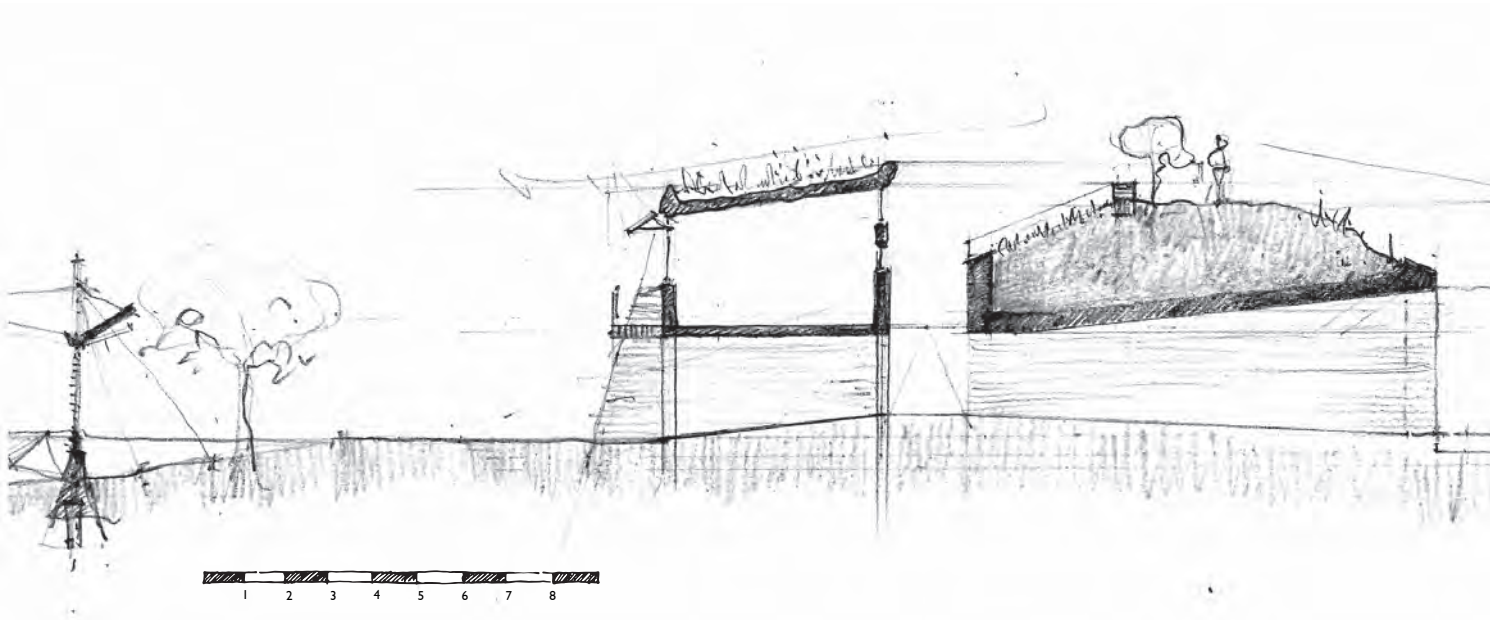



*FIGURE 5.10_Section through building, berm and fort courtyard (Author 2017)*

### 5.3.3 Iteration 3

The final design iteration focuses specifically on the volumetric form (figure 5.10) and the relation between the three structures. The model served as primary design tool (figure 5.11 & 5.12). Different textures were used to begin to explore materiality. The plan (figure 5.12) is refined to improve the circulation and heighten the sense of privacy which is required around the consultation rooms and offices. Vertical circulation (figure 5.14) is also reconsidered: a core next to the reception connects the building's two levels and the top of the berm. The form, technology and material choice (figure 5.13) are carefully considered to better reflect the conceptual intentions which had eventually been formulated properly.

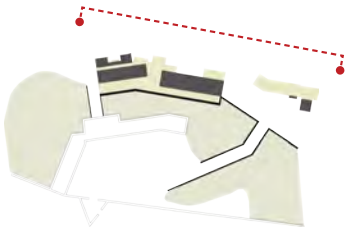


*FIGURE 5.11_Model of scheme (Author 2017)*

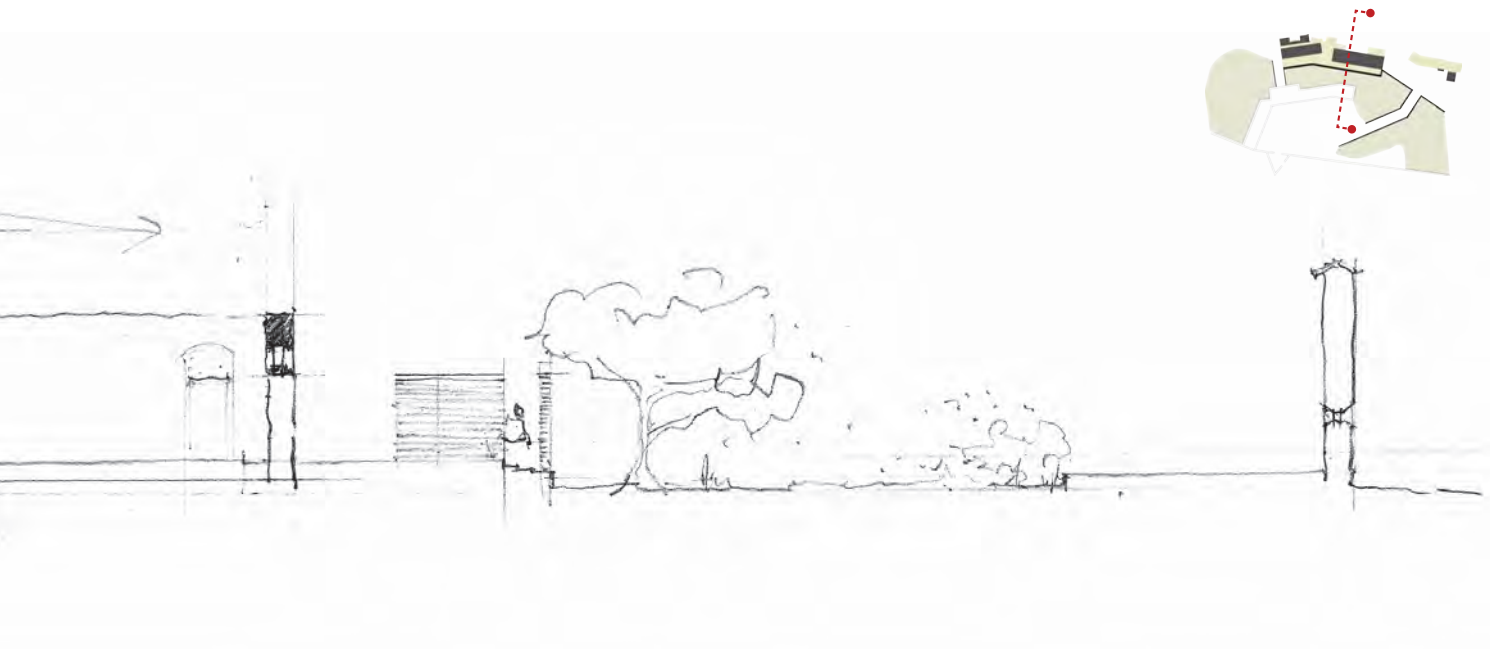
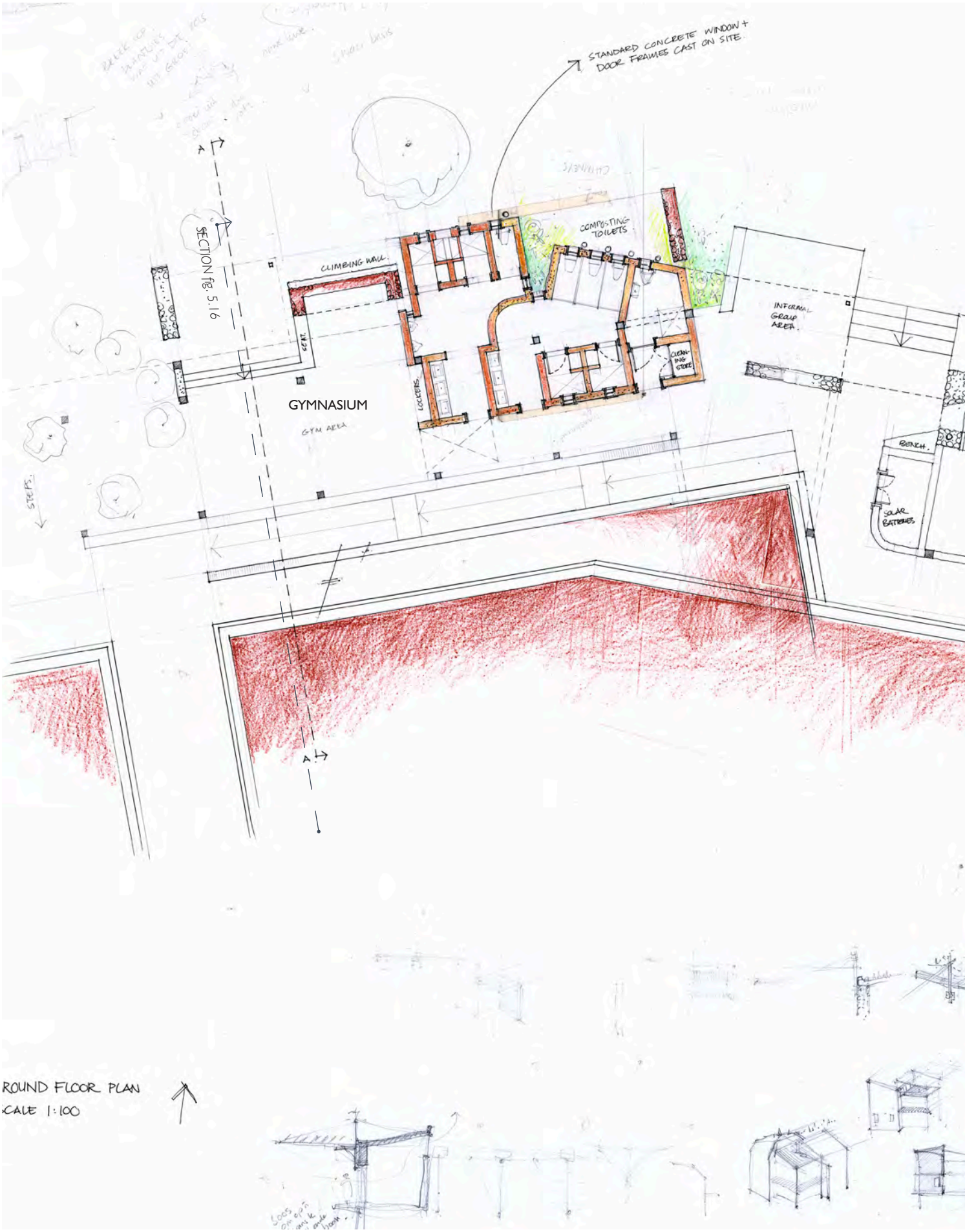
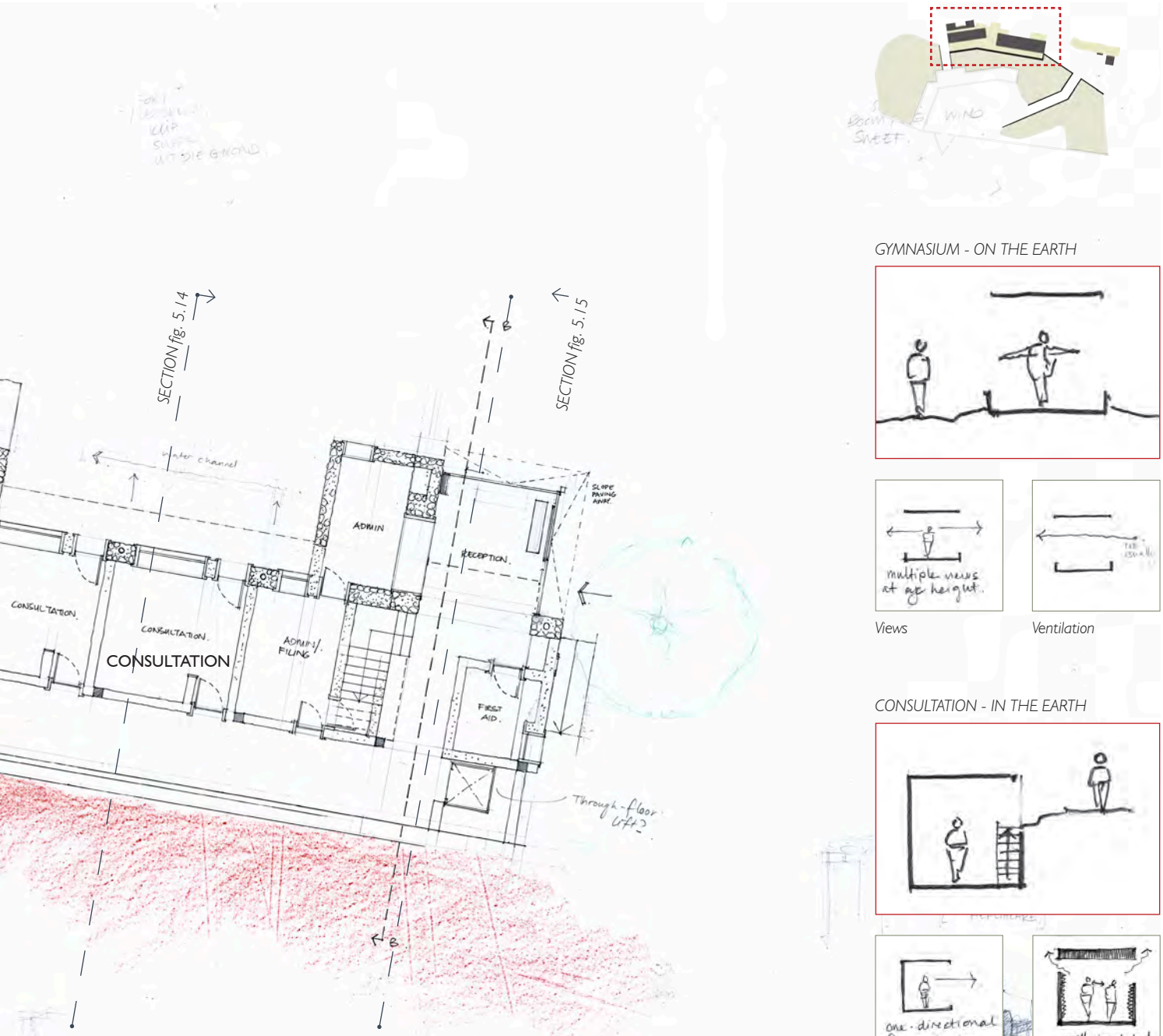




*FIGURE 5.12_Improved model of scheme (Author 2017)*




ROUND FLOOR PLAN
SCALE 1:100







GYMNASIUM - ON THE EARTH






Views



Ventilation

CONSULTATION - IN THE EARTH

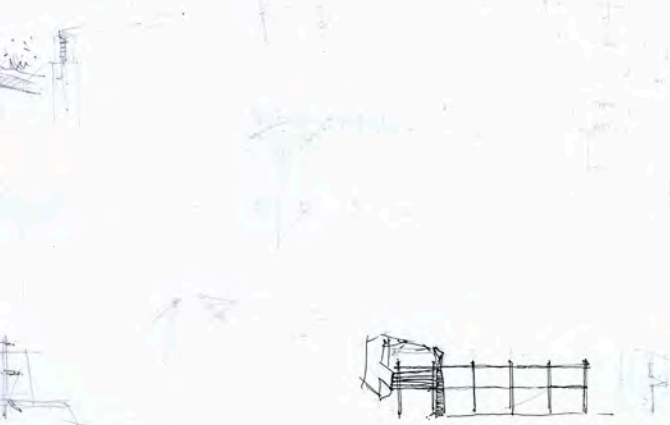





One-directional views




Acoustically insulated



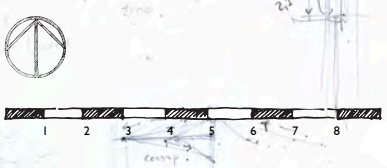
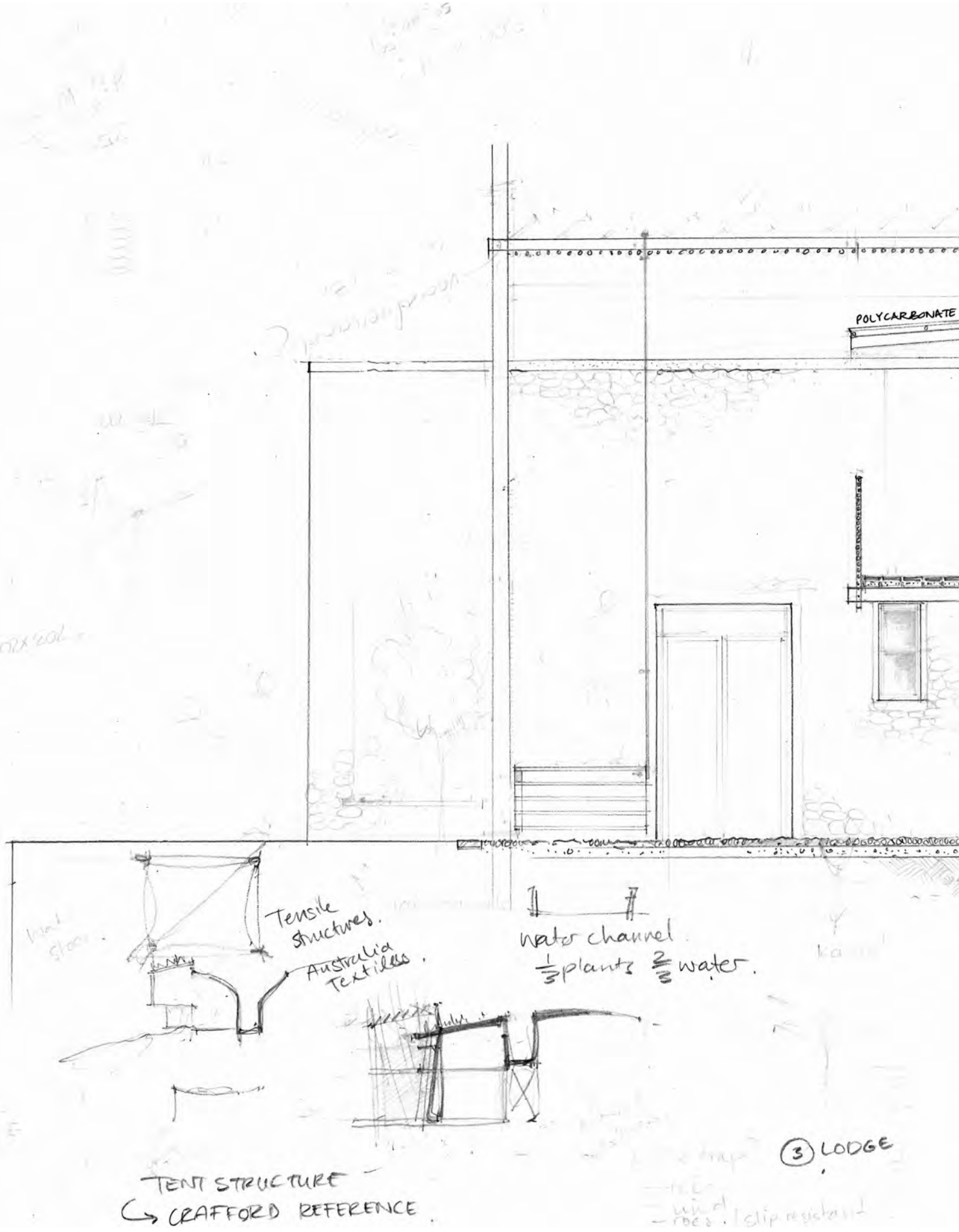



*FIGURE 5.12 Iterated ground floor plan indicating materiality. The diagrammes on the right relate the spatial parameters established (figure 4.17) to some of the programmes (Author 2017)*



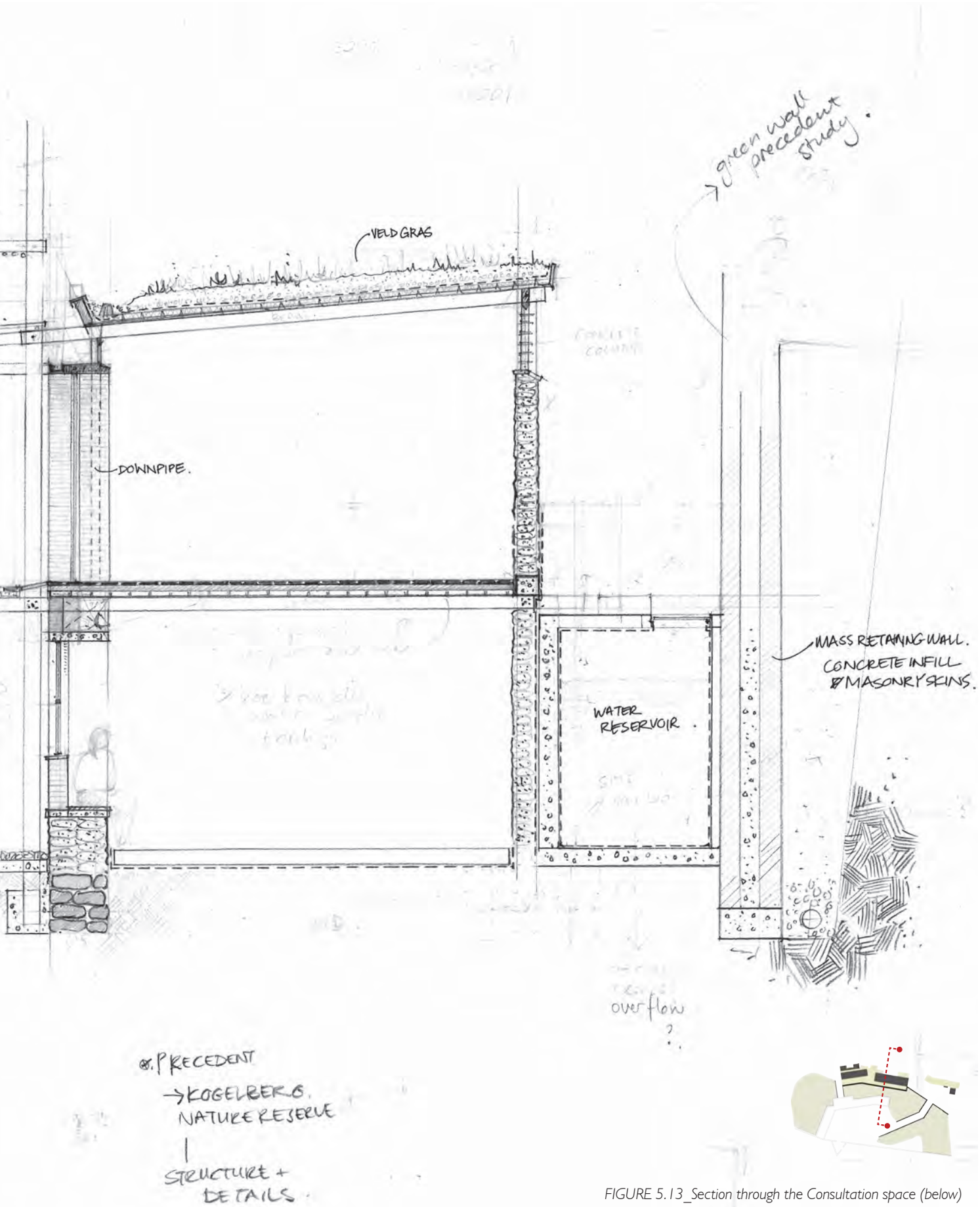



*FIGURE 5.13_Section through the Consultation space (below) and Offices (above), SCALE 1:50 (Author 2017)*

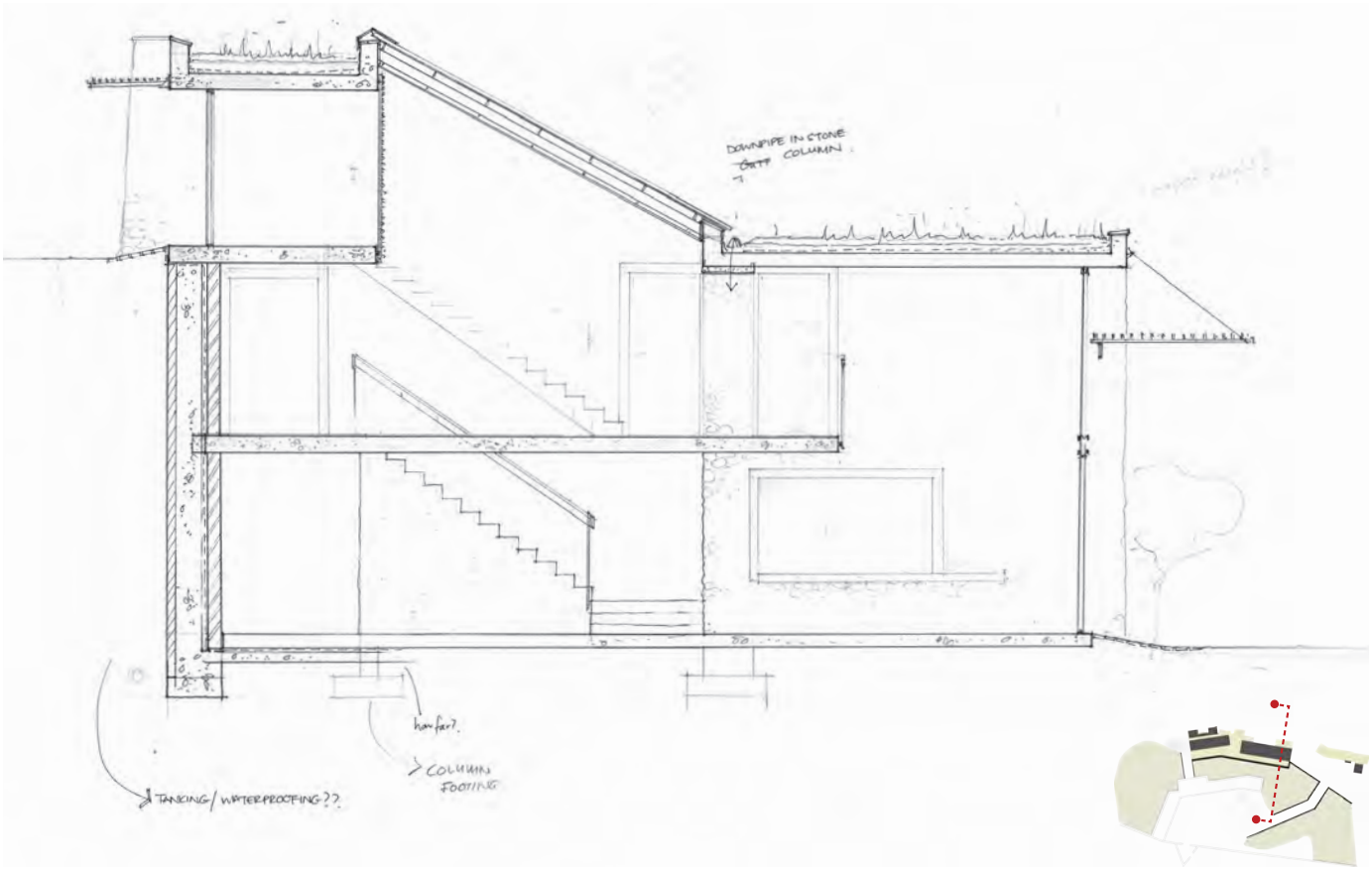



*FIGURE 5.14_Section through the Waiting area and Circulation core, SCALE 1:100 (Author 2017)*

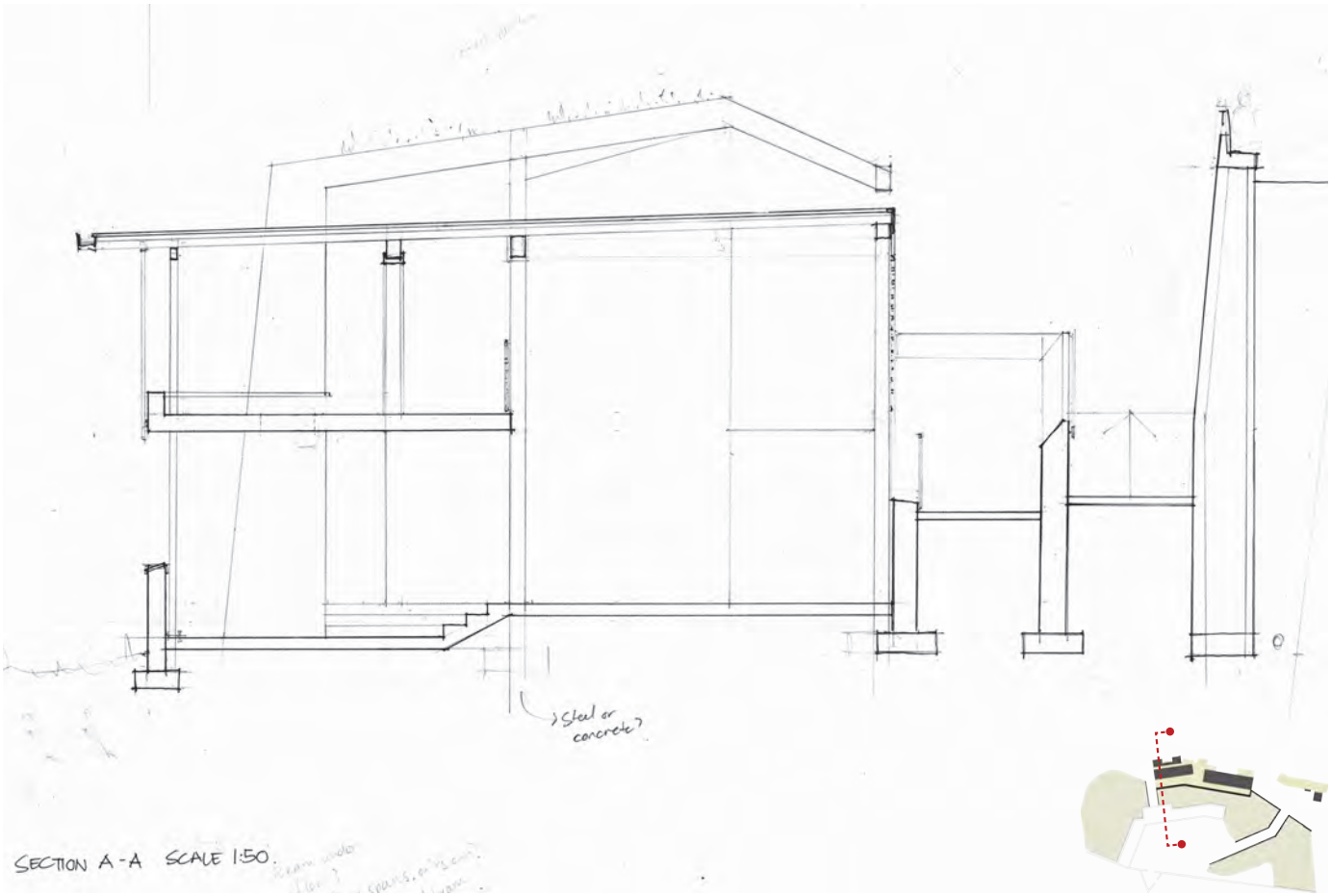
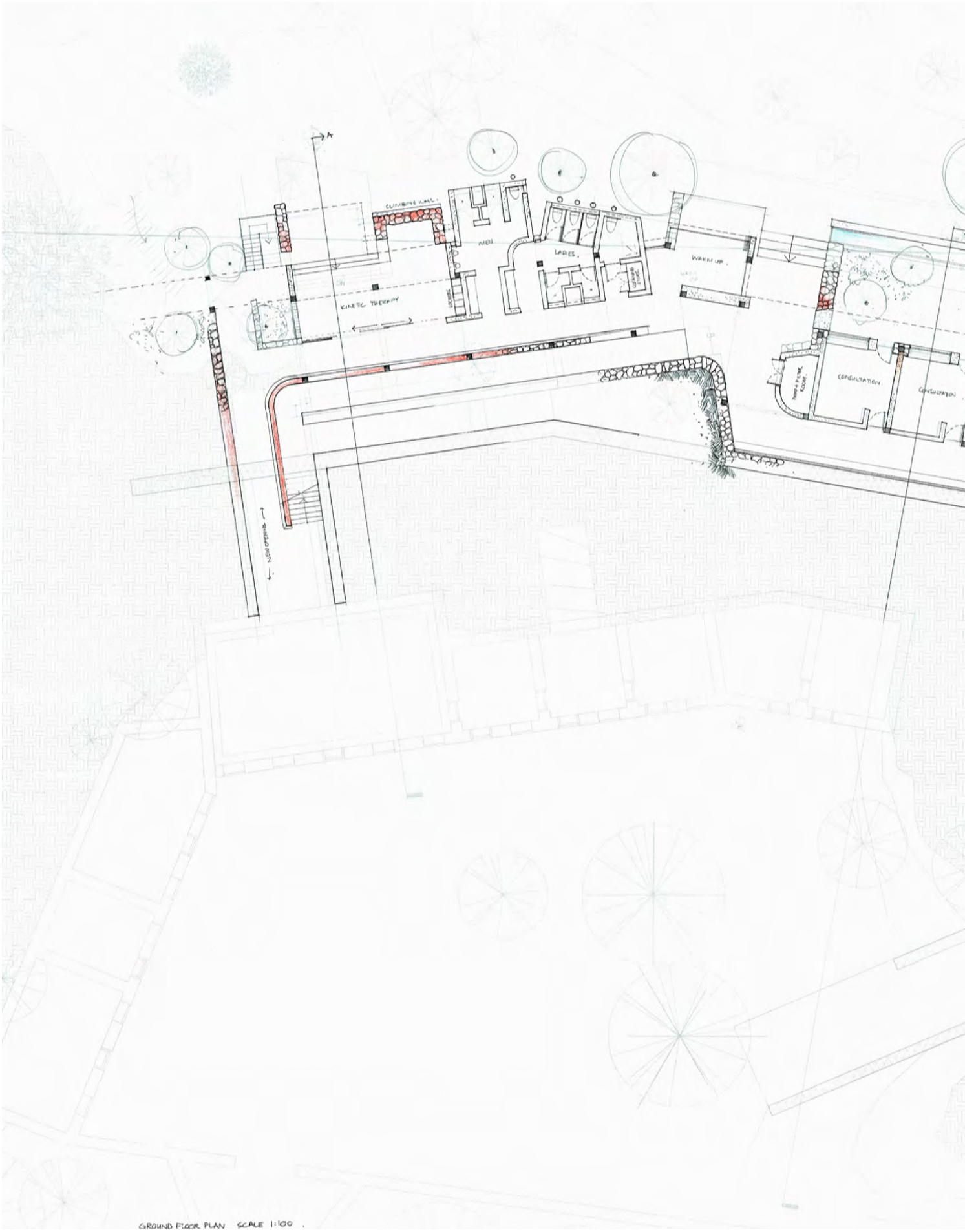



*FIGURE 5.15_Section through the Gymnasium (below) and Therapy Room (above), SCALE 1:100 (Author 2017)*

# 6. DESIGN DECISIONS

## FINAL CONCEPTUAL DESIGN

The purpose of intervening on the site is to foster a relationship between urban citizens and the natural environment of Pretoria in order to engender care. To care for the environment we need to interact with it in a way that is enjoyable yet also illustrates how it is useful. We may summarise the argument and say that in order to PROTECT the environment we need to create moments that allow us to ENGAGE. As humans, our primary means of engaging with the environment is by TRANSFORMING it to meet our needs and in that way make it accessible. The architectural intervention is informed by these three key words.
This chapter documents the final conceptual design drawings (figures 6.1, 6.2 and 6.9 - 6.11) and model (figure 6.12).




GROUND FLOOR PLAN SCALE 1:100

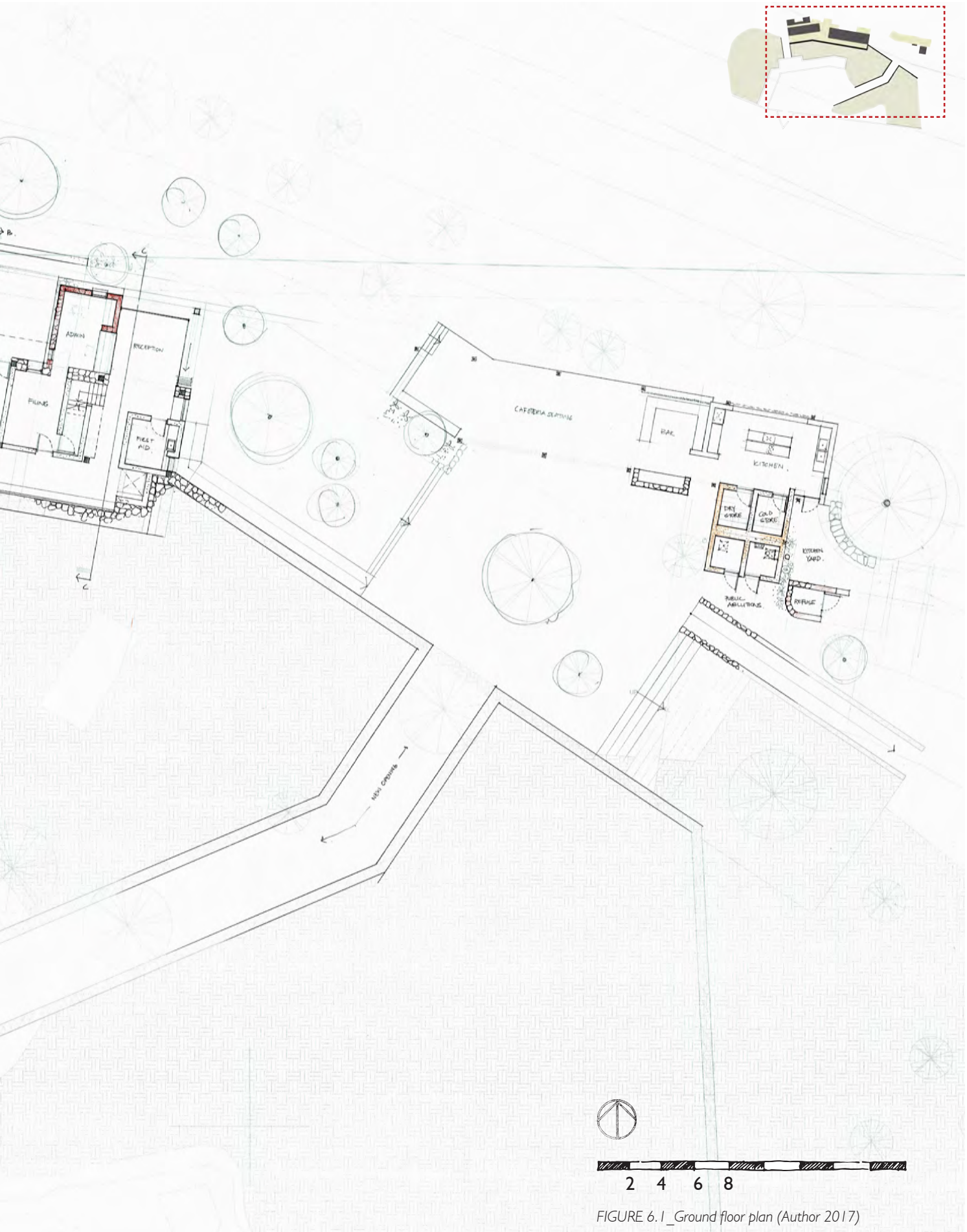
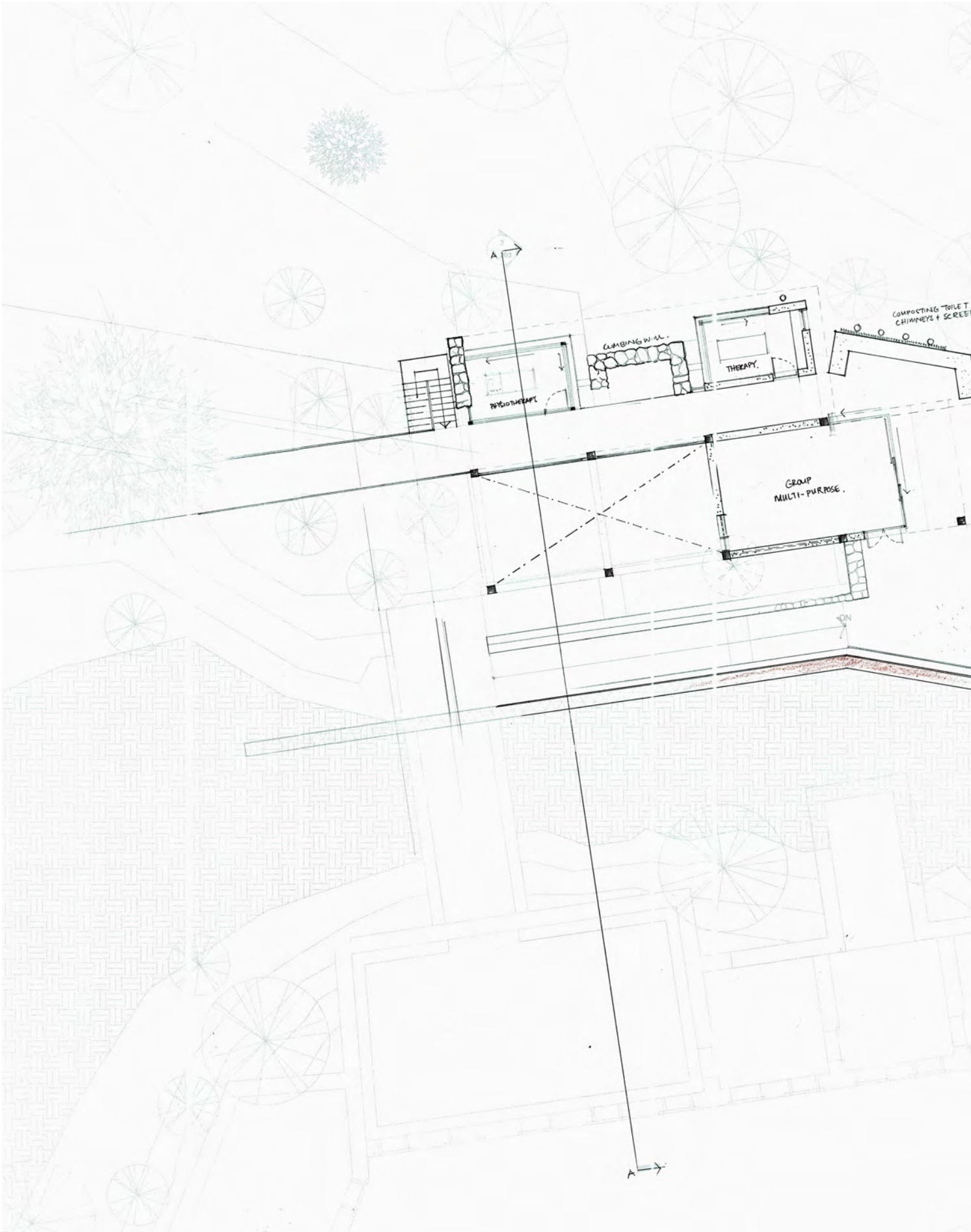



*FIGURE 6.1_Ground floor plan (Author 2017)*



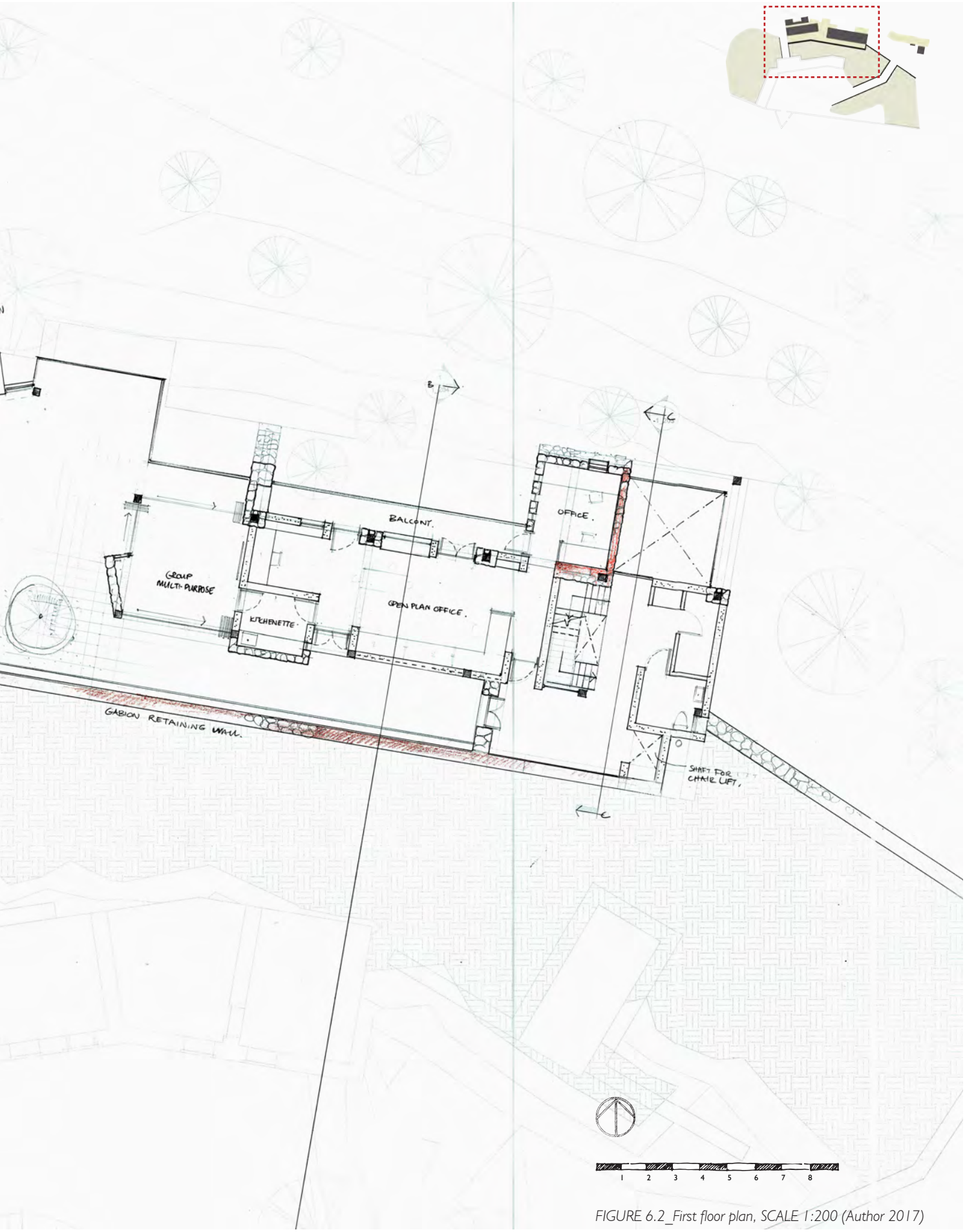



*FIGURE 6.2_First floor plan, SCALE 1:200 (Author 2017)*

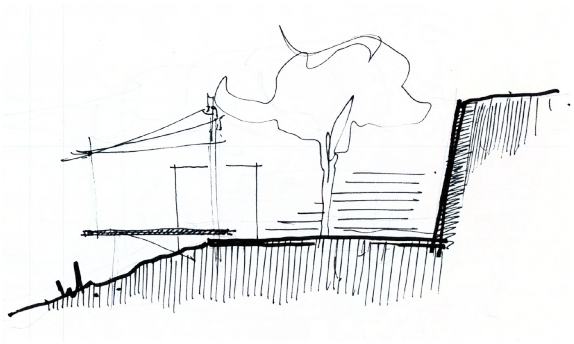


*FIGURE 6.3_Engage with the natural landscape (Author 2017)*

## 6.1 Engage

The first structure (figure 6.3), the cafeteria, is placed within existing vegetation. Its position brings people in contact with the environment and, on a programmatic level, introduces a social space which encourages people to engage with one another and experience the environment as a collective.

In form, the courtyard references a circle of stones under a tree - an old iron age meeting place. The cafeteria is a lightweight structure (figure 6.4) which frames the courtyard. It's permeability does not cut the courtyard off from the views and landscape. The floor surface appears to float from the sloped hillside.

**Engage with the natural landscape**
- Situated amongst existing vegetation
- Frames the arrival courtyard

**Support existing social activities, rituals and gatherings on site**
- Point of arrival
- Cafe
- Public Ablutions

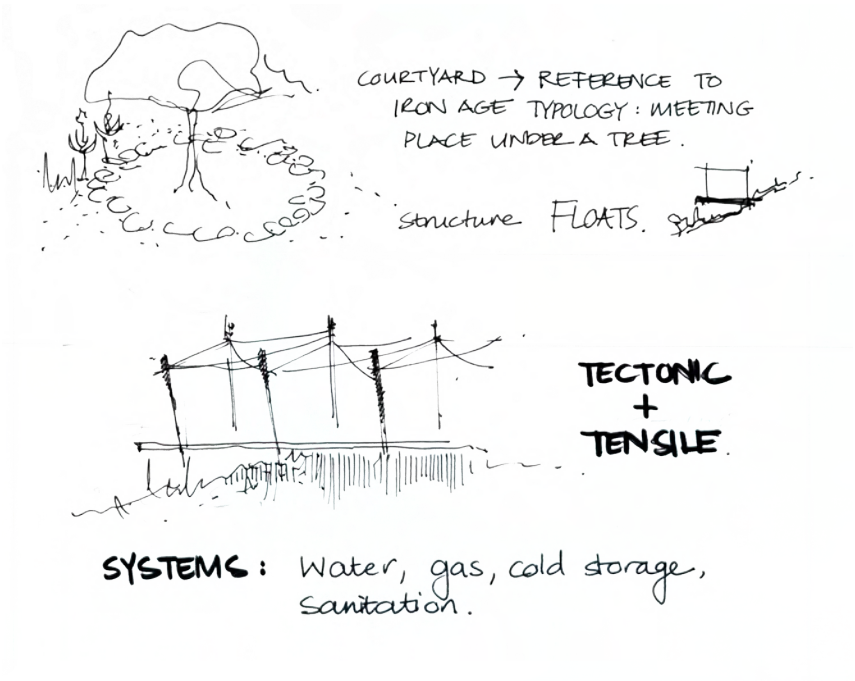



*FIGURE 6.4_Technical concept for the cafeteria (Author 2017)*

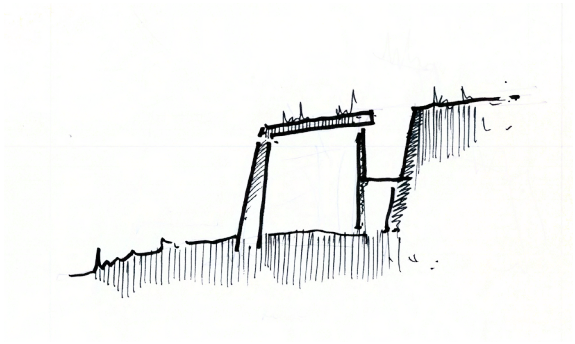


*FIGURE 6.5_Protect the fort as heritage structure (Author 2017)*



## 6.2 Protect

The second structure (figure 6.5 and figure 6.10) protects the historical fabric by serving as buttress to the badly eroded berm of the fort. Its planted roofs which mimic the natural terraces of the mountainside create opportunities for vegetation to be reinstated. The interior of the building protects the most private functions of the scheme – the offices and consultation spaces. A protective skin with small openings reinforces this idea. The stereotomic mass (figure 6.6) of the structure and its linearity are a response to the forms of the fort. A concrete frame structure provides stability for the walls which are constructed from the excavated rocks and soil. The most technologically advanced services are encased within this building.

**Protect the fort as heritage structure**

- The building is tucked into the earthen berm
- It backs the fort

**Protect the private functions of the programme**

- Well-being reception
- Consultation Rooms
- Offices
- First aid room (serves the public)

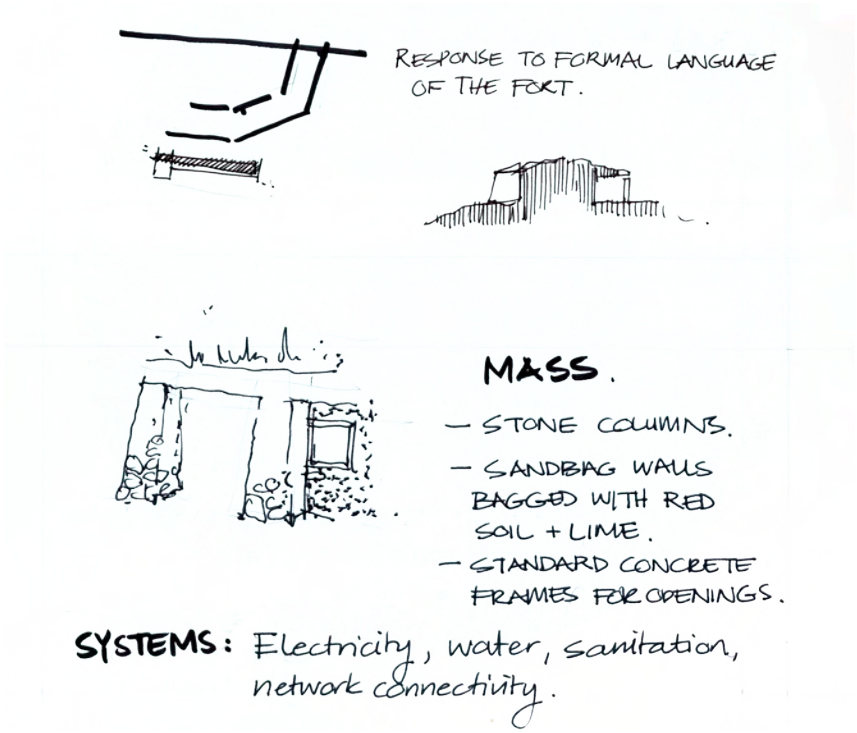



*FIGURE 6.6_A stereotomic mass of sand and stone (Author 2017)*

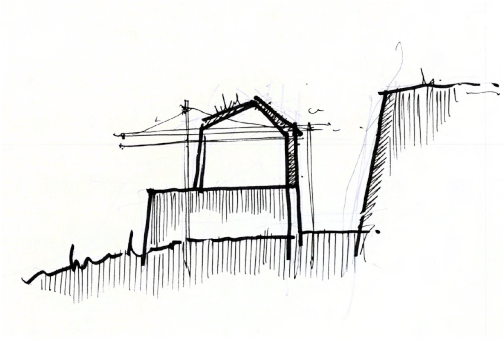
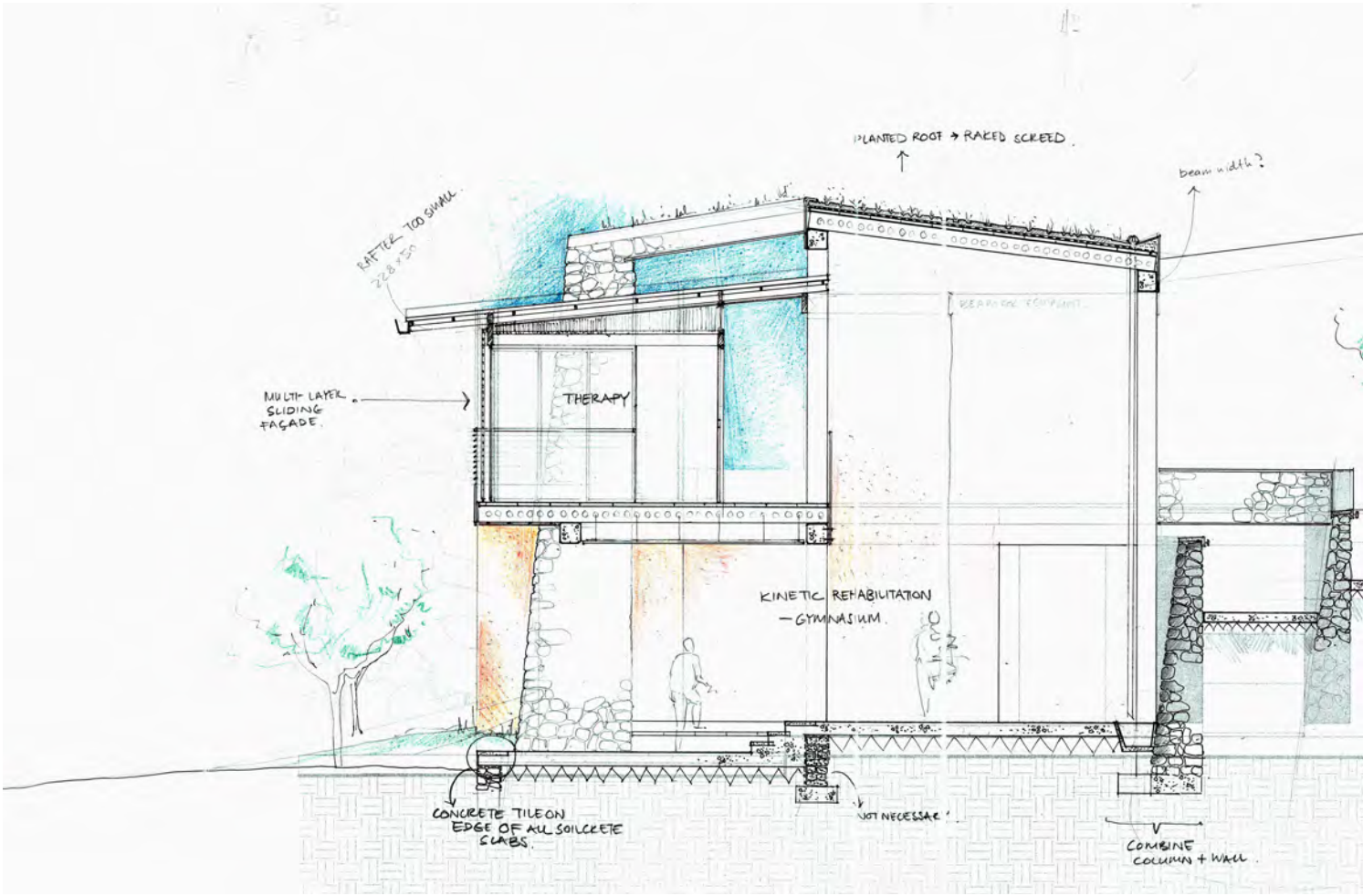


*FIGURE 6.7_Integrate landscape and building (Author 2017)*

## 6.3 Transform

The third structure (figure 6.7 and figure 6.9) mediates between what man made environment and the natural environment. The stereotomic protective structure breaks apart to allow in light and air. The building footprint respects existing vegetation and the hosts therapeutic programmes which contribute directly to becoming well; to transformation. The structure is a hybrid one (figure 6.8): the building has a solid base from which an uncovered structure rises. Air and light moves freely. Screens permeate interiors and exteriors. An experience of the elements is created within the interior spaces.



**Integrate landscape and building**

- The structure breaks away from the berm and dissolves into the established vegetation

**Healing functions**

- Kinetic therapy
- Treatment rooms
- Group therapy
- Ablutions
- Climbing wall

[Programmatic indoor activities support outdoor activities and special functions taking place in the reserve.

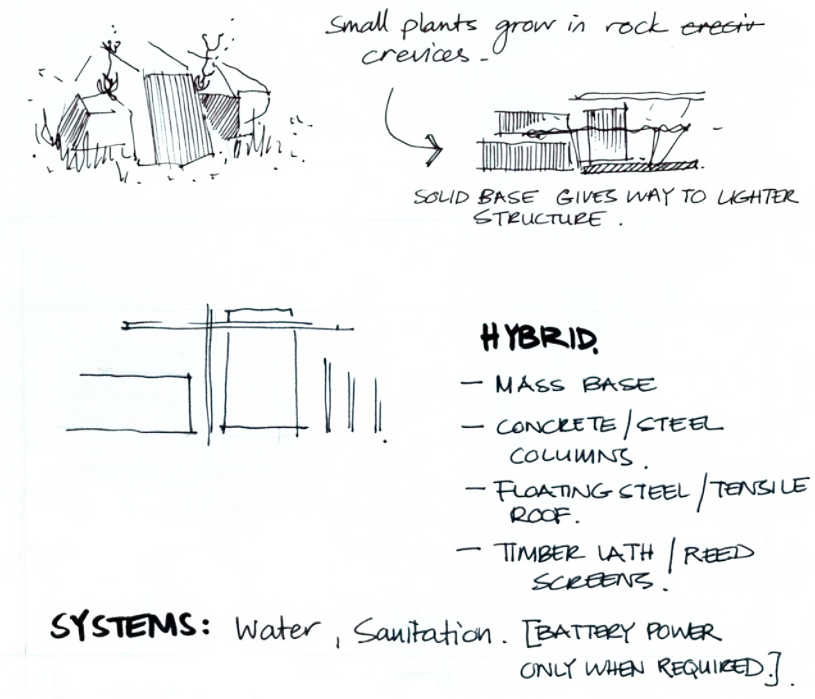



*FIGURE 6.8_A stereotomic base with lighter roof structure (Author 2017)*

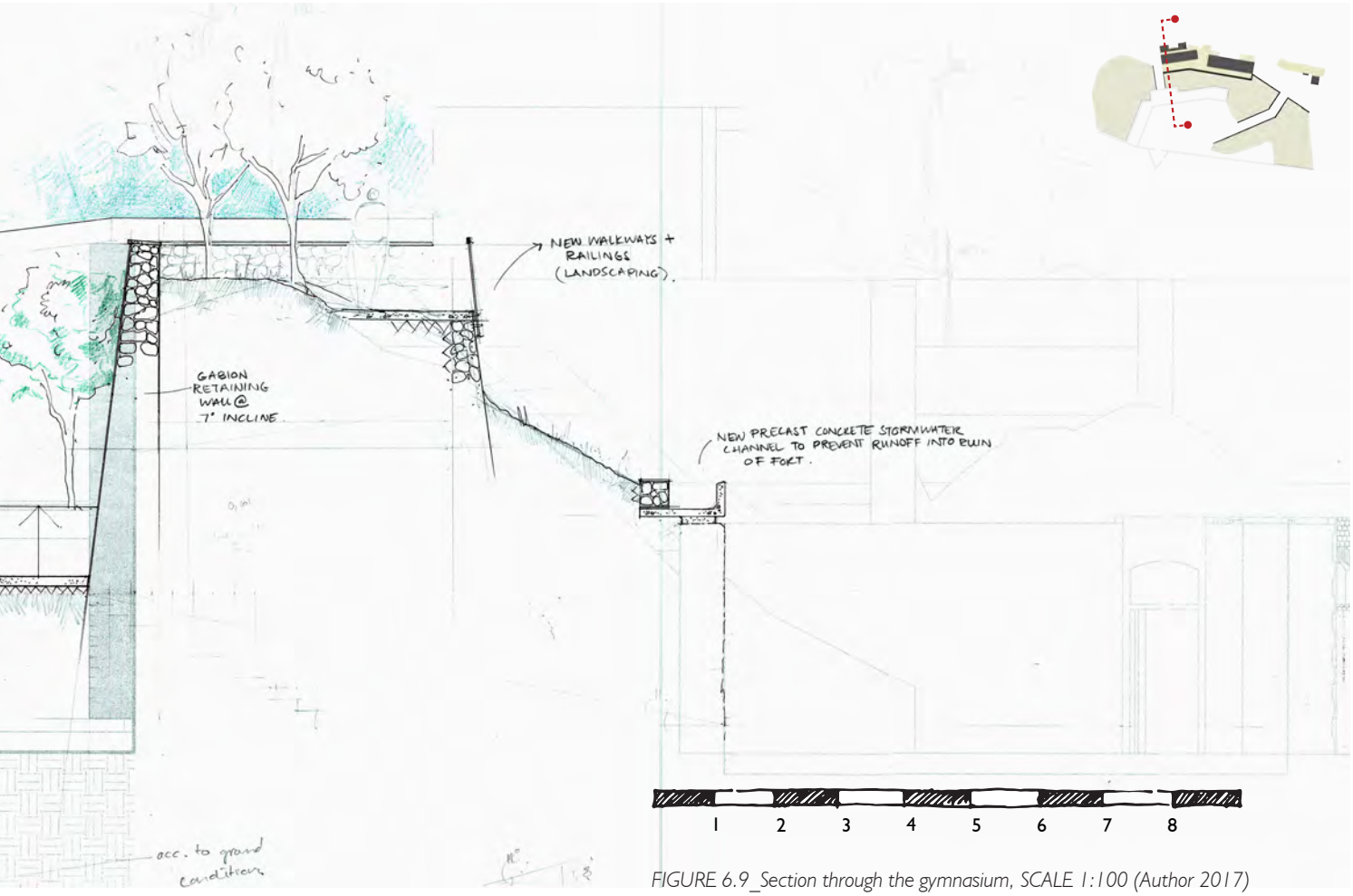
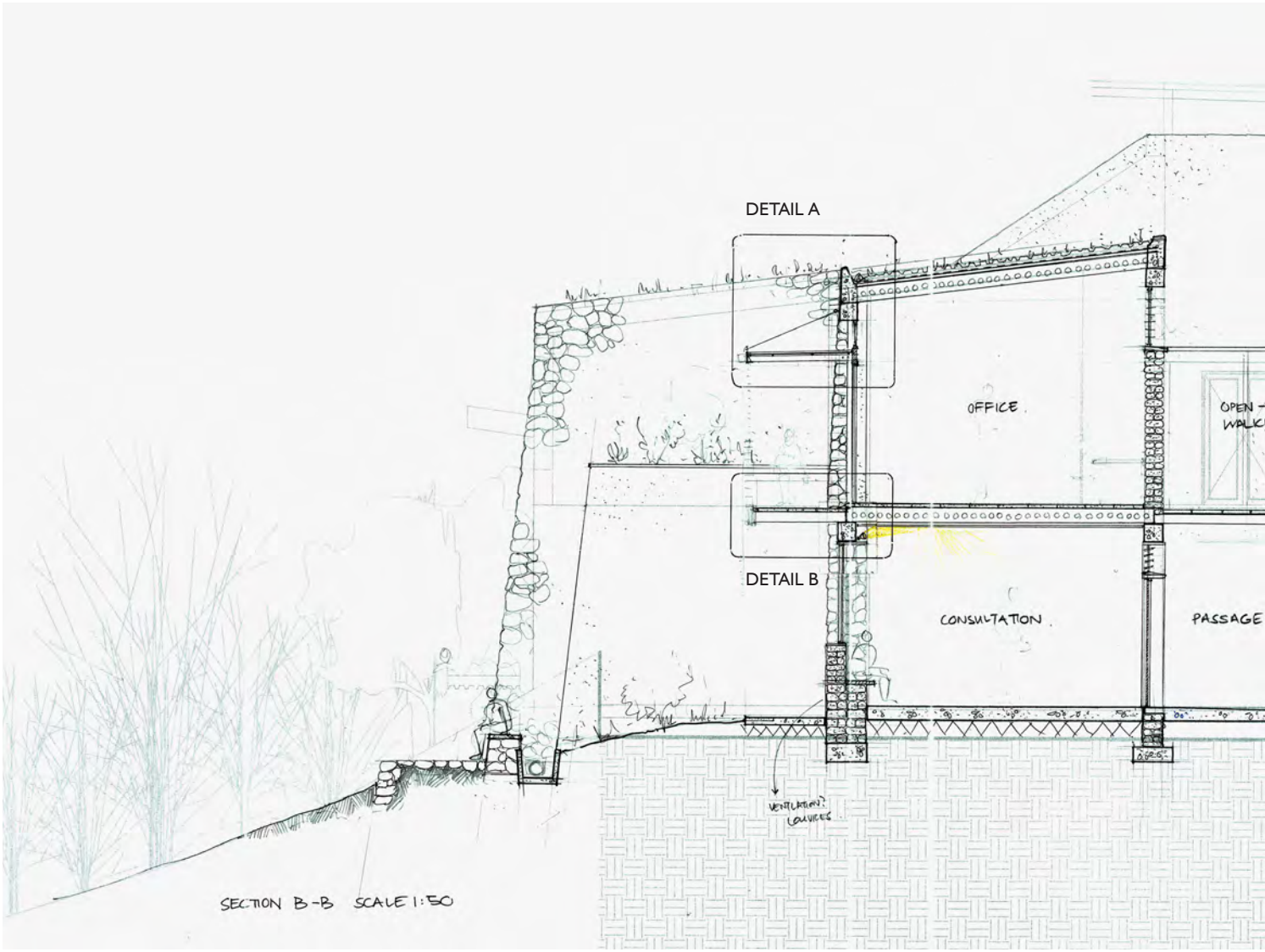
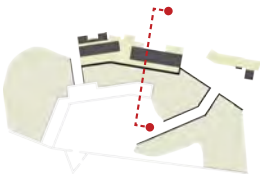



*FIGURE 6.9_Section through the gymnasium, SCALE 1:100 (Author 2017)*







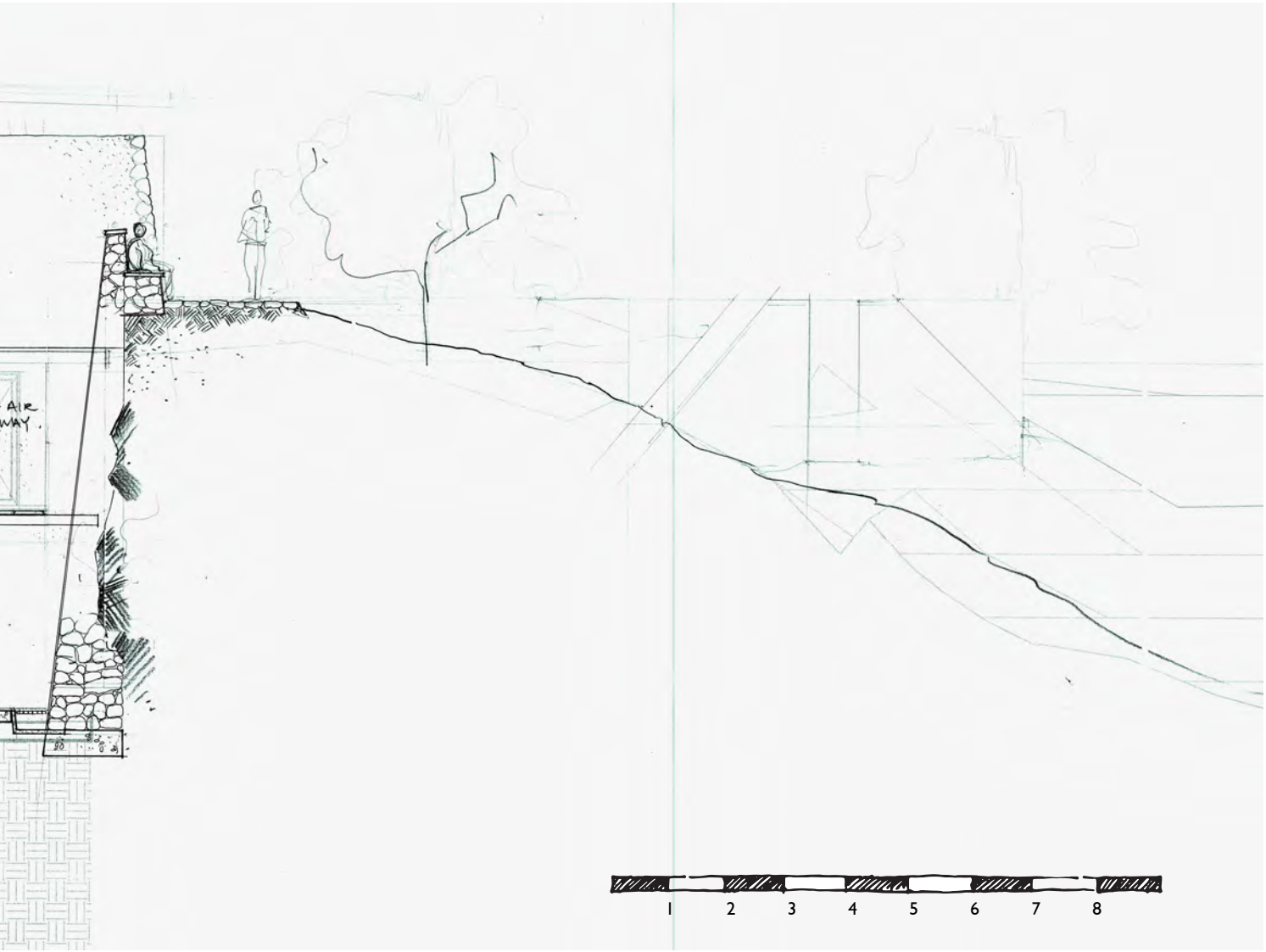
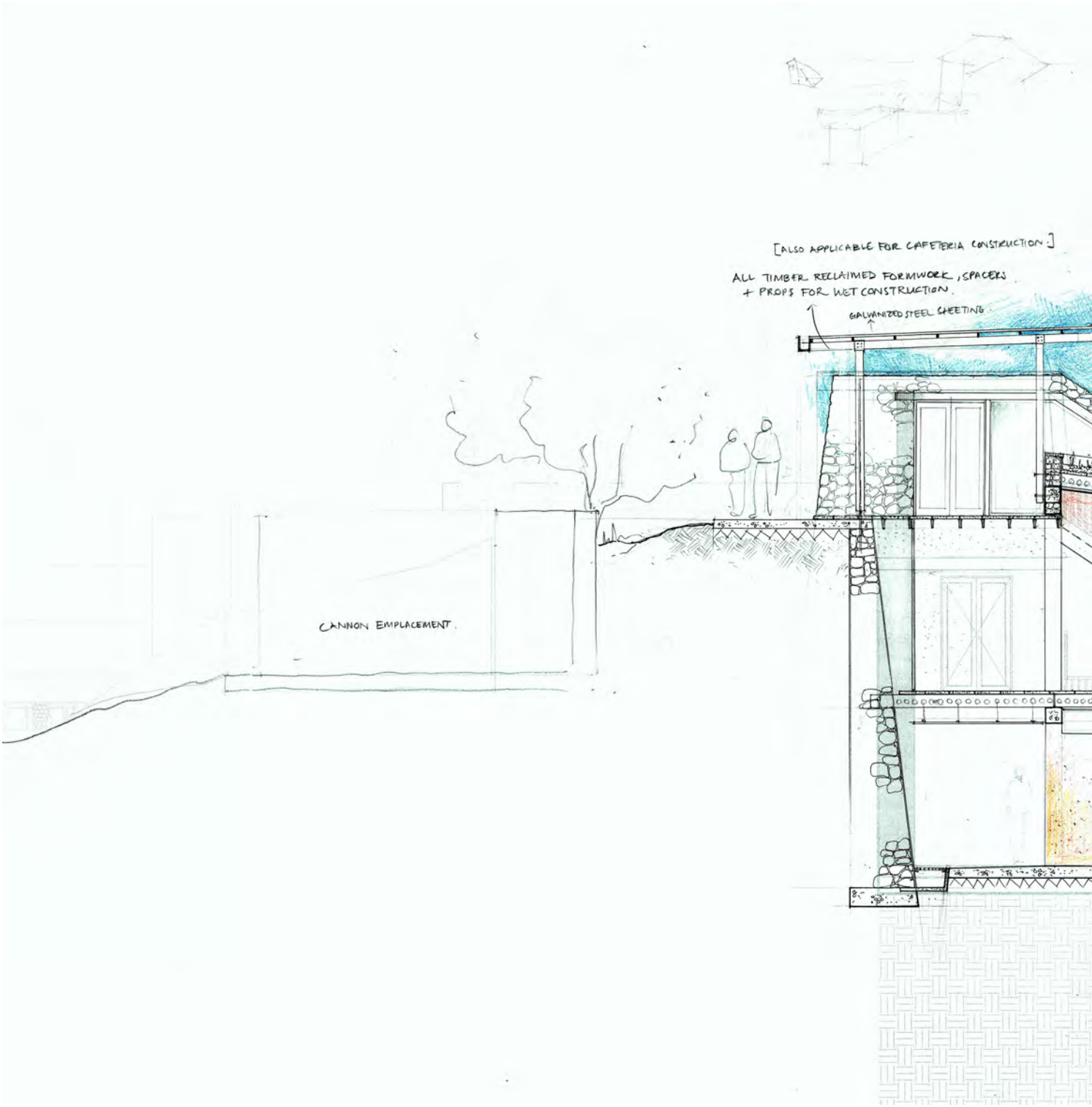



*FIGURE 6.10_Section through the consultation and office spaces, SCALE 1:100. Refer to chapter 7 for details (Author 2017)*



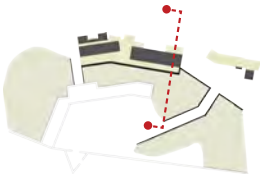
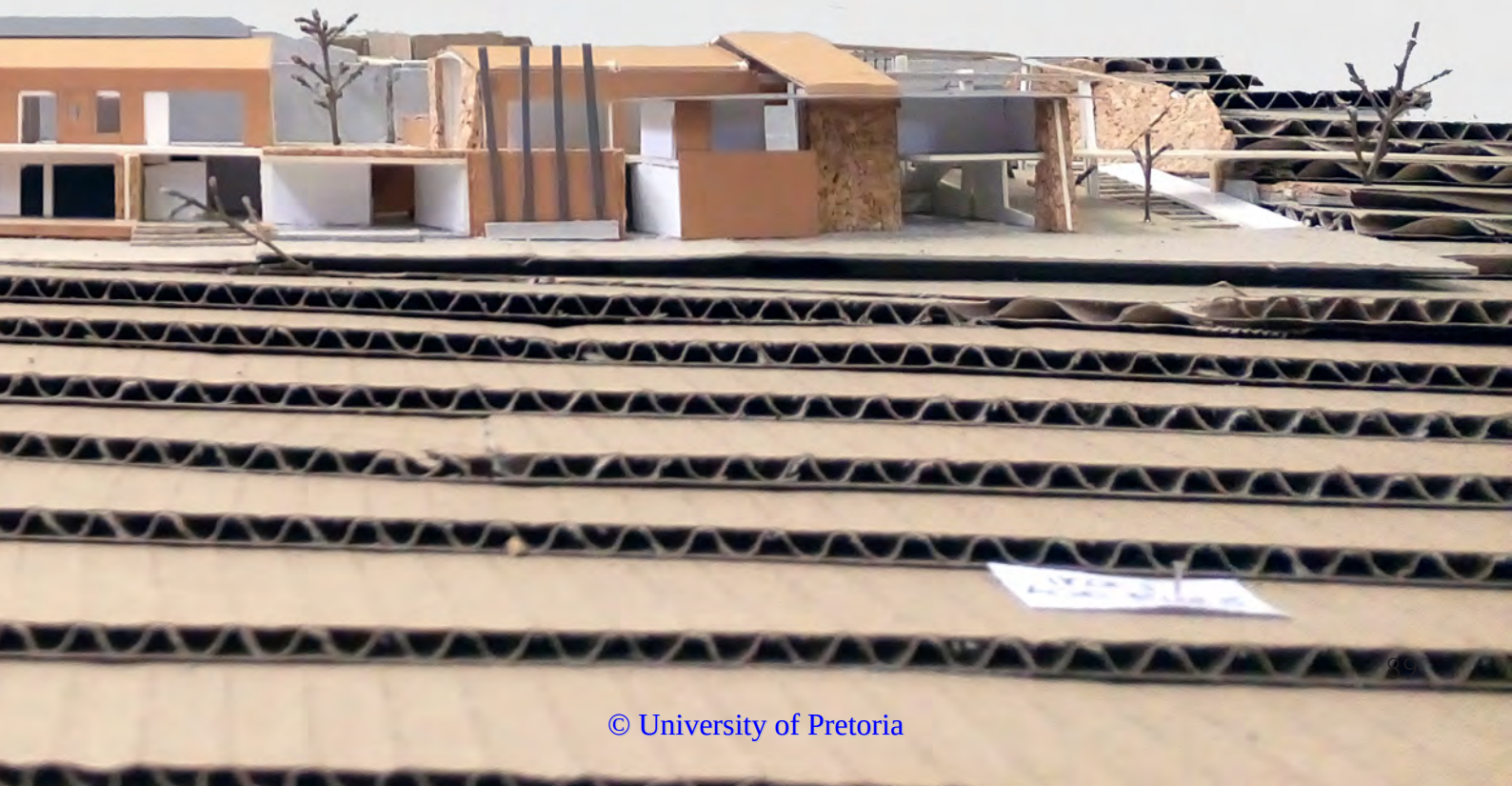





*FIGURE 6.11_Section through the waiting area, reception and vertical circulation, SCALE 1:100 (Author 2017)*

*FIGURE 6.12_Model of the scheme illustrating the north-facing elevation (Author 2017)*



# 7. TECHNOLOGY

Technology in architectural design "*presents the natural world to people in a way that allows them to understand, and hence belong within, that world*" (Lavine in DeKay 2011:321). In this manner, the technological resolution supports the project's intention of placing people into deep relations with nature as it illustrates the forces at play, highlights the specifics of place and tangibly manifests interaction with the environment.

This chapter explains how technological decisions were informed by [1] the spatial intentions as set out in the explanation of the concept (chapter 6), [2] in response to the environment, [3] site accessibility and [4] local skills and opportunities for skills development. The elements which constitute the design are unpacked in sequence of construction. Architecture is viewed as a "*process of becoming; a material narrative*". Lastly, an overview of the systems and services employed ties the project together by illustrating how separate features support each other to create a sustainable whole, a place for human-nature interaction.

## 7.1 Technology and Integral Theory

Integral theory demands that we consider the technological resolution of an architectural project from the same four perspectives that guide design decisions. The diagramme (figure 7.1) is an interpretation of the explanation and figure (2.1) discussed in chapter two. It indicates the key question that each quadrant concerns itself with when faced with decisions regarding sustainability and technology.

The *behaviours* perspective considers how effective a building is (DeKay 2011:56). Environmental design goals include:

- "*The design of high-performance buildings that maximize efficient use of water, energy and material resources while minimizing waste and pollution*" (DeKay 2011:54);
- Buildings which utilise on-site renewable resources of sun, wind and light;
- Safe, healthy places with long-term value, which eliminate toxicity.

From the *systems* perspective we learn that to "*design ecologically, we have to begin to think ecologically*" (DeKay 2011:60). The ecological thinker sees the world in terms of dynamic systems and uses his understanding of living systems as a conceptual framework for organizing activities within the built environment. Predictable processes which affect buildings, such as the movement of the sun, dictate patterns and design language. When architecture manifests process, it becomes the mediator between external processes (climate, for example) and interior processes such as bioclimatic response and human experience (DeKay 2011:67;72).

The *cultures* perspective asks how we design places that embody meaning through the manner in which it places us into relationships with Nature (DeKay 2011:82). Lavine in (DeKay 2011:92) describes architecture as "*inhabited technology*" which places humans in a relationship with Nature through technological metaphors. Technology can [1] abstract nature as intellectual investigation thereof; [2] display the transactional processes between nature and humanity through the building interface; [3] embody our story of the world by supporting ritual; and [4] record what we know of nature through architecture as manifestation of our engagement with it. Lavine suggests that design, via technology, should "*define nature in a manner that allows people to belong within it physically, emotionally and spiritually*" (DeKay 2011:99).

Patterns of space which engender rich experiences of nature, are important from the *experience* perspective. Architecture should satisfy aesthetically, emotionally, intellectually and spiritually. Technical resolutions support the contrasts, subtleties, richness of feeling and other experiential considerations of the design (DeKay 2011:104).

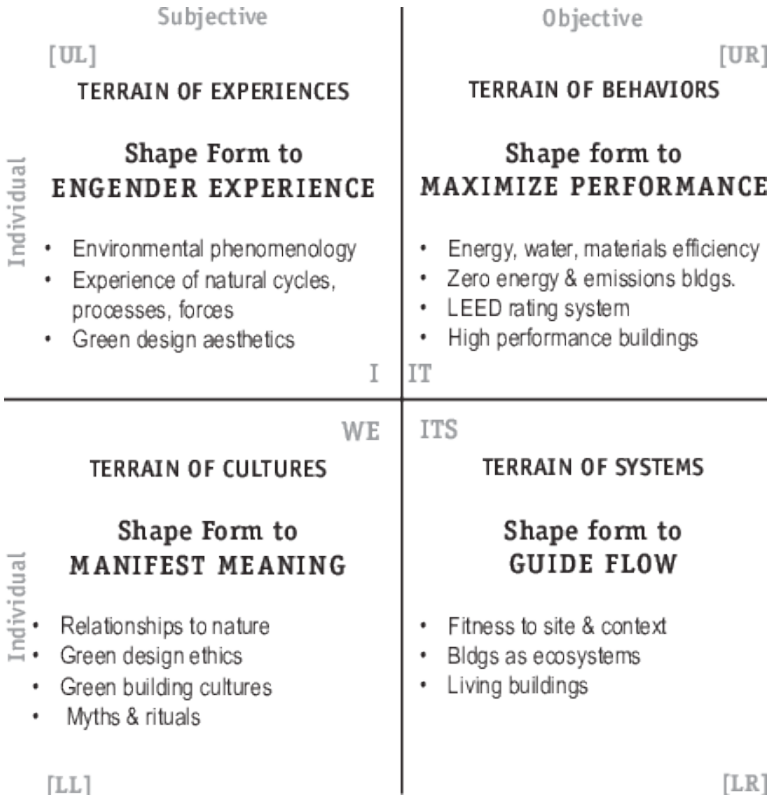



*FIGURE 7.1_Sustainability and technology from the four perspectives (compare with figure 2.1) (DeKay 2011)*

*FIGURE 7.2_Collage: textures and colours from the site (Author 2017)*

## 7.2 Criteria for technological decisions

Technical decisions have been formed based on a defined set of criteria as stated in the introduction of this chapter. This section expands upon and explains the technological drivers.

**7.2.1 Spatial intentions (conceptual drivers)**

Spatial intentions, as technological driver, fall into the category of the experience and culture perspectives. The architectural design revolves around a non-uniform route with a series of places, each offering a different experience of the natural environment (figure 7.3). Places which 'separate' or protect are designed differently from those which are exposed and draw natural cycles into the interior. Haptic qualities are crucial. Textures and colours from the surroundings (figure 7.2) are brought up close. Views are framed, hidden and revealed. Quality of sound and contrast in lighting conditions support the spatial intention.

The design offers a record of our understanding of the world which stands in direct contrast to a high-tech viewpoint. It reflects upon low-tech responses to the environment and how they may effectively be employed within contemporary building practice. Interstitial spaces embody spontaneous rituals in which communities and individuals interact with nature on a social, recreational or spiritual level.

*FIGURE 7.3a_An experiential route: arrival courtyard (Author 2017)*

*FIGURE 7.3b_An experiential route: reception (Author 2017)*

*FIGURE 7.3c_An experiential route: consultation rooms and gymnasium building (Author 2017)*

*FIGURE 7.3d_An experiential route: incision in the fort's berm (Author 2017)*

### 7.2.2 Environmental considerations (site analysis)

The second set of criteria falls within the right-hand quadrants which analyses materials and elements according to their quantifiable effectiveness and contribution to other systems. How well the building responds to the issues identified in the site analysis (refer to Chapter 3), drives choices. The architecture needs to respond to solar radiation, hydrology, geology, existing species and micro-climates and heritage structures, amongst others.

### 7.2.3 Site accessibility

The hilltop location and the need to protect the natural and historical environment during the process of construction, complicates access to the site. The existing service road only provides access to the south of the fort and to the telecommunication tower. From this point, all materials need to be moved to the building location on the north of the fort (figure 7.4). Reducing the number of materials to be brought to the site and the amount of waste to be carted away afterwards becomes an important consideration in material choice and subsequent structural solutions. Construction methods which favour manual labour are chosen over those that require large machinery which needs to be transported to site.

### 7.2.4 Skills

The construction process brings people into contact with their surrounds as much as the completed building creates the opportunity for interaction. In chapter two, the notion of "*construction as a process of "becoming"*" was introduced (Nesbitt 1996:494). Part of this process is the human experience of the environment as it changes under construction. Processes which favour manual labour and allow for the inclusion of unskilled workers are recommended. To this extent, easy construction processes and lightweight materials are chosen. The sequence of construction needs careful thought - for example, a crane cannot place beams in difficult locations. The quality of on site manufactured components are not always up to the standard of prefabricated elements, therefore a balance needs to be found and materials specified according to the finish required for specific spaces and programme requirements.

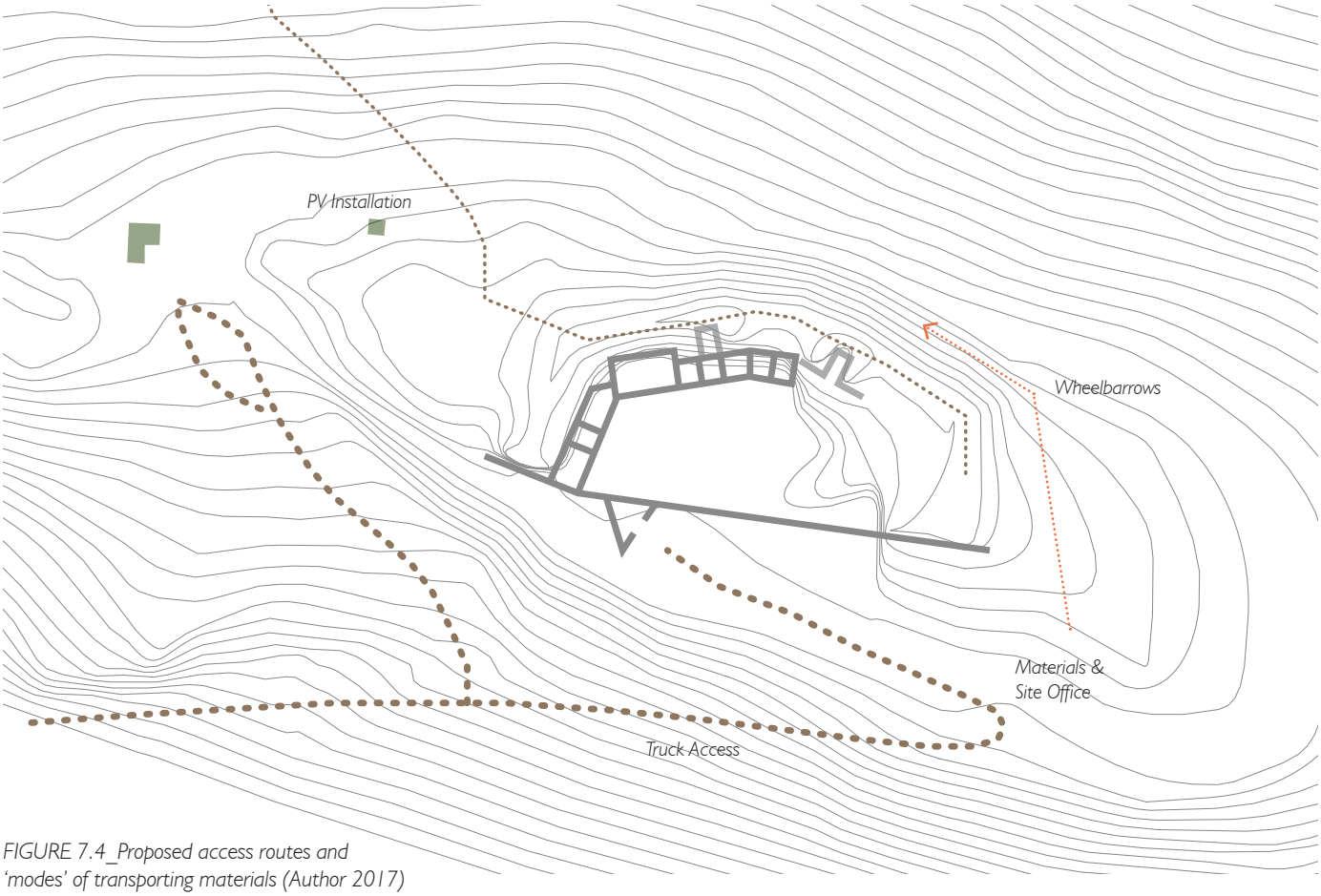
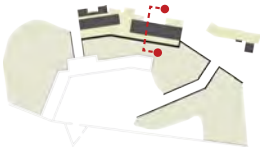



*FIGURE 7.4_Proposed access routes and 'modes' of transporting materials (Author 2017)*



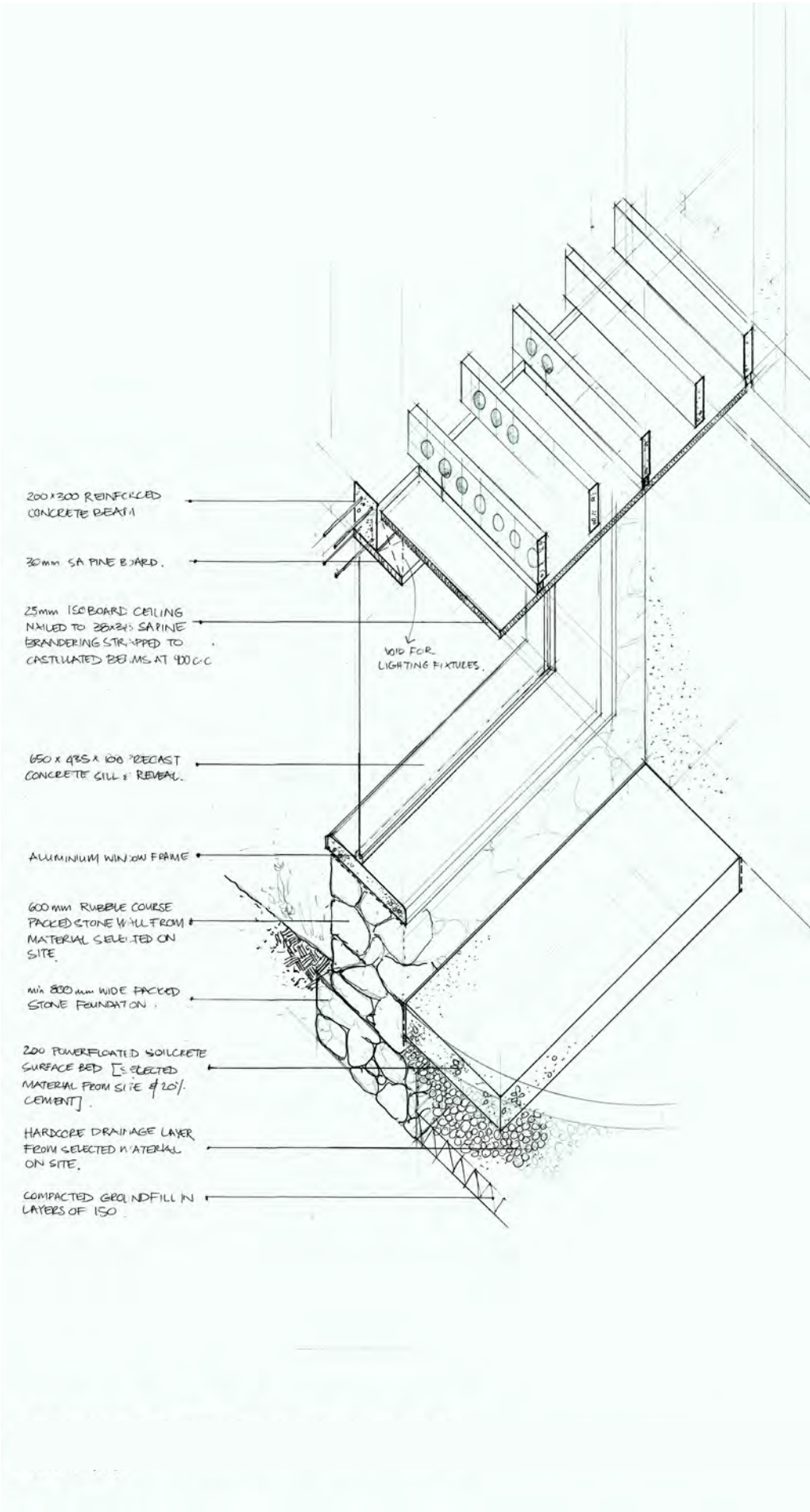
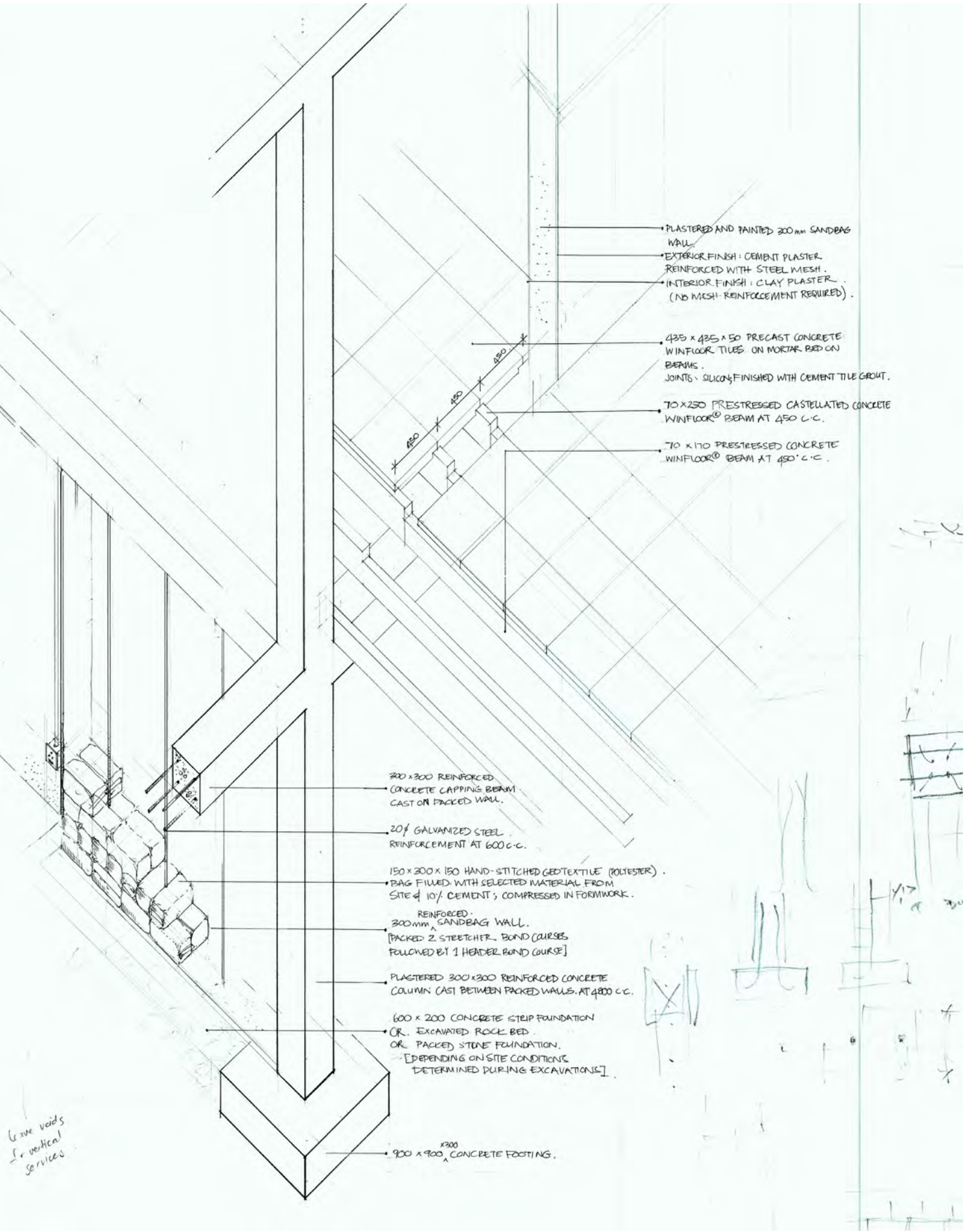



*FIGURE 7.5_Axonometric of typical construction in the consultation and office building, not to scale (Author 2017)*



## 7.3 Building Elements

This section considers all the elements that constitute the design separately in the sequence of construction. Products, materials, construction methods and principles are explained and justified.

### 7.3.1 Site preparation

In preparation, the service road is cleared and the future parking lot levelled. Trees and vegetation that need to be protected should be cordoned off and topsoil collected from construction areas. Historical walls should be propped or supported according to an engineer's specifications.

### 7.3.2 Excavations, retaining walls and sorting of materials

The necessary excavations will be done by hand except where rocks are met and chemical expansion methods need to be employed. Blasting is not an option as this places the historical structures at risk. A sheet pile retaining wall (figure 7.6) is proposed. The interlocking sheets are driven into the soil and secured at the top with anchors. This provides lateral support for the excavations (Eskandari & Kalantari 2011:1536-1537). Excavated material is to be sorted, graded and stored for subsequent construction needs. A proper survey needs to be completed after excavations to determine the extent and strength of retaining walls and foundations.

*Above*
*FIGURE 7.6_Sheet pile excavations (H.B. Fleming, Inc. 2017)*

*Top Right*
*FIGURE 7.7_Sandbag foundation; 10x10 Sandbag Housing, MMA (Designspace Africa 2009)*

### 7.3.3 Foundations and levels

The types of foundations are dependent on the nature of the excavation beds. Where solid rock is encountered, walls and columns can be directly supported, in other cases foundations will be required. Non-load bearing sandbag walls can be constructed upon a foundation of compressed sandbags (figure 7.7). Packed stone foundations can also support non-load bearing walls. All other foundations will require reinforced concrete.

### 7.3.4 Structure

A grid of 4.8m x 4.8m orders the plans. It is based on the dimensions of the flooring system. Concrete columns, for which concrete is mixed on site, supports the consultation and therapy buildings. For the most part the columns are hidden within the walls or clad in stone. Surface beds in weatherproof areas are constructed from soilcrete, a mixture of graded soil from the site and 10% cement. If levelled and sealed properly, they create a natural floor finish.

The WinDeck prestressed concrete beam and tile suspended floor system (figure 7.8) is specified for suspended floors and roofs. Although the necessary trades to cast concrete are on site, the WinDeck system is preferred over cast floors for the following reasons:

The WinDeck system (Wintec 1994:4):

- Requires no shuttering
- Requires no propping
- Requires no reinforcing
- Requires no in-situ topping or additional floor finish

Acoustically it performs on par with a plastered half brick wall, thus better than a suspended timber floor would. It will ensure the level of privacy required in the consultation rooms for example (Wintec 1994:4). The decking system consists of precast tiles which sit on top of the beams. The 435mm x 435 mm tiles are prestressed and



*FIGURE 7.8_Installation of the WinDeck system (Wintec 1994)*

only 50mm thick. This system therefore uses much less material than say, a 250mm suspended slab.

Two types of beams are available (figure 7.9). The project employs the 250mm deep castellated beam with a maximum span of 6m for interior spaces. Building services can be passed in the ceiling void between the castellated beams. The concrete tile is the interior floor finish. The 170mm deep beam is used for exterior spaces. This accommodates a step between the interior and exterior. The joints between the floor tiles are sealed with silicon sealant and grouted. A screed to fall can be cast over the tiles to manage water runoff.

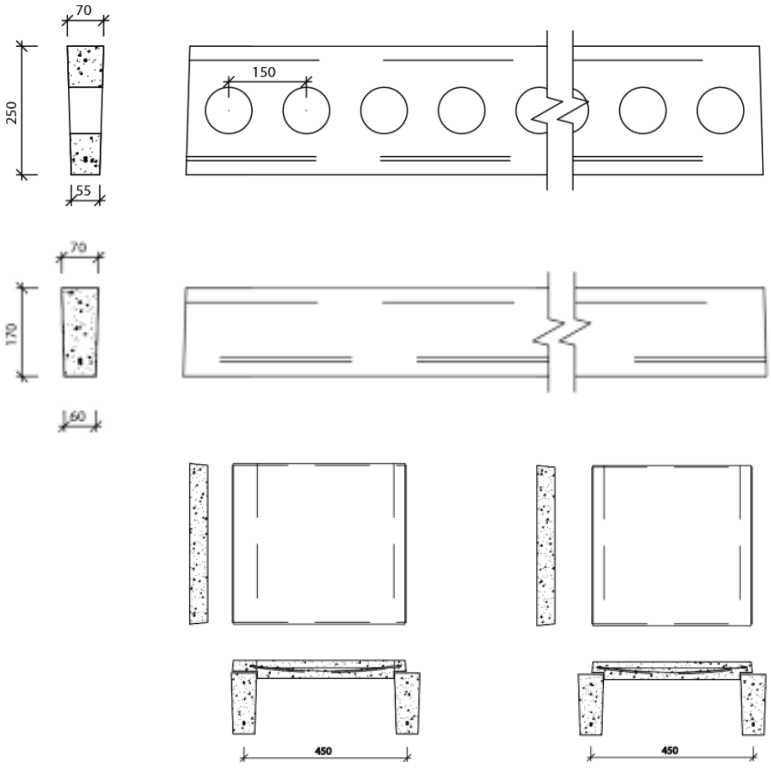



*FIGURE 7.9_WinDeck components: 250mm prestressed beam; 170mm prestressed beam; concrete edge condition tile; standard 435mm x 435mm concrete tile (Wintec 1994)*

*FIGURE 7.10_10x10 Sandbag Houses, MMA Architects (photograph sourced from Designother90 2011)*

**7.3.5.1 Precedent**

## DESIGN INDABA 10X10 HOUSING
## **MMA ARCHITECTS**
## 2008 | CAPE TOWN, SOUTH AFRICA

The Design Indaba 10x10 Housing Project challenged 10 teams to provide innovative solutions for low cost housing in South Africa. In 2008, the proposal by MMA Architects was constructed (figure 7.10). Their proposal made use of a local, innovative system called Ecobeams which consists of a timber structural frame with an infill of sandbags (Kracht 2008:1). Ecobeams "*complies with all the rules and regulations of the Cape City Council, fits within budget and fulfils all the requirements with regards to testing and certification of an alternative building system*" (Fairs 2008). The system is cheaper than conventional brick construction. The homes are therefore larger than the average subsidized housing. Local people participated in the straightforward construction process (figure 7.11).

*FIGURE 7.11_Local people assisted with the construction of the sandbag buildings (photograph sourced from Designother90 2011)*

**7.3.5 Walls**

The walls are constructed from the excavated materials and are non-loadbearing.

Interior walls are constructed from sandbags (figure 7.12). Steel reinforcing rods are embedded in the foundations. The bags are made from "*thin non-woven geo-textiles made from polypropylene or polyester*" (Kracht 2008:8) and are stitched to 150mm x150mm x 300mm in dimension. Local tailors can be employed to stitch the bags. The geotextile's structure guarantees good adhesion which is important for the stability of the wall and the adhesion of plaster. "*An earthen plaster can be applied without a wire mesh reinforcement*" (figure 7.14) (Kracht 2008:8). Bags are filled with a mixture of selected material from site and 10% cement. Once filled they are slightly wet, compressed into a mould and ready to use as masonry units the following day. The sandbag masonry blocks are layered around steel reinforcing rods which are secured in the foundation. Two running courses are followed by one soldier course layer to ensure a proper bond.

Mesh gabions and selected stones are used for feature walls and low retaining walls on the site as alternative to the sandbag walls (figure 7.13).

*FIGURE 7.12_Packing sandbags between Ecobeam supports (photograph sourced from Dezeen 2008)*

**BUILDING ENVELOPE REQUIREMENTS (SANS 10400-XA:2011):**
Minimum R-value to be achieved in zone 2 (for non-masonry walls): 1.9 $m^2$.K/W

*FIGURE 7.13_Gabion stone wall. Rock Office by a21 Studio, 2008, Hochiminh City, Vietnam (photograph sourced from Archdaily 2010)*

*FIGURE 7.14_Plastered with earth from the site. House C, Hiroshi Nakamura & NAP, 2008, Japan (photograph sourced from Archdaily, 2012)*

### 7.3.6 Openings

Timber formwork will be used to position openings during the construction of walls. Where this is not possible, or a perfect finish is required, standard precast concrete wall and door frames (figure 7.13) are inserted to ensure uniform openings. Where possible openings continue to the underside of the beams to limit the need for lintels.

**BUILDING ENVELOPE REQUIREMENTS (SANS 10400-XA:2011):**
If the total area of fenestration is no more than 15% of the nett floor area, the design complies. Any glazing surface area that exceeds 15% should be in accordance to SANS 204.

### 7.3.7 Planted roof

The WinDeck suspended system is also used for the roof, but installed at an angle of seven degrees to mimic the natural fall of the terraces of the hill which it tries to simulate. The beams and tiles are installed according to specifications. The joints are sealed with silicon and waterproofing is torched onto the surface. Expanded mesh and a thick cement screed with a waterproofing additive is applied. The screed is raked to form a surface with non-uniform grooves. A layer of topsoil mixed with seeds is applied to the surface and protected with a degradable geotextile which allows the plants to establish themselves (figure 7.15).

Endemic plants which grow in the shallow soils and rock fissures are adapted to this green roof (figure 7.16). Among the endemic taxa is the succulent shrub *Aloe peglerae* and the succulent herb *Frithia Pulcra* (Mucina & Rutherford 2006:466).

**BUILDING ENVELOPE REQUIREMENTS (SANS 10400-XA:2011):**
Minimum R-value for roof assemblies to be achieved in zone 2: 3.2 $m^2$.K/W with direction of heat flow upwards.

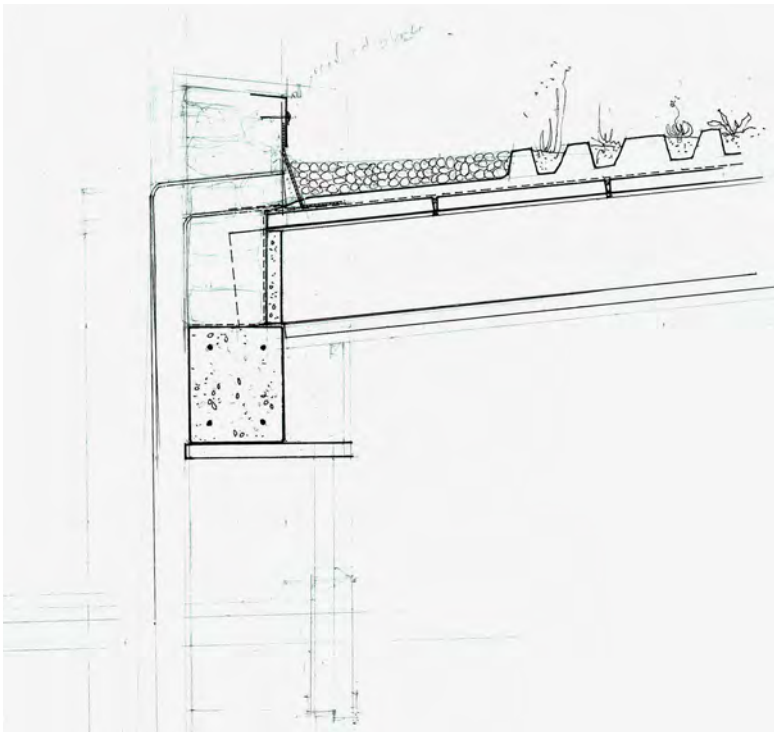


*FIGURE 7.15_Raked screed planted roof and gutter, SCALE 1:20 [detail from figure 6.8] (Author 2017)*

*FIGURE 7.16_Local plants are adapted to shallow soils and rock fissures (Author 2017)*

## 7.4 Design for human comfort - environmental strategies

### 7.4.1 Controlling heat gain

The primary concern in Pretoria is the cooling of the building. Strategies which can be implemented to cool building interiors include minimizing the exterior surfaces; shading the building envelope; providing proper insulation (especially in the roof); controlling ventilation and the infiltration of hot air; locating openings in shaded areas or in places where they catch prevailing breezes; using thermal mass to store heat or using water bodies to cool through evaporative cooling (Brophy & Owen Lewis 2011:60). This section explains three principles applied to manage heat gain.

#### 7.4.1.1 Building orientation

The buildings are organised with the longer axis running east-west as recommended (figure 7.17) (SANS 10400 XA: 10). As far as possible, all interior spaces have north facing openings to allow sunlight to penetrate in winter. Existing deciduous trees contribute to shading the building, especially on the western facade. The section of the building on the far west is lower than the natural ground level which provides protection and minimizes heat gain.

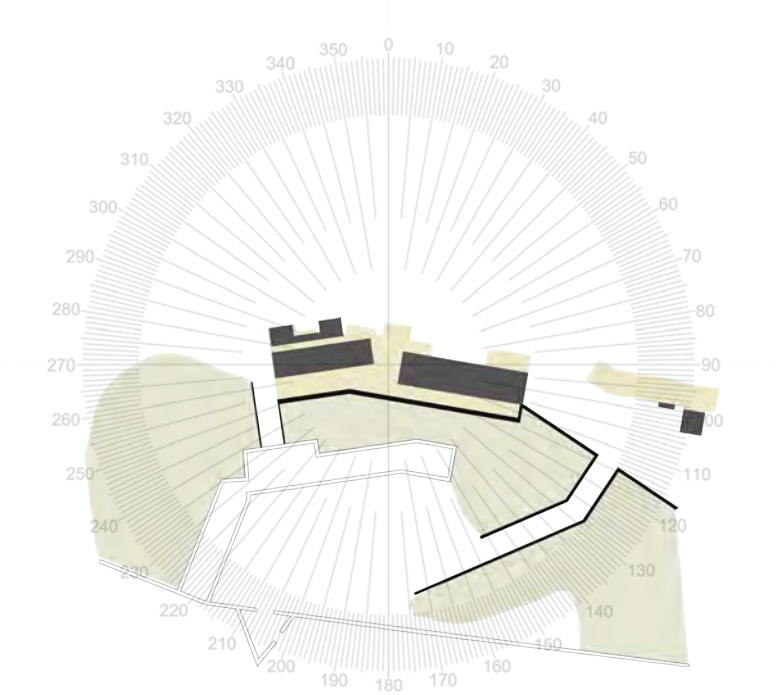
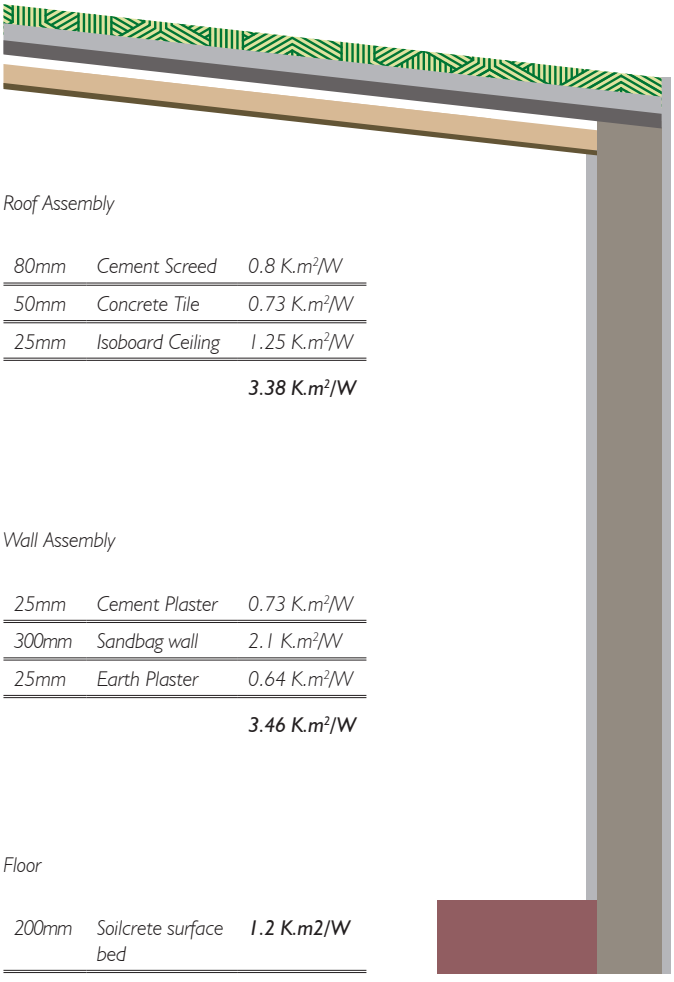



*FIGURE 7.17_Building orientation (Author 2017)*

#### 7.4.1.2 Building envelope & insulation

The stone and sand walls discussed in section 7.3.5 are thermal masses which store heat and radiate it back to the environment when the environment cools down. Sand is not necessarily a good insulator, but given the density and the width of the walls, thermal comfort is maintained on the interior (refer to R-Values as indicated in figure 7.18) (Brophy & Owen Lewis 2011:115). It is important that openings around window and doors are properly sealed. To this extent pre-cast frames into which window and door frames can be placed, may be necessary. The planted roof is relatively lightweight in comparison to more conventional green roofs. The cavity needs to be insulated. The plants minimize heat gain through the roof by cooling the air above the roof through transpiration.



*Roof Assembly*

| | | |
|---|---|---|
| *80mm* | *Cement Screed* | *0.8 K.m²/W* |
| *50mm* | *Concrete Tile* | *0.73 K.m²/W* |
| *25mm* | *Isoboard Ceiling* | *1.25 K.m²/W* |
| | | ***3.38 K.m²/W*** |

*Wall Assembly*

| | | |
|---|---|---|
| *25mm* | *Cement Plaster* | *0.73 K.m²/W* |
| *300mm* | *Sandbag wall* | *2.1 K.m²/W* |
| *25mm* | *Earth Plaster* | *0.64 K.m²/W* |
| | | ***3.46 K.m²/W*** |

*Floor*

| | | |
|---|---|---|
| *200mm* | *Soilcrete surface bed* | ***1.2 K.m2/W*** |

*FIGURE 7.18_Building envelope R-Values (Author 2017)*

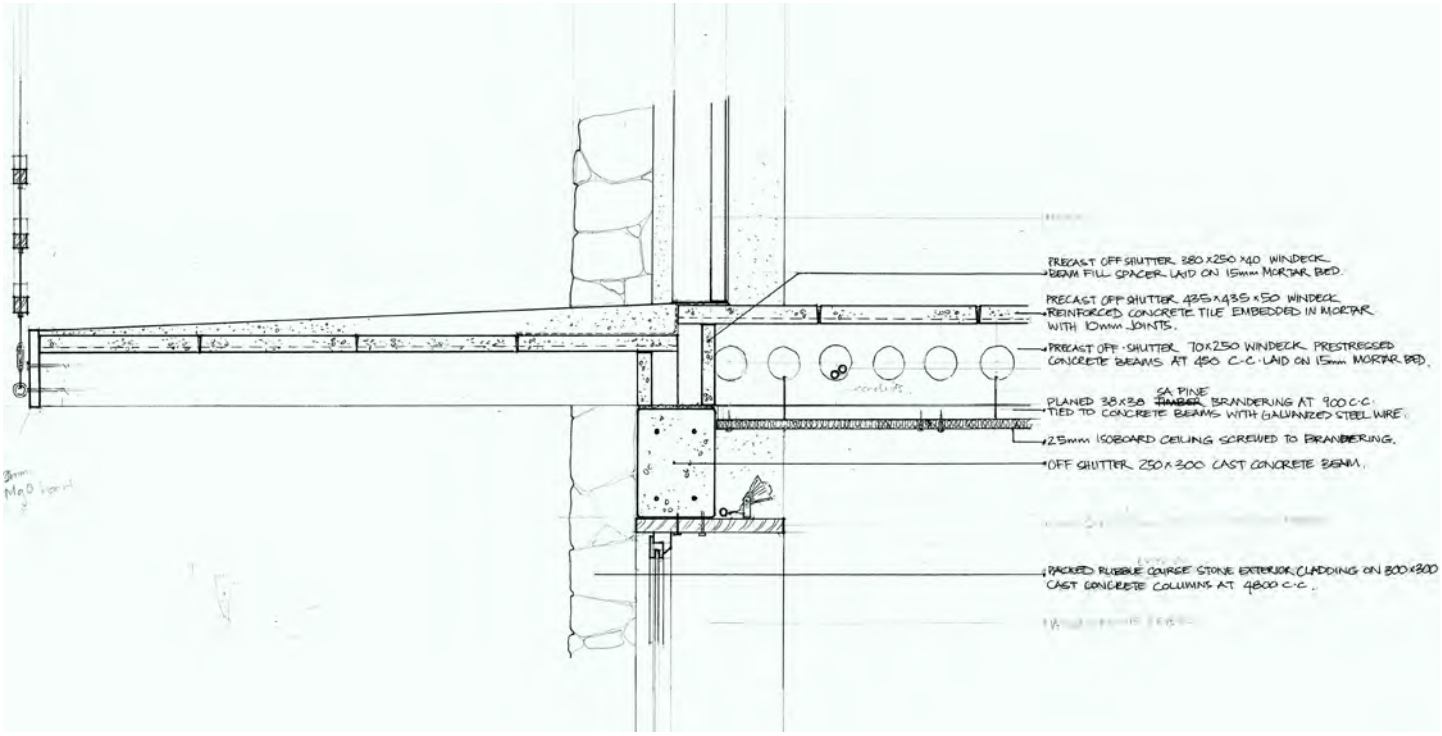



*FIGURE 7.19_Balcony doubles as shading for windows below [detail b from figure 6.8] (Author 2017)*

### 7.4.1.3 Solar Shading

In the design, windows are recessed in thick exterior walls. This ensures that they are shaded not only from direct northern sunlight, but also from eastern and western radiation. In the consultation rooms, where glazing is located closer to the exterior leaf of the wall, the balcony above acts as shading (figure 7.19). A balance needs to be achieved between adequate shading and adequate penetration of daylight.

## 7.4.2 Daylighting

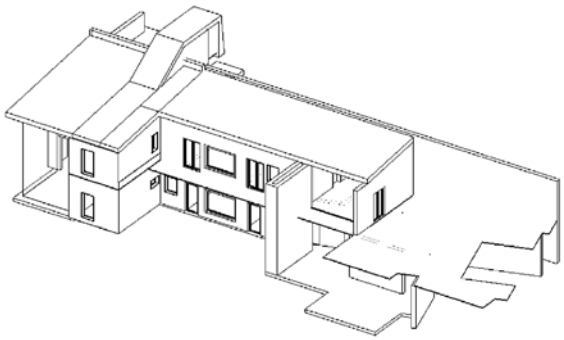
> "*Daylighting is the controlled admission of natural light, direct sunlight, and diffused-skylight into a building*" (WBDG 2016).

Daylighting needs to be considered from the inception of the design. The first consideration is the footprint of the building - deep spaces are problematic for achieving uniform lighting levels. To control glare and excessive heat gain, the window opening to floor area ratios need to be respected. Should the windows be larger due to other design considerations, the type of glazing can be adapted to control heat gain. Windows have two essential functions (WBDG 2016), namely to admit light into the interior and to provide views to the exterior. In this design, the windows on the northern facade provide views to the surrounding landscape and are situated at eye level with large overhangs protecting against the sun. The southern windows allow in diffuse light. They are located at a much higher level. Daylight-responsive electric controls are installed to dim electric lighting when adequate daylighting is sensed. Interior wall and ceiling surfaces are light in colour to evenly distribute incoming light.

Recommended lighting levels for some of the proposed activities (Veelite 2017):

Office 500 lux
Filing 300 lux
Sport facilities 200 lux
Food Preparation 500 lux
Food Storage 150 lux
Restrooms 150 lux
Canopied exteriors 50 lux

The adjacent page indicates preliminary daylight studies executed in Sefaira for the office spaces on the first floor of the central building. The first set of diagrammes (figure 7.20) represent the baseline design. The interior is well lit, but there is excessive glare and energy will be required to cool the building. The first iteration (figure 7.21) indicates the beneficial impact of increasing the roof overhang. The difference between under-lit and over-lit spaces is still too large, however.
The second iteration (figure 7.22) addresses the under-lit areas by increasing the number of windows and reducing the size of windows in over-lit areas (Sefaira 2017).



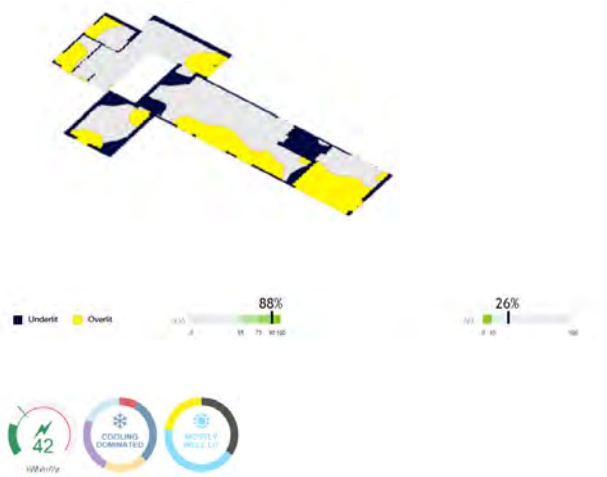
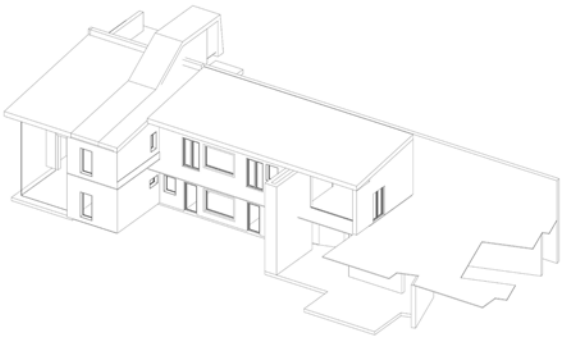



*FIGURE 7.20_Daylight base case (Sefaira 2017)*



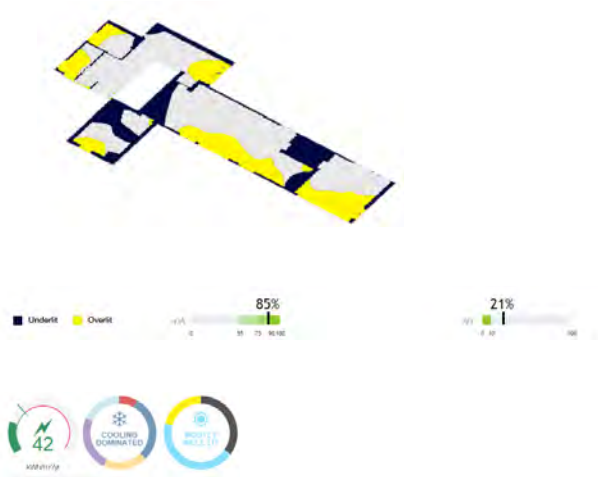
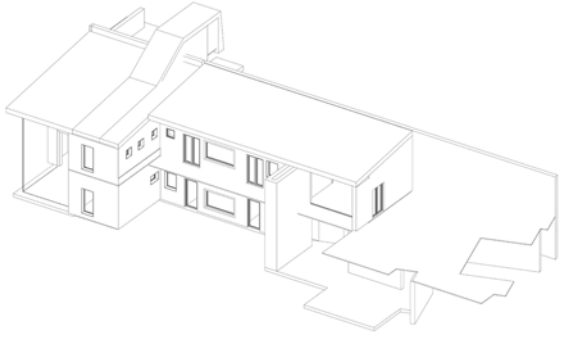



*FIGURE 7.21_Daylight iteration 1 (Sefaira 2017)*



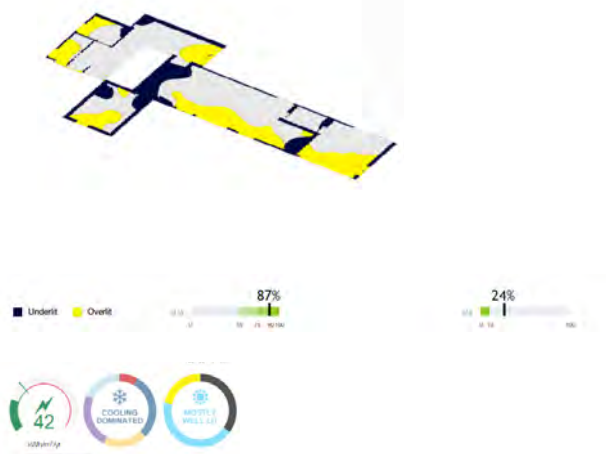



*FIGURE 7.22_Daylight iteration 2 (Sefaira 2017)*

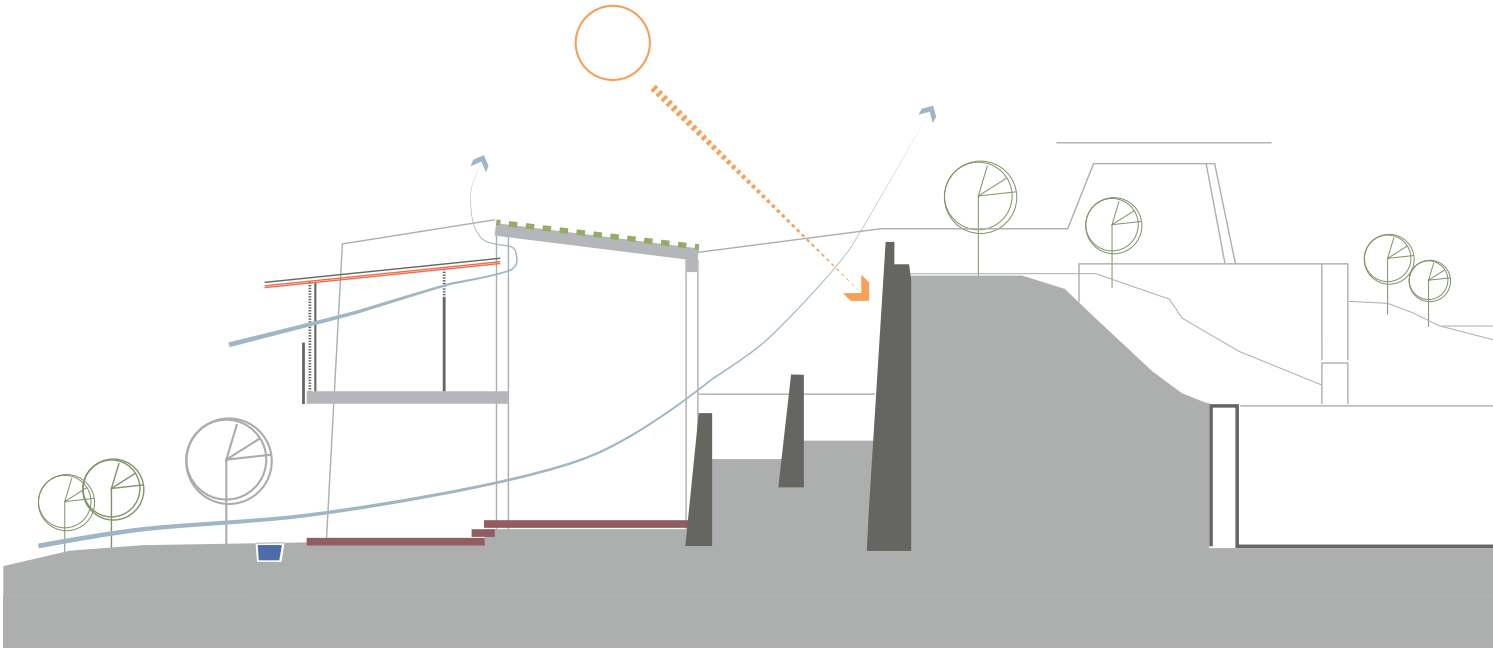


*FIGURE 7.23_Natural cross ventilation through the gymnasium (Author 2017)*

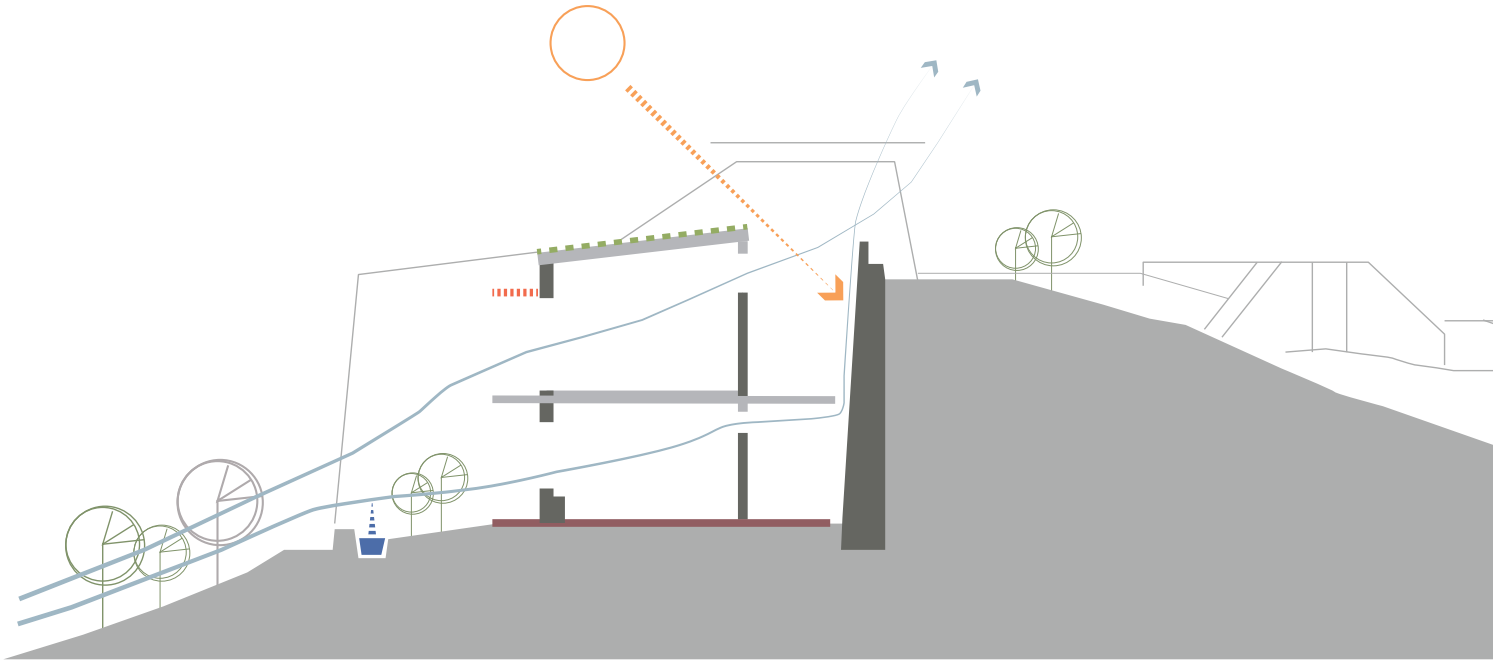
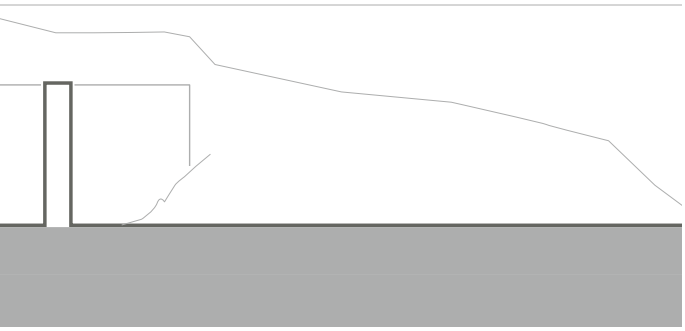
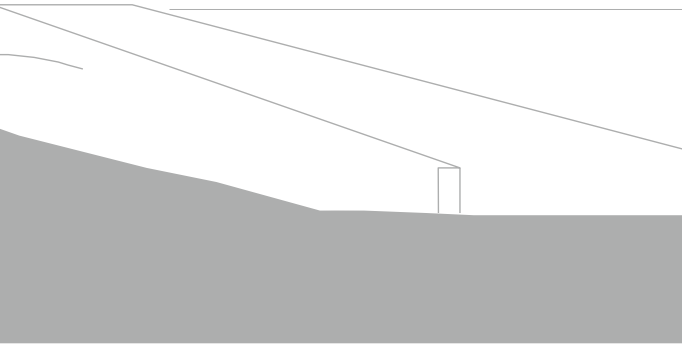


*FIGURE 7.24_Natural cross ventilation through the consultation and office spaces (Author 2017)*





### 7.4.3 Ventilation

Natural ventilation can be achieved by implementing either stack ventilation or wind driven ventilation strategies (Brophy & Owen Lewis 2011:80). Wind driven ventilation is appropriate to the design as the spaces are not deep. Large openings facing north capture breezes rising up against the hill (figures 7.22 & 7.23). The retaining wall on the south of the buildings provides thermal mass which heats up the air in the passages behind the building, drawing warm air from the smaller openings on the south of the building and out over the berm. In summer the storm water channel on the north of the structure will often contain water which will contribute to the cooling of air before it enters the building. Deciduous plants also provide shading on the north.

Natural ventilation in combination with the thermal mass elements can be used to cool the interior during summer by flushing the hot air that has gathered during the day, at night (Brophy & Owen Lewis 2011:81).

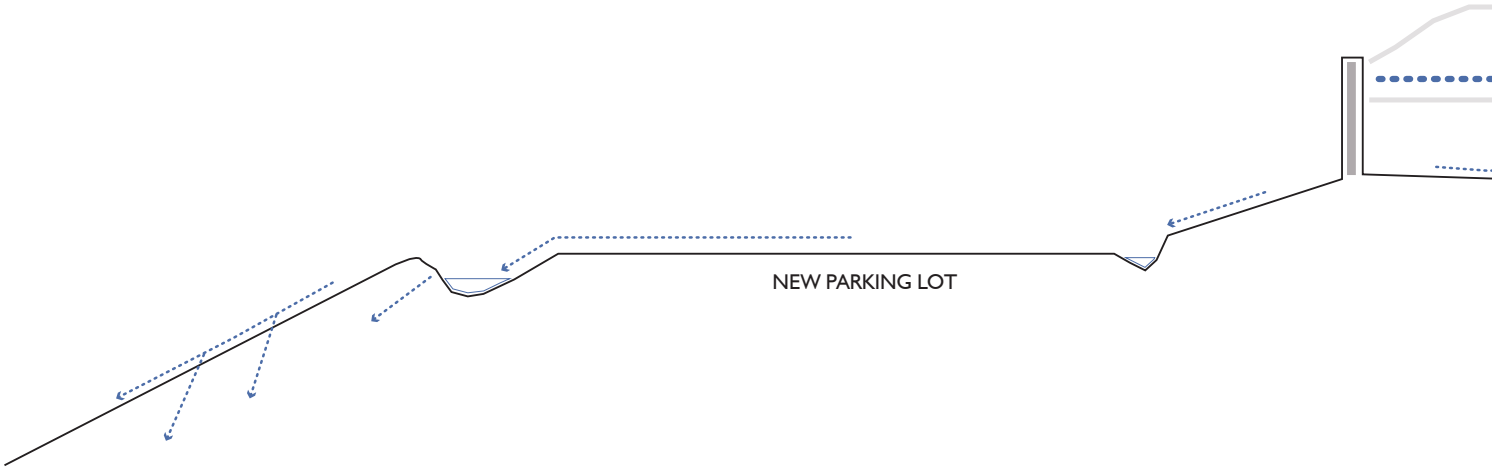



*FIGURE 7.25_Diagrammatic section indicating flow of water from berms and reticulation paths (Author 2017)*

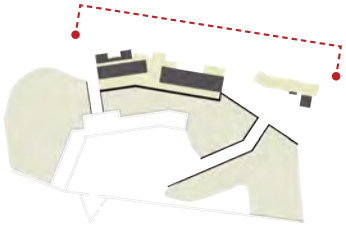
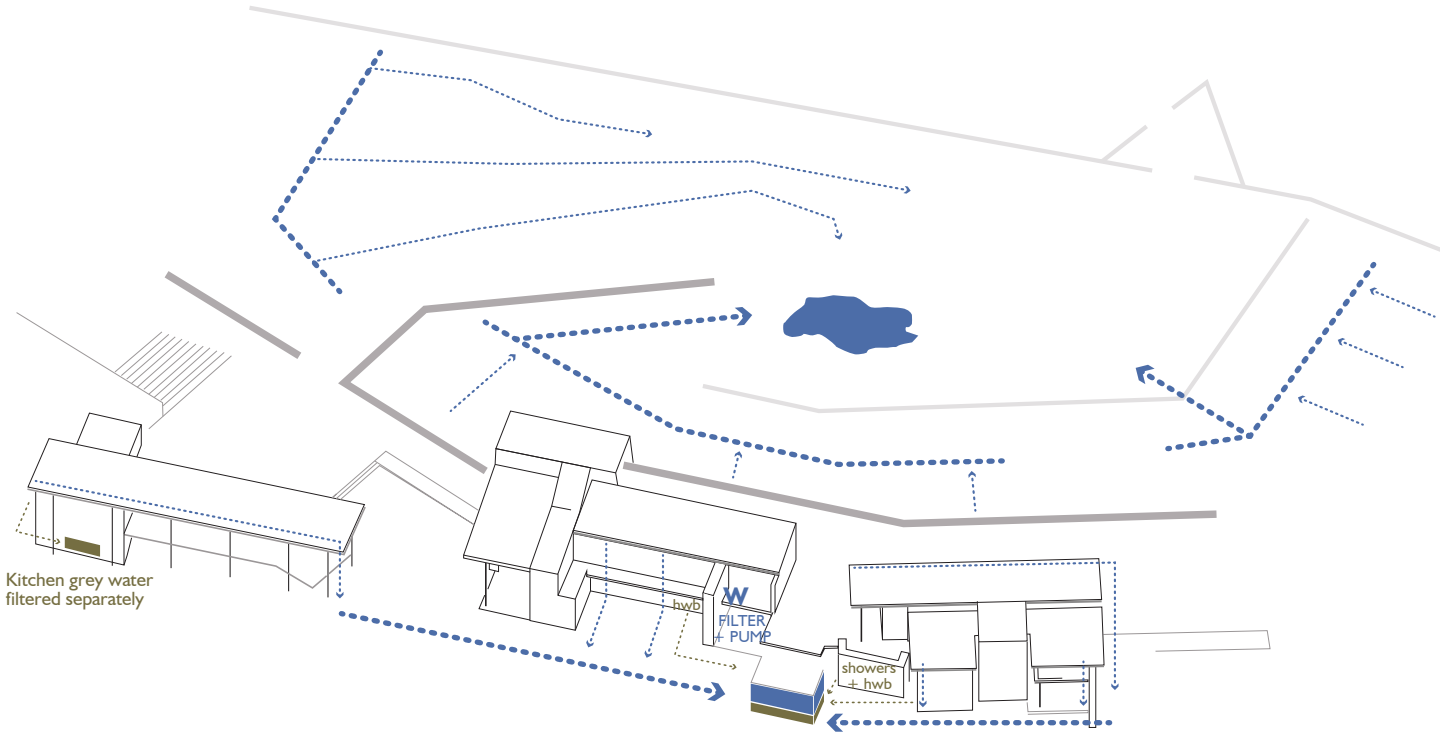
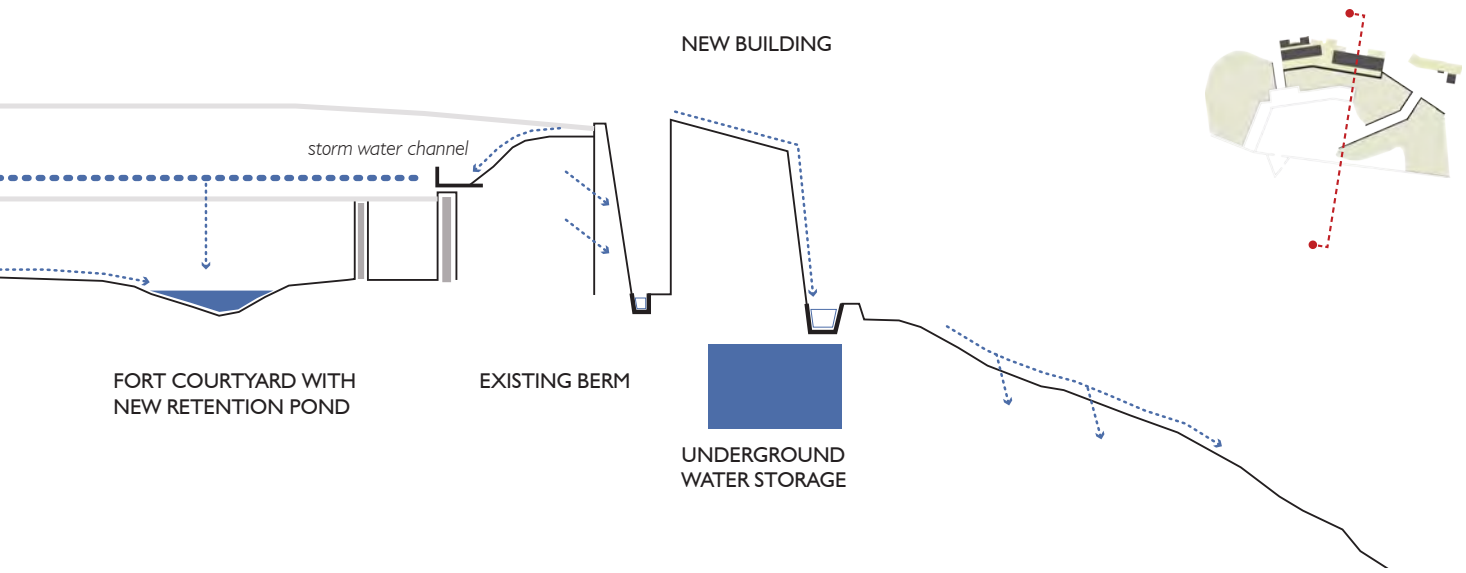


*FIGURE 7.26_Diagramme of clean and grey water reticulation on site (Author 2017)*








## 7.5 Service systems

### 7.5.1 Water

When designing for water the following are important considerations:

- Minimizing the demand
- Minimizing waste water
- Separating cycles to avoid the contamination of clean water sources.

This section considers how water will be captured, cleaned and reticulated. Solid waste is managed in a waterless toilet system and is discussed under section 7.5.3.

The site relies entirely on the capturing of rainwater as the water table at this location is impossibly deep. "*A natural drainage system mimics nature, eliminates sewage treatment concerns and costs substantially less to build*" (Brophy & Owen Lewis 2011:55). The water system collects water for the buildings needs, but also manages storm water runoff and subsequent erosion and damage to heritage structures. Water is collected from the roofs and from the berms (figures 7.25 & 7.26). Site grey water is treated through a commercial percolation system and filter. The nature of the site does not accommodate a natural wetland for cleansing. Once treated, water is stored on site for landscaping. In the fort's cool courtyard, an artificial holding pond stores rainwater for use on site, but also allows excess water to percolate back into the soil. Filter strips of permeable ground cover serve the same purpose.

The hot water demand is met through solar collectors situated on the roof above the ablutions. A flat plate collector is suitable in the given context (Brophy & Owen Lewis 2011:102).

**WATER YIELD (per month)**

Catchment area: max. average yield 65m$^3$ in rain season

Grey water yield: average 60m$^3$

Max yield per month: 120m$^3$

Min yield per month: 60m$^3$

**WATER DEMAND**

(Calculated according to SANS 10400 recommendations as specified in section 3.3)

Washing: 750l per day

General consumption: 150l per day

Kitchen: 500l per day

**Domestic demand per month (average): 40m$^3$**

**Irrigation (per month): max 40m$^3$; min 16m$^3$**

**STORAGE CAPACITY REQUIRED**

Grey water: 60 m$^3$

Rain water: 70m$^3$

**TOTAL: 150m$^3$**

* See appendices for full set of calculations.

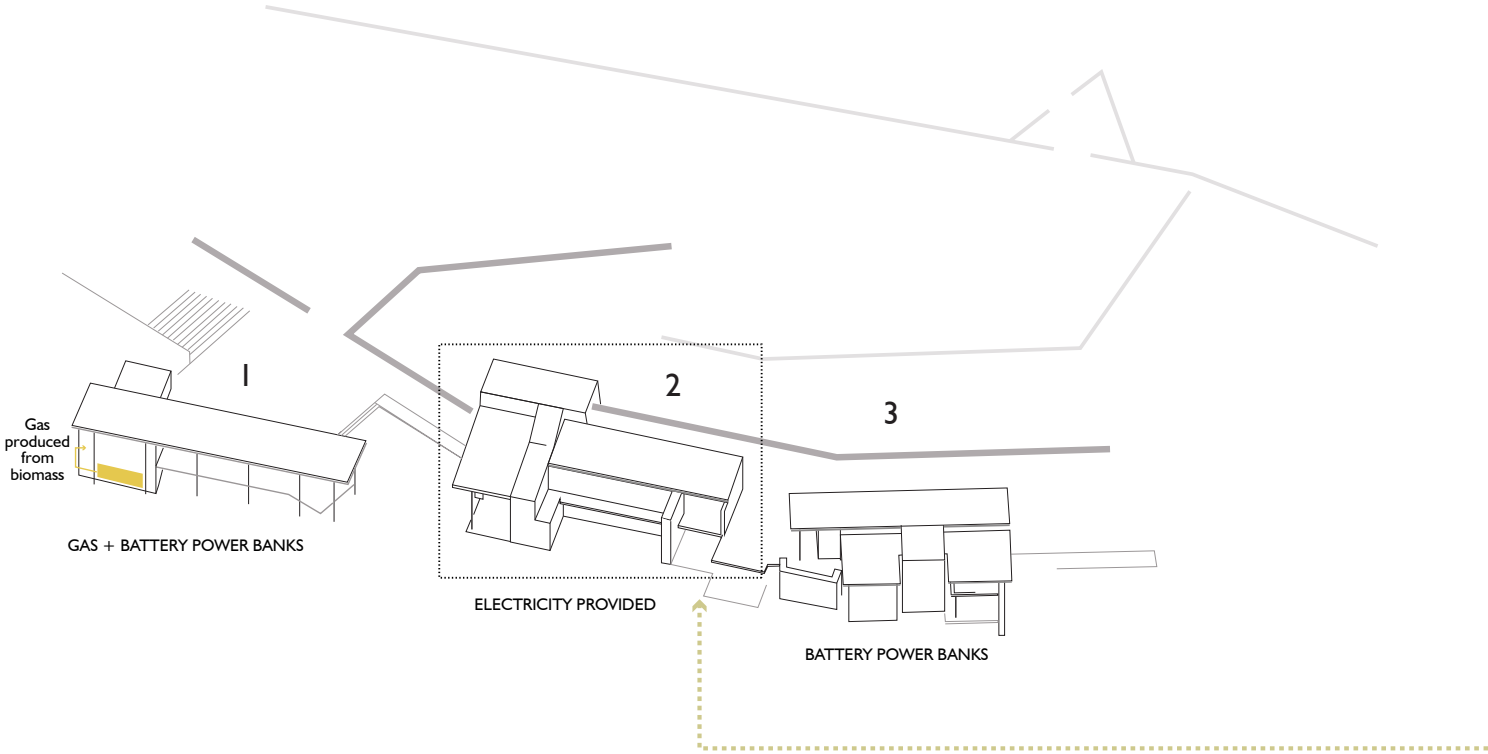



*FIGURE 7.27_Energy strategy (Author 2017)*

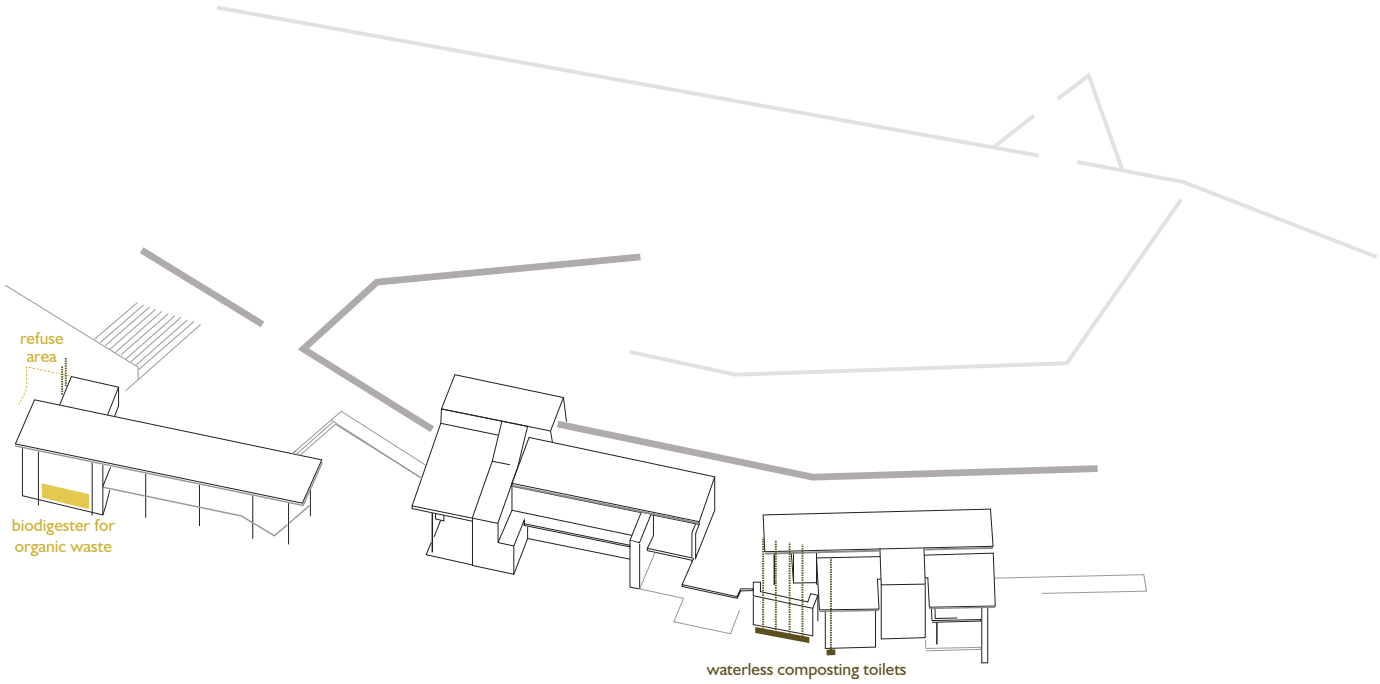



*FIGURE 7.28_Waste strategy (Author 2017)*

### 7.5.2 Energy

The complex is divided into three buildings each with different energy requirements:

1. The Cafeteria runs on its own supply of biogas with additional battery power banks employed for electrical appliances.

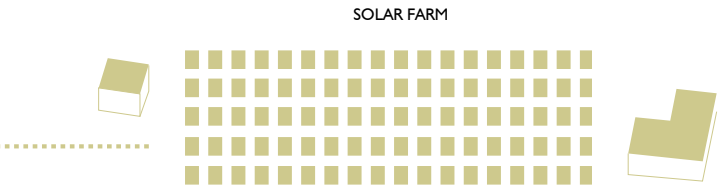
2. Activities with high electrical energy demand are grouped together in the central building.

3. The Recreational building uses minimal energy and therefore minimal electrical infrastructure. Removable batteries can be used to meet additional needs.

Electrical energy usage is minimized by providing proper daylighting, ensuring adequate ventilation and installing energy efficient equipment. The functions which require electricity are grouped together in the central building which is designed to accommodate the services and deal with additional heat gains. Electrical energy is generated by PV panels. The entire solar energy installation is situated where the old telecommunication infrastructure was located. The old buildings are repurposed to house the batteries and converters, the panels are installed in the degraded landscape and the existing service road provides easy access. The diagramme (figure 7.27) illustrates the installation on site.

The estimated average consumption per month is 160 000 kW and the estimated PV installation that is required to meet that demand is 2200m$^2$. Energy requirements have been tabulated (refer to appendices).

Gas is the main energy source in the cafeteria's kitchen. It is produced in a bio-digester that processes the kitchen's organic waste (figure 7.27).



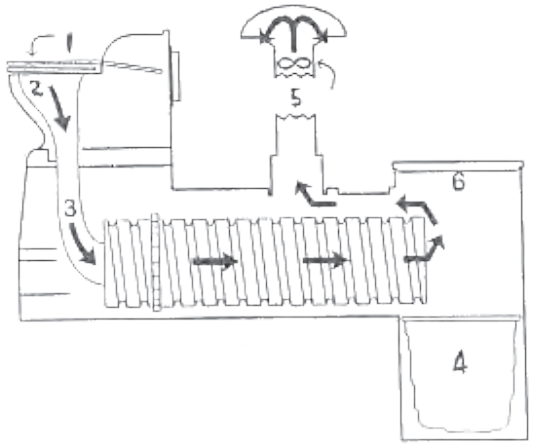




*FIGURE 7.29_Ecosan composting toilet (Ecosan n.d.)*
*(1) Toilet Lid*
*(2) Vertical Chute*
*(3) Helical screw conveyor turns when lid is lifted*
*(4) Reusable collection bag cleaned every 6 months*
*(5) Ventilation pipe*
*(6) Access lid*

### 7.5.3 Waste

Organic kitchen refuse is converted in a bio-digester to biogas for cooking and refrigeration. Non-organic material is collected in the refuse area which is situated behind the kitchen at a point close to the parking area from which it is regularly removed (figure 7.28).

Sewage is dealt with by the waterless ECOSAN composting toilet system (figure 7.29)(Ecosan n.d.). The composting toilet rotates when the toilet flush is pulled to extract the waste. The waste degrades in a composting pit. A solar chimney facilitates the process and manages odours.

# SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL

1.04

Achieved

## SB SBAT REPORT 3.4

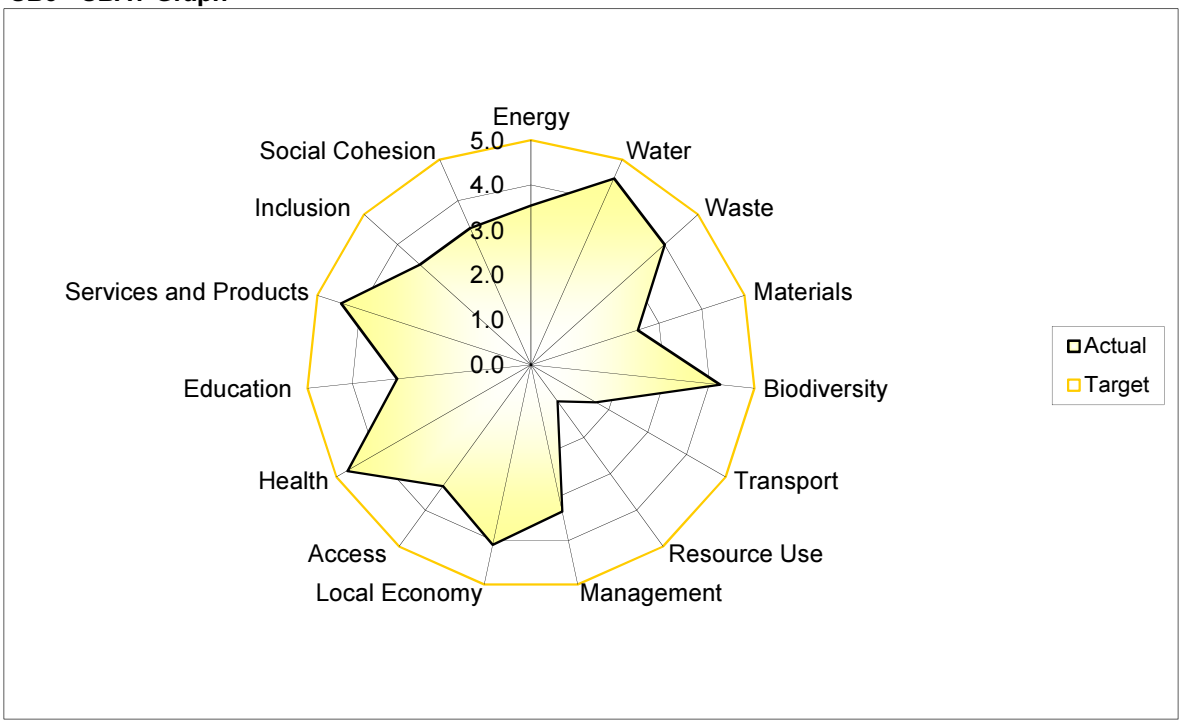
**SB1 Project**

Rehabilitation Healthcare Practice

**SB2 Address**

Wonderboom Nature Reserve

**SB3 SBAT Graph**




| SB4 Environmental, Social and Economic Performance | Score |
|---|---|
| Environmental | 3.8 |
| Economic | 2.7 |
| Social | 3.8 |
| SBAT Rating | 3.4 |

| SB5 EF and HDI Factors | Score |
|---|---|
| EF Factor | 3.1 |
| HDI Factor | 3.8 |

| SB6 Targets | Percentage |
|---|---|
| Environmental | 75 |
| Economic | 54 |
| Social | 75 |

*FIGURE 7.30_Report of the project generated by the Sustainable Building Assessment Tool (SBAT) (Gibbert 2017)*

# 8. CONCLUSION

The architectural dissertation is not scientific in nature and does not provide a singular proven answer to a hypothesis. Rather, it unpacks the process of design in order to engender cognisant decision making. This dissertation is therefore a testimony to an undertaking which grappled with the specifics of a context, a programme and theory; and the meaning or purpose of architecture in general. The site was chosen for both practical and personal reasons: personal because the author has always had an affinity to the hills and landscape of Pretoria; practical because the changes in the political, aspirational and physical fabric of the city demand that we consider *who* our city is.

The Tshwane 2055 vision (City of Tshwane 2013) intends to connect the sprawling city and develop cores within existing areas which can guide further coherent development and densification. The north of Pretoria is geographically disconnected by the linear Magaliesberg. The Wonderboom Nature Reserve is located between two of the arteries which connect the northern suburbs and industries to the city. There is an opportunity to reconsider the role of the nature reserve while proposals for the future of the precinct are on the table. Although the focus of the dissertation is on the specific attributes of the reserve, it contributes a general understanding of, and approach to, urban nature reserves. To make green areas an integral part of the city, they need to be given purpose beyond being cordoned off [research question 1]. Active conservation, rather than preservation strategies, need to be implemented.

The site's historical, cultural and natural significance are attributes which, when showcased, can revive the site and generate revenue for its continued protection [research question 3]. Development in cities need not only pose a risk to natural environments. In line with the IUCN's mandate on urban green spaces (Trzyna 2014), they should be given purpose within the daily functioning of the city. This will contribute to conservation endeavours in general because it will engender an incentive amongst urban inhabitants to nurture protected natural areas. To this extent some level of development is needed to facilitate specific human activities. Green spaces' contribution to urban areas is not limited to ecological benefits [research question 2]. They also have huge psychological and emotional benefits (Bragg, Wood, Barton & Pretty 2015). Unfortunately, this benefit only becomes apparent when people experience the environment first hand. The dissertation focuses on creating opportunities for people to engage with nature and profit in this regard.

Architecture is the tool and the activity which allows us to engage with the environment. Works of architecture are the manifestation of previous engagement. To enter into an appropriately sensitive dialogue with the environment [research question 4], a guideline was required. DeKay's approach to integral sustainable theory was applied. Sustainability in architecture focuses on improved relations between man and environment within the context of the building industry. DeKay (2011) approaches this relationship from the four perspectives of integral theory, stating that sustainable architecture cannot only be evaluated in terms of its performance or integration into natural systems, but should consider the human experience and cultural perspective too. This approach advocates that we should design to "*place people into rich and significant relationships within nature*" (DeKay 2011:321).

The site lends itself to recreational well-being activities [research question 3]. The introduction of a private rehabilitation practice, as an additional programme, brings activity to the site during the week. It also contributes an alternative income and increases safety through passive surveillance. The larger contribution, however, lies in the potential of the building and services to support public recreational activities and events. The building can serve outdoor activities, such as a ceremonial gathering, sporting event or concert for example, which may be hosted in the confines of the fort's courtyard. The dissertation's approach to heritage [research question 5] corresponds to that of Frescura (1985) and Calcatinge (2012) who state that past human endeavours eventually become part of the landscape with which we engage and should be viewed as such, not as objects to be preserved.

Wonderboom Nature Reserve's relation to the surrounding neighbourhoods and physical connection to the city could have been considered in more depth. This was not included in the scope of the project as an immersion in the natural environment became the driving factor for the project. The urban group's proposal of developing the river belts and the reserve as a coherent recreational strip also provides opportunity for further investigation.

The project synthesizes far-ranging perspectives and a wide variety of information regarding the site to which it subsequently responds to through design. Specific theoretical perspectives are applied to the design project in an attempt to look holistically at the issue of sustainability in South African architecture. Architectural form manifests these ideas. Materials which are of the site are manipulated to create spaces which bring humans into the realm of nature .

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# 10. LIST OF FIGURES

## 1. Introduction



## 2. Article



## 3. Informants

## 4. Initial perspectives



## 5. Design Development

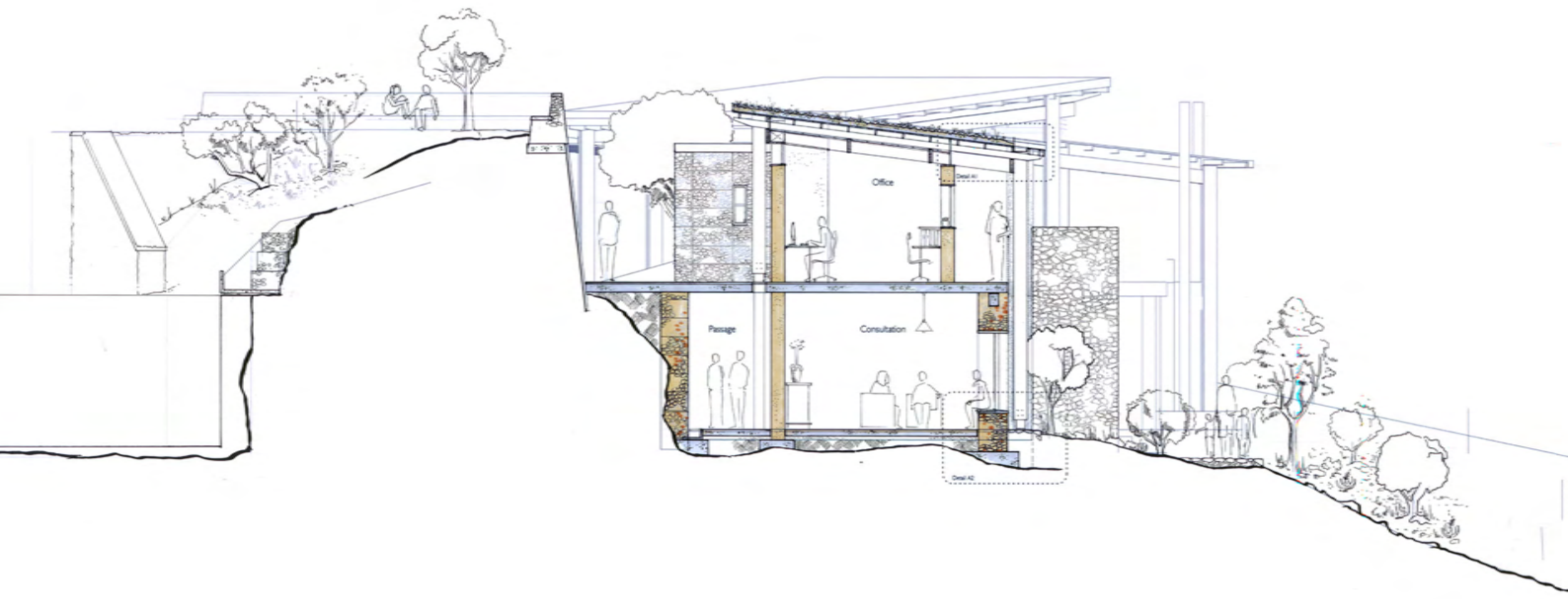


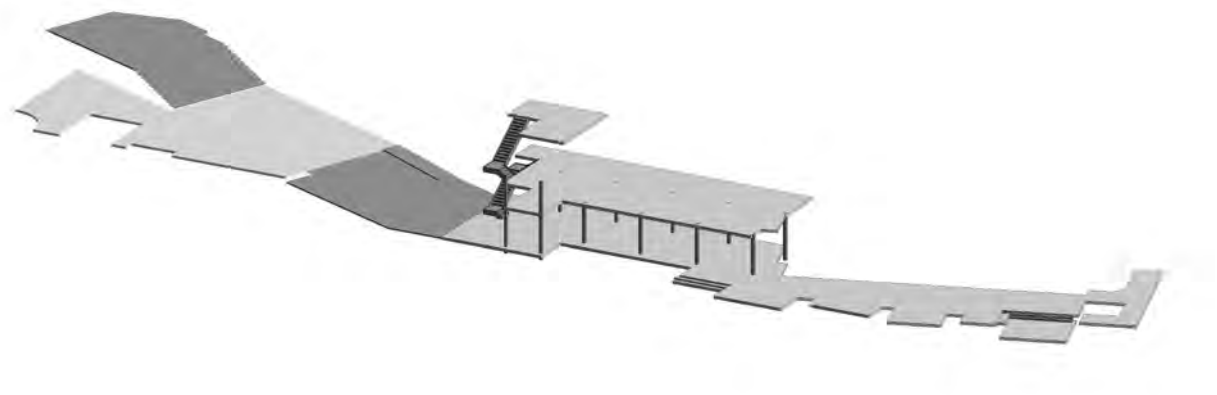
## 6. Design Decisions

## 7. Technology

# 11. APPENDICES

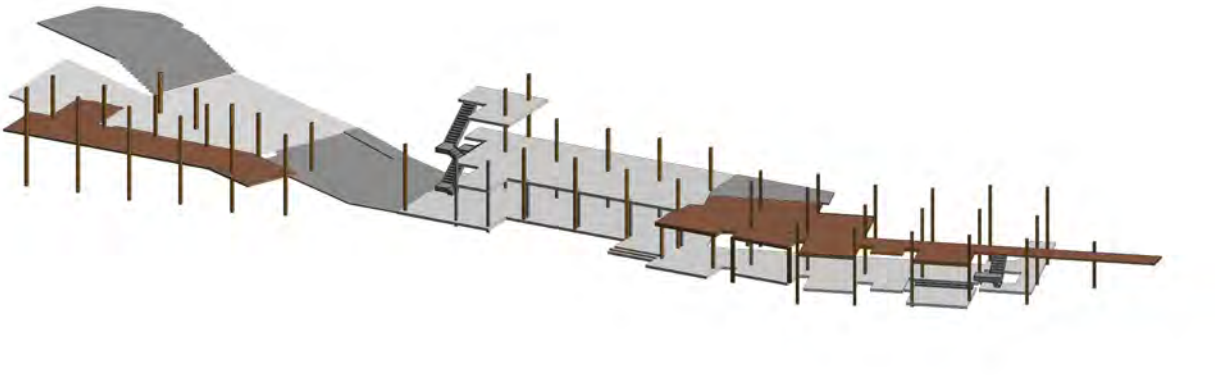




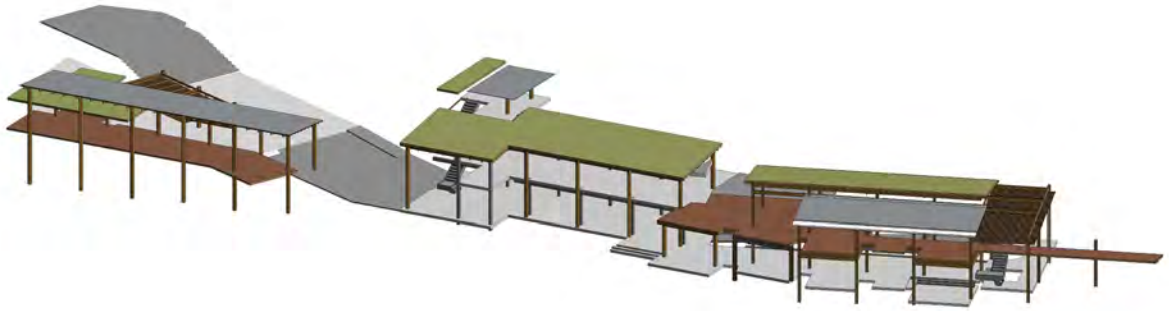


*Primary Structure - In situ Concrete columns and floor (Soilcrete Surface bed throughout)*

*Primary Structure - Structural Timber Columns & Beams; Timber Floor and roof substructure*



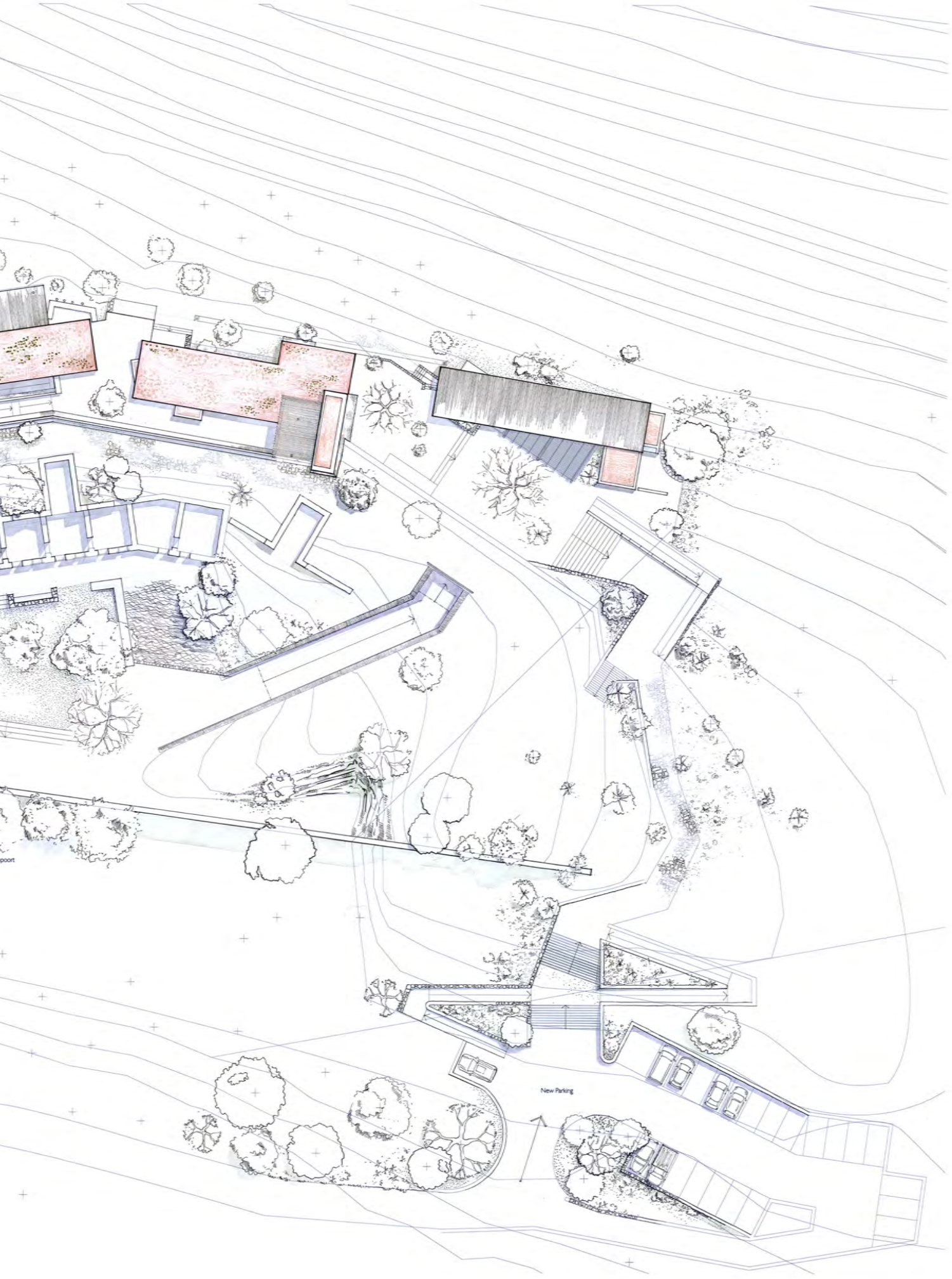
*Suspended Floors: timber boarded Floors with Compressed Earth Tiles (Brown) and Concrete Floors (Grey)*

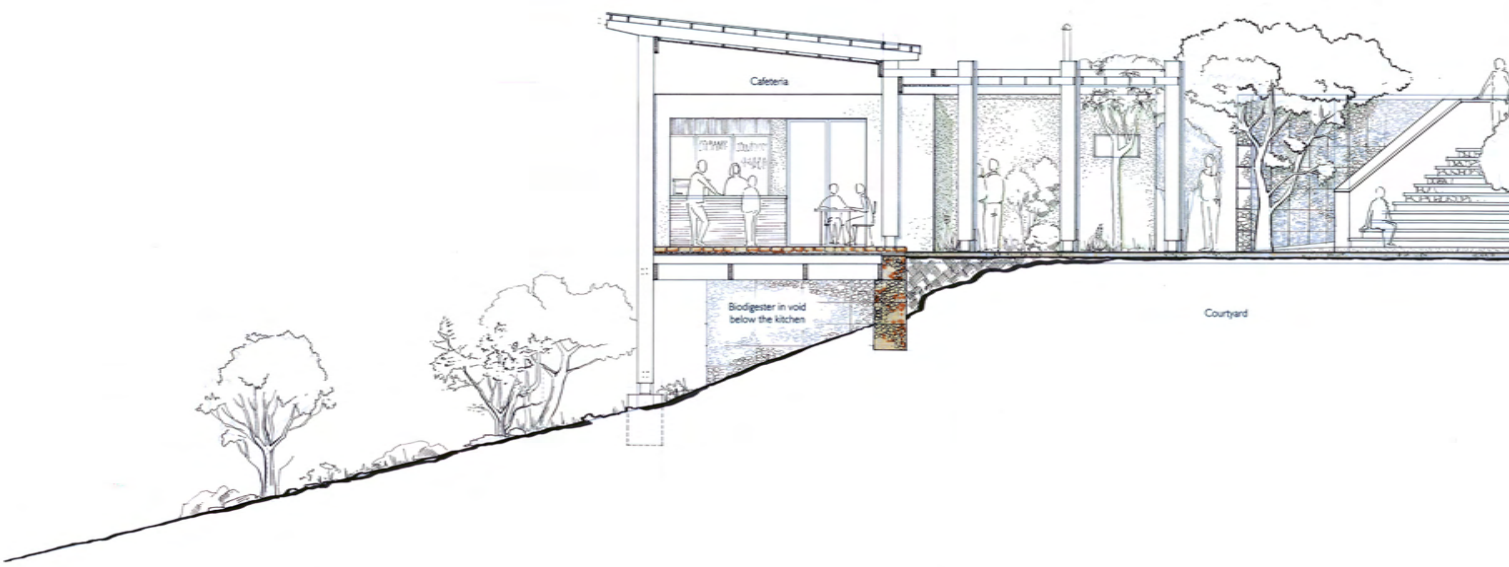


*Roofs: Planted Roofs (Green) and Steel Sheet Roofs (Grey)*

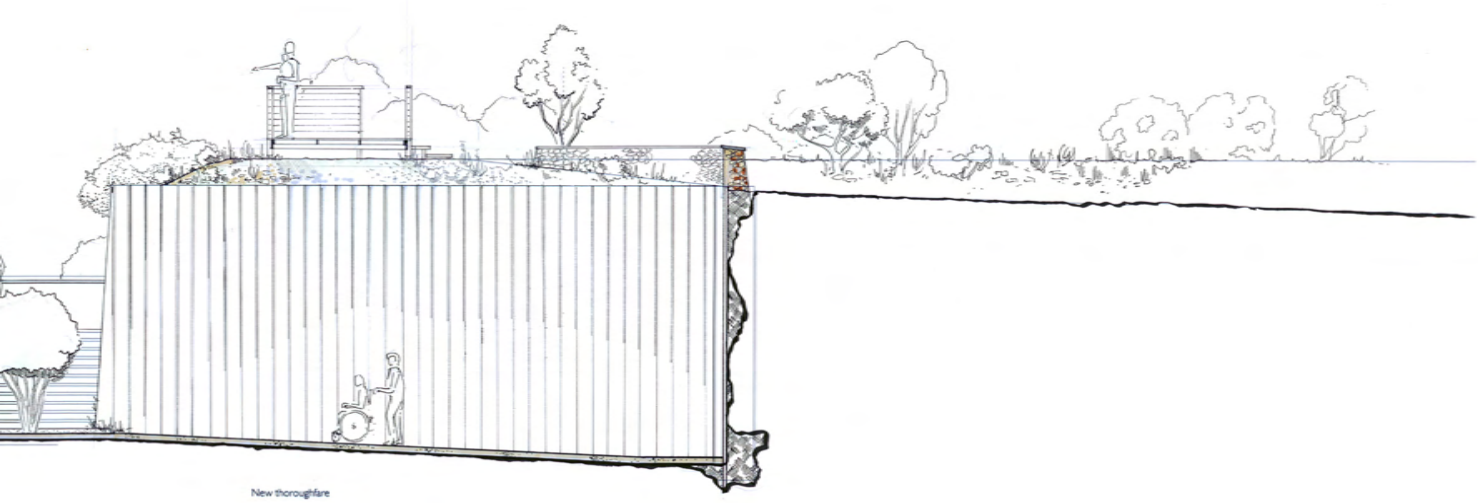
*Walls: Plastered Sandbag Walls (White) and Stone Gabion walls (Brown)*

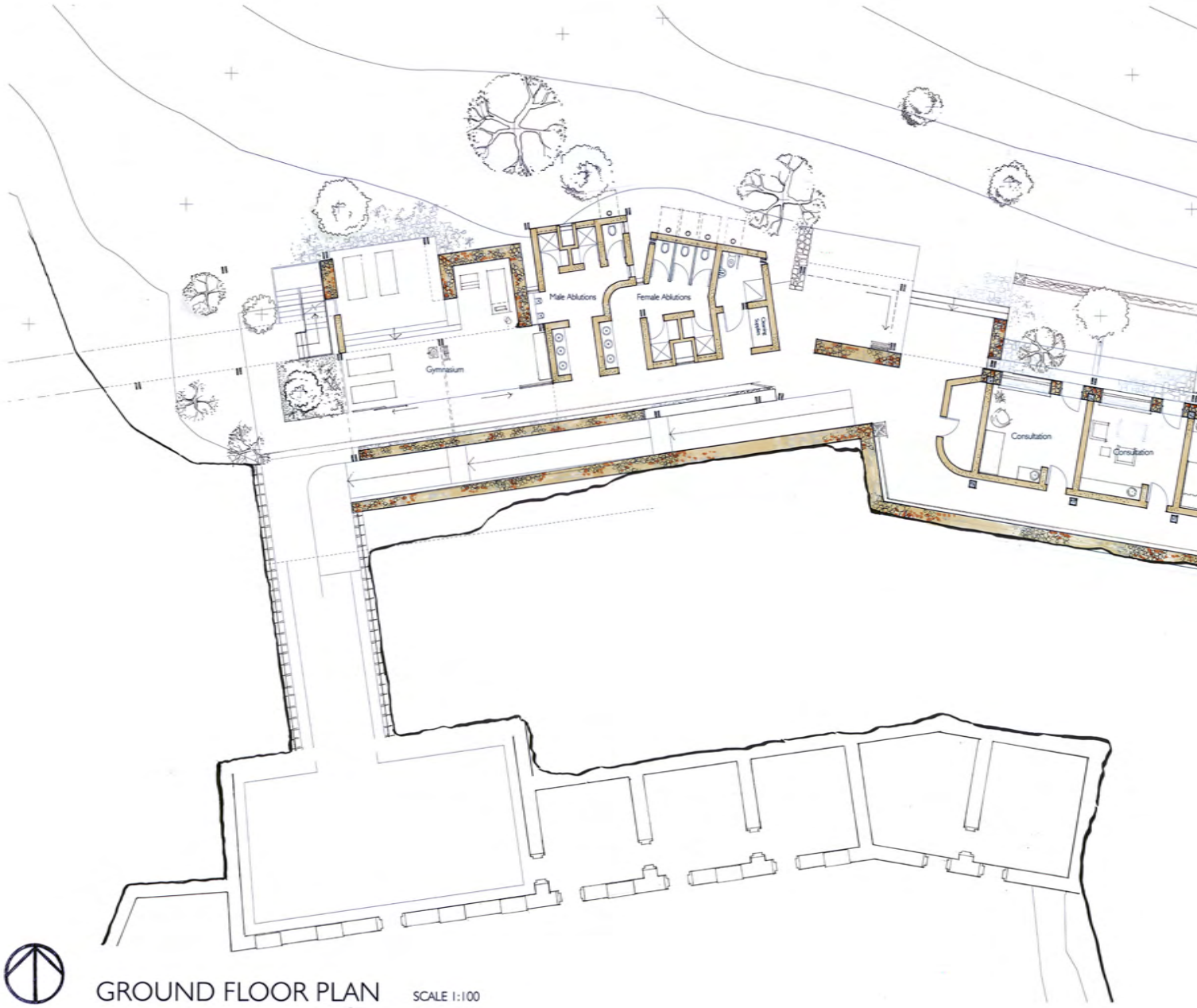

SITE PLAN SCALE 1:200



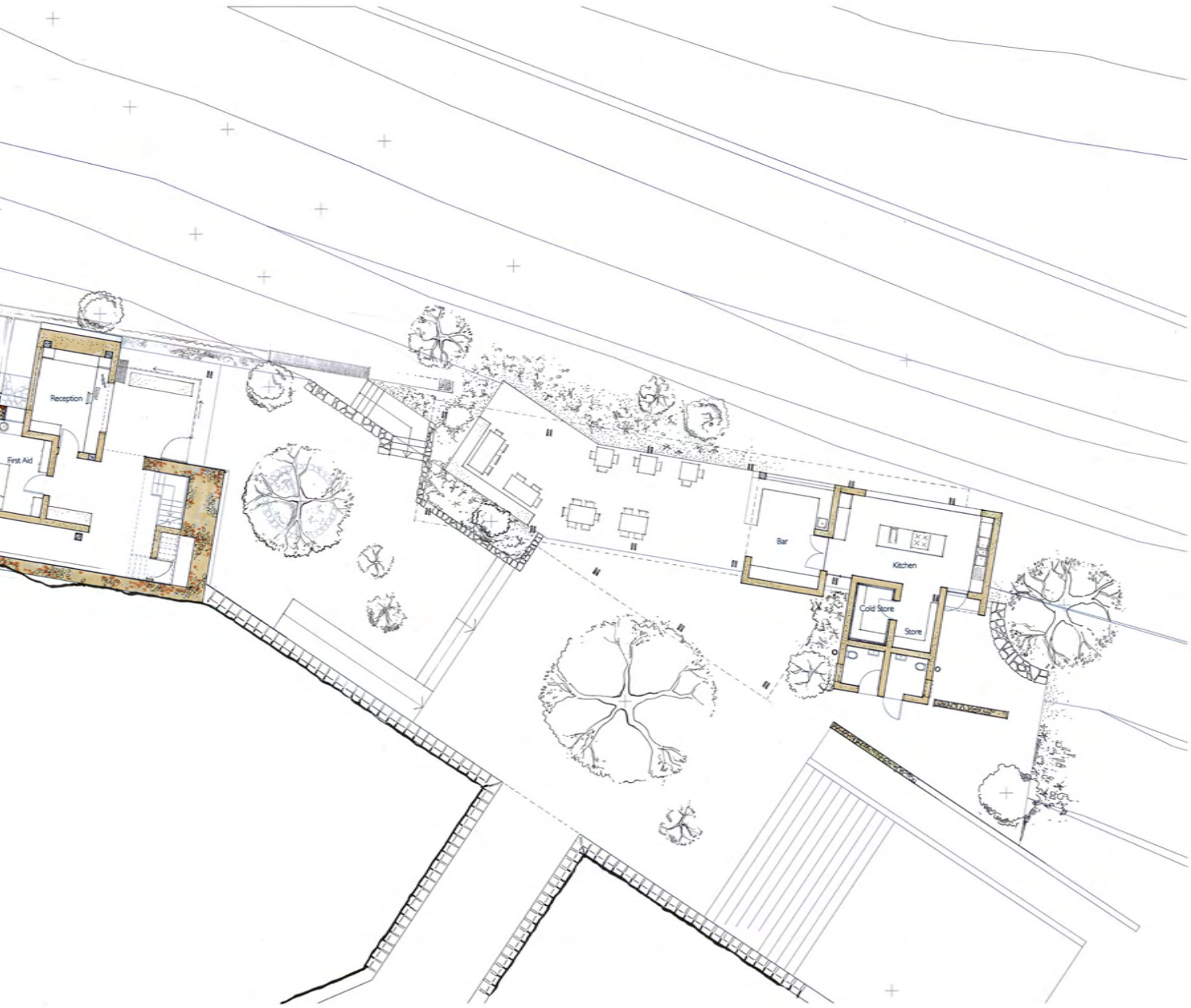


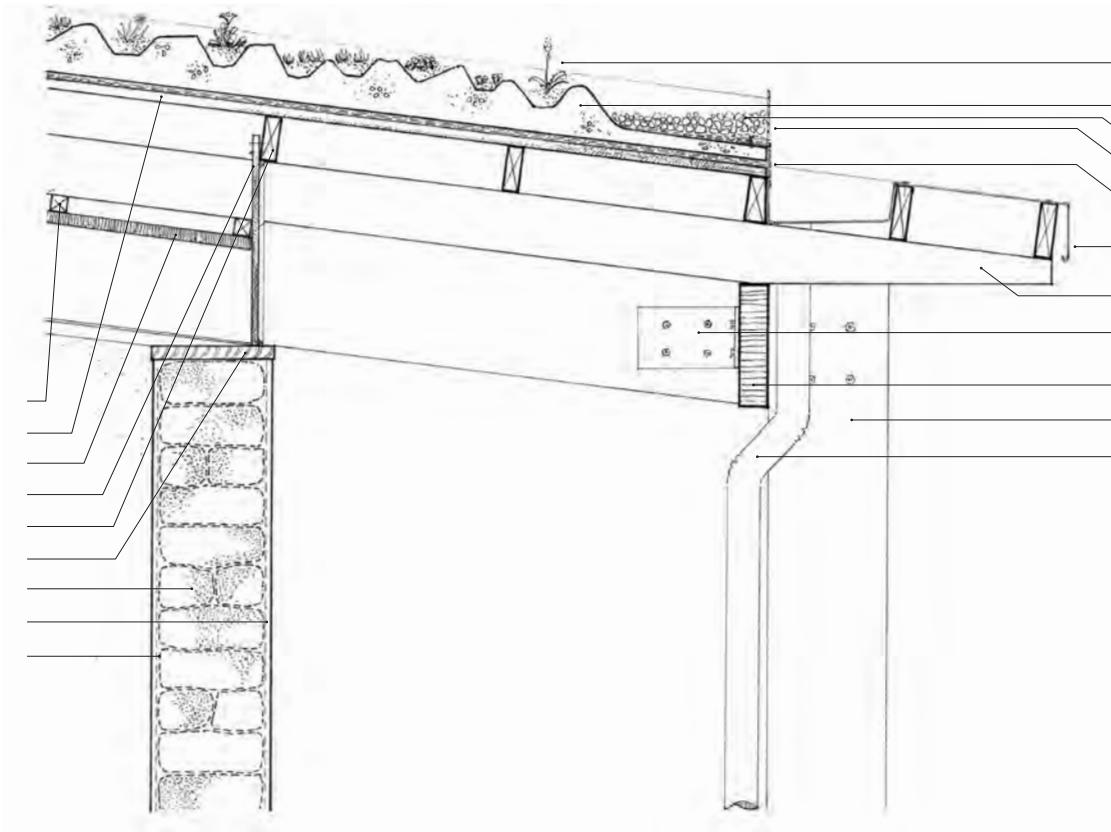

SECTION B - B SCALE 1:50






GROUND FLOOR PLAN SCALE 1:100





38 x 38 SA Pine brandering nailed to rafters at 700 c.c

30mm Plywood roof decking nailed to battens

30mm Isoboard ceiling nailed to brandering

15mm Plywood panel fixed to wall and battens

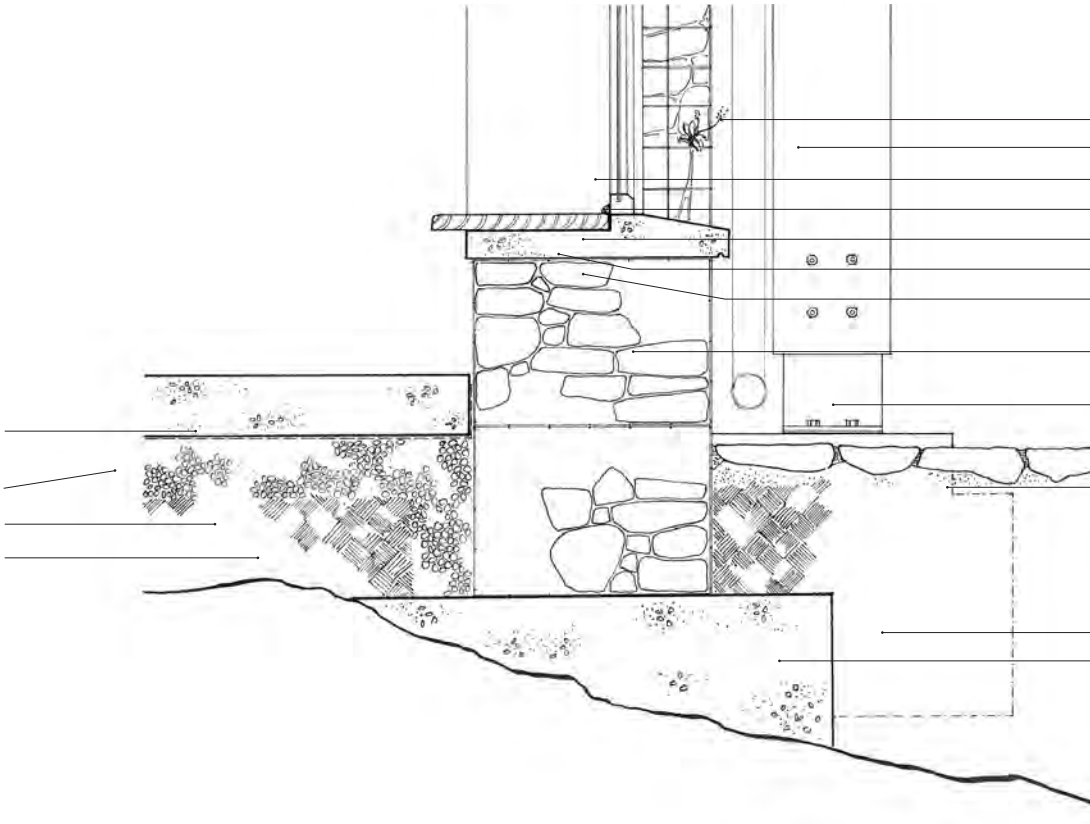
32 x 108 SA Pine batten fixed to rafters at 600 c.c

Varnished 30mm SA Pine wall plate

Plastered and painted 300mm sandbag wall

Exposed exterior finish: Reinforced cement plaster

Interior and protected exterior finish: Reinforced earth and lime plaster



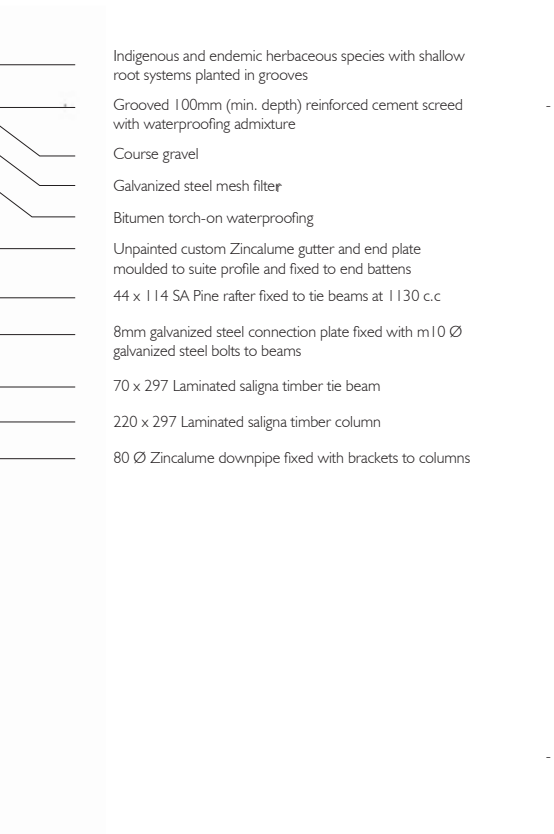
Powerfloated 150mm Soilcrete surface bed poured onto a geotextile layer to prevent the seepage of fines and concrete into the gravel capillary break layer

Geotextile

150mm - 200 mm Course gravel (capillary break)

Compacted ground fill

## Detail A1: Health Practice building roof structure detail




## Detail A2: Health Practice building foundation and wall detail