

expecto
PATRONUM

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EXPECTO PATRONUM

Protecting the irreplaceable by creating a Bio-sanctuary to cultivate and sustain South Africa's endangered pollinator species.

An investigation into the creation and design of an artificial environment and how it can be introduced into a degrading habitat to cultivate and sustain a dying species.

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Thesis M.Arch Prof

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Figure 0.1: Cover - by Author

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EXPECTO PATRONUM

Expecto - (verb) I look / I wait
Patronum - (noun) A Protector



Figure 0.2: Harry Potter Expecto Patronum Illustration

ABSTRACT

Our natural world is currently undergoing a drastic and radical transformation! Human agency has led to the erosion of the very foundations of our livelihoods, economies, food security, health and quality of life. Ecosystems, which form our life support systems and our safety nets are shrinking and collapsing. At the heart of this collapse are pollinators, such as butterflies and bees, key species responsible for maintaining these vital ecosystems, whose very existence is being threatened by human activity.

This thesis depicts a series of explorations, re-defining the environment and surface needed for pollinators in this new age of man vs nature, before manifesting and putting forth the creation of a version of an artificial environment. This version of an artificial environment is presented as a solution to sustain and revive endangered pollinators and the degrading context of the proposed site.

This thesis looks at how architecture, in its physicality, can not only assist ecosystems and pollinators in their fight for survival but also act as a catalyst for a process of awakening and awareness. The intervention proposed in this thesis aims to create a space that negotiates between the two worlds of pollinators and humans, at the intersection of the built form and the natural environment. In doing so, this will ensure a space that benefits both people and pollinators, at their respective scales. The design of this new surface / artificial environment aims to aid pollinators year-round both naturally and through artificial means, while also showcasing their contribution to human life and research to aid their survival.

The thesis demonstrates the demise of nature, illustrating the impact humanity, as a species, has had and continues to have on the natural world, primarily on the lives of pollinators. A focus on the demise of pollinators is addressed, as their brink of extinction stresses a fundamental link between the two causes of collapse and how by saving pollinators, nature in turn can be revived. By doing the above, this thesis will advocate for the creation of an artificial environment as an effective solution to sustain and revive South Africa's endangered pollinators.

Key Words:
Artificial Environment . Pollinators . Ecosystems .
Nature . Ecology . Conservation . Biodiversity

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PROLOGUE:
A LETTER TO HUMANITY

BY AUTHOR



Figure 0.3: Dear Humanity

Dear Humanity

It feels quite odd writing you a letter. I'm aware they are usually addressed to an individual and I'm not quite sure of your post address, nevertheless I thought it was time I wrote to you all, as I can no longer avert my eyes.

Humanity you have truly come a long way, and for that you should be congratulated. No other species has shaped their environment quite like you have. In a span of 200 000 years you have emerged as a powerful product of evolution, gone are the days of this unremarkable human species. You have moved and spread all over this beautiful planet from the oceans to the grasslands, from the desserts to forests and from the surface to the moon. Again, for this you should be congratulated.

There are some amongst you that believe you should continue exploring, going beyond the earth and discovering what lies beyond the stars. It's here where I kindly ask you to take a seat, for the universe does not want you quite yet. We believe you should fix or at least try to fix the problems on your own planet, before you seek refuge on the ones that exist amongst the stars.

You see, while you've been expanding and shaping your environments you have ultimately caused far too much harm to the planet. The world that once existed in balance without you, is slowly but surely falling apart, with the natural world slowly dying. This may seem harsh, but it needs to be stated; Humanity, you have caused a lot of problems, from global warming to a drastic decline in biodiversity. The level of harm you have inflicted on this planet is insufferable.

This is not an accusation, but merely a fact.

You have affected the fate of your planet's future, your only home, however you are not the only species that exist on this planet and call it home. Your actions have dire consequences for every living thing on Earth, a responsibility that carries a lot of weight with it. However, I am hopeful you will find your way out of this hole you have dug. I believe you have the ability to reverse the damage you have inflicted.

If you do not think you are equipped with the skill and strength to do so, then you should have stayed in your cave, but as we all know, that is not your style. Please stop using this planet as if you have another one to go to, you do not.

"Words are, in my not-so-humble opinion, our most inexhaustible source of magic. Capable of both inflicting injury, and remedying it."

You know what is wrong, you have the means to fix it…

01

"Dark and difficult times lie ahead. Soon we must all face the choice between what is right and what is easy ."

- Harry Potter and The Goblet of Fire.

THE BEGINNING

EXPLAINED

_This chapter provides a brief introduction to this research report and explains the formation of the core concept, its themes and research questions.

INTRODUCTION

TITLE

The title of this thesis, *Expecto Patronum*, is a spell made popular by the Harry Potter book series. This spell protects the spell caster from death, by summoning a patronus or a guardian. A patronus is a positive force, a projection of hope and the desire to survive. This thesis explores the relationship between architecture and nature and places architecture as the patronus or guardian. In doing so it begins to explore how architecture can protect ecosystems from dying out, by protecting its key species pollinators from dying out, and in turn protecting humanity by preventing our demise.

ISSUE

According to a study published by the World Wildlife Fund, humanity has wiped out 60% of all known animal species since 1970 and at least half of all plants that once existed (Carrington, 2018 A). Currently, our natural world is dying, with one of the core factors being the collapse of countless ecosystems. Ecosystems form the foundation of the biosphere (all living things on earth) and ultimately determines the health of our planet (Eschooltoday, 2018). Ecosystems are collapsing because pollinators, the species at the centre of these systems, who are responsible for maintaining them, are dying out as a result of human action. Consequently humanity's destruction of nature is affecting the maintenance of these ecosystems, causing them to collapse, hindering natures ability to provide food, fresh air, clean water and security to a multitude of people.

The result is a cascading domino effect, with damage rippling throughout the structure of all ecosystems, fracturing and breaking the millions of connections that lie at the centre of these ecosystems, resulting in chaos and destruction. Human society ultimately depends on these webs of life for clean air, fresh water and healthy food. The damage is so severe that the need to protect nature has exceeded the desire to protect species for future generations. It has become a matter of life and death for the current human population. Nature is not, simply put, a nice-to-have, it is our life support system and it is failing fast! If humanity has any hope of reversing the damage done and ensuring its continued survival, immediate action needs to be taken. It has become extremely clear that what we do to nature we unconsciously do to ourselves, for we the human species, are part of nature's fabric.

THE SPARK

THESIS PHILOSOPHY

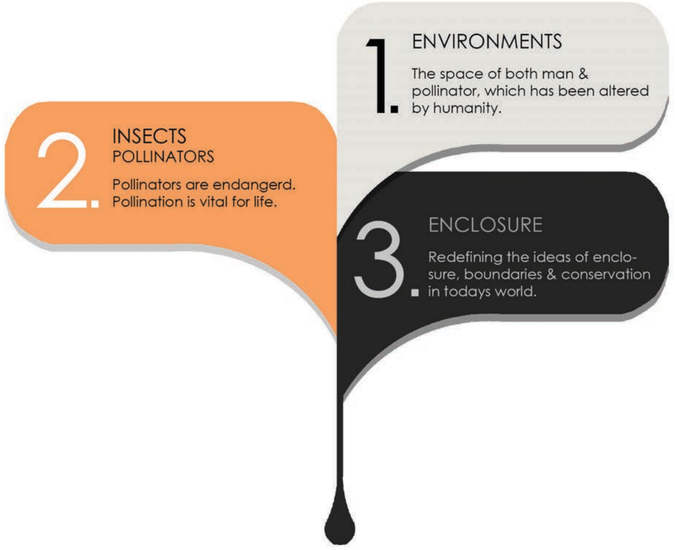


Figure 1.1: Thematic Connections - by Author

When approaching the decision of choosing a topic to research, write and design for a year, I started by looking towards the natural world (our green spaces and environments), with the concept of nature and architecture being something that had always interested me. It was around this time that I read an article on how The President of the United States of America's proposal for a border wall with Mexico, would result in the bulldozing of a large portion of the US National Butterfly Centre. Further research led me to discover that butterflies and bees were drastically declining globally, an issue which had larger cascading consequences for all species on earth.

I began to consider architecture's responsibility to the world of pollinators and how architecture could assist in reviving and restoring their habitable spaces, not solely for the benefits of humans but for the many other forms of life on earth that rely on these spaces. I began to wonder how architecture could help pollinators thrive and reduce their decline.

On one hand, I am aware that it is a larger debate between architecture and its relationship with nature, however the aim for this thesis was to focus and locate the idea of restoring a habitat and helping pollinators thrive, at the scale of building and a bee / butterfly and the intersecting layer between these two. In this way, the design becomes a mediating membrane between the two worlds and two scales. With this in mind I began looking at three themes; environments, Insects (pollinators) and enclosure (figure 1.1), to explore how the issue of pollinator extinction could be better addressed through architectural design.

If one considers bypass grafting or prosthetics as one of the many way's humanity has intervened to save a dying environment, or even the controversial approach of zoos and aquariums, then what if the same approach were applied to the issue of pollinator extinction? The creation of an artificial environment to save and sustain a dying natural environment made me question if is it possible to develop an artificial environment that emulates what the natural environment was once able to achieve, while also aiding the growth of the now existing, 'new' natural environment?

My questions above, together with the ideas of responsibility, aiding in physicality and the creation of the artificial, allowed me to formulate my research question:

Can architecture work in tandem with nature above and beyond sustainable design, in a way that allows the built form to cultivate and strengthen South Africa's ecosystems, by creating an artificial bio-sanctuary to cultivate and sustain South Africa's endangered pollinator species?

RESEARCH METHADOLOGY

THE PROCESS

In the initial stages of this thesis I began by reading literature and online articles on the issues facing pollinators and ecosystem collapse. This was done to better understand these insects, how they live, what makes up their environments and the reasons they are disappearing. This stage of research allowed me to understand the current state of the natural world and humanity's involvement in its dramatic decline. This research was balanced with research that looked at current solutions to the pollinator crisis and more progressive approaches to nature conservation. This information was valuable to my understanding of the issues facing pollinators, which was necessary in order to formulate possible solutions. The chosen material was written by reputable sources, professionals and avid individuals in the field of conservation and entomology, to ensure a comprehensive understanding of pollinator decline.

Thereafter, I began the process of site selection, exploring areas that were both degrading and inhabited by the chosen pollinators of butterflies and bees. Upon finding such a site, research unfolded into a series of site visits, wherein I documented the site through rough sketches and a series of photographs, enhancing my understanding of the site in relation to its context and the pollinators that inhabited it. The research continued to unfold into a series of explorations and iterations, with additional research required at various intervals. Each stage built on the previous, learning from the information discovered and lessons learnt before moving forward onto the next stage.

02

"Understanding is the first step to acceptance, and only with acceptance can there be recovery"

- Harry Potter & The Goblet of Fire

PRIMARY RESEARCH

EXPLAINED

_This chapter contains the primary research of this thesis. It includes an explanation on why pollinators are disappearing, what happens if they become extinct and why we need them, along with introducing the proposal of an artificial environment. This chapter also includes a site analysis and an analysis of pollinators' ecological needs and their presence on my site. In addition, this chapter illustrates the ways in which humanity has altered the natural world and proposes a more progressive form of nature conservation to be used in conjunction with my proposed artificial environment, before ending off in a concluding paragraph. This chapter explores these ideas through different representations of nature.

NATURE AS:

1 - an artificial environment
    - an introduction to my research
2 - analysed space
    - my site
3 - a pollinator's habitat
    - pollinators on my site
4 - altered by humanity
    - neighbouring humanity of my site & humanities negative effects
5 - a protected realm
    - the positive effects humanity can have on my site
6 - conclusion



Figure 2.1: Artificial meets natural - by Author

01
ARTIFICIAL ENVIRONMENT

NATURE AS AN ARTIFICIAL ENVIRONMENT

an introduction to my research

BREAK-DOWN

Introduction

Why are butterflies and bees disappearing?

The services provided by butterflies and bees

What happens if pollinators disappear?

Environments

What is an artificial environment?

The programmatic structure of an artificial environment

The year is 2080. As I breathe in the morning air, I cringe as it feels stale, different. Breakfast has become a bland array of discontent, no coffee, no fruit, just a slice of bread. As the water passes through the filter, before it enters my glass, I look outside, this world looks so different now. An array of brown and grey seem to blur together, the sun almost engulfed by smog. This world looks so different now. We were warned. We didn't listen. One by one the creatures we saw as pests started to disappear, and as they did, so did our natural world. But we still had a few trees, we thought that was enough. We thought nature could recover. We thought wrong. This world looks so different now…

INTRODUCTION

Will the butterfly become the Dodo of our children's generation? Will the bee fall into the category of the dinosaur, the once existed, the now extinct? Will the Earth still be inhabitable for future generations? This thesis aims to explore the proposal of an artificial environment to sustain and cultivate South African endangered bee and butterfly species, who are vital to the survival of nature's ecosystems and by virtue all living things on earth. This thesis will explore this idea with the overarching question, can architecture work in tandem with nature, above and beyond sustainable design, in a way that allows the built form to cultivate and strengthen South Africa's ecosystems, by creating an artificial bio-sanctuary for South Africa's endangered pollinator species? In addition, this section will explore the reasons butterflies and bees are disappearing, their role as pollinators, illustrating their contribution to ecosystems and society and the consequences that would result if they were to become extinct. This section will also investigate what an artificial environment is and the possible programmatic structure of the proposed artificial environment, and how it can contribute to the aim of cultivating pollinator species and endangered plants, while spreading awareness and promoting research.

According to a study published by the World Wildlife Fund, humanity has wiped out 60% of all animal species since 1970 and at least half of all plants that once existed (Carrington, 2018 A)(figure 2.2). Equating this to 60% of human population loss would be equivalent to losing every person in North America, South America, Europe, China, Africa and Oceania (figure 2.2), a number that frankly seems unimaginable. Despite representing only 0.01% of all life on earth (figure 2.3), humans have contributed the most to the destruction of the natural world (Carrington, 2018 B). Nature consists of a complex network of systems interacting with one another, systems that have survived for billions of years, webs of connections between all living things. These webs and connections form our ecosystems, which are the foundation of the biosphere (all living things on earth) and ultimately determines and controls the health of our planet (Eschooltoday, 2018). Our destruction of nature, is causing species at the centre of these ecosystems (pollinators) to die, causing these ecosystems to collapse, hindering natures ability to provide food, water and security to billions of people (Watts, 2018). According to the most comprehensive biodiversity study in more than a decade, natures continued demise has and will continue to result in a catastrophic loss of biodiversity (Watts, 2018), which ultimately threatens humanity's future survival.

Once something becomes extinct there is no going back. The destruction of biodiversity and the collapse of our ecosystems is due to the fact that species at the center of these webs, responsible for maintaining them, namely pollinators, are dying out. This is creating a domino effect that is rippling throughout the structure of ecosystems, fracturing and breaking the millions of connections that lie at the center of all ecosystems, resulting in chaos and destruction. An artificial environment is proposed to aid in safeguarding humanity's future, the biodiversity of our planet and prevent pollinator species (namely butterflies and bees) from becoming the modern dinosaur. This artificial environment exists as a natural environment that is not naturally occurring in the context of the site, one that can cultivate and sustain these pollinators species, promote awareness and research into conservation and the preservation of nature, with the aim to assist in reversing a small part of natures demise.

Human activity is affecting nature at a drastic rate, a rate that far exceeds nature's ability to renew and repair itself (Vidal, 2019). Human activity has impacted Earths vegetation and continued growth, in turn affecting animals and accelerating natural extinction. Changes in land use and land cover have modified and effected soils and have altered the water quality and quantity of some of the earth's natural waters, all resulting in an effect of cascading destruction (Goudie, 2000). Despite the importance of illustrating these effects, this section focuses primarily on the effects human agency has had on the livelihoods of pollinators, with the other consequences illustrated later on in the research report.

A heart can become a degraded environment. Over time, blood vessels of the human heart start to wear out, like an environment that naturally dies and is reborn. Humans consume fatty foods, and in doing so allow cholesterol or fatty deposits to enter the blood stream. Like bees to a hive, these fatty deposits start to bond together and build up inside the walls of the damaged part of the blood vessels. In order to stop the build-up of cholesterol, white blood cells flowing through the artery, follow the cholesterol and deposit along the damaged part of the wall, to prevent cholesterol build-up. The result is a process of inflammation, that starts to cause that part of the blood vessel to become hard and stiff.

Cholesterol continues to build up eventually forming a plaque. Over time this plaque starts to protrude into the blood vessel, narrowing the blood vessel. Like a damaged ecosystem, the hearts connection to the rest of the body weakens, threatening the entire environment of the body and its web of connections.



Figure 2.2: A map representing the 60% loss of all animal species since 1970, as loss of people - by Author

Lost

Remaining

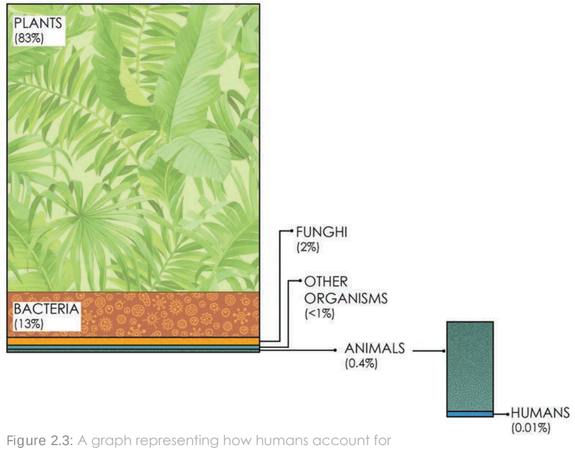


Figure 2.3: A graph representing how humans account for only 0.01% of all life on Earth - by Author

WHY ARE BUTTERFLIES AND BEES DISAPPEARING?

Insects play a vital role in sustaining life on earth by existing at the centre of almost all food webs, they act as a food source to most species, they keep the soil healthy by recycling nutrients, control pests and most importantly they pollinate a bulk majority of plant species (Carrington, 2018 C). Since insects form the base of many food webs and ecosystems, they are thus vital to the stability of ecosystems and prolonged biodiversity. The loss of these seemingly insignificant creatures have the potential to collapse entire ecosystems, with almost two thirds of all invertebrates being connected back to the butterfly on the food chain (Kearney, 2016). Their extinction would lead to a cascading event of collapsing ecosystems, leading to the death of countless other species such as bats, birds, fish, reptiles and mammals and without healthy ecosystems there is no clean air and fresh water (Carrington, 2019).

However, despite their importance, the worlds insect populations are drastically falling, nearing extinction (Carrington, 2019). Insects outweigh humanity by 17 times and yet despite this, more than 40% of insect species are declining and a third are currently endangered, experiencing an extinction rate 8 times faster than that of reptiles, birds and mammals (figure 2.4). (Carrington, 2019). If nothing is done to reduce this decline, 41% of all insects could become extinct in the next 30 years (Kiedaisch, 2019). At the current rate of 2.5% decline per year, it is believed that without intervention and drastic action, within 10 years we will have a quarter less of insects then we do now, within 50 years we will have half of the current insect population and in 100 years, insects will be completely eradicated from existence (Carrington, 2019). Insects are vital for existence, if their decline cannot be reduced this will have disastrous effects on the survival of plants and the human species (Carrington, 2019).

Despite some insect species' ability to adapt to the changing environment, species aren't adapting fast enough to outweigh the overall collapse (Carrington, 2019). As insect species continue to decline the species suffering the most are butterflies, beetles and bees. Of the 18000 known butterfly species, 3600 exist in the Afrotropical region of Africa, making Africa the second richest butterfly biographical region (Pullin, 1995). Butterfly species have declined by 53%, with 38 butterfly species endangered globally (South Africa Environmental Observation Network, 2019). 90% of these endangered butterflies are lycaenids, of which South Africa has the second largest population in the world. On top of this the monarch butterfly has decreased in population by 90% in the last 20 years. Only two monarch families exist in the world, the Monarch butterfly found in North America and the African Monarch butterfly found in South Africa. Of the estimated 30 000 bees species, 2755 occur in sub-Saharan Africa, with 1200 species found in South Africa. The global bee population has declined by 30% in the last 5 years and according to the RED Data list assessment, 40% of bee species are threatened globally (Vidal, 2019). For example, in Europe 31% of butterflies and 37% of bees are in decline, with major losses also recorded in South Africa (Vidal, 2019). In England, between 2000 and 2009 butterfly species fell by 58% and the number of honeybee colonies in the United States of America, have decreased, with 3.5 million colonies being lost from the 6 million that once existed in 1947 (Carrington, 2019). The drastic decline in these vital insects stresses the dire need for change, immediate action and conservation.

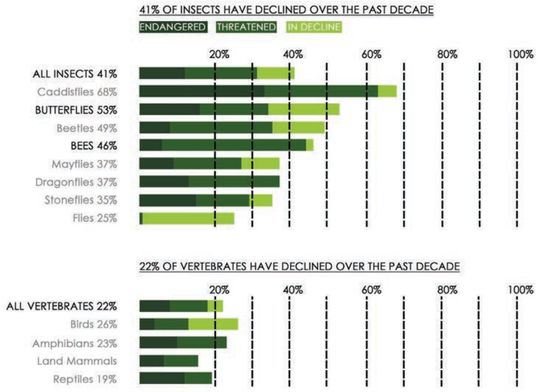


Figure 2.4: A graph representing insect decline vs vertebrate decline - by Author

One of the fundamental reasons for the drastic decline in butterfly and bee populations and an overall loss of biodiversity, is the reduction in the area of natural habitats available to species (Goudie, 2000). Habitat destruction and degradation is the leading cause of butterfly and bee population decline globally (Mecenero, 2013). At present butterfly and bee species are dying out due to three factors, specifically, habitat degradation, habitat loss and anthropogenic environmental changes (Mecenero, 2013), all of which are being accelerated by human activity.



Figure 2.5: Habitat loss as a result of deforestation

HABITAT DEGRADATION

Habitat degradation occurs when there are changes in the abiotic conditions of that habitat (changes in temperature, humidity, the micro-climate and shading), a reduction in food resources (larval host plants and nectar and pollen plants) and a loss of essential biological interactions (with specific ants), in this sense a suitable habitat is more complex than just having a specific vegetation type (Mecenero, 2013). Habitat degradation affects 84% of butterfly species, with a calculation that this could rise to 95% in the near future (Mecenero, 2013).

Habitat degradation is the destruction of the quality of species-specific habitats, which can lead to a reduction in survival and reproduction rates (Biodiversity A-Z, 2014). Due to this destruction, sub-threats can arise, such as the introduction of invasive alien species, which thrive as competing plant species are destroyed. The introduction of alien plants can lead to a displacement of animals that rely on the original, now declining plant species, which then slowly leads to the collapse of that environment (Mecenero, 2013). As such the introduction of invasive alien species can lead to the transformation of vegetation and the micro-climate, in that particular habitat patch. This then leads to a loss of larval host plants (plants that butterfly larvae feed on) and nectar and pollen sources for adult butterflies and bees, because these necessary plants cannot adapt to the changing environment (Mecenero, 2013). This can have catastrophic effects leading to a decline in pollinator populations and in some cases complete extinction (Mecenero, 2013).

Another sub-threat that can develop as a result of habitat degradation, is the creation of inappropriate fire regimes (Mecenero, 2013). Due to the changes of the habitat's vegetation and microclimate, the frequency and intensity of naturally occurring fires alters drastically, and as a result transforms the environment, above the norm from which it can recover. One way this can happen is when fires stimulate the germination (sprouting) of some invasive plant species, which then dominate the landscape, leading to a loss of host plants, leading to a decline in species population (Mecenero, 2013). Butterflies are also most vulnerable to fires during their breeding seasons, this is because butterflies are univoltine species, and as such only produce one set of offspring per year. If a fire were to break out at this stage, it would impact butterfly populations throughout all life stages; larva, chrysalis and reproductive adult butterflies, crippling population growth (Mecenero, 2013).

Lastly, another sub-threat that develops out of habitat degradation is the alteration of herbivore roles in the ecosystem, through deliberate or accidental introduction of grazing animals. This introduction reduces host, nactar and pollen plants as they are consumed by grazing animals, which then results in the transformation of the habitat, ultimately causing a loss of host plants and food sources which may be required for certain butterfly and bee species daily activities, resulting in a decline in butterfly and bee populations (Mecenero, 2013).

HABITAT LOSS

Habitat loss, which is an extreme form of habitat degradation, currently effects 61% of butterfly species and is expected to increase to 83% in the near future (Mecenero, 2013). Habitat loss occurs due to processes of agriculture and forestry,

urbanisation, and mining and industrial developments (Mecenero, 2013). Preparing a space for agriculture can include the removal of various unwanted plants to make space for crops to grow, this removal includes the removal of various host , nectar and pollen plants that are vital to the life of pollinators Agriculture also makes use of herbicides, which is a chemical substance used to control the growth of unwanted plants, unwanted for crops but vital to pollinators (Goudie, 2000). The use of herbicides can lead to the permanent removal of certain plants in a given environment, in that they can sterilise soil, kill the plant or result in an altered plant growing and once these vital plants disappear so do the pollinators that rely on them. This is because butterflies won't lay their eggs on any plant that is not a host plant and so if these specific plants don't exist, then no eggs will be laid in that area. Furthermore, if eggs are laid larvae are not adapted to eating these newly treated plants (they are poisonous) and so they will die, ending the butterfly life cycle (Goudie, 2000).

In addition, to the use of herbicides, agriculture also makes us of pesticides or insecticides, to control unwanted insects. Some pesticides contain Neonicotinoids, which not only harm plants but also pollinators. Neonics attack the nerve cells of insects affecting their behaviour or killing them directly (Aratani, 2019). Research has shown that Neonics effect pollinators by impairing their development and immunity to parasites and other diseases, wich leads to additional consequences. Considering these chemicals take months or even years to wear off, shows how the use of pesticides is adding to pollinator decline (Aratani, 2019). Deforestation also aids in the removal of habitats, as the removal of trees can alter the soil conditions, micro-climates and ultimately affect smaller plant growth in that area, all of which pollinators rely on (figure 2.4). Together agriculture and deforestation can lead to a direct loss of habitat and the ruin of surrounding habitats (Mecenero, 2013).

Urbanisation is the second biggest contributor to habitat loss. Transportation systems, residential developments and associated service infrastructure and recreational developments, such as golf courses (Mecenero, 2013), all contribute to the alteration of an environment, from removing complete habitats for development space and changing vegetation, to altering soil and water quality. Urbanisation thus results in a direct loss of habitable spaces, which leads to a reduction in butterfly and bee populations. Urbanisation also leads to a reduction in dispersal corridors, by fragmenting habitats, affecting migration patterns. Butterflies are unable to migrate to nearby habitats during their migration periods, as these habitats are either no longer suitable, they no longer exist or possibly the closest habitable space is too far away, from their current habitat for migration (Mecenero, 2013). The distance of the next nearest habitable space or safe space, being increased by urbanisation, has led to a direct mortality of butterflies as they cross or move between these transportation corridors, because the distance is too great (Mecenero, 2013). Butterflies are unable to find food (nectar plants) or a safe space to retreat from the rain or simply to rest while migrating and thus die during this migration period. Mining and industrial developments also contribute to habitat loss in a similar way to urbanisation, however it is on a much larger scale (Mecenero, 2013).

ANTHROPOGENIC ENVIRONMENTAL CHANGES

Lastly, anthropogenic environmental changes, which is pollution created as a direct result of human activity, has also led to further habitat loss and degradation. Climate change is a natural occurrence which has been catastrophically accelerated by human activities. The increase in temperature and moisture regime have led to the creation of new environmental conditions, to which species have been unable to adapt to (Mecenero, 2013). These changes in the environment have also contributed to changes in vegetation composition and micro-climate of various ecosystems, leading to a loss in host and nectar plants (Mecenero, 2013). Human activities have led to air pollution, the production of acid rain and aquatic pollution, from sewage processes, all of which have contributed to a change in the micro-climate of particular habitat patches. This results in a reduction of host plants, as they can no longer grow in these new conditions, leading to a reduction in the butterfly populations that inhabit these spaces (Mecenero, 2013).

Butterflies, particularly in South Africa, are habitat specific and are therefore very sensitive to any unnecessary disturbances or degradation of their habitat (Mecenero, 2013), as the above information illustrates. It is for this reason why conservation is so vital and why awareness is important for their continued survival.

As the plaque continues to build-up and bulge into the blood vessel, the blood vessel narrows even more and reduces the amount of blood flowing through to the heart. The arteries habitat has started to degrade. The amount

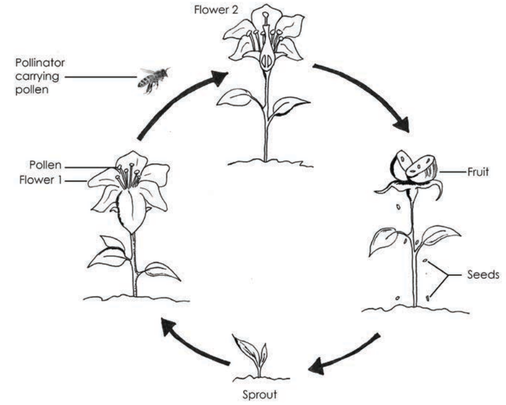


Figure 2.6: The process of pollination - By Author

of blood passing through becomes less with each passing day, as the consequence of human action starts to take hold. Like the perceived naive resilience of nature, it is easy to forget how fragile these natural environments are, we often forgetting the vital functions these organs provide, the same can be said about the butterfly and the bee.

THE SERVICES PROVIDED BY BUTTERFLIES AND BEES

Insects provide a multitude of services, from providing food for other animals to recycling nutrients, however, the most important task is that of pollination, and it is for this reason why butterflies and bees are essential for the proper functioning of all ecosystems (Carrington, 2019). Pollination is the process whereby pollen is transferred from one flower to another flower of the same species, to allow for fertilization, leading to the production of seeds (Eden Project, 2018). These seeds develop into fruits, and when their seeds are deposited, new plants can form, continuing the cycle (figure 2.6).

In this way pollination is vital for the continued production of plants for food, shelter and by-products. Pollination can occur in three ways, one of which is by the action of animals know as pollinators, of which butterflies and bees are the largest contributors. Pollination, by insects, occurs when pollinators visit plants to collect or feed on the pollen



Figure 2.7: Bee feeding from a flower and collecting pollen

or nectar and in doing so transfer pollen from one flower to the next, as they continue to forgae for food (figure 2.7) (Ipbes, 2019).

Animal and Insect pollinators pollinate nearly 75% of all crops globally and nearly 90% of flowering plants globally (Ipbes, 2019), with one in every three bites of food formed directly because of pollinator action (Hinde, 2017). As such these insects, which are currently on the verge of extinction, provide a huge free economic and environmental service, so much so that the pollination of crops globally by insects is worth up to $577 Billion (Vidal, 2019). Many plants have evolved in such a way that they rely solely on pollinators to aid in fertilization and continue their species. These pollinator dependent plants form the basis of many important items for human diets, from minerals and vitamins, to vegetables and fruit (Ipbes, 2019) and as such pollinator species survival is vital for the continued existence of these plants, and by virtue human existence. For example, many of the worlds 'cash crops' benefit from pollinator action, for both quantity and quality and are in some cases are leading exports in developing countries (coffee and cocoa) and in developed countries (almonds) (Ipbes, 2019). The production of these products adds to the economic and social structure of communities, cities and countries, in that the production of these products allows for greater employment opportunities and an influx of income into that country (Ipbes, 2019).

In addition, pollinators provide further benefits to human society, well beyond that of providing food. Pollinators contribute to medicine production (some anti-fungal and anti-bacterial agents are derived from honey), fibre production (cotton and linen) and biofuel production (Jatropha oil, canola oil and palm oil) (Ipbes, 2019). In addition, beeswax can be used to provide a protective layer to wood and musical instruments and pollinators continue to serve as inspiration in art, literature and technological design, for example inspiring the visually guided flight of robots (Ipbes, 2019).

Moreover, along with food production and the production of materials that are vital to the human species daily life, certain pollinator species can also aid in the conservation and preservation of nature. For example, butterflies are very sensitive to changes in their environment and respond more quickly than most other living organisms, such as plants (Pullin, 1995). In this way butterflies act as bioindicators, where a decline in their numbers can act as early warning signs, signaling the need for improved management of that ecosystem both to humans and other creatures, which can prevent the ecosystem and its species from declining further (Pullin, 1995). Moreover, butterflies aid in increasing genetic variation among the many plant species they collet nectar from (Kearney, 2016). Butterflies carry this out when they migrate over long distances, allowing pollen to be shared across plants that are far apart from one another. This allows for genetic variation in plants, making them more resilient against disease and thus increasing their chances of survival (Kearney, 2016).

In addition to aiding the conservation and preservation of nature, pollinators can aid in further research and awareness on the demise of nature. Pollinators, particularly butterflies have a great potential for tourism and education due to their aesthetic nature (Mecenero, 2013). The distinctive life cycle of butterflies, from egg to chrysalis to adult butterfly, makes them the perfect species to study and educate people on the beauty of life, the role of evolution and community dynamics (Pullin, 1995). Butterfflies and bees also exist as model organisms and are thus the perfect specimens for scientists to study evolution, genetics, embryology, population dynamics, habitat fragmentation and the effects of climate change (Butterfly Conservation, 2019). All of which can contribute to existing research, providing more knowledge and solutions on how to reduce species decline, ecosystem collapse and the demise of our natural world.

WHAT HAPPENS IF POLLINATORS DISAPPEAR?

The absence of these creatures would have catastrophic effects on the global natural ecosystem and socio-economic structures. Pollinators pollinate plants, the resultant seeds and fruits then feed birds, whom then feed mammals and so on, allowing for a cascading effect on each trophic level. When we start to lose these key-stone species, the results are cascading levels of extinction and loss of components which will then lead to ecosystem collapse (Beecology Project, 2019). This will then result in the lack of free ecosystem services such as water purification, decomposition and most importantly pollination. When we lose pollinators, we lose plants, which means that there is a reduction in food, shelter and nest sites for all the other wildlife (Beecology Project, 2019). The loss of plants would also affect our daily lives drastically, leading to a reduction in food, medications, clothing and construction materials.

Furthermore, the absence of pollinators would mean that the 75% of global crops and 90% of flowering plants, which rely on insects for pollination, would either reduce drastically in numbers (figure 2.8) or would need to be pollinated alternatively in order to reach the required yield to meet the global demand. On such example are almonds, which would completely disappear, as almond blossom trees rely entirely on pollination by bees (Hinde, 2017). Blueberries would reduce in number, as 90% of blueberry crops are pollinated by bees and coffee supplies would decrease in number, in that they require cross pollination by bees to become stronger and prevent disease, despite still existing they would become more rare and thus more expensive (Hinde, 2017). Furthermore, apple supplies would suffer drastically, as they rely on cross pollination by bees and cucumbers would almost be completely eradicated, as the majority of cucumber crops rely entirely on pollination by animals (Hinde, 2017).

As mentioned earlier, pollinators exist in an ecosystem consisting of a multitude of interactions, where an effect on one species ripples out effecting many more species. As such, if pollinators became extinct this would affect our dairy and meat supplies, as cows eat pollinated-dependant alfalfa, and so a reduction in this plant would reduce the number of cows, leading to a reduction in final dairy and meat products (Hinde, 2017). Overall a reduction in these plants and their resultant products would lead to a change in global crop and food supplies, leading to an increase in prices for consumers and a reduction in profits for producers (Ipbes, 2019). This interference of the global crop market could lead to an estimated annual loss of $160 billion - $191 billion globally (Ipbes, 2019), resulting in a drastic reduction in income of the agro-economy.

Without pollinators, ecosystems start to collapse. As ecosystems collapse habitats degrade with a radiating effect, surrounding areas then start to degrade to a point that not only threatens pollinators and other animals but humans as well, beyond the point of food and material supplies. The decrease in current land productivity (as a result of the continued decline of pollinators and resultant collapse of nature), makes societies more vulnerable to social instability (Vidal, 2019). The study produced by the IPBES illustrates this consequence and estimates that in 30 years the resultant land degradation, together with the effects of climate change, as a result of the collapse of the natural world, will have made certain areas uninhabitable to the point that 50 to 700 million people will be forced to migrate and relocate elsewhere, a bleak and shocking statistic (Vidal, 2019). In essence if pollinators became extinct, the results would be catastrophic, with domino effects rippling through-out all economic, social, and natural sectors of the global world, threatening the future survival of humanity and the earth as a whole.

Continued neglect of nature is evident with each passing day, restoration takes time, but there is only so much a natural system can take before it to starts to fail permanently. The heart is nature. With each passing day that this human ingests unhealthy food and exerts themselves to dangerous levels, the artery narrows even more and disastrous results occur. Blockage of the artery can lead to the heart receiving an inadequate supply of oxygen, as it gasps for help, like a habitat waving a white flag and screaming to be saved.

In some cases, the plaque can rupture and burst, exposing the necrotic material. Like herbicides blocking the growth of beneficial plants, the necrotic material can cause blood clots to form, leading to further damage. In extreme cases a part of the heart muscle can permanently die, like a species becoming extinct, never to exist again, due to a lack of oxygen, due to a lack of help. Heart attacks are inevitable but preventable. The reduction in the flow of blood to the heart can be felt, there are warning signs, picture a thousand butterflies suddenly dying, pain -the hearts bio-indicators, warning the human that something is wrong.

Coronary artery bypass grafting, man's solution to saving a dying environment. The creation of an artificial environment. A natural environment that is not naturally occurring. A blood vessel is removed from the leg and connected to a point above and below the blockage in the heart, bypassing the disturbance. A blood vessel from the leg now replacing the one near the heart. A natural element, not naturally occurring there, an artificial environment. Man's solution to the destruction of nature caused by their own activities. The heart is nature.



Figure 2.8: Produce with pollinators and produce as a result of continued pollinator decline

ENVIRONMENTS

Nature is resilient, but it is not invincible, and the damage inflicted upon it is reaching a point where it may no longer be reversible. While nature has been able to fight back and recover from some of the devastation caused by human activity, it is not recovering fast enough on its own to ensure a prosperous future for all. Just like bypass grafting, at a certain point nature requires intervention from humans, to save it from the destruction inflicted upon it by human activity, if we have any hope of surviving. The creation of artificial environments has increased in the last few years as more awareness is being disseminated about the consequences of human activity, first appearing for example in the form of nature reserves and game reserves. However as technology has developed and knowledge has grown, new environments have been established to aid pollinators, from proposed factories that release artificial pollinating robots to assist and possibly replace pollinators and synthetic apiaries that mimic external environments to aid in new research, to 3D-printed flowers that collect rain water and convert it into sugar water for pollinators and commercial honey bee hives which mimic the environments of natural hives.

We have arrived at a stage where we can and must use our knowledge to reverse some of the damage we have imposed on nature (Pearson, 2001). An artificial environment modelled after living systems (Triviño, 2014), like a prosthetic limb or a heart graft, can aid in sustaining, cultivating and accumulating species that are in decline, ultimately contributing to the revival of collapsed ecosystems and the natural world. Artificial environments are concerned with the creation of forms and functions that are similar to nature and living organisms (Triviño, 2014). In this way the environment created, does not hinder future growth but starts to merge the boundaries between artificial and natural, in way that allows the artificial form to grow with and encourage the growth of its surroundings. Humanity needs to start creating as part of nature, rather than creating solely for the benefits of the human species (Pearson, 2001).

In this way, architecture then becomes the harmonious instrument between man and nature (Triviño, 2014), creating balance, abiding by the idea of mutual respect. If we look to nature and work with nature, using it as a basis for creation and design, we can create a new type of evolutionary architecture, architecture which includes artificial environments, architecture which sustains the irreplaceable and revives the endangered.

Lately there has been an increased drive towards the approach of re-establishment as a means of conserving the endangered, particularly with butterflies and bees (Pullin, 1995). By restoring existing habitats, one can cultivate and grow the existing species already on that site and so there is no need to remove species from a dying habitat and place them in a new habitat, in the hopes that they will colonise this habitat, reproduce and start flourishing. In this way you can prevent disrupting their sensitive way of life, as if you remove a member of an already struggling species, you are simply contributing to the uphill battle they must fight to survive (Kearney, 2016).

Maintaining existing habitats aids in maintaining habitat connectivity (figure 2.9), which is vital in the fight against species decline (Pullin, 1995). This is because although good management of an area can reduce the rate of extinction, extinction cannot be stopped completely, however it can be accelerated when reserves are completely isolated from one another, forming conservation islands (Pullin, 1995). This is because it reduces the proximity of nearby habitable land that can be used by species as space to recolonise, find new food sources and nest spots, while their current habitat restores itself.

If species can't move to a reasonably nearby place or move at all, then populations could be lost one after the other, at a much faster rate (Pullin, 1995). This is because their current habitat is unable to restore itself and serve its dependent species efficiently and thus the site slowly becomes uninhabitable. This isolation also leads to larger competition for food and shelter. Thus by restoring degrading habitats, possibly through the introduction of artificial environments, this can help in restoring habitats, preventing them from becoming lost habitats and ensuring habitat connectivity is maintained.

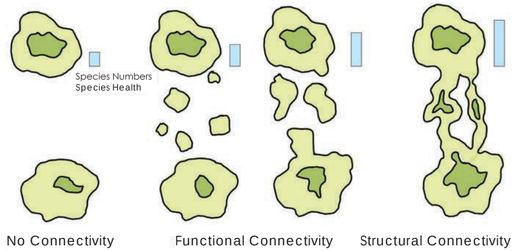


Figure 2.9: Habitat Connectivity - by Author



Figure 2.10: MIT's Synthetic Apiary

WHAT IS AN ARTIFICIAL ENVIRONMENT?

Artificial environments are not a 'one size fits all' scenario, instead each artificial environment needs to be tailor-made for the species it aims to support. This knowledge however is not based on a simple observation, but rather based on copious amounts of research into the various species, how they live and move, their daily interactions and most importantly their natural environments and ecological needs (Beecology Project, 2019). Artificial environments may be perceived as unethical depending on the level of built involvement and disconnect from the natural world, such as zoo enclosures or conservation 'islands'. The word artificial means something that is made or produced by humans, something that is not naturally occurring; however, it does not refer to something that is separated from the natural. It is this point that suggests the success of artificial environments, in that artificial environments, although not naturally occurring should not be removed from the natural environment they are trying to mimic or support, or void of any resemblance to the naturally occurring structure and systems of an environment. Success of these environments is increased when they do not live in isolation but rather mimic the layers of interaction in ecosystems and exist rather in totality.

The MIT's synthetic apiary (figure 2.10), although being a sealed room, still provides a mimicking connection to

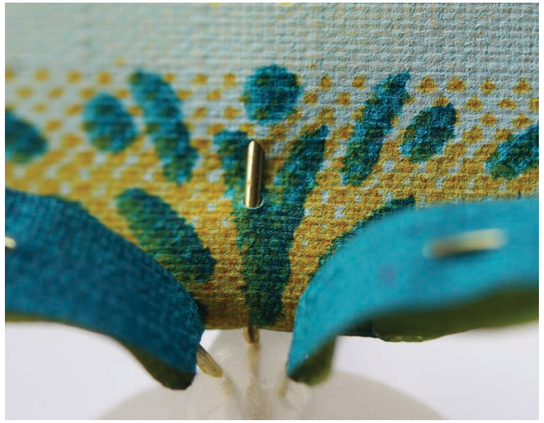


Figure 2.11: Matilde Boelhouwer's 3D printed flowers

the natural environments and habitats of bees. Subdued lighting simulates daylight, wind controlled by fans mimics natural air flow, and a pollen and nectar substitute, that although being artificial, still resembles the natural thing. This artificial environment succeeds because it doesn't see this environment as separate from the natural environment of bees, but rather mimics it and adds to it artificially. In this way bees living in this environment do not go against any intrinsic behaviours but rather go about their natural lives, they eat nectar, collect pollen, drink water, live and breed in a hive, all while basing this on the cycle of the day (when light is or is not present) and thus live in an environment that does not seem incorrect or unnatural.

Dutch designer Matilde Boelhouwer's 3D printed flowers are artificial creations, however they are based on the real thing, certain patterns and colours are borrowed form real flowers and imprinted on the synthetic material (figure 2.11). These artificial flowers mimic the structure and design of natural flowers, in petal shape, size, colour, pattern and design but also in their function of creating a sugar water substance consumed by pollinators. In this way the flowers are still able to attract pollinators and reward them in the same way as their natural counterpart. This link to the natural prevents these artificial flowers from existing in isolation, as an unnatural form, and so when placed in natural environments, these flowers are able to blend into the surrounding natural environment and

work with it, providing an artificial alternative and additive to pollinator environments. In this way this artificial environment becomes a 'natural' creation that is not naturally occurring, allowing for a more ethical approach of human and built intervention into saving these endangered species. Artificial environments and human involvement are easier when you apply them to insect species, their habitats do not need to be fully enclosed for their survival and our protection. The habitats of butterflies and bees, are small in terms of their immediate spaces (homes) and yet vast when one considers the vast distances they travel, foraging for food and so complete containment becomes more of a hindrance then an advantage, when approaching conservation of these creatures.

Larger ethical concerns around artificial environments, come into play when approaching artificial environments for larger animals, the likes of which are typically found in zoo's or aquariums. These spaces blend less between natural and man-made and often lean heavier towards the man-made side of the scale. These environments become designer environments, processed and so removed from the naturally occurring, despite the mimicking attempts. These spaces often require a custom-made infrastructure, required to simulate the many different natural environments of the enclosed species, making use of air conditioning for heating and cooling management and water treatment and waste processing plants (Marvin and Rutherford, 2017).

These spaces, in their attempt to preserve these species, directly impact the outside natural environment, adding to its degradation, due to the vast amounts of energy and resources required to create and maintain these large enclosed and designed environments. In this way their attempt to create comfortable inside worlds accelerates the damage of the outside world (Marvin and Rutherford, 2017). It thus becomes clear that the approach of creating new 'indoor' environments do more harm than good and thus suggests the need for a more collective and collaborative approach, when creating artificial environments for all creatures. Instead of using resources to develop climate-controlled and natural-environment mimicking insides, we need to work with the outside natural world to improve the 'outside' (Marvin and Rutherford, 2017).

In addition, as shown in both the MIT synthetic apiary and 3D printed flowers, there needs to be a connection to the natural environment to ensure success of an artificial environment, with both projects showing how when artificial environments exist in and link to natural environments they are successful. In this way the artificial environment that this essay proposes is one that works in tandem with nature, in the hope that the two become one. Rather than separating these insects form their natural world, elements will be added to the natural world and their natural environment to aid in their improved survival, rather than removing them from their natural environment, transforming it into a 'new' artificial environment.

THE PROGRAMMATIC STRUCTURE OF AN ARTIFICIAL ENVIRONMENT

Creating an artificial environment, (which this essay defines as a natural environment that has been modified), with the necessary host, nectar and pollen plants, along with nesting and overwintering sites, is the first step in creating a successful habitat, to aid conservation and promote growth. The colonisation and growth of populations are vital considerations in determining the success of artificial environments as an instrument to combat species decline. For butterfly colonisation of a site, the factors that influence female activity are vital and for population persistence the factors that influence male and female activity are important (Pullin, 1995). Large areas with suitable host plants and nest sites, promote the arrival of both butterfly and bee egg-laying females, which contributes to the stability of a habitat, these two conditions also lead to egg-laying females remaining on the site, aiding colonisation and species growth (Pullin, 1995). Warm conditions also contribute to the success of a habitat, as warm conditions facilitate flight activity, encouraging migration, foraging and further colonisation, along with providing adequate temperatures for species to survive.

Despite these factors, namely the necessary vegetation and temperature, this on its own is not enough to rehabilitate a habitat and prevent further loss of biodiversity. In addition to the establishment of vegetation vital for continued growth, these new environments need to be regularly researched. This should be done in a way that allows us to advance our understanding of these endangered species ecology and biology (Pullin, 1995) and to help us figure out what the ecological needs of different species are and what's missing in some areas (Beecology Project, 2019). In this way this artificial environment becomes a research site, a place where dying species can be examined in their 'natural' environment. This will allow for the development of new solutions on how to preserve these species and reduce declines, as extinctions are not avoidable, but they can be slowed. Research into butterflies (because of their unique life cycle) and bees, not only provides data that can assist in their own conservation, but it also contributes to global research and can bring with it funding, potential prestige and foreign exchange, all of which help a country grow and develop (Pullin, 1995).

In addition to research, these artificial environments need to aid in the creation of new habitats for migratory purposes, whether naturally through surfaces that allow for the growth of plants or through man-made shelters for bees and butterflies, along with built landscape elements that assist with water catchment and drinking, along with mud supplies for butterfly nutrients. These spaces are vital in ensuring species do not become isolated and decline faster than natural. A seed store not only serves as a safety net to prevent host and nectar plant decline on the site but also acts as a mechanism through which vital vegetation can be given to visitors, to grow in their own environments, thereby increasing green lungs or pause moments for pollinators, to aid in migration, new site colonisation and reduce species decline.

Conservation of nature and protection of biodiversity often falls short, simply because there is not enough awareness by the public (greater community, outside that of conservationists). Artificial environments will only be successful, if in the greater scheme, people realise the ways in which human activity is destroying the natural word. In today's technology driven era, a data centre aimed at collecting and electronically distributing all the research done on site to the greater public, together with on-site education programs, will aid in informing people on the issues of nature's collapse and species extinction (Pullin, 1995).

In this way information can start being disseminated to spread awareness about the greater issue of biodiversity loss and natures demise, with the supply of information being vital to ensure consistent support for nature conservation (Pullin, 1995). Thus programmatically, this artificial environment will require a research component, one that researches the necessary species and the demise of nature and exhibits this research to visitors to spread awareness. This space will also require a data area aimed at collecting and disseminating data, together with an educational component, educating people on the importance of pollinators, thus being able to inform more people. Most importantly this artificial environment needs to meet the ecological needs of pollinators, and aid the growth of relevant host, nectar and pollen plants to aid in species colonisation of the new environment and continued growth, along with a possible breeding scheme to aiding in increasing population numbers.

This artificial environment is an image of a new approach to existing with nature. A vision that understands the need for mutual respect, if we do not want to be incriminated in natures demise, for architecture serves as the perfect catalyst for a process of awakening and awareness (Pearson, 2001). This artificial environment serves as one of many needed interventions to start the process of preserving nature. A single intervention may seem futile in the greater scheme of things, but when one considers the action of the butterfly and the bee, some of the world's smallest inhabitants, we can truly see the effects that one organism, one intervention, can have on the survival of the world. The issue of nature's collapse is extremely complicated but only by tackling individual ecosystem collapses and species decline, does humanity stand a chance of improving our situation and reversing some of the damage we have inflicted on the natural world, over the last few centuries. It has become very clear that what we do to nature, we unconsciously do to ourselves, for we, the human species, are part of its fabric (Pearson, 2001).

A heart can die and so to can nature...

Subsequently this thesis aims to design a version of an artificial environment as a built form with a 'double sided skin' to assist endangered South African pollinators, namely butterflies and bees. This version of an artificial environment will embody the ideas of a prosthetic limb and a coronary artery bypass heart graft (figure 2.12) in that it will exist as something natural, yet an unnaturally occurring element in the site, to sustain and cultivate a dying environment and the endangered pollinators located on the proposed site.

In order to ensure this artificial environment can assist pollinators and the proposed site, both a site analysis and pollinator ecological needs and lifestyle studies will be conducted and documented, to ensure a tailor-made approach. This is to ensure that the ecological and spatial needs of the pollinators versus the needs and spaces of people working on the site are understood, ensuring that at different scales, all are accommodated to aid in growth and success. In addition, this artificial environment will be designed to allow it to merge into the natural environment, becoming an extension of it over time.

By embracing the concept of re-establishment, the intervention will be placed in an existing degrading setting, to restore and revive the site, preventing it from becoming a

lost habitat and ensuring the maintenance of connectivity of the nearby green spaces. The focus of habitat connectivity, ensures the existence of additional sites to which pollinators can migrate too, to find food, recolonise, increase in population and allow their current habitat to revive and restore itself. In essence this artifcial environment becomes a double skinned intervention, on the one hand supporting and providing for pollinators and the degrading site and on the other hand, supprting and facilitating spaces for people working on the site.

Humanity has a fatal flaw; a failure to recognise incremental change. As natural systems change from one state to another, we almost instantly forget what we have lost...

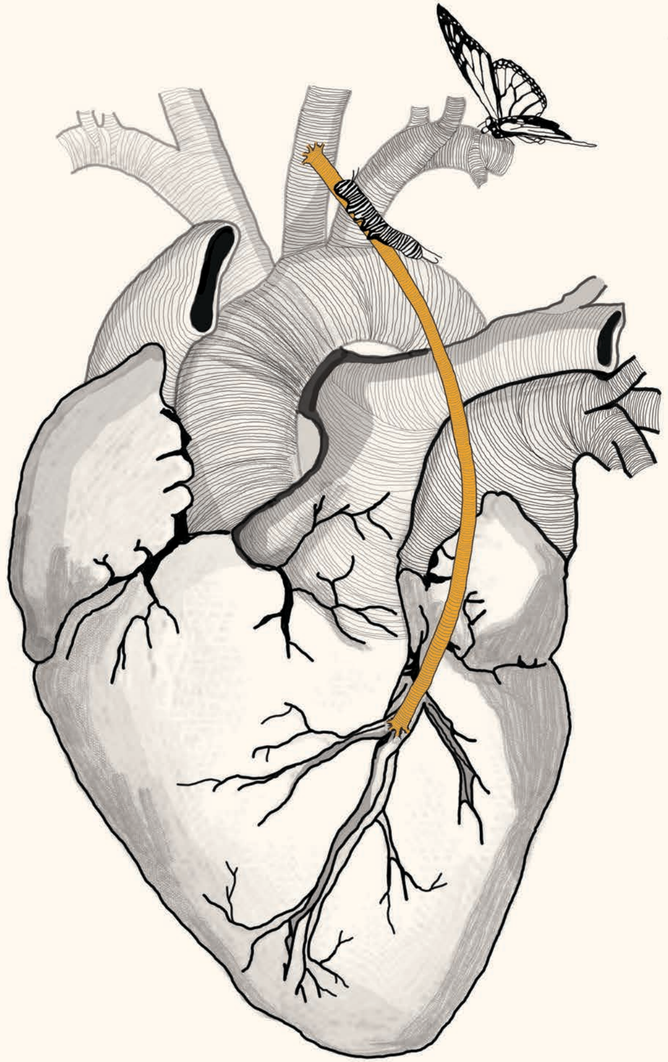


Figure 2.12: Coronary Artery Bypass Graft - An Artificial Environment - by Author

02
ANALYSED
SPACE

NATURE AS ANALYSED SPACE

my site

BREAK-DOWN

Site Location

Reasons For Site Selection

Development of the site through time

Thresholds

Topography

Pictorial Journey through the site

Site Inhabitants

Experience of the site - extract by Author

Take- Away

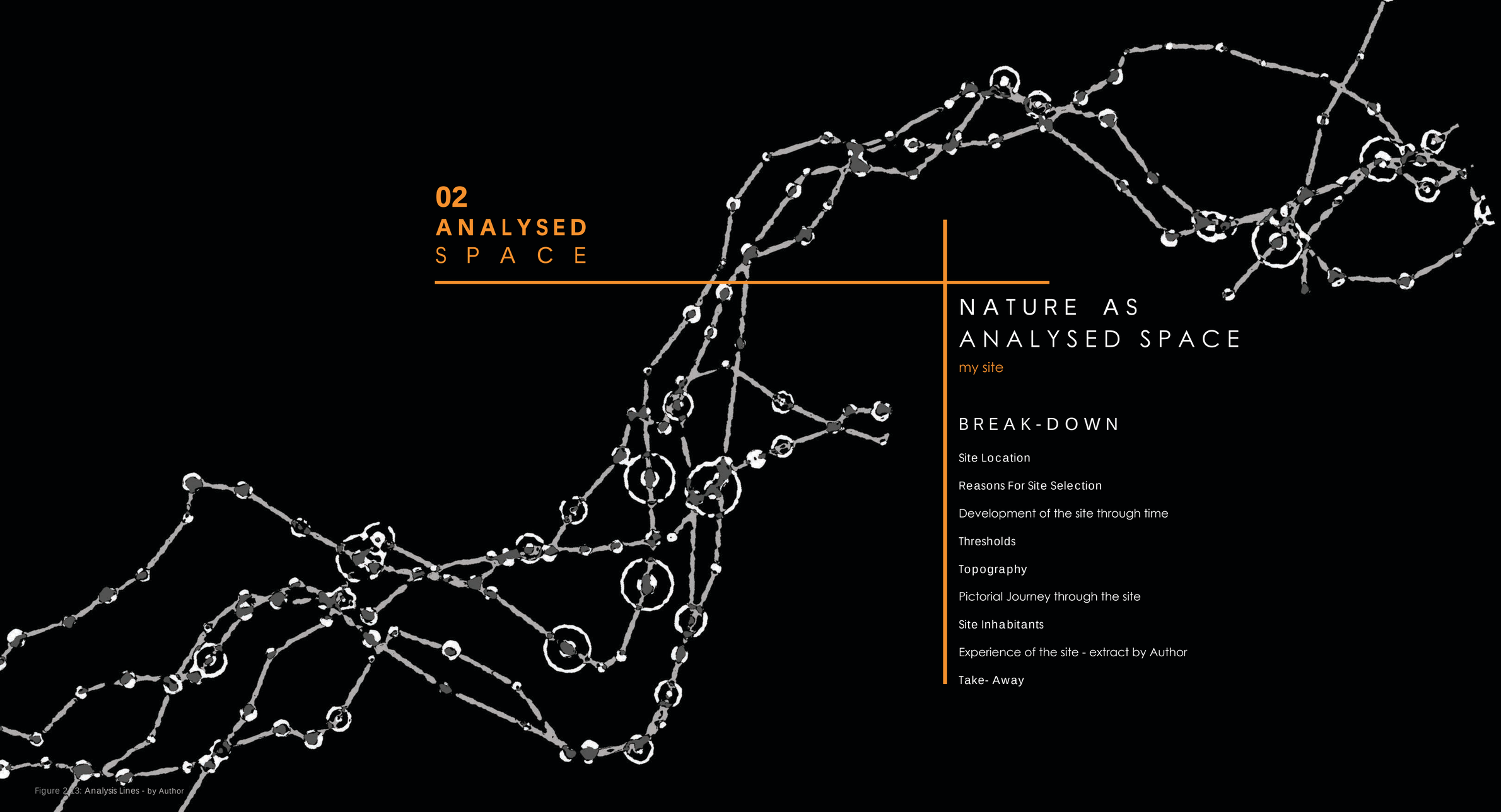


Figure 2.13: Analysis Lines - by Author

SITE LOCATION

The proposed site is located in Pretoria (The City of Tshwane) on a vacant plot, located adjacent to the Roodeplaat nature reserve and Roodeplaat dam.

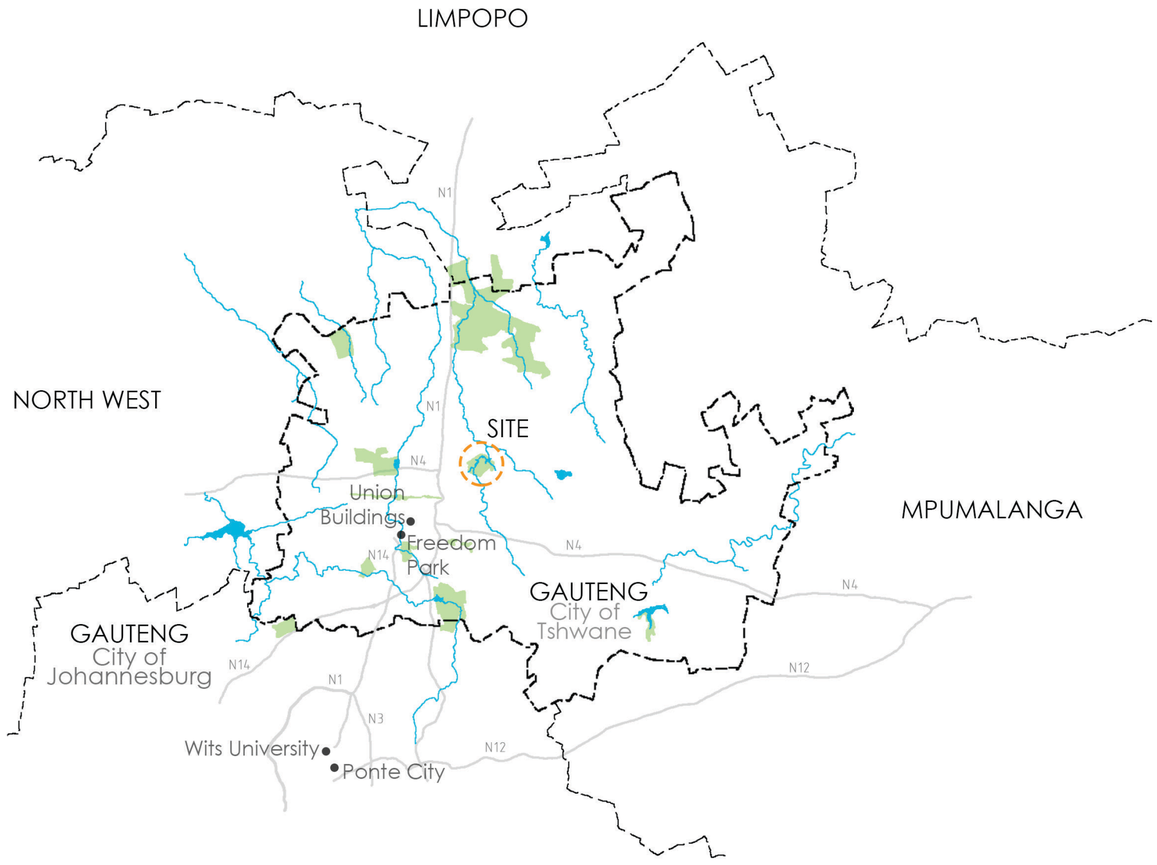


Figure 2.14: Site Location Map - by Author

SITE SELECTION

This site was selected for three reasons as stated below. Approaching site selection, the proposed design intervention could have been placed in either the urban environment, void of pollinators or in the extreme opposite being only landscape, void of people. This site was selected because it existed in the middle of these two extremes, it has both natural landscape with existing pollinators and low-density human settlement. However, this site selection does not exclude the urban or extreme natural environment for anyone else.

1) NATURAL LOCATIONS:

The site is located adjacent to the Roodeplaat nature reserve and Roodeplaat Dam. These two places allow for an existing ideology of conservation, on to which my design can build on. The electric fence, boarding my site and the nature reserve, has done its job in preventing human trespassing, while still allowing for species to move between the two sites. In this way there are large arrays of plant species, three sited butterfly species, ants, dragonflies and birds, that constantly move between the two sites.

This relationship of nearby habitable spaces, is vital for rehabilitation of a habitat and reducing species decline. This is because species need to have nearby habitat patches, they can migrate to and recolonise within, when their current habitat needs time to recover from years of their own interaction. Not only does this allow nature time to recover, ensuring habitat patches don't become destroyed (leading to species decline), it also allows species to recolonise new land and spread their reach, multiplying, aiding their fighting against extinction. By selecting this degrading site, my design can assist in restoring it, preventing it from becoming lost and breaking the chain of nearby habitable green spaces.

2) ZONING:

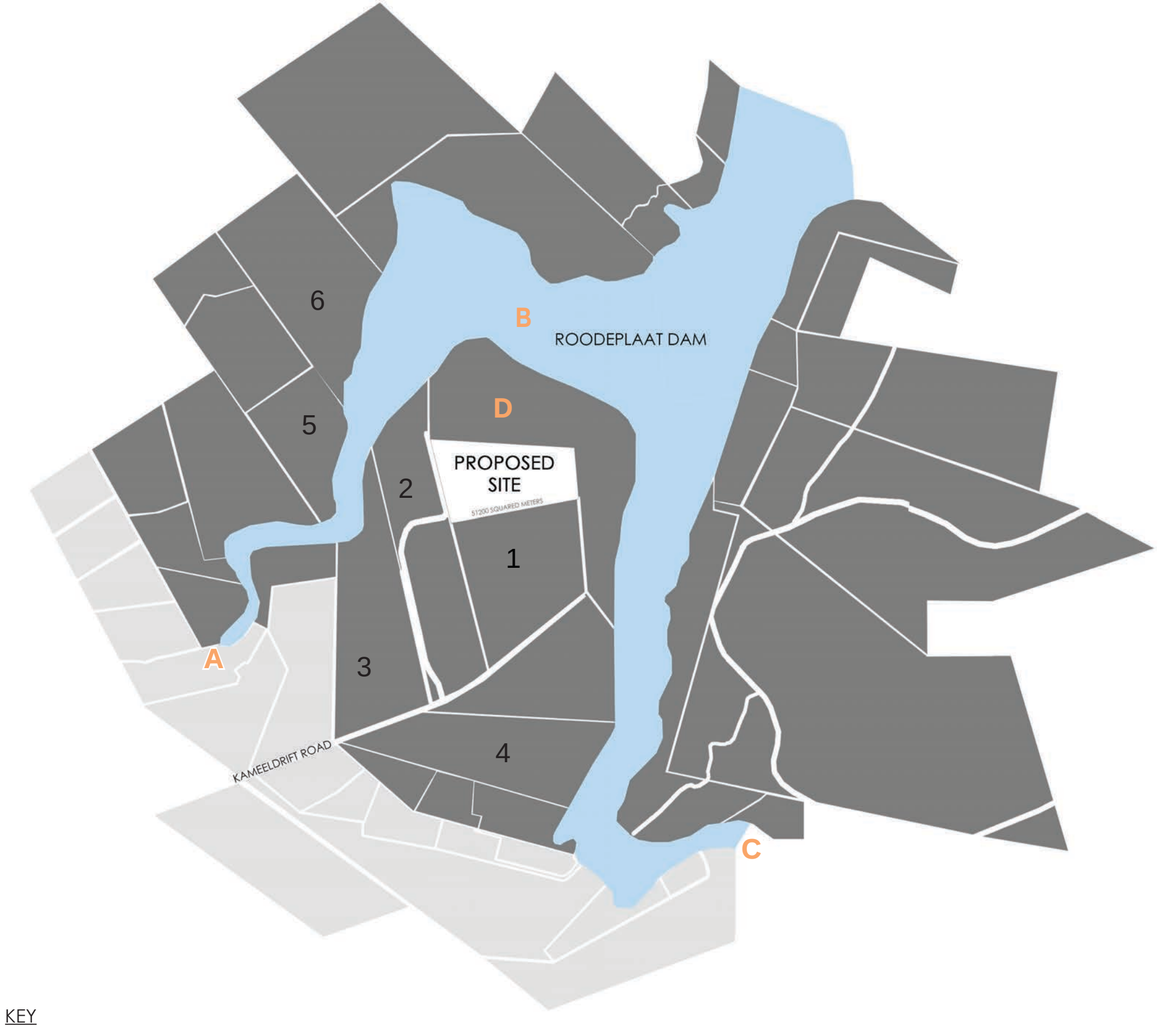
This site is currently vacant and zoned for residential development. Any proposed residential development will most likely destroy large parts of the current land and interfere with the delicate and complex web of systems that currently exist on the site. In doing so it could accelerate the collapse of this ecosystem, increasing species decline and adding to the degredation of the context of the site.

By placing my design on this site, it acts as a mechanism through which the site can be protected and sustained. It also allows for the increased awareness and dissemination of information on the need to protect existing habitats and rehabilitate them as a means to reverse the damage done, by humans, on the natural world.

3) SURROUNDING BUSINESSES:

My site is located in an epicenter of tourist / retreat-esque attractions, with multiple resorts, B n' B's and even some wedding venues, surrounding the site. This together with the activities that take place along and, in the dam, such as rowing, picnicking and fishing, add a level of constant attraction and influx of people.

The attraction-esque nature of these destinations and attractions will aid in bringing people to my site. An influx of people is an essential component in ensuring people visit sites of conservation, allowing them to be educated and informed on what is happening. This not only creates awareness but also allows for the dissemination of information (into the greater area) on the importance of conservation and the current status of the natural world. This process promotes further awareness, conservation and change in the fight against natures demise.



KEY

WATER SOURCES
A - Hartbees Spruit
B - The Roodeplaat Dam
C - Pienaars River

NATURE RESERVES
D - Adjacent Roodeplaat Nature Reserve
■ - Additional Nature Reserve Areas

TOURIST ENVIRONMENT
1 - Manzi Monate Holiday Resort
2 - Marleo Holiday Resort
3 - The Blades B n'B
4 - Faircity Hotels
5 - Die Stoor Wedding Venue
6 - Hengelaars Resort

Figure 2.15: Site Selection Maps - by Author

DEVELOPMENT THROUGH TIME

These pictures through time, show the clear effects of human activity on the natural world, from a decrease in rain and vegetation growth (as a result of climate change and biodiversity loss) to the resilience of nature to return and recover.



In 2001 the dam levels are high and the north eastern corner of the site and beyond its extents, into the nature reserve, shows the development of many small trees.



In 2004 the dam levels have started to drop most noticeable at the western edge of the land. Despite the low water levels, the north eastern corner continues to show hope, with a few more trees developing.



In 2005 the dam levels have continued to decline, most noticeable at the western edge of the land, with the channel leading into the Hartebees Spruit being almost dried up. The growth of vegetation on the site seems to have come to a standstill.



In 2008 the dam levels have declined considerably, now becoming noticeable around the entire site as the water retreats from the edge of the dam, reflecting a clear drop in the amount of rainfall, as nature continues to decline. The growth of vegetation on the site seems to have remained stagnant since 2005, with the grass covering the site, appearing to have almost completely died out, possibly suggesting a decline in species on the site, further accelerating the collapse of this ecosystem.



In 2010 the dam levels appear to have returned to normal, following the drought period from 2005, showing clear signs of improved environmental conditions. Vegetation has also increased on the site, particularly towards the south eastern corner and spots of green ground cover are starting to appear through out the site.



2011 shows a clear period of growth with a large number of plants appearing on the eastern side of the site, along with plants appearing at the south western corner. The ground cover seems to have returned, bring back the more green appearance of the site. There also appears to be a third man-made path starting from the south west corner, possibly suggesting more activity on the site.



2018 shows continued growth of the site with more plants appearing along the eastern edge of the site, moving towards the centre of the site. There is also a clear increase in the number of trees at the top of the northern corner of the nature reserve, with a few trees starting to appear along the western edge and centre of the site. This growth shows clear evidence of an ecosystem that is thriving.



2019 shows continued growth and health of the site, with a few more plants appearing along the eastern edge of the site, moving towards the centre of the site. There also appears to be more plants spreading from the north west and south west corners towards the centre of the site. There is clear evidence of the growth in ground cover, (which could suggest an invasive element) with the third man-made path almost being completely covered along the western edge of the site.

Figure 2.16: Site Development Pictures

SITE THRESHOLDS

Access:

Ⓐ Primary Entrance
-Through Marleo Holiday Resort
Ⓑ Secondary Entrance
-Through Manzi Monate Family Resort
Ⓒ Man-made Paths

Boundaries:

① Hard built edge
- fence & Marleo Holiday Resort
② Invisible edge
- cadastral / zoning line
③ Semi-transparent edge
- electric fence bordering the nature reserve & site

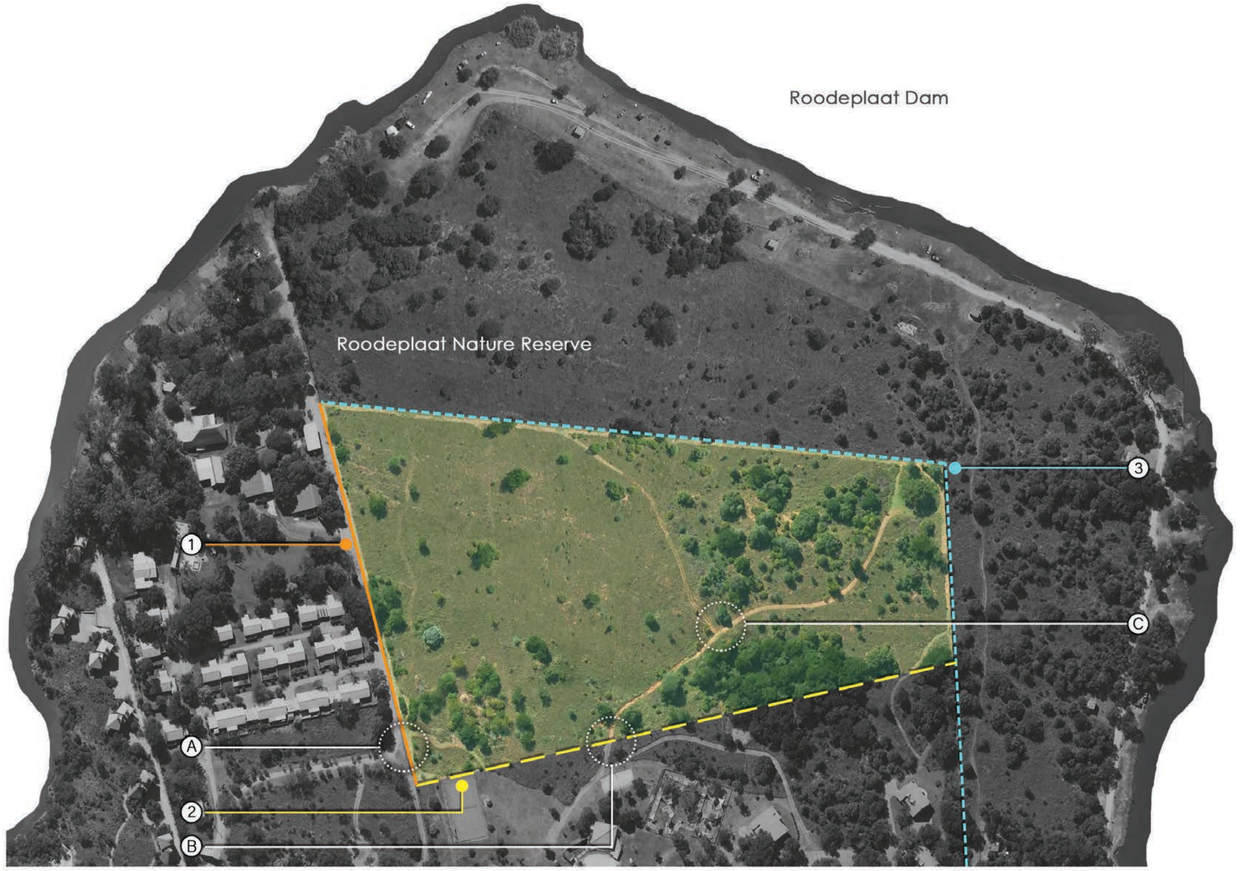


Figure 2.17: Site Thresholds Map - by Author

SITE TOPOGRAPHY

The site and the surrounding land, gradually slopes down towards the dam. Seven contour lines pass fully through my site, with two additional contours intersecting the site at the north western and north eastern corners. These contours have an elevation difference of 1m. In this way the site starts at its highest point of 1231m above sea level and ends at an elevation of 1223m above sea level. This 9m decline allows for a gradually sloped site.

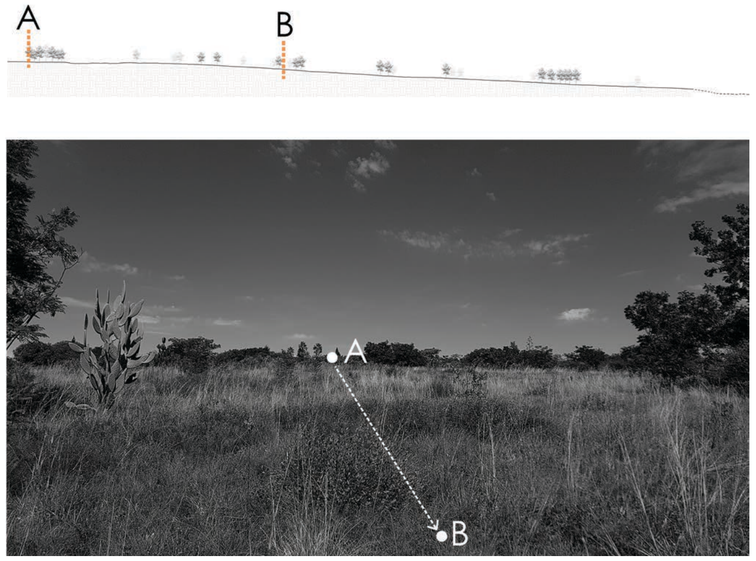


Figure 2.18: Section and photograph depicting the gradual slope of the site - by Author

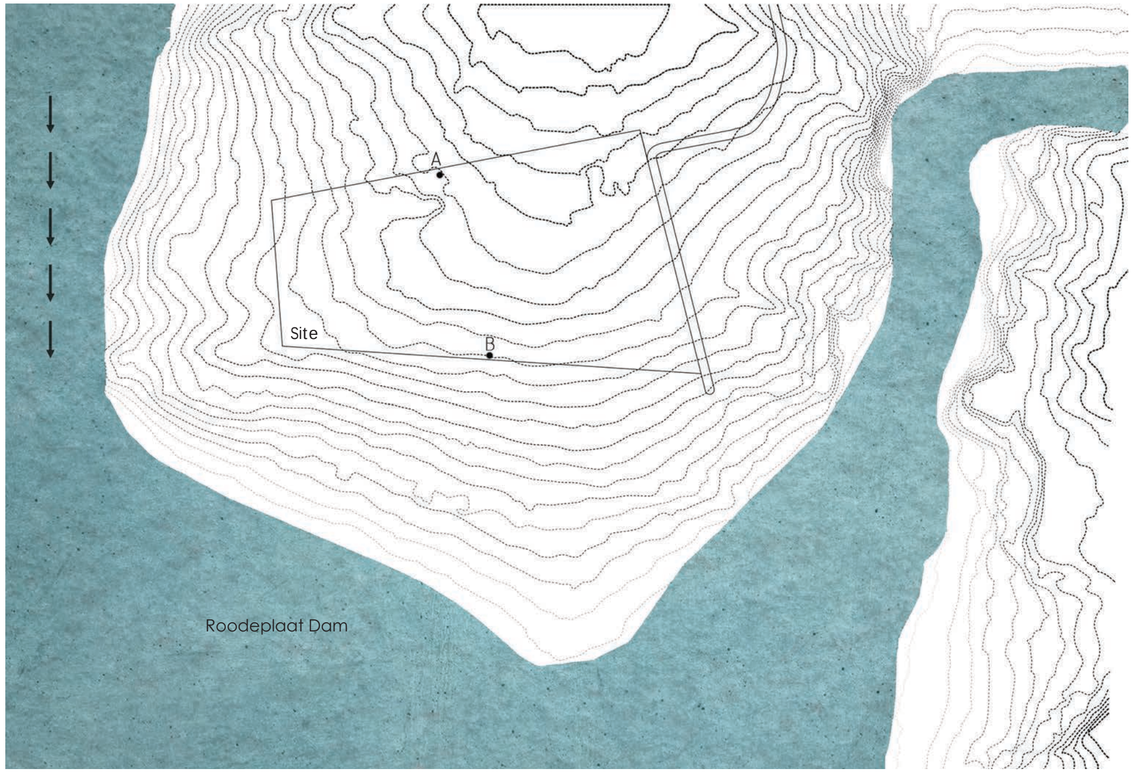


Figure 2.19: Site Topography Map - by Author

PICTORIAL JOURNEY

A series of photographs documenting my journey through the site, starting from the invisible edge, moving along the man-made paths and semi-transparent edge.

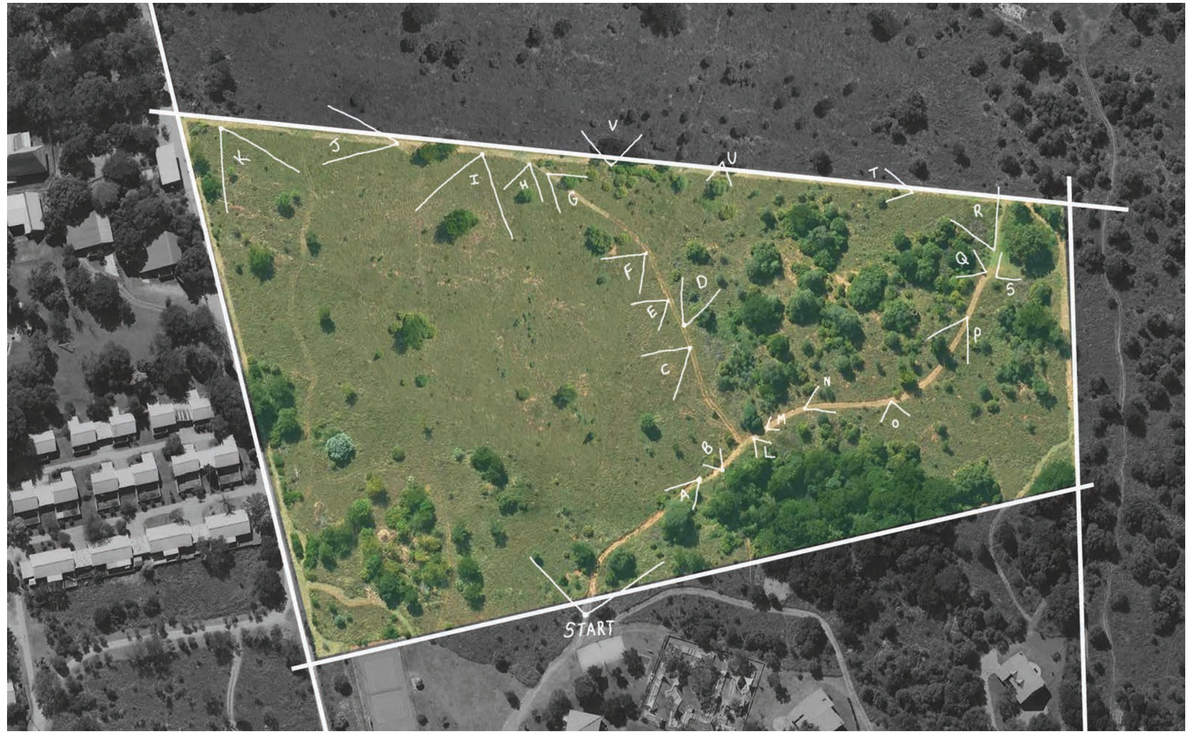


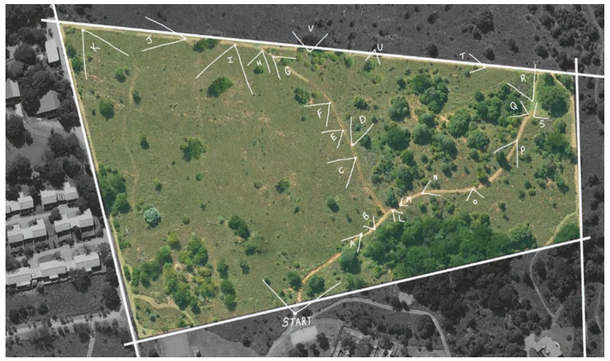
Figure 2.19: Locality Map - by Author

START





Figure 2.20: Photograph looking down the eroded man made paths into the site - by Author



Locality Map



A - Eroded Path



A - Carpenter Ant



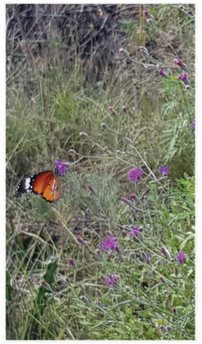
B - Syringa Tree & Nest



C - Hyperthelia Dissoluta (wild grass), dominating the site



D - View of the Roodeplaat Dam



E - The African Monarch



F - Dominant wild grass moving throughout the site



G - Looking back up, along the one man-made path





H & I - Larger trees dotted amongst the dominat wild grass (Hyperthelia Dissoluta)

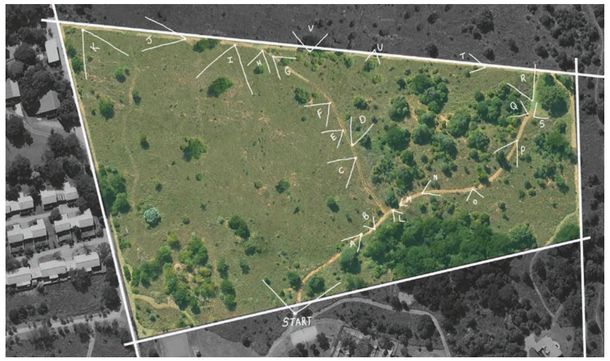


J - The electric fence, bounding my site and the Roodeplaat nature reserve



K - Ferns, flowers & trees dotted amongst the wild grass

Figure 2.21: Pictorial Journey Series - by Author



Locality Map



L - Flowering Plants



M - The African Monarch



N - Pine trees, found through-out the site





O - Nectar flowers (Hilliardiella Oligocephala) lining the wild grass



P - The second man-made path lined with wild grass



Q - Larger trees providing natural protection



R - The far right hand corner of the site looking out onto the dam



S - The far right hand corner of the site



T - The electric fence bordering the site and nature reserve



U - Hypolepis Sparsisora



V - Looking through the electric fens into the nature reserve

Figure 2.21: Pictorial Journey Series - by Author

SITE INHABITANTS

Due to the sites relationship with the nearby dam and adjoining nature reserve, various species of both plants and animals have migrated to the site and started to form their own habitat patches on the site.

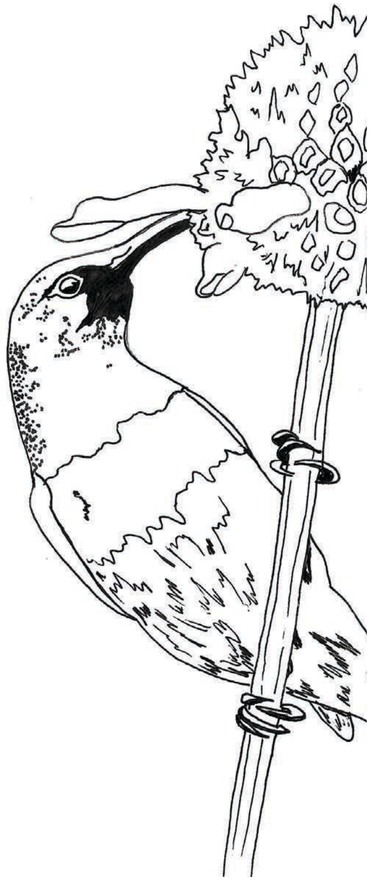


Figure 2.22: Sunbird Sketch - by Author

01 PINE TREE: (Plant Lust, 2018)

Origin: Not indigenous to South Africa – comes from the Mediterranean and Northern Europe
Sun Exposure: Full sun required
Seasonal Status: Evergreen
Soil Needs: Well drained
Water Requirements: Occasional

02 ALOE MACULATA: (Plant Lust, 2018)

Origin: Indigenous to South Africa
Sun Exposure: Partial sun, with bright shade
Seasonal Status: Evergreen
Flowering Time: Yearly
Soil Needs: Well drained
Water Requirements: Low

03 SYRINGA TREE: (Plant Lust, 2018)

Origin: Not indigenous to South Africa
Sun Exposure: Bright Shade
Seasonal Status: Deciduous
Flowering Time: October to November
Soil Needs: Well drained
Water Requirements: Occasional

04 HILLIARDIELLA OLIGOCEPHALA: (Plant Lust, 2018)

Origin: Indigenous to South Africa
Sun Exposure: Mostly Sun
Seasonal Status: Decidious
Flowering Time: Summer & Autumn
Soil Needs: Well drained
Water Requirements: Regular
Other: Supports pollinators

05 HYOLEPIS SPARSISORA: (Plant Lust, 2018)

Origin: Native to South Africa
Sun Exposure: Partial sun, partial shade

06 HYPERTHELIA DISSOLUTA: (Plant Lust, 2018)

Origin: Native to South Africa
Sun Exposure: Full Sun
Seasonal Status: Decidious
Flowering Time: Summer

07 POGONARTHRIA SQUARROSA:

Origin: Native to East and Southern Africa
Sun Exposure: Full Sun
Seasonal Status: Decidious
Flowering Time: Summer
Water Requirements: Low

08 AFRICAN MONARCH: (Willis and Woodhall, 2010)

Host Plant: Milkweed
Nectar Plants: Species of Gomphocarpus, Ceropegia, Stapelia and Huernia.
Life Span:
-Males: 10 -15 Days
-Females: 7 – 12 Days
Predators:
-Larval stage: Arthropods (spiders, ladybugs)
-Adult Stage: Birds

09 YELLOW PANSY: (Reid, 2019)

Host Plants: Plants of the Acanthaceae Family, specifically Barleria Pungens
Nectar Plants: Many plants rich in nectar, such as Origanum syriacum.

10 BROAD-BORDERED GRASS YELLOW BUTTERFLY: (Kloof Conservancy BioGuide, 2018)

Host Plants: Hypericum Aethiopicum and Chamaecrista mimosoides
Nectar Plants: Justicia, Ruellia and Lamiaceae
Adult Life Span: 2 - 4 Weeks

11 AFRICAN HONEY BEE: (Biokids, 2019)

Food Source: Nectar & Pollen from various flowering plants, honey (stored, concentrated nectar) & secretions produced by other members of their colony.
Nest Locations: In tree hollows or rotten logs, along with man-made structures of wood and rock piles.
Life Span:
-Queen: 2 – 5 years
-Female Bees (Worker Bees): 2 - 4 weeks (summer) or 11 months (if they survive through winter)
- Male Bees (Drones): 4 – 8 Weeks
Predators: Spiders, wasps, birds (the Meropidae and Honeyguides) and toads

12 CARPENTER ANT (University of Minnesota, 2019)

Food Source: Living and dead insects, honeydew
Nest Locations: In rotting tree trunks, roots, stumps and logs



01 . PINE TREE



02 . ALOE MACULATA



03 . SYRINGA TREE



04 . HILLIARDIELLA OLIGOCEPHALA



05 . FERN
HYPOLEPIS SPARSISORA



06 . HYPERTHELIA DISSOLUTA



07 . POGONARTHRIA SQUARROSA



08 . AFRICAN MONARCH
DANAUS CHRYSIPPUS AEGYPTIUS



09 . YELLOW PANSY
JUNONIA OENONE S



10 . BROAD-BORDERED GRASS YELLOW
EUREMA BRIGITTA



11 . AFRICAN HONEY BEE
APIS MELLIFERA SCUTELLATE



12 . CARPENTER ANT
CAMPONOTUS

Figure 2.23: Site Inhabitants

THE SITE

Extract by Author



Figure 2.24: The site, with a monarch in flight - photograph by Author

As I walked along a pebble pathway, which pierced a manicured lawn, passing Manzi Monate's reception, I was confronted by a sudden change in the ground, gone was the pebble pathway, now replaced by a strand of eroded soil. Following this eroded pathway, passing a tennis court and swimming pool, I arrived at a wall of grass, tall strands of thatch like grass gently swaying in the wind, neatly placed on either side of the path. Walking through the field of grass felt slightly ominous, I couldn't quite see what was around me or what lay ahead. As I kept walking, the view of the resort behind me slowly faded away, as I constantly checked my GPS to see when I would arrive at the chosen site. After a short walk the eroded pathway came to a crossroads and it was here that I got the first view of my site. A field of green and yellow, dotted with reds, browns and orange, with the turquoise dam in the distance. The site felt alive, the dominant grass swayed in the wind as monarchs and yellow butterflies flew around, darting from one strand of grass to the next.

I ventured through the site, guided by the eroded pathways and I couldn't help but smile. There was something so nostalgic about observing the butterflies, sketching their flight paths and capturing them through the lens of my phone. There was this feeling of elation, being immersed in this natural environment, surrounded by these silent yet majestic creatures, with the sounds of the wind rustling through leaves and jumping crickets as the perfect background. As I continued to move thought the site time stood still as I began to explore the world of the pollinators and this site, they call home. I walked along the edge of the electric fence, bordering my site and the nature reserve, observing how the butterflies and birds passed through completely unfazed. The site seemed unbothered by my arrival with a couple of ants crawling over my shoes as I stood still observing the butterfly's movement – afraid to make the slightest movement, of the fear that they might fly away.

There was evidence of degradation though, the pathway beneath my feet, the dominant grass that seemed to push out other, more delicate plants and the clear lack of flowering plants. Moving along the pathways and boundaries of the site, through the grass and around the various trees, I began to spot the vegetation hidden amongst the grass and the spaces butterflies perched on. There was this beauty in the interconnectedness of it all. The site was a living, breathing system.

TAKE-AWAY

From the information provided in this section it is clear that the proposed site does not exist in isolation, despite its barriers, it too is an element of nature and exists as a component of a larger ecosystem. This is an import idea to understand as the design will need to consider how it interacts in the greater scheme of things, both in relation to the human related neighbouring spaces and the natural ones. The documentation of the site throughout time, clearly indicates the fragility of nature, along with its resilience and so the design should both mimic this idea of adaptance and resilience through time, while also understanding that at times it may need to go against the natural changes in order to ensure continued survival.

The analyses carried out clearly indicates how the site is a living breathing entity and so placement of design, impact on the land and footprint are all issues that need to be considered carefully, in order to ensure that the proposed artificial environment appears and interacts as a beneficial 'natural element', despite being placed and not grown.

03
POLLINATORS
HABITAT

NATURE AS A POLLINATORS HABITAT

pollinators on my site

BREAK-DOWN

On-site pollinator movement

Pollinator Travel Distance

Ecological Needs of Butterflies

Ecological Needs of Bees

Butterflies

Honey Bees

Solitary Bees

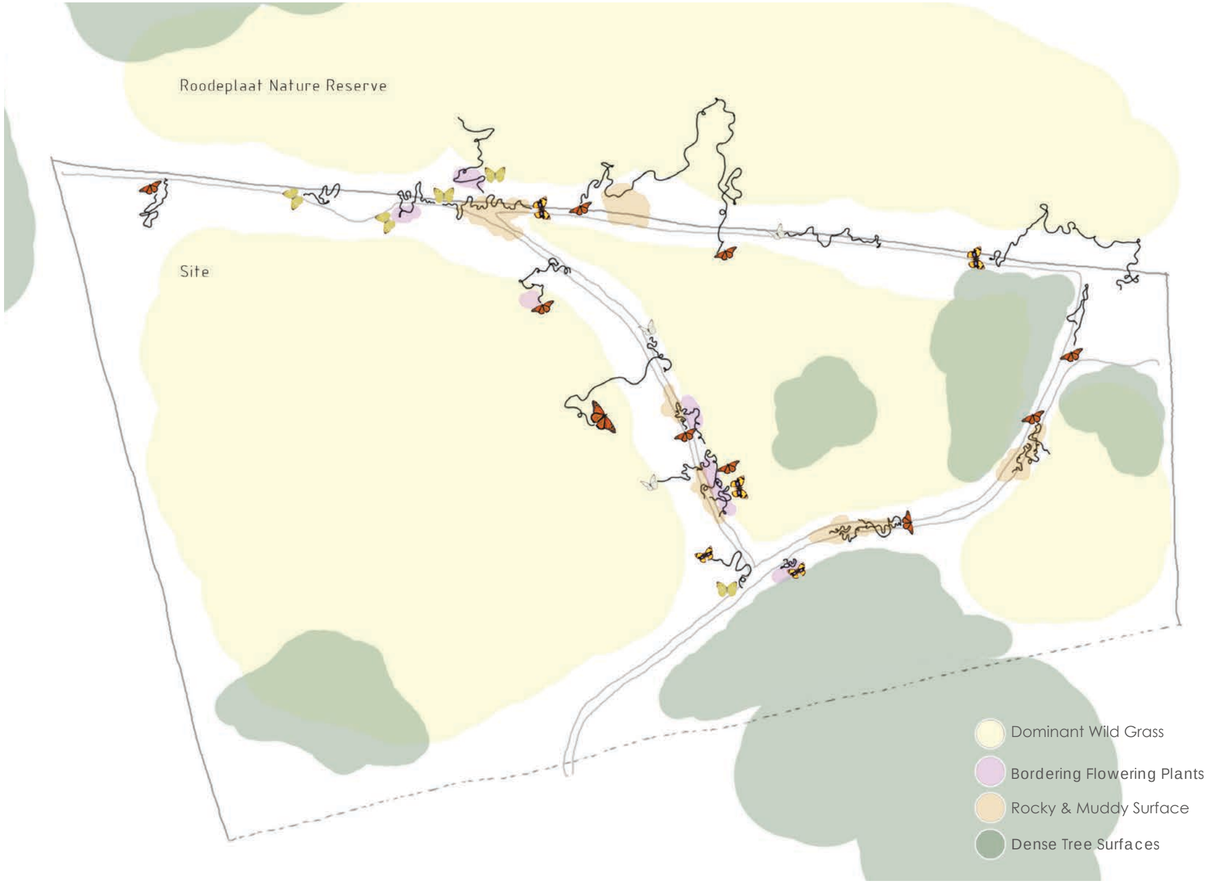
Pollinator Vision

Take Away

Figure 2.25: Pollinators Habitat - by Author

ON-SITE POLLINATOR MOVEMENT

Figure 2.26: Pollinator Movement Map - by Author



My analysis of the movement of butterflies on the site took place over a period of two hours and allowed me to better understand the relationship these pollinators have with the site. The movement of the butterflies was more or less contained along the man-made path running through the site and the electric fence boundary of the adjacent nature reserve, with their movements being sporadic and often turning around and back over a previous movement path.

The man-made path became an element that cut through the largely dominant wild grass, which covers most of the site. The few flowering plants on the site had been pushed to these boundaries of path and grass, which is the main reason why the butterflies movements were largely contained along this path. The flowering plants provide a nectar source for butterflies to feed off of.

The eroded nature of the pathways has unintendedly created an exposed surface allowing for rocks to be exposed untouched by the wild grass, and for water and mud to collect along the surface. As documented, various butterflies were perching and basking on rocks and sticks along the pathways, absorbing the heat from their surfaces. Butterflies are cold blooded and can not generate enough heat required to fly and so they need to absorb heat from surrounding surfaces. These factors explain why the butterflies movements were largely contained around these areas.

A few butterflies were sipping the water and mud puddles along the paths. This action is known as puddling, which butterflies engage in as a means to drink the muddy water and absorb nutrients and salts from the mud which is essential for their diet.

In addition to the action and movement along the paths and its boundaries, some butterflies did move further into the grassy areas, presumably for shelter, a few leafy plants and decaying wood could be seen scattered amongst the wild grass.

Butterflies also moved between the site and the nature reserve, passing through the electric fence, to reach the larger supply of flowering plants and the rocky surfaces, (used for basking) in the nature reserve.


Dominant grass pushing the flowers to the edge.


Butterfly feeding on nectar


Basking on a rock


Basking on a stick


The exposed, muddy surface


Decaying wood, scattered amongst the wild grass

POLLINATOR TRAVEL DISTANCE

Pollinators travel vast distances, foraging for food, moving to a warmer habitat, looking for new ideal sites to lay eggs, colonise, create a nest or even to perch and rest. As such I looked at the average distance of travel for both bees and butterflies in relation to my site.

Bees forage up to an average of 2.3km from the location of their hive, mostly in search of food, however this travel time can also be used to locate new ideal nest sites, if the hive is planing to swarm. Bees may also travel this distance to search for overwintering sites, if their hive is unable to generate enough heat or is not located in a warm enough environment to sustain the colony during the cold months of winter.

Some southern butterflies may migrate north during colder months. They migrate to find warmer habitats as warmth promotes flying, egg laying, food sources, host plants and most importantly their continued survival. Unlike the African Monarch which does not migrate during Autumn or even Winter, due to the warmer southern weather, the northern monarchs, found in North America, migrate up to 3200km. They often travel south or even west towards Mexico, to escape the cold North American winters as they cannot survive the cold of most of the United States of America (Monarch-butterfly, 2018).

Monarch butterflies, that migrate to these warmer conditions, will spend their time here until the winter month passes in their usual habitat, making areas like Mexico, overwintering sites. Butterflies will then migrate back to their original habitats to lay the new generation of eggs (Monarch-butterfly, 2018).

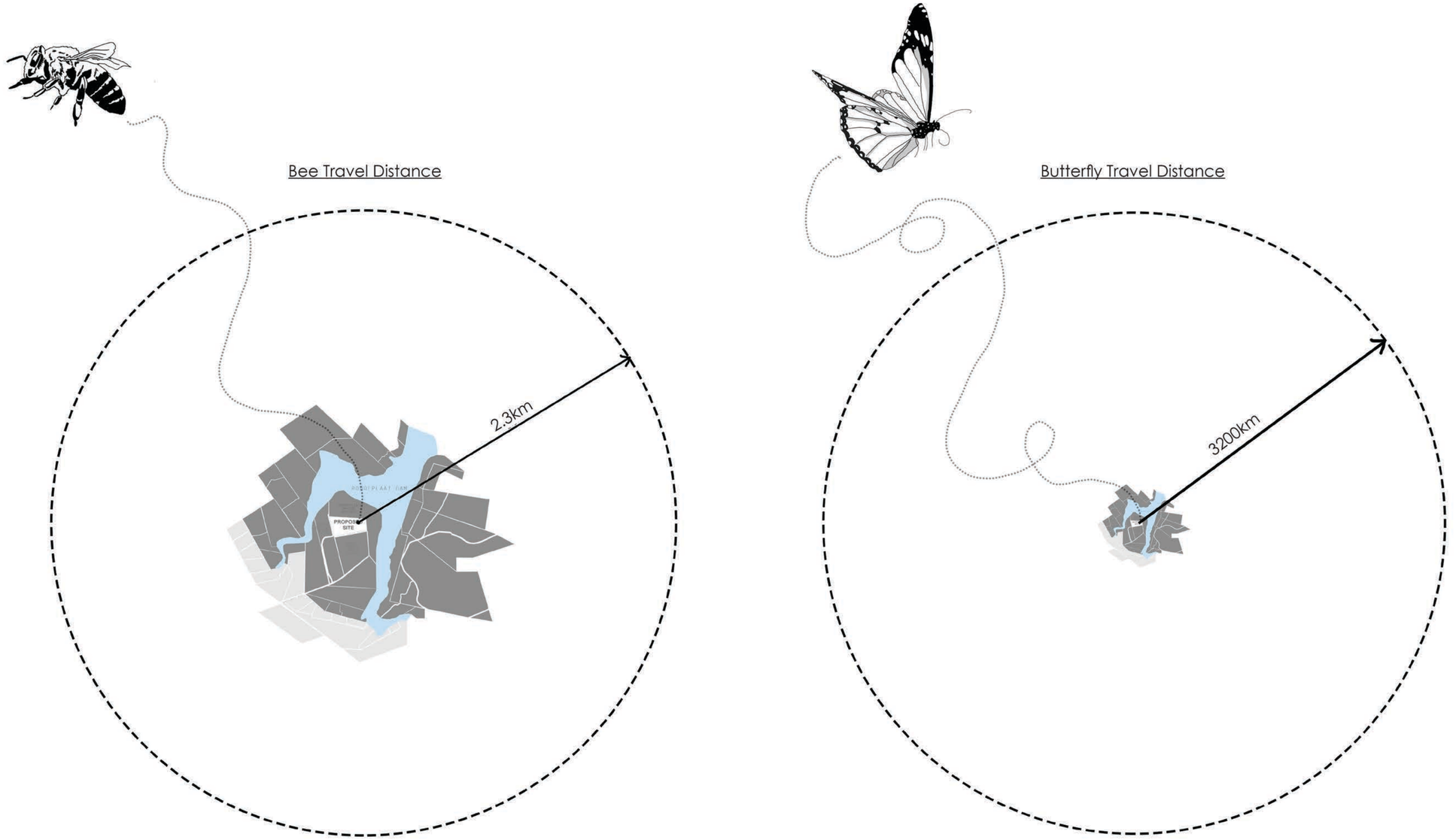


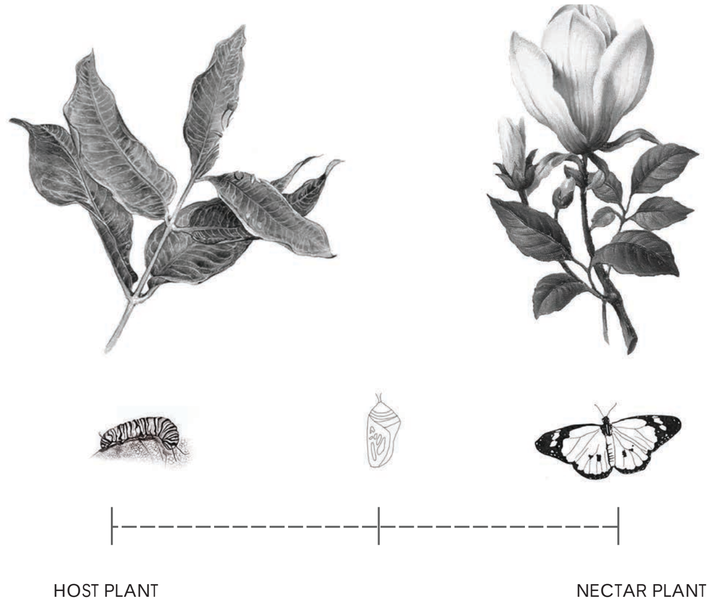
Figure 2.27: Pollinator Travel Distance from Site - by Author

ECOLOGICAL NEEDS OF BUTTERFLIES

The ecological needs of butterflies primarily involve host plants and nectar plants.

Host Plants:
This is the plant butterflies lay their eggs on. This then becomes the plant the growing larvae and future caterpillar eat to develop, and the plant or surface on which a caterpillar usually forms its' chrysalis to transform into an adult butterfly (Mecenero, 2013).

Nectar Plant:
This is the plant butterflies visit to drink the nectar from, which is their primary food source.(Mecenero, 2013). During this action butterflies collect pollen on their legs and pollinating flowers, as they move from flower to flower.



Additional Elements:



Mud - for nutrients



Water

Figure 2.28: Ecological Needs of Butterflies

ECOLOGICAL NEEDS OF BEE'S

The ecological needs of bees primarily involve nectar and pollen plants and nest sites

Nectar & Pollen Plants:
These two resources can come from the same plant or two different plants. Nectar is used by bees as a fuel source, while pollen is used to feed bee larva, allowing for new bees (SANBI, 2018).

Nest Sites & Over Wintering Sites:
Bees require adequate places to build their hive or comb, usually hanging off a branch or in a hollow wood alcove. During winter bees surround each other in a clump to generate heat and survive winter, some bees may even move to more insulated sites over this period (Hadley, 2019).

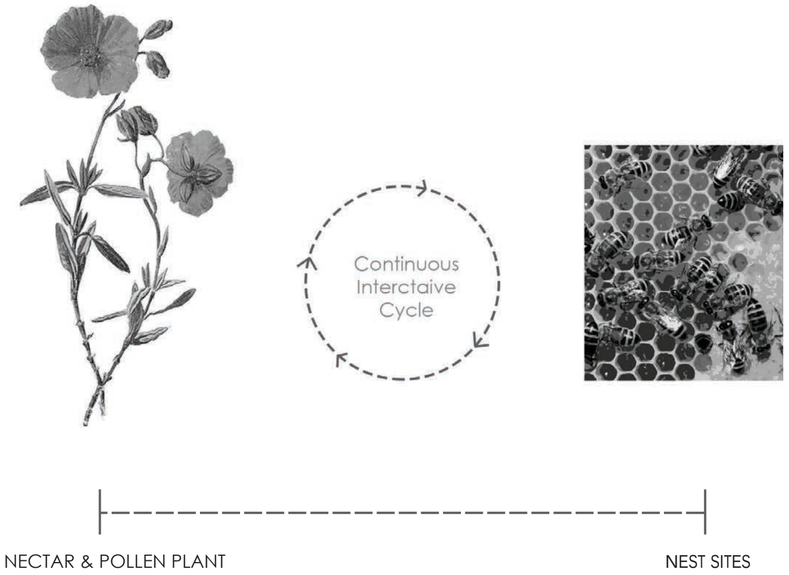


Figure 2.29: Ecological Needs of Bees

Additional Elements:



Water

BUTTERFLY LIFE-CYCLE

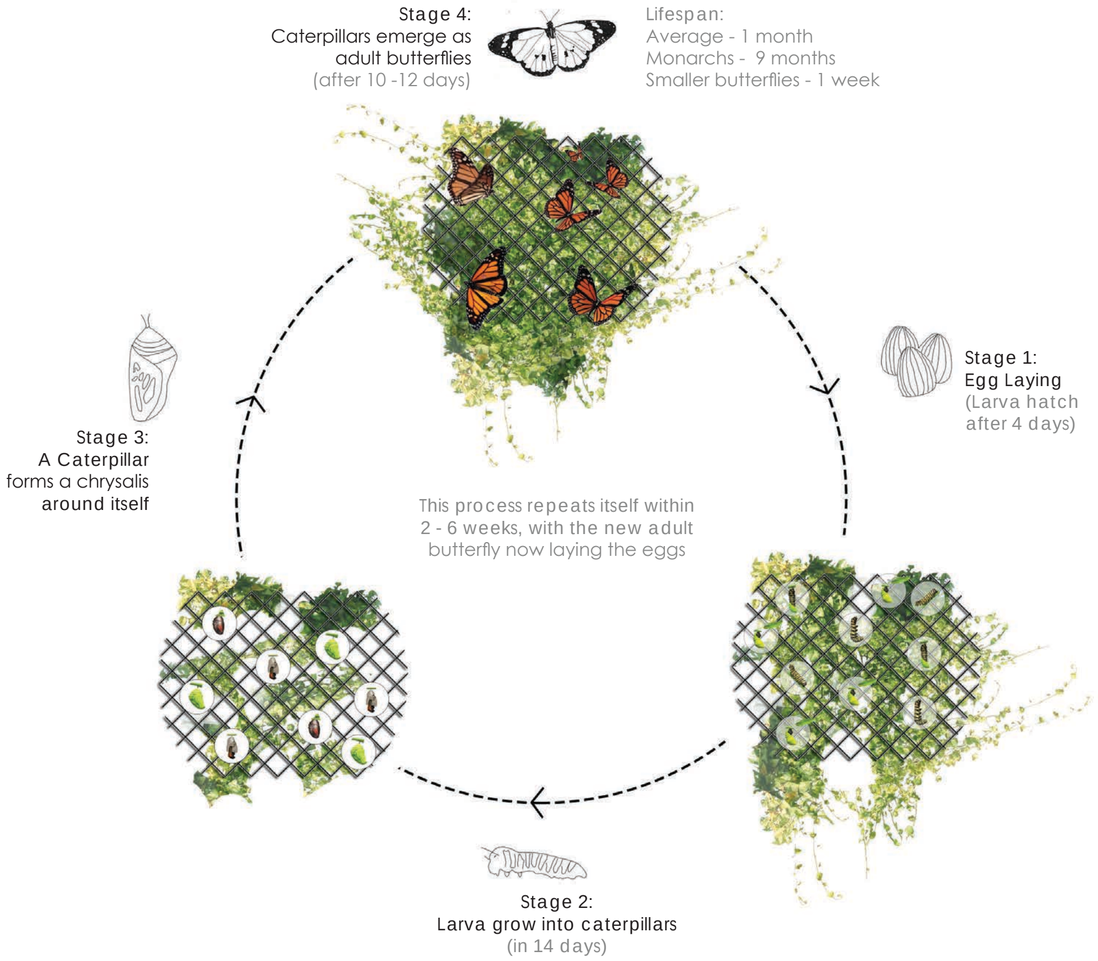
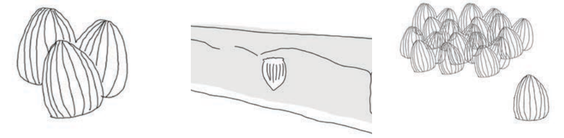


Figure 2.30: Butterfly Life-cycle - Sketch by Author

DATA



500 eggs are laid at a time (Monarch)

Each egg is placed on the underside of its own leaf

1 in 20 eggs make it to adult hood



Caterpillars consume the entire host plant

Caterpillars consume 27000 times their body weight

Butterflies drink between 1.8kg - 2.3 kg's of nectar a day

Figure 2.31: Butterfly Data - sketches by Author

HONEY BEES

Two species of bees exist, the Honey bee and the lesser know solitary bee.

Honey bees are colonising insects and as such, form colonies consisting of advanced social orders. A hive can contain anywhere from 20 000 to 50 000 bees on average (Huh, 2019). Within a hive there are three social casts; the Queen bee, the drone bee and the worker bee (figure 2.33).

DATA



20 000 – 50 000 bees live in a single hive



1500 - 3000 eggs are laid a day



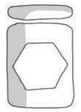
1 Honey bee visits 50 – 1000 flowers a day



A hive can gather pollen and nectar from 500 million flowers in a year

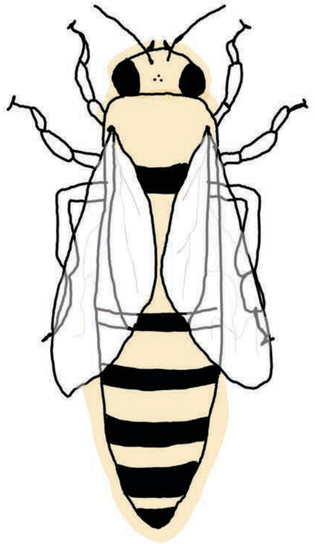


1 bee makes 1/8th of a teaspoon of honey in its life



A hive can make 27kg's of honey in a season

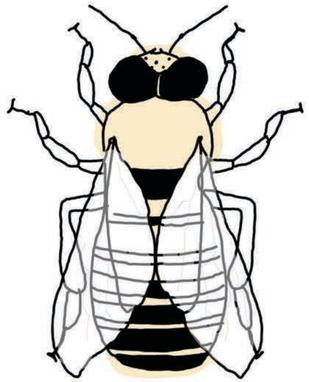
Figure 2.32: Honey Bee Data - sketches by Author



THE QUEEN BEE

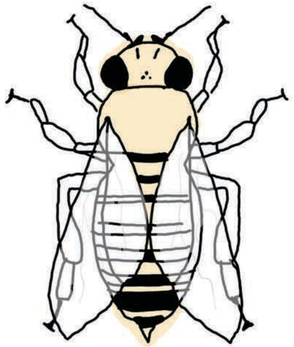
The queen bee is the largest and longest living bee in the colony (living from 2 – 5 years) and is the only sexually developed female in the hive (Huh, 2019). The queen bee's primary job is to lay eggs to produce the next generation of bees, which she does all day long, laying 1500 – 3000 eggs a day (Huh, 2019).

A queen bee becomes the queen by being fed a substance known as royal jelly, when she is still in her larval stage. Royal jelly is richer in nutrients compared to the food given to worker bee larvae and it is this substance that allows her to develop into a fertile bee (Gillespie, 2018).



THE DRONE BEE

Secondly there are drone bees, who are the only male bees in the hive (roughly 300 bees) and their primary objective is to mate with the queen bee. After mating with the queen bee, they either die or are forced out of the hive by worker bees (Huh, 2019). Drone Bees live 4 - 8 weeks.



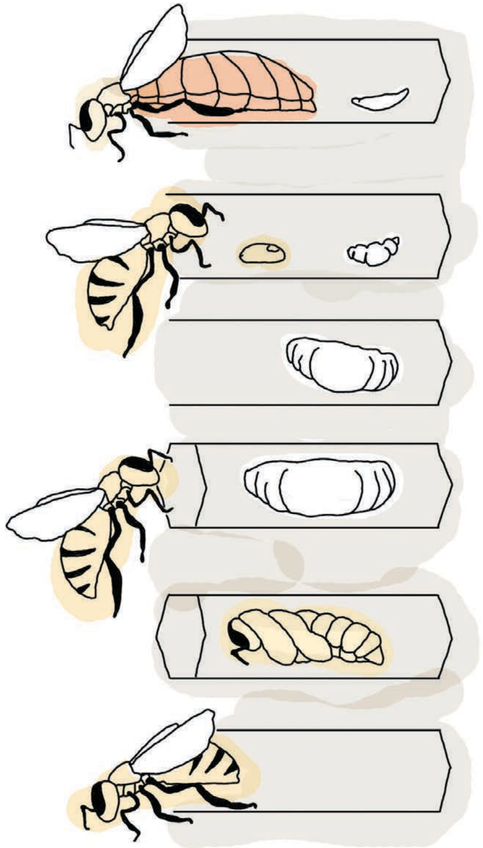
THE WORKER BEE

Lastly there are worker bees, who are infertile female bees and make up majority of the hive. Worker bees are the life force of the hive as they care for the eggs, feed the larvae and clean and guard the hive. These bees also forage for nectar, process the nectar and build the comb (hexagon framework of the hive) (Huh, 2019).

Worker bees have a shorter life span in summer (2-4 weeks), when they leave the hive to forage as they are more susceptible to predators. However worker bees born closer to winter live longer (11 months), as they spend most of their time inside the hive keeping it warm during the colder months and are thus less susceptible to external factors (Huh, 2019).

Figure 2.33: Types of Honey Bees - sketches by Author

HONEY BEE LIFE-CYCLE



Stage 1:
The queen bee lays an egg in the brood cell, laying up to 2000 / 3000 eggs a day

Stage 2:
A worker bee feeds the hatched larva

* Food that a female larva receives determines if it becomes a worker or a Queen.

Stage 3:
Larva reaches full growth

Stage 4:
A worker bee caps the cell to protect the larva

Stage 5:
Larva spins a cocoon and becomes a pupa

Stage 6:
Pupa matures into an adult bee & emerges leaving the cell

* Queens: 16 days to reach maturity
Workers: 21 days to reach maturity
Drones: 24 days to reach maturity

Figure 2.34: Honey Bee Life Cycle - sketches by Author

BEE LIFE-CYCLE THROUGH THE SEASONS



SPRING
Eggs are laid & new bees are born

SUMMER
Bees carry on collecting pollen & continue building their hive

AUTUMN
Bees store up honey as a food source for the cold winter months

WINTER
Bees spend most of their time in their hive & consume the honey store



Figure 2.35: Through The Seasons - by Author

SOLITARY BEES

Unlike honeybees, solitary bees do not make honey and are non-colonising and thus work and live as individuals. The only time two solitary bees interact is for mating purposes, with all females being able to lay eggs (Mason Bees, 2019). Solitary bees do not live in hives but rather form their nest in tunnels or burrows underground. It's in these nests where a solitary bee lays her eggs, laying 20 – 30 eggs in her lifetime.

Solitary bees are very effective pollinators, often visiting 20 000 – 100 000 flowers a day, making them 30 – 115% more effective than Honey bees (Mason Bees, 2019). Solitary bees collect pollen through the dry method. This method involves solitary bees storing the pollen and nectar on dry hairs on the underside of their abdomen and since these hairs are dry the pollen easily falls off as they move from flower to flower (Mason Bees, 2019). In addition, solitary bees pollinate flowers by moving in a back and forth motion, from flower to flower allowing for optimal cross pollination, increasing their effectiveness.

Honey bees use the wet method of pollination which involves mixing the pollen and nectar in their mouths with an enzyme that will allow it to be later turned into honey (Mason Bees, 2019). After this mixing, the pollen and nectar mixture is stored on thick hairs found on the back of their legs. The Honey bee will then return to the hive to deposit this mixture before return out to forage again (Mason Bees, 2019). This process is a lot slower than the method of solitary bees and also requires more Honey bees, thus making solitary bees faster and more efficient pollinators.

DATA



1 solitary bee pollinates as much as 120 Honey bees



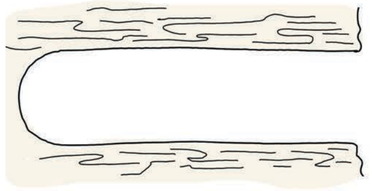
A female solitary bee lays 20 – 30 eggs in her lifetime



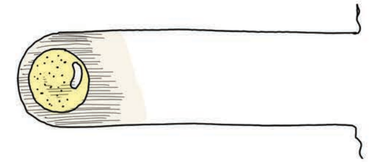
1 Solitary bee visits 20 000 – 100 000 flowers a day

Figure 2.36: Solitary Bee Data - sketches by Author

SOLITARY BEE LIFE-CYCLE

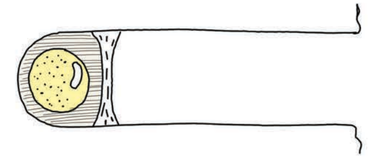


Stage 1:
A solitary bee locates a nest spot (tree tunnel) and then collects the necessary materials to create a cell for the first egg

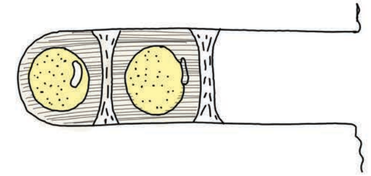


Stage 2:
The solitary bee places a ball of pollen stuck together with nectar inside the cell (for the larvae to eat) and then lays the egg on top. Space is left for the larvae to grow into an adult bee

* The female bee decides whether to lay male or female eggs, placing males at the front and females at the back since males emerge a couple weeks before females.



Stage 3:
The bee then builds a partition wall sealing off the cell



Stage 4:
The female bee repeats the process until the nest is full. She leaves a space at the front of the nest and then seals it off. She then moves on to another nest to lay more eggs

Stage 5:
A growing solitary bee spends its early months in the nest growing. During winter they form a cocoon and grow into a pupa, after which they emerge in spring or early summer as an adult bee. Once the adult bee has mated, the female bee looks for a suitable nest site and the process starts all over again.

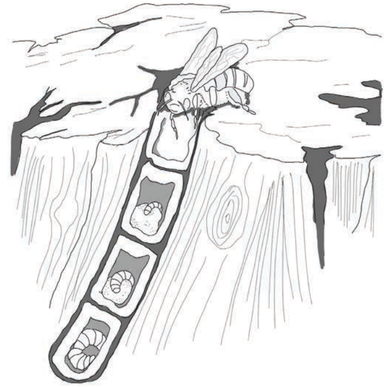


Figure 2.37: Solitary Bee Life-cycle & Nest in a Tree trunk - Sketches by Author

BUTTERFLY & BEE VISION

Humans can see colour that falls between the wavelengths of 400 and 780 nm , allowing us to distinguish 10 million different shades of colour (figure 2.38), however unlike pollinators we are unable to distinguish ultraviolet rays of light (less than 400nm) (Hodgson, 2017). The ability to see ultraviolet light is what aids pollinators in locating flowers and their pollen and nectar filled centres.

A bee is able to see colours of light between 300 and 560nm in length, which includes ultraviolet rays of light, and colour receptors for blue and green (Hodgson, 2017). However, this excludes colour receptors for the colour red (figure 2.38) and so red flowers appear black to bees.

Similarly to bees, butterflies are also able to see green, blue and UV light, which aids them in locating nectar (Atkinson, 2018). However unlike bees, butterflies are able to see the colour red and are thus often attracted to bright red, pink and purple flowers.

Flowers have evolved to accommodate this vision range and use ultraviolet light patterns and lines (invisible to the human eye) as nectar guides, directing pollinators to the centre of the flower where the food source is located (figure 2.39). A flower uses these patterns (located on their petals) as a way to attract pollinators to ensure pollen will be collected and their genes transferred, ensuring the continued growth of that particular flower species (Hodgson, 2017).

The use of colour and UV patterns could be used in my design to attract or repel certain pollinators. For example UV paint, bright coloured materials and flowers could be strategically placed to attract pollinators to the artificial food sources. Flowers, in colours visible to bees, could be placed further way from entrance spaces preventing possible stinging by honeybees, in favour of rather placing bright reds and colours bees are not attracted too.



Figure 2.38: Human visible light vs Bee visible light





Figure 2.39: Human vs Pollinator Vision, showing nectar guides, visible under UV light

TAKE-AWAY

The analysis done in this section represents two very important findings. Firstly pollinator movements can not be controlled or contained, they move from flower to flower as these are their environments, their homes, their rest stops, their egg laying sites and their food sources. Flowers and plants are not permanent, they are living and as such will eventually wither and die and so pollinators will move again to find new areas of flowering plants. This analysis is present on the site with butterflies moving along the path of flowering plants, however as they dwindle in numbers, due to the dominating wild grass, butterflies have ventured into the neighbouring nature reserve to search for new flower sources, new habitat patches, they need the option to move freely. This suggests that a containment approach of conservation is not ideal and would most likely hinder their growth and future prosperity.

The second finding of the analysis is that butterflies and bees have a very specific set of ecological requirements, needed for their continued survival and proper functioning. Furthermore, these ecological requirements are controlled by the seasons as they are living organisms. Plants are not immortal, they exist in a constant cycle of life, death and re-birth. Some plants grow in spring or summer, thriving in the warm heat and humidity, others bloom in autumn and winter, flourishing in the cold winds and shaded environments. The control of the seasons effects their food sources and egg laying sites, it alters their environments for favourable nest sites and flight activity, so much so that pollinator life-cycles have evolved to suit the favourable elements of the seasons. They lay eggs in spring when most host plans or pollen flowers bloom, ensuring plentiful food source for the larva and this ensures that they grow into adult bees or butterflies during summer, the season when nectar and pollen plants are the most plentiful. At this stage new adult bees are able to assist the hive in preparation for the cold months to follow. Their lifestyles have adapted to the seasons.

Thus, two points are presented; full containment is not beneficial and rather **there should be a more non-enclosure approach**. Secondly, the design should **provide the required ecological needs and visual aspects** and either mimic the lifestyle of the bees and butterflies and change with the seasons, or challenge this with an environment that is favourable year-round, or possibly it becomes **a hybrid of both approaches.**



04
ALTERED BY HUMANITY

NATURE AS ALTERED BY HUMANITY

neighbouring humanity of my site &
humanities negative effects

BREAK-DOWN

Introduction

Humanity & Vegetation

Humanity & Animals

Humanity & Soil

Humanity & Water

Humanity & My Site

Figure 2.40: Altered By Humanity - by Author

The basic laws of ecology state that everything is connected to everything else, and so you cannot affect one thing without it altering something else (Goudie, 2000). With this concept in mind, although this thesis places larger emphasis on examining the plight of pollinators as the natural world continues to degrade, one needs to understand how this result is connected to as a series of other consequences caused by human action. The law of ecology is ever so relevant when one looks at the state of the natural world, human agency has resulted in a series of cascading events, with areas of the natural world being affected one by one and then these effects overlapping and causing additional consequences. An analysis carried out discovered that out of six indicators of the biosphere (deforested areas, terrestrial vertebrate diversity, carbon dioxide release, population size, water loss and N release) half of these components have changed more in a single generation since 1950, than in the whole of human history before that date, as a result of human agency (Goudie, 2000) (figure 2.41), reflecting how severe the natural environment has been altered by human activity.

"Most of the change of the past 300 years has been at the hands of humankind, intentionally or otherwise. Transformation has escalated through time, and in some instances the scale of change has shifted form the locale and regional to the Earth as a whole" (Goudie, 2000). The information that follows details how humanity's impact on the natural world has resulted in catastrophic consequences, from altered vegetation impacting continued growth and affecting animals' species and the rate of natural extinctions, to soils being modified and affected through changes in land cover and use. Additionally, human activity has also resulted in changes in the quantity and quality of some of earth's natural water sources.

HUMANITY & PLANTS

Human agency has possibly had the greatest influence on plant life than any other component of the environment (Goudie, 2000). Since the beginning of civilization, human activity has resulted in the loss of 50% of all know plant species (figure 2.42)(Vidal, 2019). Some of the main causes of plant decline include fire, grazing, deforestation and pollution. Despite fire's natural benefit of facilitating seed germination, it does inevitably destroy habitats, however fires and this process of destruction are a natural occurrence, one from which nature can recover. However, when human agency interferes, primarily through deliberate suppression, this begins to affect nature beyond a recoverable rate, with the effects of a naturally occurring fires becoming more destructive. The method of deliberate fire suppression leaves behind inflammable material on the ground which is aimed at preventing fires from forming. However when a fire does form in the area or nearby this method, as a result of the inflammable material left behind prevents fires from burning out faster and causes them to stretch up to reach untouched material it can burn off, resulting in a crown type fire (Goudie, 2000). The consequences of this are greater air pollution and more devastating habitat destruction.

Despite grazing increasing biodiversity (by creating more niches) and contributing to further plant growth (when animals expel consumed seeds), human consumption and increased demand for food has resulted in heavier grazing. Heavier grazing leads to more excessive trampling of the ground, which accelerates soil erosion and deterioration, reducing future plant growth (Goudie, 2000). Furthermore, heavier grazing can also kill plants, as they can be completely consumed by cattle, allowing unfavourable plant species to become dominant. These species can then dominate this environment, spreading unnaturally and invading the surrounding areas. For example, the practice of excessive sheep grazing in Australia led to the removal of Kangaroo Grass, significantly changing the nature of Australian grasslands (Goudie, 2000).

Trees have been removed for decades, to provide land for agriculture and materials for fuel. Deforestation has catastrophic effects on the environment, as it leads to a reduction in biological diversity as a result of habitat destruction and species extinction (Goudie, 2000). It also leads to changes in local and regional environments, because the removal of trees and plants change water flow, increase soil degradation and increase sedimentation of rivers (Goudie, 2000), as there is now a reduced level of protection from the natural elements on the site. Deforestation causes changes in global environments because there is now a reduction in carbon storage trees, leading to an increase in carbon dioxide content in the atmosphere and changes in global temperature and rainfall patterns (Goudie, 2000). These three changes, caused by deforestation, are drastically altering our ecosystems, adding to and accelerating the destruction of nature.

Lastly, the pollutants given off by human activities have also had an effect on plant life, such as sulphur dioxide air pollution, which is toxic to plants (Goudie, 2000). Soil erosion (a form of soil pollution) alters the structure of soil causing it to become unstable, coupled with the concentration of clay-rich sediments (as a result of water pollution), causes areas of water logging or compaction to occur, which can hinder root penetration, affecting future plant growth (Goudie, 2000). Through attempts at suppressing fire, increased grazing and the expulsion of pollution, as a by-product of human activities, human agency has drastically altered earths vegetation in a way that not only threatens current and future plant growth but the survival of all know species that rely on plant life, including humans.

HUMANITY & ANIMALS

Humankind, as a result of evolving as a species, have impacted Earth's animal populations through domestication, dispersal, expansion and extinction of animals (Goudie, 2000). Animals dispersed by humans, knowingly or otherwise, can pose a threat to existing ecosystems. For example, in 1957 several Africanised honeybees, brought from South Africa to Brazil for research purposes, escaped (Goudie, 2000) and moved northwards, towards Central America and Texas, expanding at rate of 300 – 500 kilometres per year. Their introduction, although accidental, created a now existing environment where they compete for resources, with an already established population of European honeybees, leading to greater competition and species decline (Goudie, 2000).

Human influence on animals continues with instances of expansion. For example, the introduction of mongooses into Jamaica to control the growing rat population had unintended consequences. While reducing the rat population, the presence of the mongooses led to the annihilation of many native birds and land mammals, due to the new man-made level of competition for food (Goudie, 2000). Extinction is not always unnatural; it is a biological reality part of the process of evolution. In any period there are naturally doomed species that may die out due to their inability to adapt to naturally changing environments or climate, through competition with other species or even as a result of natural disasters such as floods and earthquakes (Goudie, 2000).

However, despite the natural occurrence of species extinction, the rate of extinctions, as a result of human activity in the last 400 years, has increased compared to that of the natural species extinction rate (Goudie, 2000). It has been calculated that from the 1900's to the present, human

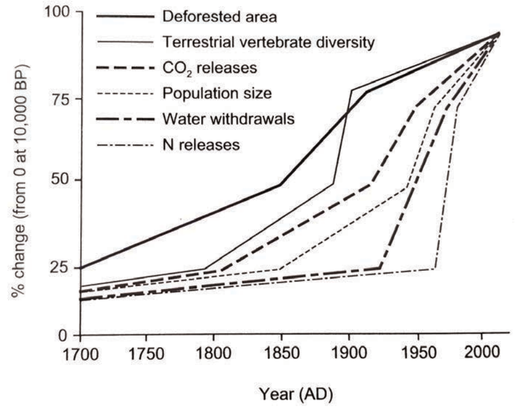


Figure 2.41: A graph representing the effects of humanities impact on six components of the biosphere

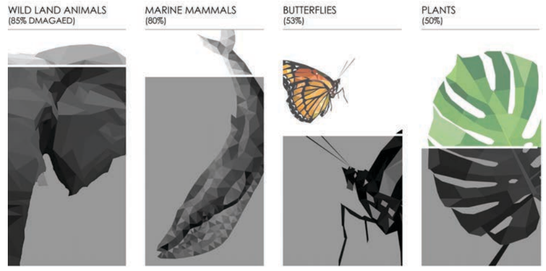


Figure 2.42: A graph representing the loss of nature since the start of human civilization - by Author

activity has accounted for the death of one species every year. However due to the state of the natural environment and humankind's continued negative impact, this rate is expected to be the demise of one species every day and within a decade we could be losing one species every hour, losing between 20% to 50% of our species by the end of this century (Goudie, 2000). The above stresses the dire consequences that human agency has on animals, and in turn their impact on nature, as animals play a vital role in sustaining, maintaining and enriching nature. Thus, stressing the drastic need for change and immediate conservation.

HUMANITY & SOIL

Soil is one of humanity's most vulnerable and dependable resources. Humanity's change in land use, new technologies and continued colonization of space, has impacted the quality and integrity of earths soils, by altering salinity levels (affecting ground water), soil structure (reducing plant growth) and increasing soil erosion (affecting the function and integrity of soil) (Goudie, 2000).

The salt content or salinity of various soils is a naturally occurring and normal characteristic of soils in many desert areas, around the world (Goudie, 2000). Whilst high levels of salinity are common amongst desert soils, human agency from water removal, irrigation and dam construction, has led to an increase in the salinity levels of non-dessert soils. Increased salinity in soils can increase a soils impermeability to water, preventing root formation and affecting existing and future vegetation (figure 2.43). Moreover, increased salinity in soils can alter water interacting with this now altered soil. As water mixes with the higher salt soil, the water absorbs some of the salts causing it to posses a higher concentration of nitrates, which when leached into water supplies, can make water undesirable for human consumption (Goudie, 2000).

Furthermore, this increased salinity soil and water combination can also kill plants at a cellular level, by collapsing its cells. In addition, through the process of evapotranspiration of irrigation water, sodium ions are left behind in the soils and absorbed by clay particles. This process makes the surrounding soil impermeable to water and thus prevents root formation, resulting in the death of vegetation (Goudie, 2000). These barren patches of land then become vulnerable to soil erosion by wind and water, due to the lack of vegetation, which would have provided security from these elements, further damaging the soil (Goudie, 2000). Despite salinity being a natural occurrence, it is evident how human activity has resulted in the creation of soils that not only damages drinking water, but also destroys plants and the structure of soils preventing future growth.

The structure of soils is vital in aiding its suitability for plant growth and protection against erosion. This structure can be altered by compaction, through excessive grazing or machinery. This compaction applies excess pressure to the soil, increasing its resistance to root penetration and reduces the rate of water infiltration, both of which reduce plant growth (Goudie, 2000). Moreover, Soil erosion is being increased by human activities such as construction, urbanisation, mining, fire, drainage, ploughing and deforestation, causing it to become one of the biggest issues harming the environment (Goudie, 2000). Soil erosion results in the removal of the top layer of soil, which contains most of the soils nutrients vital for plant growth, thus reducing the number of healthy plants grown in that area. Removal of this layer can lead to lower crop yields and high produce costs (Queensland Government, 2016). Soil erosion reduces the ability of soil to store water, promote plant growth (as roots struggle to absorb enough water from its soil, hindering strong plant growth) and overall support biodiversity and is thus a huge threat to natures survival.

With relevance to the built environment, the highest rate of soil erosion occurs during the construction phase, when a large amount of the ground and soil is exposed, along with continued disturbances through the use of vehicles and excavations (Goudie, 2000). During this process, the amount of soil erosion and damage that occurs, can be equated to the same level of damage that occurs over decades as a result of agricultural and even natural erosion (Goudie, 2000). In attempt to further our own existence, human agency has altered the earths soils, in a way that is starting to threaten the very existence we strived to achieve, by damaging the natural world.



Figure 2.43: The effects of increased soil salinity

HUMANITY & WATER

Water is another essential necessity to sustaining life and an important characteristic in many industrial systems and ecosystems, which has led to many people controlling water resources through various interventions, affecting both the quantity and quality of earths water sources (Goudie, 2000). Urbanisation's use of impermeable surfaces has increased the build-up of flood runoff, as these impermeable surfaces prevent flood runoff from returning to the ground. This also affects our ground water supplies as flood runoff is unable to return to the ground preventing the recharging of our natural ground water supplies. On the other hand, urbanisation can also negatively accelerate the recharging of ground water supplies, through inadequate infrastructure. This includes the leaking of sewers or water mains (Goudie, 2000), whose leakage seeps into the ground, drastically increasing the ground water supplies, at an unnatural rate.

Furthermore, through the process of extracting ground water, human agency has further reduced ground water supplies through a reduction in the water-table, which can lead to ground subsidence (sinking). A reduction in the water-table can lead to the drying out and subsequent shrinkage of below surface soils, which can lead to voids forming below the ground, which can open up, forming sink holes engulfing land and killing people (Goudie, 2000). An example of ground subsidence can be seen in a case that took place in South Africa in 1964. In the far West Rand, the consequences of gold mining resulted in the local water table falling by more than 300 meters. This reduction in the water table resulted in the clays, lining the roofs of these now empty voids, drying out and shrinking, resulting in the earth giving way and collapsing into the underlying void (Goudie, 2000). This consequence resulted in a 30-meter-deep and 55-meter-wide sinkhole, opening up in Gauteng, killing 29 people in 1964 (figure 2.44).

In addition, water sources can also be contaminated as result of human activities, such as through thermal pollution. Thermal pollution occurs when water, that is unnaturally heated (while being used as a cooling agent in power stations) is expelled into a natural water source (Goudie, 2000). This altered water can now negatively affect the fauna and flora that rely on this water sources, as fauna and flora are very sensitive to temperature change, thus alerting their environment.



Figure 2.44: The Blyvooruitzicht sinkhole

HUMANITY & MY SITE

The creation of two neighbouring resorts has shown to have had some negative impact on my site. The creation of a tar road along the western boundary for Marleo Holiday Resort, created a very impermeable barrier clearly affecting the growth of trees along the western edge of my site. Documentation of the site throughout time, has revealed that trees appear to grow from the edges of the dam - land boundary, moving inwards, towards the center of the land wherein my site is located. However, the impermeable and impenetrable surface of the road has shown to be a clear hindrance in allowing plants to move closer to my site along the western edge, accelerating the sites degradation (figure 2.45).

This has contributed to the sites degradation as the lack of trees along this edge has resulted in a reduced level of protection from the natural elements for smaller, more delicate plants. This is clear when one notices that only the weed like, wild grass seems to have survived in that region, with other species of plants occurring more towards the eastern side of my site, were there is greater protection. This lack of protection has essentially aided wild grass growth and allowed it to become the dominating plant on the site, pushing out other more delicate plants such as flowering plants and smaller shrubs, towards various edges of the site. This is most noticeable along the man-made paths, where one can spot a few of the flowering plants (on which butterflies and bees feed) dotted along the edge of the grassland, fighting for space as they get pushed out and overthrown by the now dominant wild grass. This results in a reduced food supply for pollinators leading to a reduction in their numbers and contributing to the degradation of the site.

The man-made paths have also negatively affected the site and pollinator livelihood. These paths show the clear consequence of compaction and how it can alter a soils structure and accelerate soil erosion. These paths are completely void of any plant life and rather consist of rocks and eroded areas, still showing the paths forged by water as it flowed along its surface. The effects of compaction have altered the soils structure and accelerated soil erosion to the point where roots are unable to penetrate the soil and even if they could the healthiest layer of soil, to aid plant growth, has been removed. In addition, excessive pressure of people walking along these paths has compacted the soil, leading to a reduction in the rate of water infiltration, clearly illustrated by the apparent water paths imprinted in the soil (figure 2.46), which would reduce the amount of water available to plant roots.

These conditions have essentially created a dead zone (figure 2.47)of unhealthy ground, causing flowering plants located on the boundary of wild grass and path, to slowly fade away as they are being pushed out by the wild grass and their roots can't penetrate the neighboring unhealthy ground, further degrading the quality of the site. This has resulted in very few beneficial flowering plants remaining on the site, not for a lack of flowering plants existing in the area (as seen in the neighboring nature reserve which has many flowering plants), but rather due to the lack of available healthy space. This leads to a reduction in pollinator numbers on the site, as they would either start to die out or stop visiting due to the lack of food, which in turn then has additional negative results on the other plants and species on the site, leading to further degradation. These alterations of my site show the clear negative impact humanity can have on the natural world, even at the micro scale.

Humanity's modern expansion has resulted in an actual and permanent impoverishment of the world (Goudie, 2000). All the above highlight how human activities have affected and changed our environment, supporting the findings of a biodiversity study produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which declared that human activity from deforestation and over exploitation of the seas and soils, to the pollution of air and water, is driving our natural world to the brink of extinction (Vidal, 2019). This study stresses the fact that nature is collapsing, and our planets' support systems are so stretched that humans may face widespread species extinction and mass human migration, unless immediate action is taken (Vidal, 2019). The current situation of environmental collapse is resulting in the loss of our life support system and jeopardising the future survival of the human species (Carrington, 2018 A). What is happening to our natural world, is that the structure and function of natural systems, that have supported life on earth for over 400 million years is collapsing (Kiedaisch, 2019), accelerated by a species that only takes up 0.01% of all living organisms on earth.

The executive director of the World Wildlife Fund said that humanity "is sleepwalking towards the edge of a cliff" (Carrington, 2018 A). He urges people to understand that the current situation of environmental collapse is not just about losing the beauties of nature, as devastating as that is, it is about losing our life support system and jeopardising the future survival of the human species (Carrington, 2018 A). It is thus clear that while the human species has explored and expanded all over the Earth, we have undoubtedly caused our planet severe harm, that now not only threatens the very place we call home but our own existence and thus suggests an immediate need to alter our ways.



Figure 2.45: Tree movement & road obstruction on site - by Author


Figure 4.46: Eroded & compacted man-made path - Photograph by Author


Figure 2.47: The dead-zone of the man-made path - Photograph by Author

05
PROTECTED
REALM

NATURE AS A PROTECTED REALM

the positive effects humanity can have on my site

BREAK-DOWN

What is rewilding

Why do we need rewilding



Figure 2.46: A Protected Realm - by Author

WHAT IS RE-WILDING?

Humanity has existed for so long in a world we consider as continuously expanding, with this idealized image of open spaces filled with people and creations based on new discoveries. However, if the information in the previous sections of this chapter illustrates anything, it is that this idealistic image is just that, an image and not a reality. Nature is in a state of free fall, with pollinators on the verge of extinction, resulting in a series of cascading consequences rippling through out all natural, social and economic sectors of life. Humanity has forgotten how to work in tandem with nature, "we have forgotten how to be good guests, how to walk lightly on the earth as its other creatures do" (Goudie, 2000). As we look for ways to rectify the damage done to the natural world the concept of rewilding has evolved and developed into a progressive approach to nature conservation (Rewilding Europe, 2011).

Rewilding is a form of environmental conservation and ecological restoration that when implemented correctly, has the ability to create self-sustaining environments, alleviate the effects of climate change and increase biodiversity (True Nature Foundation, 2019). Rewilding views humanity as having the ability to create the right conditions to promote prosperity, whether that be by removing dams to free up rivers or by reintroducing species that have disappeared as a result of human agency. However, it then acknowledges the survival and self-governance of nature and suggests that once we have created these conditions we should step back and let nature manage itself (Rewilding Europe, 2011) (figure 2.49).

Rewilding works to restore lost and declining species by giving them spaces to thrive and increase in population, primarily through the introduction of lost animal species or key-stone species into natural environments (Rewilding Europe, 2011). Through this approach it aims to restore natural processes and wildlife areas, providing connectivity between these places, in order to avoid creating 'conservation islands', which increase species decline (Rewilding Earth, 2018).

Rewilding focuses primarily on the introduction of key-stone species, which largely consist of apex predators, such as wolves, sharks and large cats, however key-stone species also include pollinators, such as butterflies and bees. This is because a key-stone species is defined as a species that helps define its entire ecosystem and whom without that ecosystem would be drastically different or even cease to exist (National Geographic Society, 2019). In addition, key-stone species are species who have low functional redundancy, which means that if this species were to disappear from an ecosystem, no other species would be able to fill or replace its ecological niche (National Geographic Society, 2019). In this way any organism from a plant to a shark can be a key stone species, they are not always the most plentiful or largest species in an ecosystem but are however largely always species that have a large influence on the food webs of ecosystems (National Geographic Society, 2019).

This begins to clearly reference the action of pollinators as key-stone species, in that they are responsible for maintaining healthy ecosystems, whom without would collapse, primarily through the action of pollination. Some plants can only be pollinated by certain butterflies or bees, a process that cannot be replicated by another group of species – hence their niche and pollinators also form the basis of almost all food webs, allowing them to be defined as key-stone species.

In terms of key-stone species, pollinators are classified as key-stone mutualists. Key-stone mutualists refers two or more species that participate in a series of mutually beneficial exchanges, where a change in one species would alter the other and transform the entire ecosystem (National Geographic Society, 2019). Pollinators, from butterflies to bees, have an interrelated existence with plants and are responsible for gene flow and dispersal of these genes throughout ecosystems, engaging in a series of mutually beneficial interactions (National Geographic Society, 2019). Their existence as key-stone species makes them the perfect candidate for rewilding, in combination with design, to aid in their continued growth, prolonged survival and rejuvination of the site.

Rewilding, as a method of positive conservation, does not see itself as a one stop fix, a solution with a defined end point, but rather it is a developing process, where every step of progress is seen as success (Rewilding Europe, 2011). Rewilding focusses on ensuring wellbeing, in that it aims to sustain and improve nature. This is because when nature is healthy and thriving, this has positive effects on all living organisms, including humans, in that we rely on the natural world for clean water, fresh air and healthy food (Rewilding Europe, 2011). Rewilding continues to increase as a method of conservation, as more evidence arises on how nature effects humans mentally and physically for the better. This together with its belief that through certain actions nature can become self-sustaining once more, rewilding is growing as the leading strategy in reviving the dying natural world.

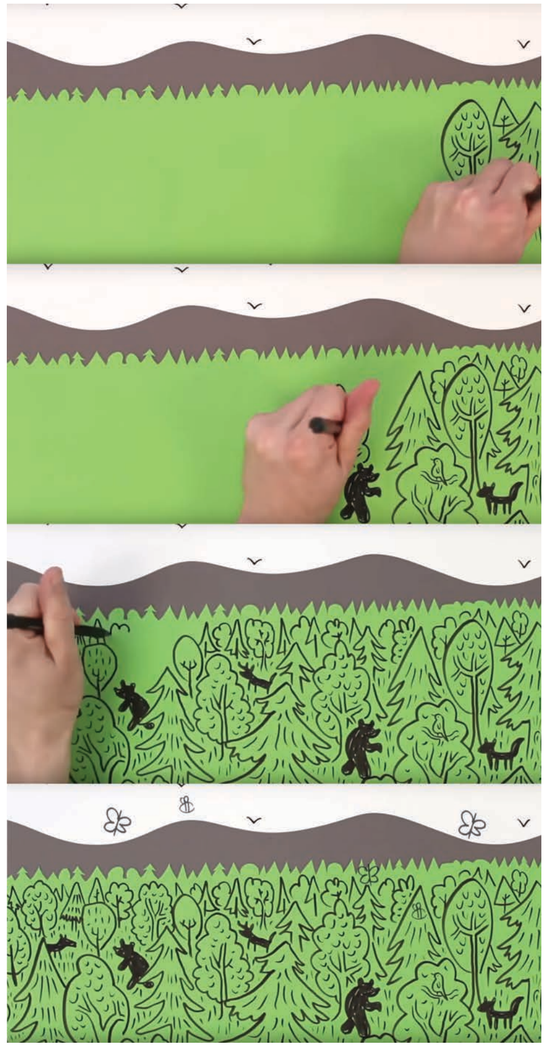


Figure 2.49: Rewilding - humanity creating a starting point & then stepping back

WHY DO WE NEED RE-WILDING?

Rewilding is seen as a replacement to traditional conservation methods. Traditional conservation methods believe to have failed primarily for their thinking of 'nature is priceless' and so we must protect it. This ideology often leads to conservation motivated by nostalgia, we want to be able to escape to a place of 'nature' and see it like it was in the good old days. The problem with this underlying ideology is that people raced to 'protect' habitats that were rarer or more man-made, which lead to various other habitats degrading and the unconscious creation of fragmented habitats, that were not connected and thus become fragile in the long run (Rewilding Europe, 2011). Fragmentation is a huge issue that conservation methods hope to rectify, in that species need to be able to move between spaces to not only seek out better food sources and shelter, but also to allow their current habitat to restore itself, to ensure its continued use and beneficial rewards. If these spaces are spread to far apart species are unable to migrate to new spaces, they run out of food sources and their habitat is unable to recieve a break and revive itself for future use and so both animals and nature suffer.

In line with the nostalgic tones of traditional conservation methods, spaces were selected based on their aesthetic value, a place people would want to visit, something picturesque that would make a nice photograph backdrop (McCay, 2019). Nature conservation became a process of choosing land that had picturesque views and charming landscapes, and although some of these places may indeed have needed protection, the problem of what we view as important natural landscapes came into question (McCay, 2019). Do people view natural landscapes, such as intweweaving hills, as having an intrinsic value in themselves due to their aesthetics or from a conservation point of view? Do these spaces maybe instead have little value when compared to areas that are more biodiverse, but may not be as visually appealing, such as wetlands (McCay, 2019)? In this way traditional methods of conservation, with their ideology of nature being priceless, did indeed end up putting a price on nature, selecting spaces not entirely for their importance but rather for their aesthetics and possible income. New methods of conservation acknowledge the older methods and its inevitable failure in restoring many habitats, understanding their reasons for failing in that philosophical and scientific arguments often always fall short, when compared to job creation and increased profits (McCay, 2019). However newer methods of conservation understand the need to push past these perceived notions, in the aim to save and restore dying and disappearing habitats, despite their aesthetics and level of potential income.

Whereas traditional methods of conservation defined conservation according to a preservation worthy landscape approach, rewilding understands that there is a more complicated definition of nature (McCay, 2019). Rewilding sees the aesthetics of nature but also acknowledges the importance of everything we don't see, all the seemingly hidden ecological processes taking place in that environment. Where traditional conservation methods stated idyllically that nature was priceless, rewilding states that nature does indeed have a price and what it provides for existence can be defined and valued, it places a value on environmental benefits (McCay, 2019). Rewilding works with growing conservation ideas and acknowledges the price of the services nature provides, from providing fresh air and clean water, right down to the role of pollinators.

Thus, rewilding is needed not only as an approach to protect nature but also as a means of restoring nature and its complex arrangement of ecosystems (figure 2.50). This approach aims at creating functional landscapes, landscapes that allow for the creation of natural processes that shape and alter ecosystems, natural processes such as flooding, grazing and scavenging (Rewilding Earth, 2018). In this way, the interaction of these processes (stimulated by rewilding) allow for the creation of ever evolving environments, rather than stagnant habitats and thus promote growth and future prosperity for all (Rewilding Earth, 2018).

In an age where nature is struggling to survive and human agency is needed to revive these dying habitats, rewilding places itself as the most conscious approach, in that it acknowledges the strengths and weaknesses of both parties involved. Rewilding identifies humanity's strength in having the ability to create the perfect starting point for nature to recover (possibly through a designed intervention) while acknowledging our weakness in becoming dangerously over involved. On the other end of the spectrum, this approach identifies natures strength in being self-governing and resilient and its weakness in being unable to revive itself without help.

When one considers this approach with design in mind, we can identify that the starting point needed by nature, provided by humanity, can become the artificial intervention, modelled after the ecological needs of the species to be sustained. This then creates the perfect condition to allow such an environment to become self-sustaining, allowing nature to then manage itself. Together these observations allow the approach of rewilding (together with design) to situate itself as the most viable option in reversing the damage done to the natural world, and more specifically to the context of my site, while ensuring future growth and prosperity for all involved in the site's ecosystem.



Figure 2.50: The Carrifran valley in Britain restored through initial tree planting

06
NATURE AS ...

IN CONCLUSION

This information clearly expresses the affect humanity, as a species, has had on the natural world but also clearly illustrates how humanity can assist in rectifying the damage we have imposed. Drawing from all the above information, one can deduce that pollinators and nature need assistance in ensuring their continued survival. One can clearly see the importance pollinators play in maintaining not only natures ecosystems but the effects they have on the social and economic sectors of the world and humanity as a whole. The explorations done and the ones to follow, clearly show how the creation of an artificial environment could exist as the best possible solution to reviving a dying ecosystem without hindering nature too much.

By understanding the ecological needs of pollinators and the reasons they are dying, one can conclude that the approach of mimicking the natural to create something that is no longer able to exist naturally can become the next step in the fight to aid pollinator extinction. One can also see that nature is unable to sustain itself and so any natural intervention may only be short-lived, reinforcing the importance of introducing an artificial intervention to improve pollinators and by virtue nature's chance of survival. In order to improve the chances of something living one would need to provide something that could never die, ultimately suggesting how the approach of the artificial or prosthetic becomes a very important consideration when one begins to approach the question of how can pollinator extinction, the extinction of something living, be better addressed.

03

"It is my belief...that the truth is generally preferable to lies."

- Albus Dumbledore, The Goblet of Fire

VIABILITY REPORT

EXPLAINED

_This chapter includes a viability report, exploring the feasibility of the proposed intervention, by outlining various components of the proposed intervention from the clients to financial modeling. This is done in order to investigate the interventions feasibility and how such a proposal can be implemented successfully .

THE PROJECT

This project aims to create a bio-sanctuary / artificial environment for South Africa's endangered pollinator species, particularly butterflies and bees. This is to be located on a site adjacent to the Roodeplaat nature reserve and Roodeplaat dam, in Pretoria. This intervention aims to serve as a place that protects and provides for these species and one in which research is generated to aid in pollinator survival. In addition, this space aims to educate the public on the importance of these species and the roles they play in maintaining our ecosystems, becoming a space that ultimately provides for all species, be it butterflies, bees, plants and humans.

This bio-sanctuary serves as an intervention to assist in the revival of these dying species, in an aim to cultivate and grow the existing species on the site, to aid in the fight against ecosystem collapse and revitalise the context of the site, to contribute to the larger issue of safe guarding humanity's future, the biodiversity of our planet and prevent pollinator species from becoming extinct.

THE CLIENT

The aim of this design is to protect the irreplaceable and revive the endangered, and so therefore established organisations, currently fighting against the collapse of the natural world, would be the most suitable potential clients and sources of funding for such a project. This project would require both the economic backing and status from privately owned organisations, together with the assistance and the larger administrative reach of government/public organisations, and as such I believe a private/public consolidation would provide the best client structure.
Four possible clients for the proposed client consolidation would be SANBI, LepSoc, The NAC and Manzi Monate and Marleo Holiday Resorts.

SANBI
The South African National Biodiversity Institute (SANBI)
SANBI, is a public department, under the department of environmental affairs, who coordinates, monitors and reports on the state of biodiversity in South Africa and participates in ecosystem restoration and rehabilitation, in order to preserve habitats and prevent the loss of biodiversity. SANBI's mission is one of preservation and education, through increasing our understanding on the importance of biodiversity, SANBI believes this will lead to better management of our natural environments, leading to greater conservation and preservation methods. The function of SANBI, as a body aimed at conserving South Africa's rich biodiversity, is one reflective of the National Environmental Management Biodiversity Act (NEMBA), 2004. Through six programmes SANBI follows the structure of NEMBA, allowing for a governance structure that aids in protection, conservation and education with regards to South Africa's Biodiversity.

As the fight for conservation is one that requires consistent support from all sectors, SANBI is associated with various other organisations, including The National Research Foundation, The Botanical Society of South Africa, South African National Parks, South African Tourism organisation and The World Wildlife Fund, to name a few. Together all these organisations assist SANBI in its goal of protecting South Africa's biodiversity for the benefit and enjoyment of all.

The overall mission of SANBI is to conserve South Africa's biodiversity and restore and rehabilitate existing habitats (through various interventions), this organisational mission and expertise, not only aligns with the mission of this project, but also suggests that they will be able to provide invaluable advice throughout the whole project, with regards to issues of working with nature, reaching the public and achieving conservation. SANBI also has a large national and global reach, working with many conservation lined agencies and organisations all over the world and thus would be able to bring a sense of prestige to the project, along with potential financial backing, due to being well established. These ideas all suggest why SANBI could be a perfect candidate as a client, for such a project.

LepSoc
The Lepidopterists' Society of Africa is a non-profit organisation aimed at promoting awareness and improving knowledge of Afrotropic butterflies and moths. In doing so, LepSoc also promotes research into these species and aids in their conservation, through interactions with their society members, members of the public and conservationists worldwide.

The proposed Bio-sanctuary has various programmatic components to aid in both species and habitat conservation, one of which is a research area. The whole site will start to exist as a research and education 'site', in that these species can start to be observed in their natural habitat, along with a physical research 'centre', to aid data collection and research exhibiting. This new artificial environment or bio-sanctuary can become a place that allows for additional research into butterflies, both about their ecology and biology, but also on how to conserve them and reduce their overall species decline. It will also serve as space where people can be educated and informed about the plight of nature and the danger these creatures are facing, spreading further awareness about the threat's butterflies face and the importance they pose to humanity's future survival. A space that not only aids and furthers research into butterflies, but also promotes the growth and dissemination of knowledge and awareness on these creatures, is one in line with the mission of LepSoc, and thus makes them the perfect organisation to assist in the creation of such a project. LepSoc's members are also avid butterfly lovers and most are professional lepidopterists and can thus provide vital information about the habitats and lifestyles of butterflies, which will be vital in the design stage, particularly the early stages of design. This will allow for a successful end result and design that will aid in butterfly growth and cultivation, further suggesting why they would be a perfect client for this project.

The National Arts Council (NAC)
Conservation of nature and protection of biodiversity often falls short, simply because there is not enough awareness by the public (greater community, outside that of conservationists). Artificial environments will only be successful, if in the greater scheme, people realise the ways in which human activity is destroying the natural word. Through education programs and recreational spaces, to draw people to this artificial environment, people will be able to be informed on the issues of nature's collapse and species extinction. In this way information can start being disseminated to spread awareness about the greater issue of biodiversity loss and natures demise, with the supply of information being vital to ensure consistent support for nature conservation.

It is for this reason why I believe an organisation in the field of arts would be a great asset, an organisation that has a vested interest in reaching people and experience on how to educate people through entertainment, would be a valuable client. The National Arts Council would serve as the perfect candidate due to their vision, as an agency of the department of arts and culture, is to promote the culture of South Africa (which has a strong connection to nature) and to develop and promote excellence in the arts. In this way this council could assist with the procurement of environmental awareness specific cultural events to educate and attract more people to the project and possibly even provide financial assistance for the development of the various education nodes of the program.

The site for this proposal, is located in an epicentre of tourist and retreat-esque attractions, with multiple resorts, B n' B's and some wedding venues in close proximity. This together with the activities that take place along and, in the dam, such picnicking, rowing and fishing, add a level of constant attraction and influx of people to the area. The NAC could build on this existing attraction context, in a way that would allow them to entertain and reach the people already visiting the area and attract a larger influx of people to the area. An influx of people is an essential component in ensuring people visit sites of conservation, allowing them to be educated and informed on what is happening. This not only creates awareness but also allows for the dissemination of information (into the greater area) on the importance of conservation and the current status of the natural world. This process promotes further awareness, conservation and change in the fight against natures demise.

Manzi Monate / Marleo Holiday Resort
Manzi Monate and Marleo, are not only holiday resorts which neighbour the proposed site, but also a space through which you can enter the site. As previously mentioned, the success of conservation sites is owed to its ability to draw people to the site and so a holiday resort could act as the perfect mechanism of attraction, through which people could be drawn to this project. These resorts could also benefit from this project as an additional attraction and draw for their own businesses, making it a beneficial pairing, suggesting why they could truly be good candidates for clients of this project.

In this consolidation SANBI would exist as the primary client and financial benefactor, where the other three clients, LepSoc, NAC and Manzi Monate, would exist as secondary clients, providing some funding for certain spaces and act as tenants, renting and leasing spaces within the project. Within this project, these three organisations (LepSoc, NAC and Manzi Monate / Marleo) are identified as clients (not just as tenants) as their contribution is fundamental to the development of this project and continued functioning and success. All four organisations have a vested interest in aspects of the proposed design, whether it be the overarching aim of reviving nature, reversing ecosystem collapse and improving pollinator population numbers or even in smaller programmatic components which aim at informing, educating and entertaining people. It is for these reasons why I believe these four organisations would be the

best possible and most suitable clients to form an efficient public/private client consolidation (figure 3.1).

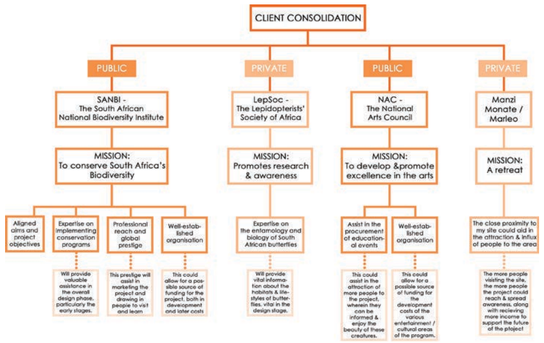


Figure 3.1: Client Consolidation Break-down

PROJECT DEFINITION / PROGRAM

This Bio-sanctuary / artificial environment serves as a mechanism through which butterfly and bee populations can be cultivated and sustained, becoming a space that encourages these species growth and the growth of the surrounding landscapes. In this way these species can be strengthened in number, which can reduce the sites degradation and contribute to the larger fight for the revival of the natural world. This bio-sanctuary / artificial environment will require the necessary host, nectar and pollen plants in order to promote growth and stability of the existing pollinators. This is the first step to creating a successful habitat, to aid conservation and promote growth.

In addition to the establishment of vegetation vital for continued growth, these new environments need to be regularly researched in a way that allows humanity to advance their understanding of these endangered species ecology and biology. In order to accommodate this function, this artificial environment will have three dedicated research laboratories (plants, butterflies and bees), a place where these dying species can be examined in their 'natural' environment. This will allow for the development of new solutions on how to preserve these species and reduce declines, as extinctions are not avoidable, but they can be slowed. A component of the plant laboratory will store seeds of these vital food and host plants, serving as a safety net to prevent host and nectar plant decline on the site. It will also act as a mechanism through which vital vegetation can be given to visitors, to grow in their own environments, thereby increasing green lungs or pause moments for pollinators, to aid in migration, new site colonisation and reduce species decline.

To aid in species growth both the bee and butterfly lab technicians and researchers will monitor the eggs and larvae laid on host plants and in hives around the site, removing some of the butterfly larvae, to grow in the more controlled environment of the laboratory, creating a version of an on-site breeding scheme. In addition to laboratories, a diagnostic clinic will be set up based on the research carried out by Susana Soares (chapter 4). This clinic uses bees as diagnostic tools to test for certain illnesses such as cancer and diabetes and thus serves not only as a space to diagnose people but also to exhibit the other ways in which pollinators can aid humanity, beyond the role of pollination.

Artificial environments success will be owed to the realisation that how human activity is destroying the natural word. Through education programs and recreational spaces, drawing people into this artificial environment, people will be able to be informed on the issues of nature's collapse and species extinction. This will allow for information to be disseminated to spread awareness about the greater issue of biodiversity loss and natures demise, with the supply of information being vital to ensure consistent support for nature conservation.

Thus programmatically, this artificial environment will require research laboratories, spaces that research the necessary species and the demise of nature and exhibits this research to visitors to spread awareness. This space will also require a diagnostic clinic, and an educational component, educating people on the importance of pollinators, along with a recreational component (possibly a restaurant), to further draw people to the site and thus be able to inform more people. Most importantly, this artificial environment will need to aid the growth of relevant host, nectar and pollen plants to aid in species growth and colonisation of the new environment and, together with a possible breeding scheme, aid in increasing population numbers.

TARGET MARKET

The target market for this proposal can be grouped into four categories:

1. Endangered pollinators and nature
2. Conservationists
3. The 'slightly' informed
4. The 'to be informed'

Endangered pollinators and nature are the main target market for this proposal, and the main group this proposal aims to help and benefit. This project serves as a haven for endangered butterflies and bees, a space where their species can be cultivated and grown, and where there is ample supply of food and shelter all aiding in their improved growth and colonisation. This design serves as an approach to reversing the damage inflicted upon nature by humans and by strengthening these species and the context of the site, the hope is that the domino effect and interrelated character of ecosystems, will allow this improvement to ripple out, improving this site and surrounding areas ecosystems, contributing to the enhancement of nature.

In addition to benefiting pollinators and various plant species, this project targets various people orientated category's, as humanity is the largest threat to nature and pollinator species future survival (despite humanity relying entirely on nature and pollinators for their continued survival). As such some of the programmatic functions serve to inform people on the threats these creatures are facing, how people can help and what is currently being done. The second category, conservationists, include individuals who are educated in the field of conservation and environmental science, as well as possibly people who don't necessarily have scientific degrees, but whom have developed a passion for conservation and the protection of the natural world and its species. Both of these groups are aware of the plight of nature and the danger the collapse of the natural world pose to species survival, including humans, and the overall survival of the earth. This project provides a space where they can further their research and possibly learn more about these creatures and the condition of nature, while still providing a space where they can enjoy watching, interacting with and learning from and about these pollinators.

The 'slightly' informed are people who may be aware about the fact that humans are destroying the natural world but have more of an overview of the larger issues, such as climate change and the general consequences, such as that climate change is having a negative impact on earth. The 'to-be-informed' are people who are not aware about what is happening to the natural world and pollinator species. Together with the slightly informed, these are the two groups this project aims to reach and influence the most, whom with their help, greater conservation of nature is possible. The aim is for this project to provide a space for all categories, a space where they can watch these beautiful creatures, learn about their biology and importance and the beauty and importance of nature, all while being in a tranquil and natural setting, enjoying a day in nature.

FINANCIAL CONSIDERATIONS

Sustainability comes with an inherent cost increase as the materials and systems used are not necessarily standard, and thus require a level of skill, provided by specialists which also result in an increase in overall costs. The materials may need to be sourced internationally if adequate materials are not located locally. This could alter the costs and time frame of the project and so early sourcing of materials and overall planning is essential. The use of sustainable technologies and construction requires a level of skilled labour, which may also increase the costs of the overall project (as it isn't the standard) and lengthen the time of the construction phase. Due to the level of complexity and meticulous nature of planning required when it comes to sustainable design, this could potentially allow for various advantages for instance most of the costs and the projects time frame could be known upfront. However, early planning is essentially to work out and discuss these necessary considerations, in order to ensure that the construction phase is as efficient as possible, when it comes to time, costs and quality of the final product.

Due to the selected site and design ideology of conservation there are various economic implications that occur as a result of professional fees, site work fees and site preparation fees. This project requires early planning and integration between all facets in order to ensure the development process (of both design and construction) is done with ease and is as efficient and successful as possible. This project has a huge sustainable ideology embedded in it and so it requires the assistance of various specialist consultants to ensure the project is carried out in the most environmentally friendly manner, both in the inception of the design and during the construction phase. In order to ensure that this happens, most consultants will need to be included in the early design stages and development stage of the project, which would result in an increase in professional fees.

FINANCIAL MODELLING

DEVELOPMENT COSTS & PROFESSIONAL FEE

Based on a rough estimate calculation of the development costs for this project (figure 3.2), the total rough estimate of the development costs is R45 379 000.00. Considering the architect will provide a full service, using the project cost base fee calculation, wherein the project falls into the 8th cost bracket, the following professional fee can be calculated:

Professional Fee = Primary Fee + Secondary Fee
3 776 249 + (45 379 000– 40 000 001) x 8.50%
3 776 249 + (5 378 999) x 8.50%
3 776 249 + 457 214.915
R4 233 963.92

As per the information provided by property24 the site is currently available to be purchased for R12 950 000.00. If SANBI, as the primary client, is unable to pay that amount they can take a bond from the bank. This bond with a 20-year loan term and 10.25% interest rate, would result in monthly repayments of R 128 000.00.

DEVELOPMENT COSTS - ROUGH ESTIMATES
Based on The Africa Property Construction Cost Guide of 2018

SPACE / PROGRAMMATIC FUNCTION	SIZE (m^2) - rough	COST (PER m^2), IN RAND	TOTAL COST, IN RAND
Research Laboratories	500	14000	7000000
Laboratory Admin	250	7700	1925000
Research Exhibition Space	200	16150	3230000
Diagnostic Clinic	300	14000	4200000
Restaurant	280	6300	1764000
Conservation Spaces:			
Pollinators Roof Spaces (open enclosures)	2500	7120	17800000
Education Nodes (2 spaces)	500	15600	7800000
Miscellaneous	2000	830	1660000
TOTAL	6530	81700	45379000

Figure 3.2: Development Costs Table - Rough Estimates

ECONOMIC VIABILITY – FUNDING

SANBI – SANBI would exist as the primary client and financial benefactor, paying for the land and 80% of the project development (as per the programmatic breakdown, figure 3.3). SANBI, as the main client, would look at their own resources and funding mechanisms, to make the main funding contribution and would then reach out to the various funds below to make up the short fall. These foundations are funds who fund projects with a conservation ideology, in the vein of protecting nature and its biodiversity.

The Green Fund:
The green fund is a newly established fund, managed by the Development Bank of South Africa (DBSA) on behalf of Department of Environmental Affairs. This fund aims to assist South Africa in its transition to a greater environmentally beneficial development path, supporting green / environmentally positive initiatives.

The Lewis foundation:
The Lewis foundation aims to create a society that is actively committed to nature conservation and thus exist as a foundation who fund conservation and animal welfare programs, leading to positive environmental impact.

The World Wildlife Fund Nedbank Green Trust:
The WWF Nedbank Green Trust, is a trust that partners with various projects, providing financial assistance to help create projects which provide new ways for people and nature to thrive. The Green Trust helps support projects that focus on the conservation of nature, with the World Wildlife Fund being the primary benefactor, wherein applications are assessed through Nedbank.

In addition, SANBI would then approach the other clients (LepSoc, NAC, Manzi Monate and Marleo) motivating them to make a small but equal percentage contribution to the overall project costs and thus between all four clients the remaining funds, to finish the project, would be raised. LepSoc, in addition to their client contribution for the overall project costs, as a secondary client would rent the research centre space, sharing it with SANBI. LepSoc would further their individual research on the entomology and biology of butterflies and bees, as well as develop new research based on their observations and experiences on the site. The NAC, in addition to their client contribution for the overall project costs, as a secondary client or tenant would lease/rent the educational spaces in the project for a fixed amount, wherein they can host educational performances fortnightly.

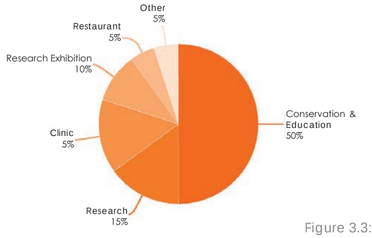


Figure 3.3: Programmatic Breakdown

FINANCIAL VIABILITY - INCOME

In terms of financial viability, this project will receive various sources of income which will allow it to meet operating payments and to allow growth while maintaining service levels. However, the project will also need to have initial capital, or a float provided by SANBI, to not only pay for the project but also have adequate funding to maintain and sustain the project/development during its existence.

The project will receive a source of income from seven aspects of the project (figure 3.4). These sources of income include the entrance fee - used for the general maintenance and running of the space, the restaurant, planned education programs for school groups, with tours included and guided tours through the site, identifying the vegetation, species and the research being done on site. Income will also come from the rent derived from the research facility and diagnostic clinic, for interested parties, at an agreed fee. The site breeding program will also provide a source of income, in three areas. Firstly, through the selling of species bred on the site, secondly through selling of consulting services on how to rejuvenate environments, earning a consulting fee and lastly through installation of satellite stations', using the methodologies developed on the site and species grown on the site. For example, this would include the creation of 'satellite stations' in various urban and rural areas to promote pollinator action, migration and colonisation.

CONCLUSION

This proposal is an image of a new approach to existing with nature. The issue of nature's collapse is extremely complicated but only by tackling individual ecosystem collapses and species decline, does humanity stand a chance of improving our situation and reversing some of the damage we have inflicted on the natural world over the last few centuries. A client consolidation becomes the perfect client structure for such a project, as there is a larger interest in the conservation of nature and a greater source of opportunities for funding. These organisations combined, provide a wealth of knowledge on how to conserve nature and pollinators, along with how to move and inform people. Through the funding scheme proposed and efficient and early planning this project has shown to be economically and financially viable. With the addition of a relevant and existing target market and the benefits of the proposed site, this proposal outlines how such a project can be established in a successful manner, in a way that benefits all.

MONTHLY INCOME - ROUGH ESTIMATE

SOURCES OF INCOME	MONTHLY TOTAL, IN RANDS
Entrance Fee	118 417
Planned Education Programmes	35 000
Guided Tours	19 500
Rent - of Restaurant	40 000
Rent - of Clinic	25 000
Rent - of Laboratories	25 000
Site breeding program	20 000
General Consulting / instalation recommendations	63 000
Corporate instalations - Consulting, installation and produce - 2 per month	180 000
TOTAL	525917

Figure 3.4: Monthly Income Table - Rough Estimates

REVENUE FORECAST - for the income calcultaion
Entrance fee: Standard: R85 per Adult and R65 per minor School Trip: R50 per person
Tour cost: R30 Half take guided tours
School Education Visits @ 4 per week (42 wks) groups of 50 students @ R50 ea.
Consulting Fee - 3 hrs / week @ R500 per hour
Installation Fee - R45000

WORKINGS:

Entrance Fee - Standard: R85 per Adult, R65 per minor & School Trip R50 per person	Total	Per month
Normal Weekend visits @ 200 per week-end	780 000	65 000
Normal Weekday visits @ 10 per day	221 000	18 417
School Visits @ 4 per week (42 wks) groups of 50 students @ R50 ea.	420 000	35 000
	1 421 000	**118 417**

Tour Cost @ R30 (Assume 50% of visitors take the tour)	Total	Per month
Normal Weekend visits @ 200 per week-end	156 000	13 000
Normal Weekday visits @ 10 per day	78 000	6 500
	234 000	**19 500**

Consulting Fee - 3 hrs / week @ R500 per hour
Installation Fee - R45000

Figure 3.5: Monthly Income Table - Workings

04

"Never trust anything if you can't see where it keeps its brain"

- Arthur Weasley

SECONDARY RESEARCH

EXPLAINED

_This chapter documents various existing artificial projects that have been developed to assist in the pollinator crisis, culminating in a moment of reflection on how these designs have influenced my own thinking and resultant intervention.

ARTIFICIAL PRECEDENTS

In order to understand what my proposed design of an artificial environment could achieve, it was important for me to research existing global artificial environments. An analysis of these environments, methods and technologies, developed to save and assist dwindling pollinator numbers, was carried out to see what exists and to learn form these designers approaches, in order to understand how my design could aid the fight against pollinator extinction.

Bees exist as the most well know pollinator and so most of the existing research focuses on how to save bees. With this in mind the precedents that follow apply to all pollinators, however most highlight the effects on bees.

The first five precedents are the projects that most inspired and interested me, the eight projects that follow are equally interesting and are included to show some of the other methods which have been developed to save pollinator species. All precedents existing as a guide on how to create a successful artificial environment.

PRECEDENT 1 : SYNTHETIC APIARY

Media Matter Group
MIT Media Lab

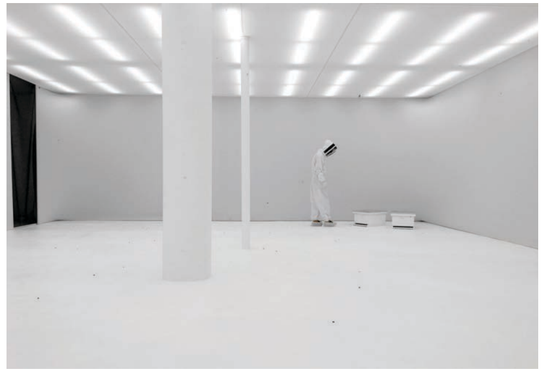






Figure 4.1: The MIT Synthetic Apiary

FROM THE DESIGNER

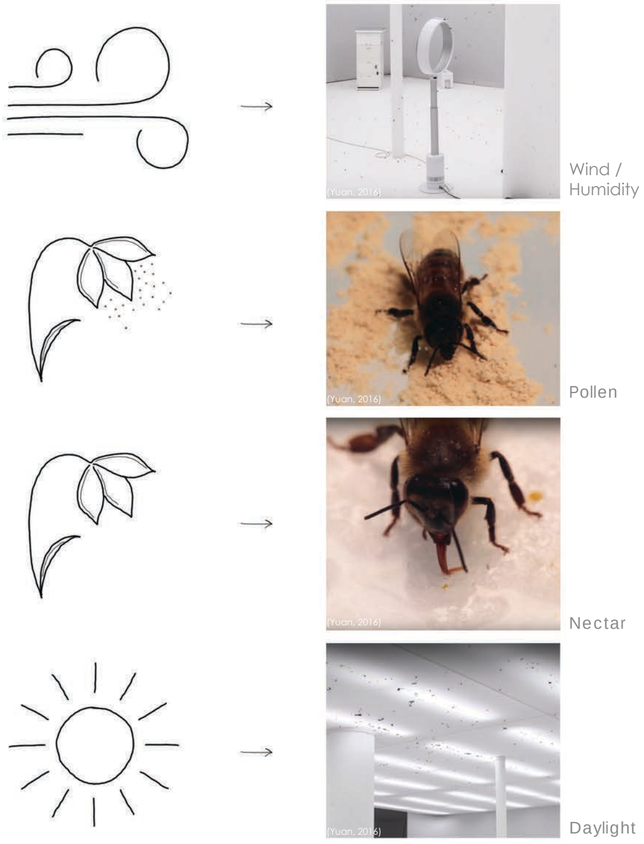
The Synthetic Apiary places honeybees in a controlled, sealed environment, investigating the potential possibilities that arise as these seasonal honeybees can now thrive all year-round, in a simulated spring environment, through engineered light, humidity and temperature (Mediated Matter, 2016). Due to the synthetic nature of the project bees are provided synthetic pollen and sugar water mimicking their natural food source. In this controlled space large-scale investigations of hives can be carried out, together with regular evaluations of health and wellbeing (Mediated Matter, 2016).

This project represents an opportunity of co-habitation, enabling natural cultivation in an artificial environment (Mediated Matter, 2016) and is a response to the rapid decline of global bee populations. Through the artificial environment created, researchers hope to investigate and explore bee behaviour, in a way that allows them to put forward proposals on how we can better integrate biology into architecture, for the benefit of both humans and socially organised organisms (Yuan, 2016).

MY TAKE-AWAY

I really loved the concept of the synthetic apiary, in that everything that exists in this environment is artificial, and yet because they have researched and understood the ecological needs of the bees, the artificiality of it all doesn't create something alien but rather mimics the world of the bee perfectly, preventing the bees from going against any inherent behaviour.

MY TAKE-AWAY SKETCHES



I really loved the way the ecological needs of the bees were studied and then replaced by possible artificial elements. This precedent was one of the first examples that really showed me the possibilities modern technology and built forms could have in mimicking natural environments.

PRECEDENT 2 : ARTIFICIAL FLOWERS

Matilde Boelhouwer
Dutch Designer







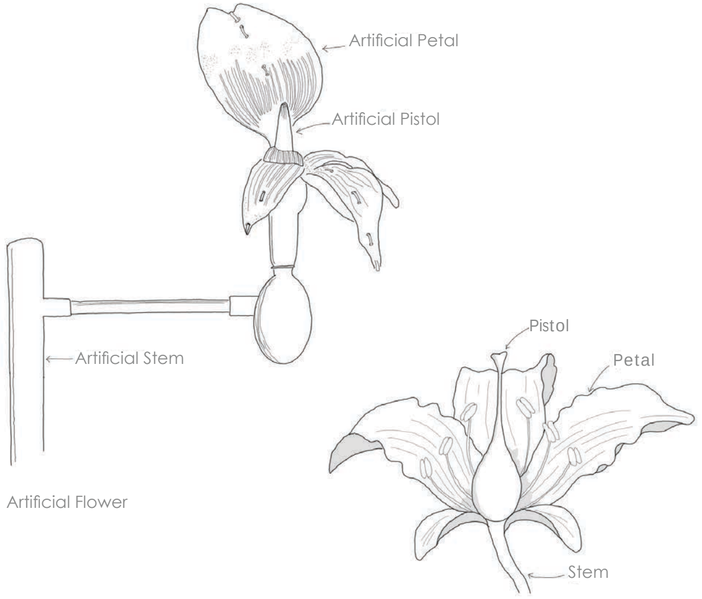
Figure 4.2: Matilde Boelhouwer's 3D Printed Flowers

FROM THE DESIGNER

Matilde Boelhouwer designed a series of artificial flowers that convert rainwater into sugar water, serving as an emergency food source for urban pollinators, which is needed due to the lack of flowering plants in urban areas, which has resulted in insect's species declining drastically. Using screen-printed polyester, a series of petals were cut out and attached to a small 3D printed container at its centre, which was then attached to a 3D printed stem (Hitti, 2018). The containers collected rainwater and transferred it down the 3D printed stem into a tank containing sugar. Here the rainwater mixes with the sugar to create an artificial nectar substitute (sugar water), which is then pumped back up into the stem containers to be consumed by pollinators, providing an emergency food source when natural flowers cannot be found (Hitti, 2018).

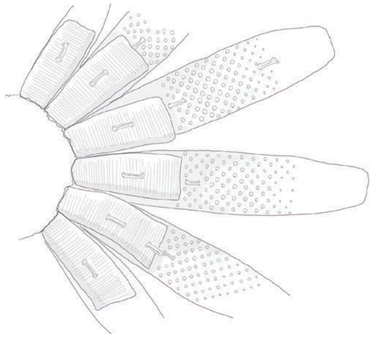
Matilda Boelhouwer studied flowers and chose three shapes most favoured by pollinators, the daisy, favoured by bees, Fabaceae (the pea family) which attracts butterflies and moths and Lamiaceae (mint) which attracts bumblebees (Hitti, 2018). In addition to shape she also explored colour, how pollinators see the world and how they feed from a flower. For example, butterflies tend to favour red or pink flowers, in contrast to bees, who because they see the world in honey-comb pixels rely on their colour range and thus prefer green, blue, violet and yellow (Hitti, 2018). In addition, butterflies have a longer tongue then most pollinators and therefore require more time to feed, which has resulted in them favouring flowers with larger bottom petals to give them more stability (Hitti, 2018). As such Boelhouwer designed red flowers with larger petals and deeper feeding centres to accommodate butterflies, whereas she used a contrast of yellow and violet patterns to attract bees from afar.

MY TAKE-AWAY SKETCHES



Artificial Flower

Natural Flower



Mimicking natural flower textures

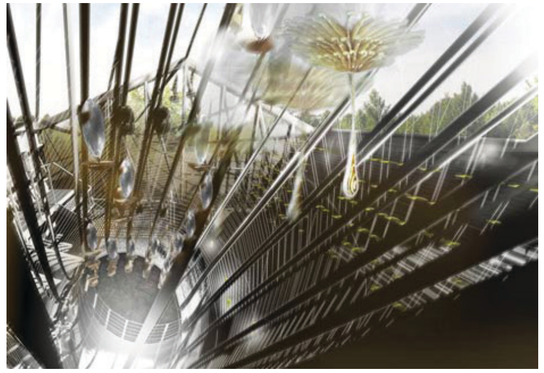
MY TAKE-AWAY:

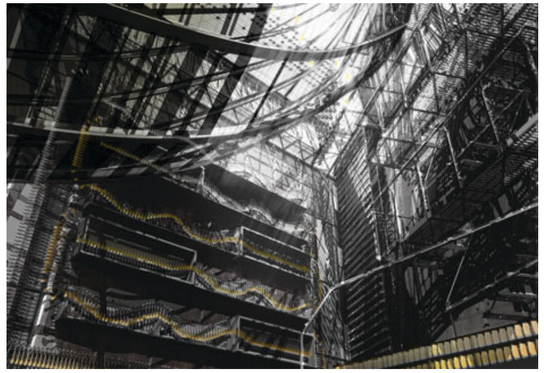
There is something so whimsical about these designs that makes you smile, it's such a simple idea yet beyond effective.

I was really influenced by Matilda Boelhouwer's approach to this design, through the way in which she analysed the natural form of the flowers structure, location of parts, patterns and petal overlap, and then emulated those same ideas in her artificial creations. This approach really made me realise the importance of understanding the structure and design of the natural form, if an artificial creation is to succeed.

PRECEDENT 3 : LONDON WITHOUT BEES

Ben Kirk
2011





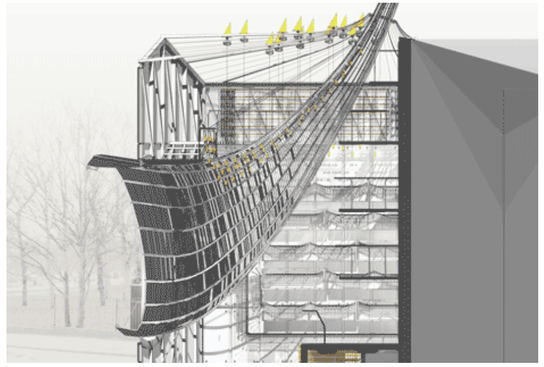


Figure 4.3: Ben Kirk's London Without Bees Proposal

FROM THE DESIGNER

Located in Kew Gardens, London, Ben Kirk proposes the creation of a trumpet-like tower that would release artificial spores, covered in pollen, suspended from latex balloons, into the air to be transported by wind across London, to pollinate plants (Frearson, 2011). This proposal acknowledges the drastic decline in pollinator numbers globally and in London and proposes an artificial replacement rather than a sustaining intervention.

This proposal answers the most drastic scenario, what if bees and pollinators completely disappeared? What would we do then?

MY TAKE-AWAY

Ben Kirk's London without bees, stood out to me for its radical proposal. The design does not suggest a way to save the bees, but rather acknowledges that maybe the best solution would be to design for the highly inevitable realisation that the bees will disappear. The design had a sci-fi characteristic about it, both in built form and the artificial pollinators it deploys. This idea of 'sci-fi' started to stick with me, something almost alien and futuristic but for the present. The sci-fi aspect also seemed very artificial, almost prosthetic in nature, and allowed for an alternative source of both aesthetic and architectural style inspiration.

Such as in the work of Matilda Boelhouwer, Ben Kirk analysed the structure of pollen spores to create an artificial replacement that mimics the success of the natural creation, in order to ensure success of the artificial creation. This idea of again studying the natural to create the artificial was an important take-away.

MY TAKE-AWAY SKETCH

I really loved the whimsicality and sci-fi approach to the design. The spore balloon looks like a mix between a fairytale and a flower from an alien planet.

This whimsical approach is what I really took away from Ben Kirks design. It has a gentleness and delicacy to it that seems to echo the delicacy of butterflies and bees. I knew that whatever my design would be, I wanted to ensure aspects of it at least emulated this delicacy and whimsy that reflected the pollinators and the beauty of nature, but also this idea of the futuristic imagination of something artificial.



PRECEDENT 4 : VULKAN BEEHIVE

Snøhetta
Olso, Norway
2014







Figure 4.4: Snøhetta's Vulkan Beehives

FROM THE ARCHITECTS

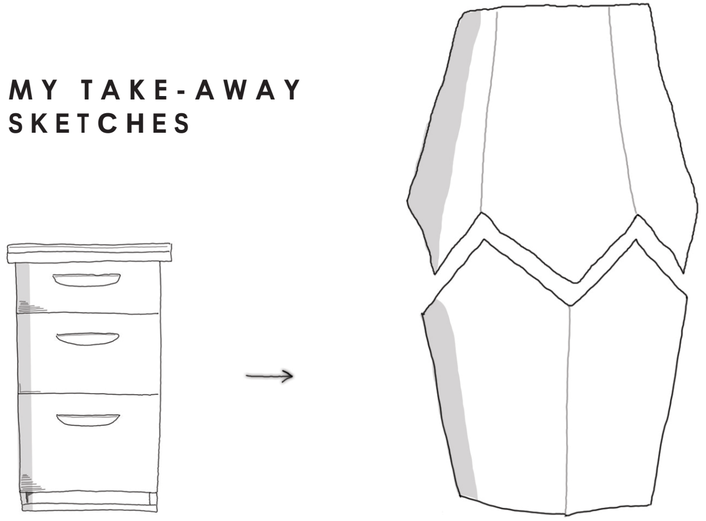
The beekeepers hive is one of the oldest man-made artificial environments for bees, however the design of Snøhetta Architects takes a more aesthetic and architectural approach, while still considering the environment of the bees. Collaborating with a beekeeper, two hives were created to house 160 000 bees (Howarth, 2014). Inspired by the natural honeycomb geometry two hexagonal forms intersect to form the hive, with a honey tone wood finish, used to further reference the inspiration of the bee (Howarth, 2014).

The hives are placed on the roof of an Oslo food court, encouraging bees to take up residence in the city, bringing back the dwindling biodiversity (Howarth, 2014). With surrounding rooftop herb gardens, the food court and bees enter into a mutually beneficial relationship, providing plants for pollination and in return providing honey. The placement not allows for a food and honey relationship but also strengthens the relationship of the surrounding green spaces.

MY TAKE-AWAY

Snohetta's beehives, although not as radical as the above three ideas, stood out to me simply because it was a re-imagining of an already designed artificial environment for the bees. Despite the architectural twist and addition of aesthetic appeal, the design still included the old but tested structure of the beekeeping hive, inside the shell. Again there was this idea of learning from what you are trying to emulate and readapting it to suit the new scheme, while not forgetting it or removing it completely. There is always this link to the natural or once existing.

MY TAKE-AWAY SKETCHES



I really liked the way the architects re-envisioned the traditional beekeeper's hive box through a very simple shell addition. The updated aesthetic did not ignore the architecture of the bees, and instead used the hexagon as its driving geometry.

Despite not being very unique in function, I really like how this design still reflected the need to study the natural (both the original beehive box and bee geometry) and emulate that in the artificial, in a very simple result. This showed me that even in simplicity, an artificial environment can still be successful, as long as one studies the natural forms they aim to emulate and assist.

PRECEDENT 5 : CANCER DETECTION

Susana Soares

FROM THE DESIGNER

Susana Soares, a designer from Portugal, has developed a device that uses bees as the diagnostic tool, to detect if a person has cancer and other serious diseases. Scientific research demonstrated that bees can accurately diagnose a variety of diseases, such as tuberculosis, lung and skin cancer, and diabetes, from an early stage of infection (Bryant, 2013). This is because the Apocrine glands in humans are known to contain pheromones that retain information about a person's health, pheromones that bees' antennae can identify (Bryant, 2013). Bees can be trained within 10 minutes using the method of Pavlov's reflex to target a wide range of natural and man-made chemicals and odors, including the biomarkers associated with certain diseases (Bryant, 2013). Bees are exposed to these odors and then fed with a water-sugar mixture and within 10 minutes can associate a specific odor with a food reward (Bryant, 2013).

The device is a glass object which has two enclosures; a smaller chamber that serves as the diagnosis space and a bigger chamber where previously trained bees are kept for the short period of time necessary for them to detect general health (Bryant, 2013). People exhale into the smaller chamber and the bees rush into it if they detect, on the breath, the odor that they were trained to target (expecting food in the area where the smell is located) (Bryant, 2013). If the bees remain in their chamber, then the test is negative for the tested disease. Bees become bio-sensors. This design may not be a habitable artificial environment, but it does start to highlight how bees can be used in unconventional ways, that can benefit both humans and bees and could lead to an increased desire to save these important creatures.

MY TAKE-AWAY

Susana Soares's cancer detection chambers caught my attention because it had the underlying message of save the bees but did not scream this, instead it showed how incredible bees can be and how beneficial they are to humans above the idea of pollination. The glass chambers had this whimsical design that caught my attention, again echoing this idea of the sci-fi or futuristic.

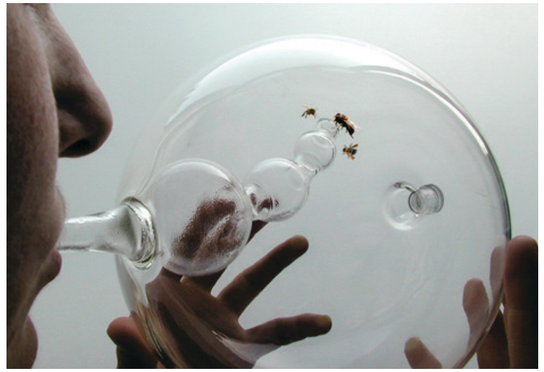
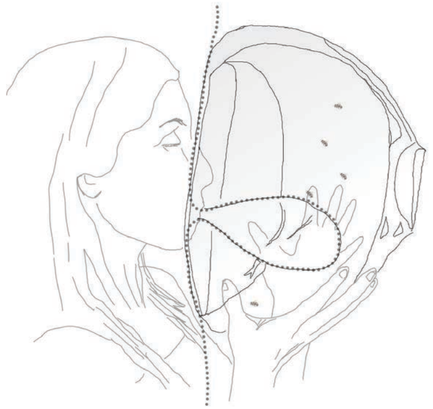






Figure 4.5: People Carrying-out Diagnostic Tests

MY TAKE-AWAY SKETCH



HUMAN SEPARATION BEE

I was really inspired by the curved, whimsical nature of these glass orbs but also in the way that it blurred the boundaries between human and pollinator.

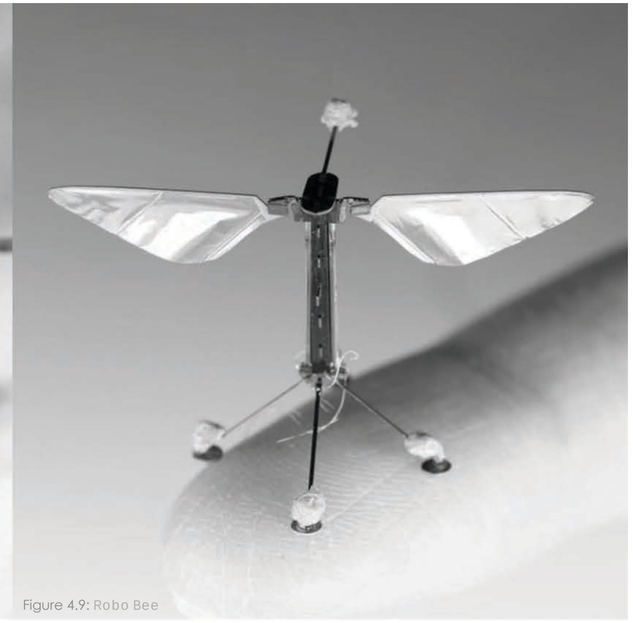
The chamber design possibly placed a thought in my mind about the idea of double layers, layers of separation, a concept which in retrospect would become the driving thought behind my design later on.



Figure 4.6: Bee Saving Paper - Exposed UV Patterns


Figure 4.7: Toxin Removing Powder


Figure 4.8: Bee Backpack


Figure 4.9: Robo Bee

BEE SAVING PAPER

SAATCHI & SAATCHI

Saatchi & Saatchi (a creative agency) have collaborated with City Bees (an organisation that focuses on bees in urban communities) to create Bee Saving Paper (Saatchi & Saatchi, 2018). Bee Saving Paper is a biodegradable form of paper that can be used for many standard paper purposes. However, what makes it important to bees is that it contains a unique form of energy-rich glucose that acts as an energy drink for bees, when they land on the paper (Bee Saving Paper, 2018), 2018). The unique form of glucose, doesn't make the paper sticky but rather provides an energy boost for bees to help them fly further in search of a larger variety of pollen plants, preventing them form becoming exhausted and weak during their foraging periods (Bee Saving Paper, 2018).

The paper has a second function, in that it is filled with honey plant seeds, which can either be carried by bees, after they leave the paper and planted elsewhere along their journey or can grow in the exact spot of the paper, as the paper degrades. In this way an extra rest stop for other bees is also created (Saatchi & Saatchi, 2018). In addition, the paper is covered in a water-based UV red circle, paint pattern visible to bees, which they identify as the same pattern they see on flowers for where pollen is located (Bee Saving Paper, 2018). In essence what is created is a form of paper that is friendly to nature both in use and when it is thrown away.

HEALTHY POWDER

WASHINGTON STATE UNIVERSITY

Pesticides used to treat various plants are harmful to bees, in that pollen covered in even microscopic amounts of pesticide, when consumed by bees, can build up in a bee and reduce its lifespan (Magee, 2018). A grain of salt weighs 58 500 nanograms and in contrast it takes only 15 nanograms of pesticide to kill a bee (WSU Insider, 2018). To combat this problem researches at Washington State University have developed a powder that acts like a microscopic magnet and when ingested by bees (mixed into a sugar solution), collects the ingested toxic material and removes it from the bee, once expelled (Magee, 2018).

BEE BACKPACK

CISCO & MANCHESTER SCIENCE

Cisco, a technology enterprise, has partnered with Manchester Science to develop bee backpacks (Magee, 2018). These backpacks are small RFID chips (sensors) that are safely attached to a bee with adhesive and are used to record and identify individual bees and their movements, in order to understand the threats to bee health (Magee, 2018). These sensors and the data collected, allows researchers to analyse stress factors in a bee's day to day life from pesticides and air pollution to diet and extreme weather (Carter, 2019). Bees are highly predictable and so any deviation from their traditional routine can be identified and help researchers identify stressors in their environment. The aim of the backpack is to provide a more efficient method to assist scientists and researchers in solving the global bee crisis.

ROBO BEE

HARVARD UNIVERSITY

Researchers at Harvard University, are looking at alternatives to natural pollinators, answering the very realistic question of what if all pollinators disappeared. They tackled this question by developing Robo-bees, very small flying robots, with movable wings (modelled after the hover fly), who are able to hover over a flower and spread pollen, powered using the concept of piezoelectricity (Buczynski, 2013). The model is still in the development stage, as researchers are still developing the computer guiding system to help the robots fly, along with still trying to figure out how to fit a battery inside such a small structure (Buczynski, 2013). However, after a few more years of research it is believed that these structures could assist and possibly even replace struggling pollinator populations.



Figure 4.10: Bee Sperm Bank



Figure 4.11: Solar Sanctuaries



Figure 4.12: Bee Spotter

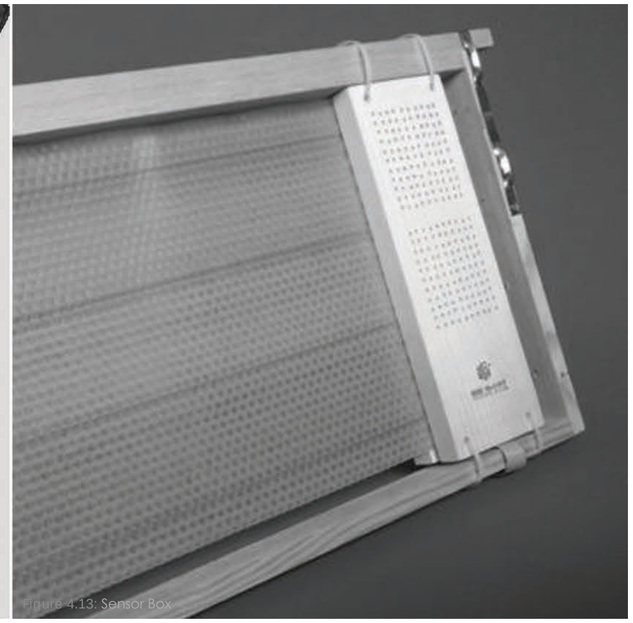


Figure 4.13: Sensor Box

BEE SPERM BANK

WASHINGTON

The worlds first bee sperm bank is being set up by Entomologist in Washington, with the aim of increasing the genetic diversity of bee species (through selective breeding), producing species of bees which are more resistant to various diseases such as colony collapse disorder (Buczynski, 2013). Research teams collect bee semen samples from male bees all over the world, which are then frozen in liquid nitrogen and brought back to the United States (Buczynski, 2013). Through selective breeding the aim is to understand the genetic code of bees, in a way that can allow for entomologists to fight colony collapse disorder, a phenomenon in which adult bees mysteriously disappear from their hive, in the fight to save dwindling bee population numbers (Chang, 2013).

SOLAR SANCTUARIES

BUMBLEBEE CONSERVATION TRUST

Solar farms often involve the use of large spans of land, in order to set out and arrange the required solar panels. An organisation known as the Bumblebee Conservation Trust (BBCT) noticed that there were often large open, vacant areas of land in between the various solar panel arrangements and together with the fact that these farms are often fenced off for security, created the perfect environment for a safe haven to assist pollinators (Buczynski, 2013). BBCT partnered with a British company, Solarcentury, to turn solar farms into wildlife sanctuaries specifically designed to attract pollinators (Buczynski, 2013). These large gaps of land were turned into acres of wildflower meadows, with native plants being planted to attract a variety of native wildlife (Buczynski, 2013). Solarcentury's solar farms now not only generate clean, carbon-free energy but are also revive endangered pollinator species.

BEE SPOTTER

UNIVERSITY OF ILLINOIS

Researchers at the University of Illinois, created BeeSpotter, an online platform that engages everyday citizens in assisting scientists in collecting vital bee data, creating a systematic nationwide effort documenting pollinator status in America (Buczynski, 2013). BeeSpotter allows users to upload photographs for identification by registered entomologists, creating a baseline for monitoring population declines. It also helps increase public awareness of the issues facing pollinators, enhance appreciation of pollinators and the importance of pollination as an ecosystem service (Buczynski, 2013).

SENSOR BOX

BEE SMART TECHNOLOGY

Bee Smart Technology has developed a small box, containing sensors, which can be attached to the frames of beekeeping hives (Kleinman, 2016). This technology aims to allow beekeepers to remotely monitor their hives, which is essential in maintaining a healthy hive. The system monitors factors from hive temperature and humidity to colony activity and whether the queen is mating (Kleinman, 2016). All this information is vital in helping a beekeeper determine the health of their hive and livelihood. The data collected is sent via a cloud data centre to Bee Smart servers, to be processed and analysed before being sent to the beekeeper (Kleinman, 2016), allowing for a more efficient system of monitoring a hive.

ARTIFICIAL PRECEDENTS

IN CONCLUSION

These designs and their approaches emulated the role of pollinators, they are small creatures and may seem insignificant at times, and so the design could be simple and delicate and yet their combined action is so powerful and their contribution to existence so vital and so the design could also be extreme and radical.

These precedents showed me the importance of studying the subject you aim to emulate, the importance of carrying the ecological needs of pollinators over to the artificial, in order to achieve a beneficial and successful result. Most importantly, all of these artificial precedents showed that the creation of something synthetic or artificial is not only possible but has the potential to be extremely successful and beneficial in assisting humanity with research and understanding, while most importantly assisting pollinators as they fight for their survival.

05

"Let us step into the night & pursue
that flighty temptress, adventure."

- Albus Dumbledore, The Half Blood Prince

MODEL EXPLORATION

EXPLAINED

_This chapter documents various model explorations that were carried out to explore the core concept of the design, being pollinator extinction and architectures relationship with nature. In addition, it promoted thinking about the ideas that intertwined with the core themes, from movement, intersection and co-existence, to habitation, forms and weight.



Figure 5.1: Microscopic movement model scans overlaid

MICROSCOPIC MOVEMENT OVERLAID

Ecosystems consist of a series of interconnected relationships and interactions, each one feeding off the next. This model (photographed and overlaid in figure 5.1) began to explore the ways in which these movements overlapped and intersected.

The curved shapes mimic the form of plant cells, while also expressing the figure eight dance done by bees or the infinity pattern of a butterflies wing movement.

The overlaid scans intensified the interweaving nature of the model and allowed for more moments of both interaction and separation, as lines crossed over each other intersecting and then separating as they pulled away, before coming together again to from a curve. This overlapped nature of separation and intersection not only echoed the interweaving nature of ecosystems but also humanities current relationship with insects. Both species exist in the same space but often stay out of each other's way, however there are moments of interaction, when insects enter or houses or when we pass through their environments every time we step outside.

It's this very idea of intersection and interaction that I want to emulate in my design, with spaces for humans and for pollinators mixing and overlapping at various points in the design, and then possibly separating and pulling away, to allow for more individualised spaces, before overlapping again. In this way the program can be inter-weaved, with seemingly separated functions interacting with one another, bringing the two species together.

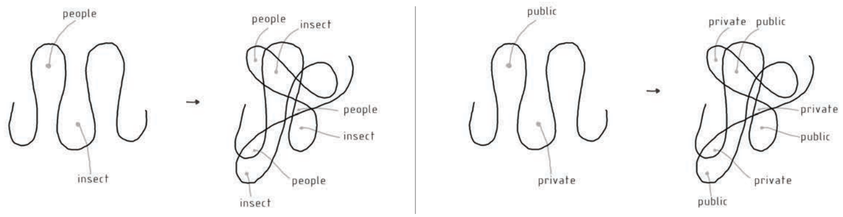


Figure 5.2: Mimicking the interconnectedness of ecosystems - by Author

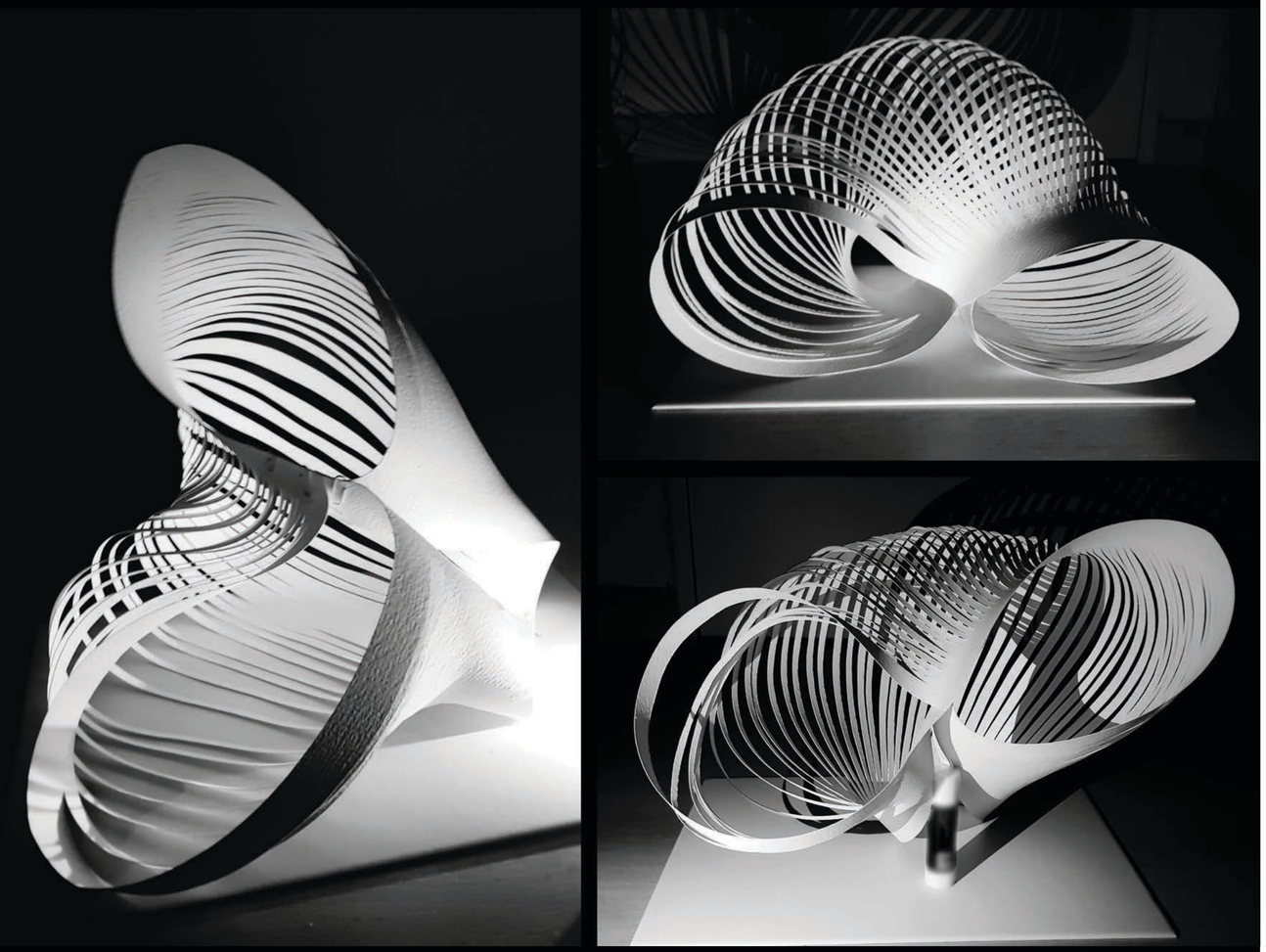


Figure 5.3: Habitat Abstraction Models

HABITAT ABSTRACTION

These concept models began to explore the curvilinear nature of pollinators habitats, from the curved form of a chrysalis, to the ribs of a bee hive or the inter-weaving nature of a birds nest. All created by the same base shape, these three different forms began to echo the idea of one underlying concept amongst all pollinators habitats, the concept of enclosure or more specifically where enclosure and openness meet.

The flexibility and light weight nature of the paper started to allude to the possible presence of this design, something light weight that did not seem obtrusive, yet something that could still hold its form and stand against the natural elements, becoming something almost skeletal in nature.

Together two ideas emerged from this model exploration, the first being the meeting place of enclosure and openness and the second being the concept of flexibility meets stability.

This lead me to think about how I could re-define enclosure or containment and what that would mean in terms of nature conservation and protection for butterflies and bees.

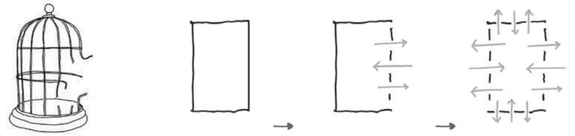


Figure 5.4: Re-defining Enclosure - by Author



Figure 5.5: Clay Models

REVERSE IMPRINT

I began to explore the idea of a growing building. Either it would look like nature had taken over a forgotten space after some catastrophic event or perhaps the plants would grow with the design from the very beginning, moving through its solid form and breaking through to sprout leaves.

Reversing the imprint technique, (where plants are pressed into clay, leaving behind an imprint, as shown in the flat models), the 3 dimensional models began to accommodate the growth of plants, by allowing the plant stem and roots to weave around and through the curved forms, as they grew.

In hindsight the clay hardened far too quickly, preventing the plants from developing and maneuvering through the forms, however the concept still came through, when I weaved the plants through the forms, once they had grown separately. This started to allude to a possible facade or core structural idea in my design, this being a building which grew with and encouraged the growth of its surroundings.

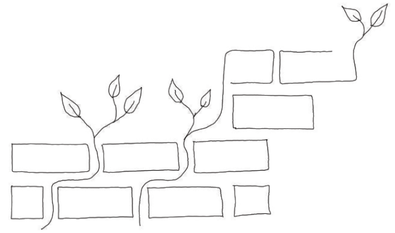


Figure 5.6: A building that grows - by Author

06

"Anything's possible if you've got enough nerve."

- Ginny Weasley, Order of the Phoenix

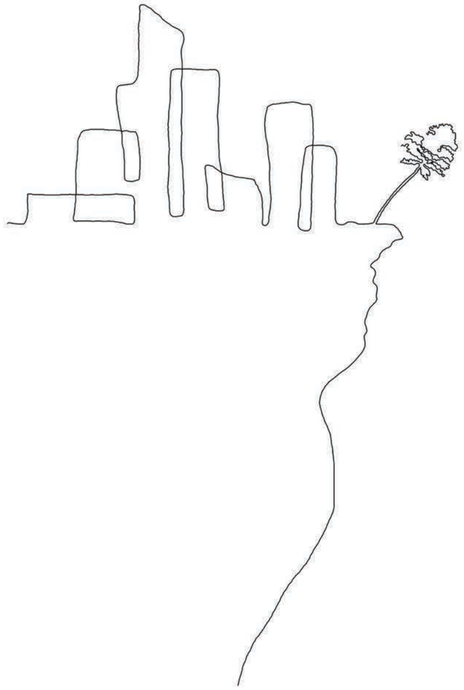
DESIGN DEVELOPMENT

EXPLAINED

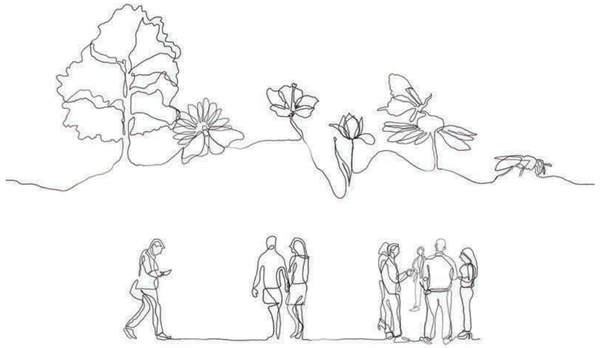
_This chapter unfolds into a series of four design iterations, each design building on the lessons learnt from the previous, in a process that started to refine and shape the research and proposed design.

EXPLORING THE SURFACE

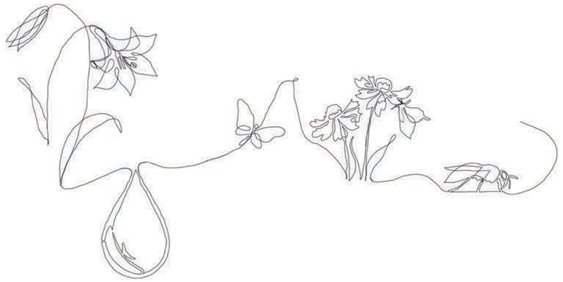
A sketched scenario of
the core design concept



a disappearing 'surface'



giving the 'surface' back to
plants & pollinators



food . water . shelter

the 'surface' provides

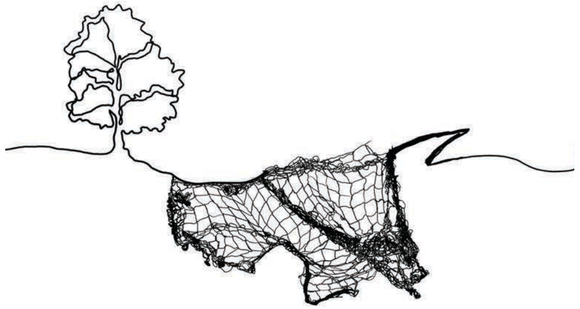


man surface / veil bee

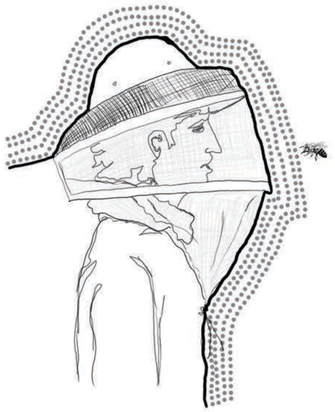
layers of seperation



tilting the layers,
a double sided skin

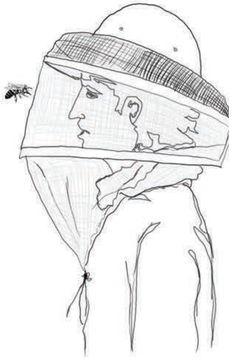


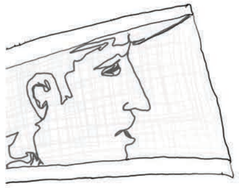
the net is the 'surface'
the 'surface' is the net



. separates .

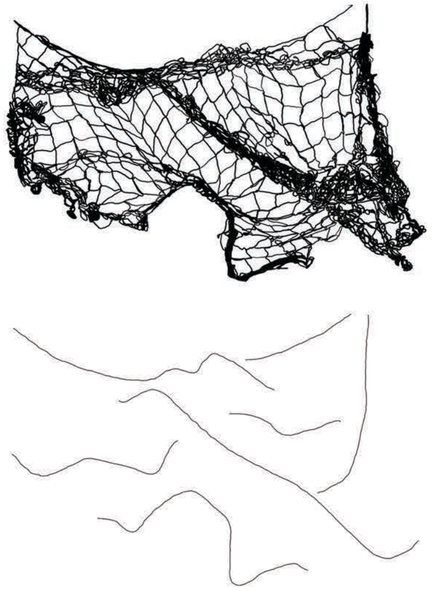
. connects .



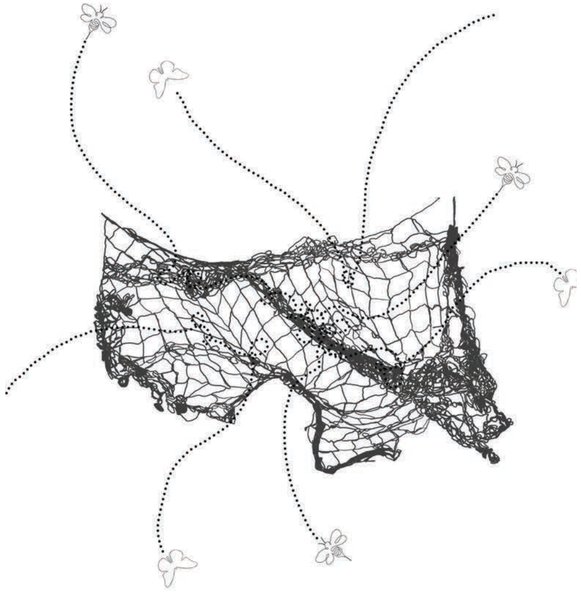


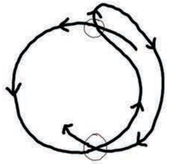
. camouflages/transparent .

the 'surface'

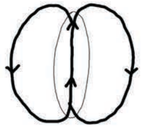


peaks . and . valleys

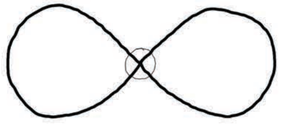




the round dance



the waggle dance



the movement of a wing

the ‘surface’ ..... one-stop shop ..... moments of interaction .....

WHAT IS THE SURFACE ?

The surface of nature is shrinking as the built environment grows.

The surface needs to be given back to plants and pollinators.

We need to understand the importance of the surface and what it provides.

Insects have always seemed alien to humans, we have interacted with them but always through a ‘veil’ of separation.

If one alters that layer of separation, one could place importance on the surface, placing the pollinators above and the people below, where the ‘surface’ becomes this ‘double skin’.

This shift allows the layer of separation, the veil, the net, to become the new ‘surface’- the altered surface.

The ‘surface’ connects, separates and moves from transparency and camouflage to enclosure.

The ‘surface’ peaks and drops into valleys, as it mimics the flexibility of the natural environment, while also mimicking its rigidity and quiet strength.

The ‘surface’ is altered to become the surface the pollinators lost, to become the surface pollinators require in the new age of nature vs man.

Like a butterfly and bee whose movements continuously overlap, the ‘surface’ brings people to pollinators and pollinators to people. It brings landscape up and extends the surface.

The ‘surface’, the veil, the net becomes the artificial environment.

Figure 6.1: Exploring the surface - sketched scenario - by Author

DESIGN DEVELOPMENT

The pages that follow are the collection of precedents anlaysed for design iterations 01 - 04, followed by the 4 design iterations themselves.

This chapter concludes in a comparitive analysis and moment of reflection before moving forward.

The linear design progression of exploring the surface:

01 THE 'SURFACE' AS THE GROUND → 02 THE 'SURFACE' AS THE WALLS → 03 IN-BETWEEN THE 'SURFACE' → 04 THE 'SURFACE' AS THE WHOLE

DESIGN ITERATION 01

The 'Surface' As The Ground

PRECEDENT 1 : WARREN OF SUBTERRANEAN SERVICES

Rasem Kamal
Jordanian Desert, Jordan
Proposal

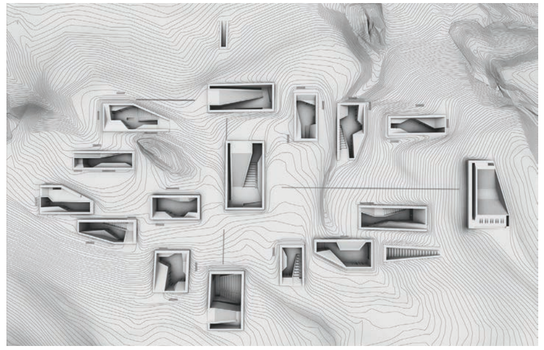








Figure 6.2: Warren of Subterranean Services

FROM THE ARCHITECTS

This proposal focuses on subtraction rather than addition, subtracting voids and spatial volumes according to the users needs of circulation, function and natural light, creating a network of burrow-like spaces below the surface. The result is an architectural form that does not distract from the views of the surrounding mountains, allowing for a non-distracting architectural presence (Mairs, 2016).

Flipping the relationship between explicit and implicit, this proposal, based on ants' nests, allows for excavated sanctuaries to announce themselves from interior not exterior, redefining form follows function into subtraction follows function (Mairs, 2016).

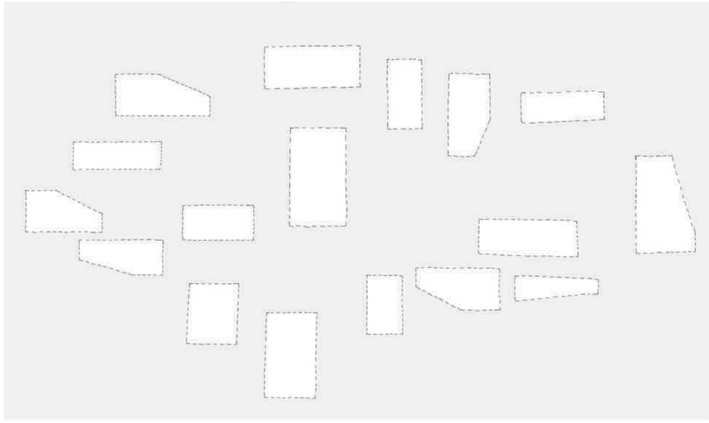
MY TAKE - AWAY

I really loved how this design, for the most part, left the surface untouched and appeared to gracefully dot itself along the surface of the dessert terrain. There was a beauty and poetry in the way the design appeared unobtrusive in contrast with the surroundings and how the natural elements built and shaped the internal habitable spaces.

Besides the beauty in its arrangement, I really loved, how in section the spaces started to come alive and how the natural rock shaped the internal spaces into these beautiful and natural looking forms, almost as if they had been burrowed out by ants.

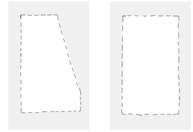
Given the approach of iteration 01 in placing my building below ground, in a natural habitat, this design really stood out to me as a possible guideline on how to carry out such an approach.

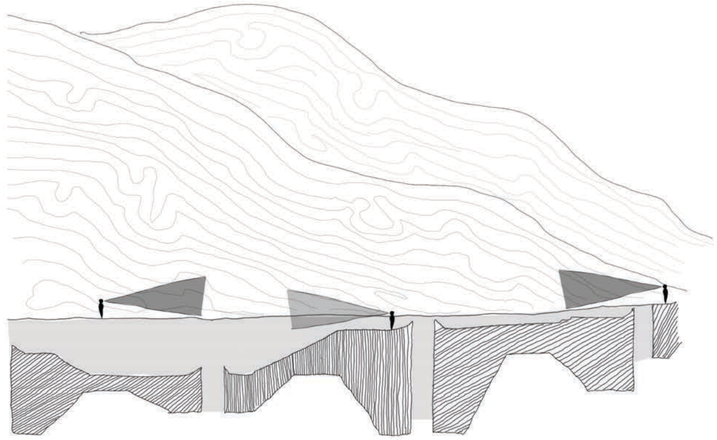
MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS



The graceful placement of the forms, along the landscape has a delicacy to it. The simple geometry of the forms allows for simplicity and adds to the unobtrusive nature of the design

By repeating the shapes of the exposed spaces, a sense of controlled chaos is created.





The way the building sits below the ground allows the surrounding landscape to be unobstructed. Yet the ability to see the surroundings from below and the building from above allows the building and landscape to blur and blend together in a harmonious relationship.

DESIGN ITERATION 01

The 'Surface' As The Ground

PRECEDENT 2 : UK'S NEW HOLOCAUST MEMORIAL

Sir David Adjaye & Ron Arad Architects
The banks of the River Thames, London
2019 Proposal





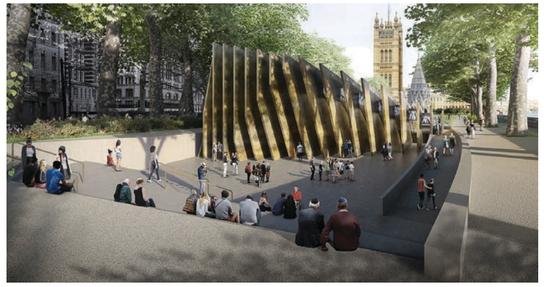




Figure 6.3: UK's New Holocaust Memorial

FROM THE ARCHITECTS

This holocaust memorial proposal is designed to contextualize the memorial above and use the stories and facts of the Holocaust to explore anti-Semitism extremism, and other forms of hatred and prejudice in today's society, below. In order to keep the park as a park and to maintain the green space, the Holocaust Memorial was embedded into the land, with visitors approaching the site only noticing two fins shinning in the distance, surrounded by green park-scape . This intriguing design gives a sense that something is happening underground and encourages people to find out more. Visitors enter the space (which descends below the ground) by passing through 23 bronze fins, requiring each visitor to enter in an isolated, solitary way, each pathway planned as a different experience (Archdaily, 2017 A)

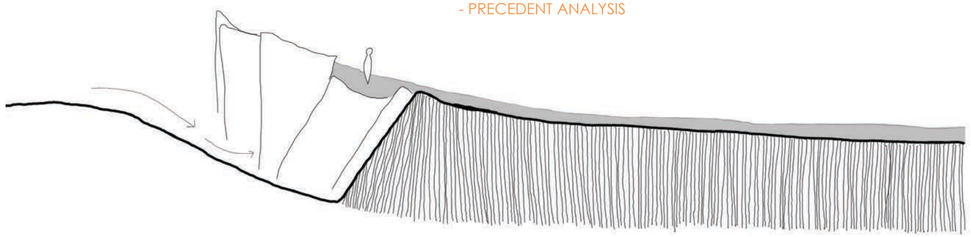
The design was approached as a means of revealing the layers and stories of the Holocaust and not let them remain buried under history. In this way the design becomes a living place, rather than solely existing as a monument to the past. In addition, it becomes a monument that reminds one of the fragility of life and the constant strive for a more equitable world (Archdaily, 2017 A).

MY TAKE - AWAY

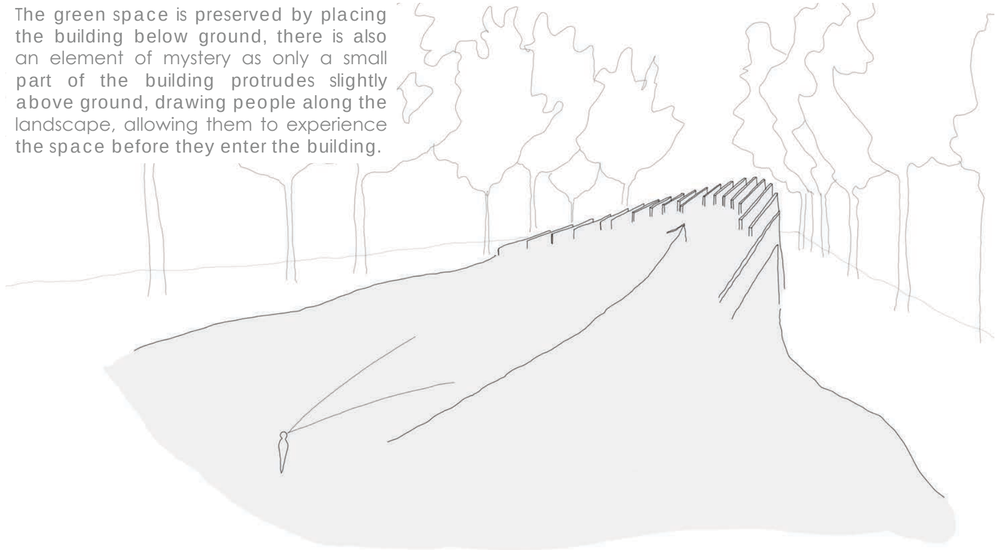
I was really interested in how the entire building was placed below ground and how only a slight entrance was revealed to people approaching the memorial, in this way the surface remained the surface, a habitable green space. There was also a beauty in the way natural light entered the interior spaces and created constant moments of reflection and contemplation. This idea of making people think, resonated with me and my design concept as I wanted people visiting the site, to have these moments where they contemplated the destruction of the natural world and the plight of pollinators and what the world might look like without pollinators in it.

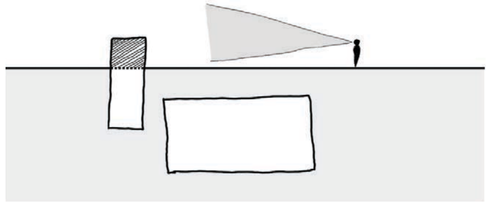
MY TAKE-AWAY SKETCHES

- PRECEDENT ANALYSIS



The green space is preserved by placing the building below ground, there is also an element of mystery as only a small part of the building protrudes slightly above ground, drawing people along the landscape, allowing them to experience the space before they enter the building.





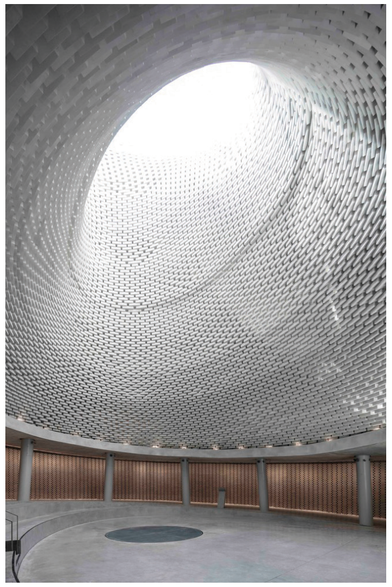
A possible idea could be to place the building below the surface to free up the surface but then have an element that signals a space below.

DESIGN ITERATION 01

The 'Surface' As The Ground

PRECEDENT 3 : THE MEMORIAL HALL OF ISRAEL'S FALLEN

Kimmel Eshkolot Architects
Jerusalem, Israel
2018





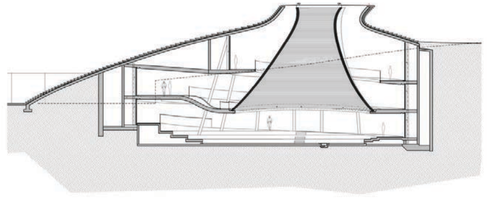


Figure 6.4: The Memorial Hall of Israel's Fallen

FROM THE ARCHITECTS

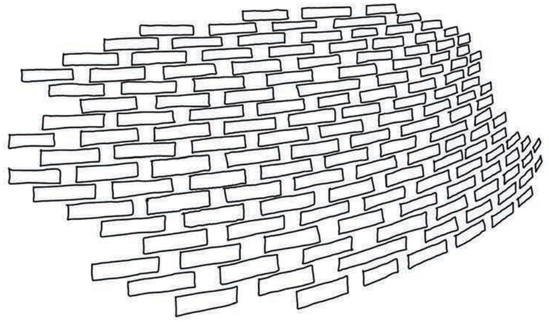
This memorial exists as a structure that commemorates Israel's fallen soldiers, with the centre piece consisting of an undulating funnel-shaped formation of bricks that stands in the centre of the hall and opens up to the sky, pulling in natural light through the space (ArchDaily, 2018). The spiraling funnel is comprised of more than 23000 concrete bricks, each individually engraved with the name of a fallen soldier. This memorial exists as a serene space, excavated into the surrounding mountain, with a lot of natural light entering the interior space and filtering through the brick lace-like pattern of the funnel, adding a sense of isolation and quietness, for which the space requires (ArchDaily, 2018).

MY TAKE - AWAY

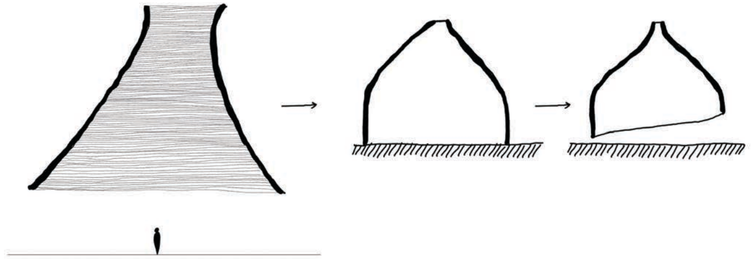
The whimsicality of the lace-like funnel is what initially drew me to this project. I loved the way the funnel resembled the homes of insects and felt almost alien or other-worldly. The space had a great sense of contemplation and reflection, which again drew me to this idea of having similar spaces in my design that allowed people to contemplate the fate of the natural world and what this meant for humanity.

There was something about the simplicity of this design and the way it sat in the landscape that really intrigued me and made me excited at the approach of excavating into my site.

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS



The delicacy of the lace-like brick work combined a sense of fragility and strength creating a real sense of whimsy and fantasy, an almost floating tower of bricks, curving in a way that seemed unnatural for the very solid material, adding a sense of wonder and other worldliness.



I was inspired not only by the whimsicality of the tower but also by the ability of this funnel shape to create a space of contemplation and awe. It created this environment which forced someone to ponder and look up to the sky from beneath the surface and contemplate their predicament. This ability to create such a space really interested me.

DESIGN ITERATION 02

The 'Surface' As The Walls

PRECEDENT 1 : THE BIRDS AND THE BEES INSTALLATION

Harrison Atelier Architects
Socrates Sculpture Park, Queens, New York
2016





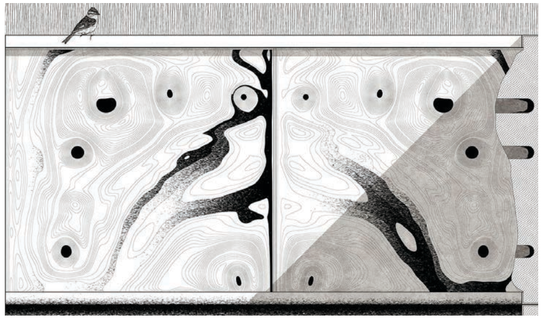


Figure 6.5: The Birds and The Bees Installation

FROM THE ARCHITECTS

The Birds and the Bees redefines the traditional birdhouse and addresses the issue that the traditional birdhouse was designed for human convenience but almost completely misses the point of who is inhabiting this space (Harrison Atelier, 2016). The Birds and The Bees becomes a pavilion with a wall lined with hand-cast cement panels designed to accommodate local small and cavity nesting birds, along with solitary bees, found on the site. The panels have apertures sized according to the habitable species and to deter predators. In addition, their interiors are lined with channels to drain water away from the interior cavities, along with small ladders to allow fledglings to crawl out of the nests (Harrison Atelier, 2016).

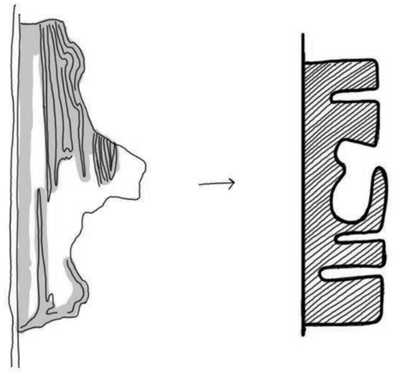
This pavilion makes a visual argument that building to cohabit with other species should be considered among the new ways of living into today's age (Harrison Atelier, 2016).

MY TAKE - AWAY

I really loved how this design approached birds and bees as the architectural client and how it made the argument that we need to design for multiple species and consider the idea of cohabitation in todays climate. Their approach of panel design made it seem that this folly could be placed in almost all designs allowing for the possibility of cohabitation everywhere in today's world.

This design made me more aware of the need to cater for and design for my clients, the butterflies and bees, and not soley the people working on the site. I also needed to focus on the bees and butterflies and how they could inhabit the traditional 'human only' spaces.

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS



The folly designs really made me realise that I needed to visualise the pollinators as the client and to design for their habitation in conjunction with people working on the site. The idea of shaping a panel into a habitable space really inspired me.



I liked how the folly design had a movement to it, almost mimicking the movement of the species it chose to house, creating a sort of topographical pattern, adding an additional designed aesthetic to the panel.

DESIGN ITERATION 03

In-Between The 'Surface'

PRECEDENTS 1 : PROGRAM SPECIFIC PRECEDENTS

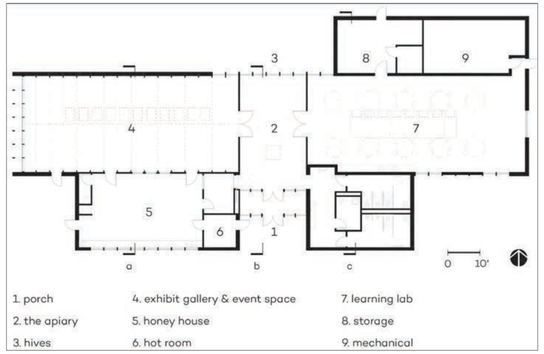
MY TAKE - AWAY

These precedents were chosen for their programs and the similarity between their programs and my designs own program.

I analysed these precedents to understand the sizes of certain spaces such as laboratories, seminar rooms, research offices and store rooms. I also wanted to understand the relationship between certain spaces, such as where are the write-up room and store room placed in relation to the laboratory and how does one enter a laboratory, is it from the side or back and are there multiple entrances?

I also wanted to look at things such as does a consultation room also have a patient examination area in it or are these two separate spaces. I began to look at reception spaces and how a reception area could differ, does it have a desk or a full-on office space. I began to analyse these spaces to understand how issues of privacy were dealt with and where the divide occurs spatially.

In essence these precedents served as a means for me to understand size, spatial relationships and over all planing when it came to laboratories, offices and clinic-esque spaces.



TASHJIAN BEE AND POLLINATOR DISCOVERY CENTER

MSR Design
Chanhassen, MN
2016

PRECEDENT FINDINGS:

Average Laboratory Area: 70m2
Average Laboratory Storage Room Area: 30m2
Average Laboratory Toilets: 40m2 - for the whole lab
Average office Area: 12m2 per office
Average open / communal office: 100m2
Average Conference Room Area: 25m2

Average Clinic Consulting Room 10m2 / 12m2
Average Waiting Area: 30m2
Average Reception Office Area: 20m2
Average Break Room Area: 20m2 / 42m2 - larger room
Average Clinic Toilets 20m2 (2 toilets each at 10m2)

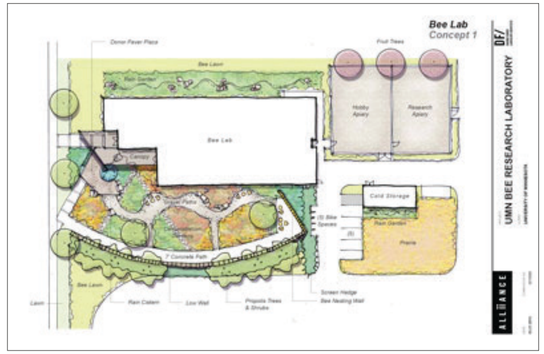
Average Apiary Area: 180m2, with 5m2 equipment
Average Honey Extraction Room Area: 60m2, with 30m2 storage

Laboratories are mostly accessed from the side, with the entrances being perpendicular to the lab desks.

Write up rooms / offices are near the laboratories, usually used as a barrier between lab and entrances or utility spaces.

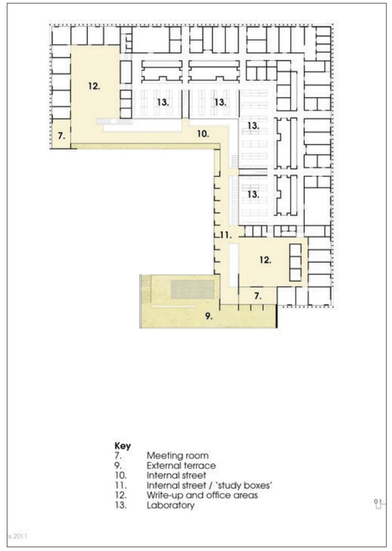
Boardrooms / conference rooms can be used as barriers of privacy between reception or waiting room areas and offices or consultation rooms.

Most consultation rooms have the doctors office and a patient examination area in the same space.



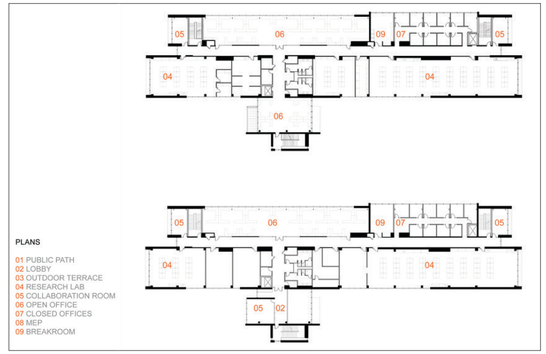
BEE AND POLLINATOR RESEARCH LAB

Alliiance Architects
Minnesota



SAINSBURY LABORATORY

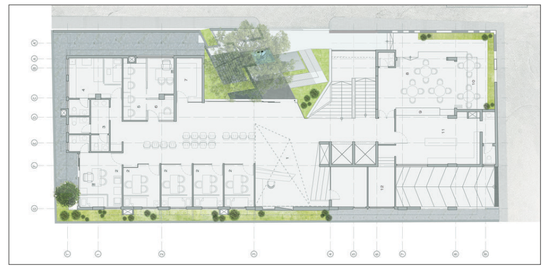
Stanton Williams
Cambridge, UK
2010



BIOPROCESS INNOVATION CENTER

Clark Nexsen
Durham, North Carolina
2016





NAVYAS WELLNESS CENTER

Cadence Architects
Bengaluru, Karnataka, India
2018

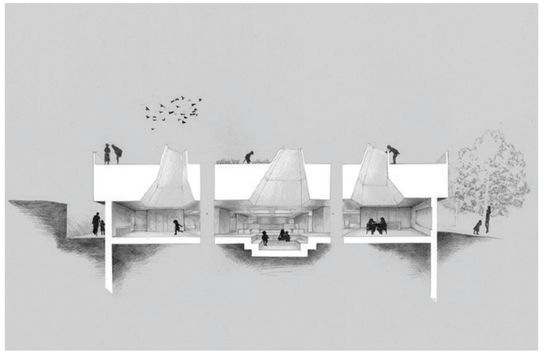
Figure 6.6: Program Specific Precedents

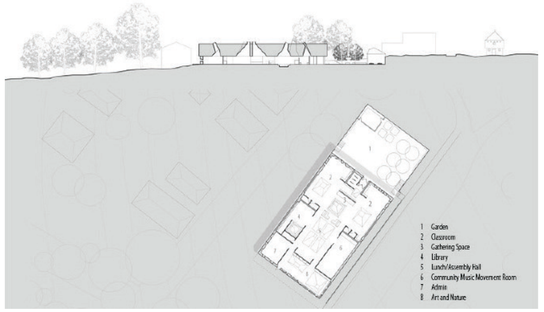
DESIGN ITERATION 03

In-Between The 'Surface'

PRECEDENT 2 : MONTESSORI SCHOOL

Laura Dempsy
Windsor, Nova Scotia
Proposal





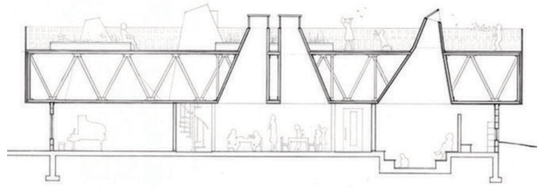


Figure 6.7: Montessori School

FROM THE ARCHITECT

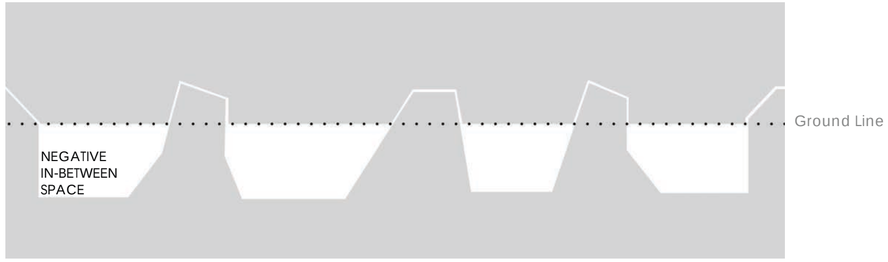
This project investigates the importance of natural light in classroom settings, through the use of large oculi skylights. The goal for this project was to explore how daylight could become an integral element in classroom design, with the intention to one day remove the need for artificial light all together (Dempsey, 2010).

MY TAKE - AWAY

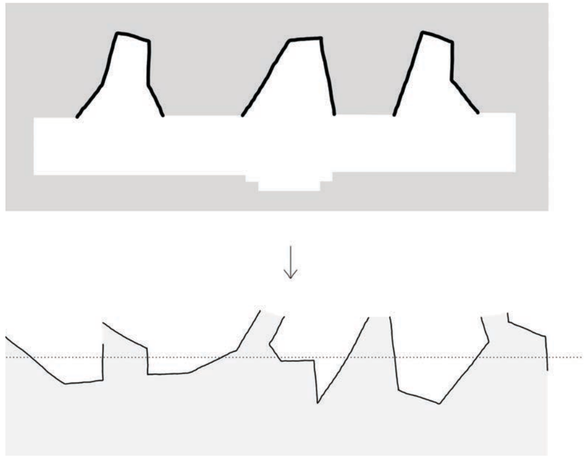
Despite this project focusing on the importance of natural light, what I really took away from this design was the design of the large roof and the jaggared and natural shapes of the oculi. The large roof concept began to present itself to me as potential spaces for pollinator habitats and follies, that could be placed above 'the surface' and in the 'roof-like' structure.

I also liked the spaces that could be created below the surface through the introduction of such skylights and how the light quality could allude to a sense of sacredness and sanctuary.

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS



The negative in-between space of this design started to get me thinking about how this space in my design (the space between surface and design below) could be reused as a possible space of pollinator habitation, allowing for human insect interaction.



The interesting skylight shapes and the forms they created in the interior spaces made me rethink the possible shapes of the protrusions and how this could create a more interesting space both above and below the ground, with the undulations blending into the surrounding landscape.

DESIGN ITERATION 03

In-Between The 'Surface'

PRECEDENT 3 : LOUVRE ABU DHABI

Ateliers Jean Nouvel
Abu Dhabi, United Arab Emirates
2017



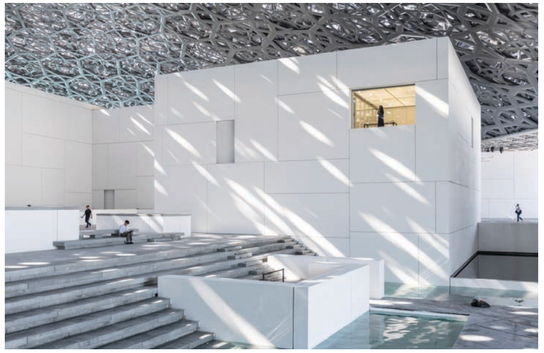




Figure 6.8: Louvre Abu Dhabi

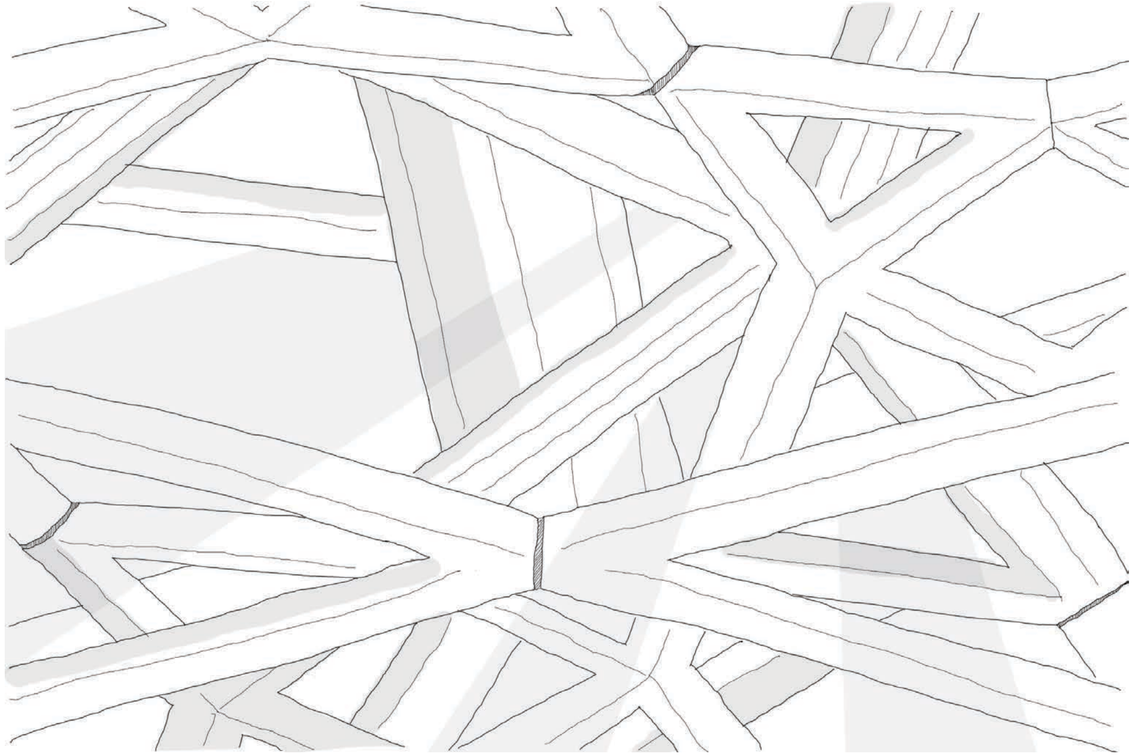
FROM THE ARCHITECTS

The Louvre Abu Dhabi exists as the final destination of an urban promenade, in which it houses some of the worlds most precious works of art. The Louvre Abu Dhabi becomes a museum city, with 55 individual buildings and 23 galleries, of which part of it is covered by 180 meter diameter dome, visible from the sea and the surrounding areas of Abu Dhabi (ArchDaily, 2017 B).

Drawing from Arab architecture the striking element of the dome begins to embody the core principles of this design style while evidently shifting from a traditional approach to a more modern approach. The dome consists of 8 layers which allows for a beautiful play of light in the internal spaces (ArchDaily, 2017 B).

MY TAKE - AWAY

What caught my attention in this design was the play between light and shadows created in its internal spaces, as light passes through the 8 layered dome. I knew that design iteration 03 would most likely be below ground and so I was curious in how I could let natural light in, without creating the usual large skylight openings but also how I could manipulate the light depending on the function of the space and so this design although being contextually different to my own, served as a great source of inspiration. In addition I liked the net like weave and quality of the dome and how this texture was achieved through a material that is not fabric and one that is not traditionally soft and lattice-like.



MY TAKE-AWAY SKETCH - PRECEDENT ANALYSIS

I was inspired by the domes construction, the way it allowed for a play of light and shadow creating an interesting atmosphere, almost ethereal in nature. The lattice-quality appeared to look like vines growing and spreading throughout the museum along with echoing the interweaving mesh of a net. This lattice form started to make me think about the idea of artificial nature.

DESIGN ITERATION 04

The 'Surface' As The Whole

PRECEDENT 1 : MONARCH SANCTUARY

Terraform / Mitchell Joachim
Nolita, New York City
For The Shenzhen Biennale (UABB)
2019

FROM THE ARCHITECTS

The Monarch Sanctuary will serve as a large-scale Lepidoptera terrarium, where the double skin facade exists as a vertical meadow garden that serves as a crucial way station and habitat for the at-risk butterfly (Joachim, 2019). The double skinned façade is lined with beneficial plants and nutrient capturing panels, and together with its covered ETFF layer, creates a stable and carefully controlled climate for butterflies to thrive and prosper. Butterflies have the ability to move freely between the building facade and wild population, enhancing overall species population numbers (Joachim, 2019).The Monarch Sanctuary building works to enable the public to witness biodiversity in the urban realm. The aim is to make a spectacle which includes plant life, in designing for other species and in conveying images of new possibilities for urban regeneration. The building exists not only as a sanctuary and haven for dwindling butterfly species but also exists as a visual statement in humanities failure with their relationship with nature, while also making reference to habitat destruction (Joachim, 2019).

MY TAKE - AWAY

Despite this project existing in the urban context, I really loved how it accommodated the butterfly species, not only through the addition of beneficial flowers and plants but also through the use of designed panels, such as ones that captured mud (which butterflies rely on for nutrients) and panels that contain artificial flowers to ensure constant perching stations. I really enjoyed how this design treated butterflies as the main client and created a space fro them to thrive and prosper in an environment which traditionally does not usually favour them. This design aims to save these species, while also educating the public on the predicament butterflies are facing and how humanity has contributed to their demise. This design comments on mans need to design not solely for humanity but to also consider cohabitation, which I really liked and found relevant in relation to my overall concept.



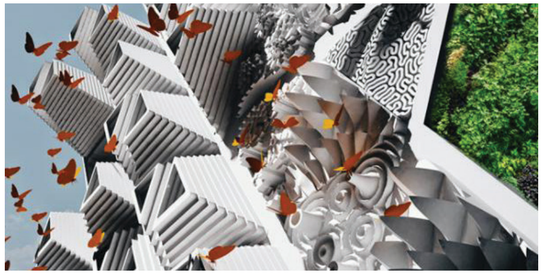
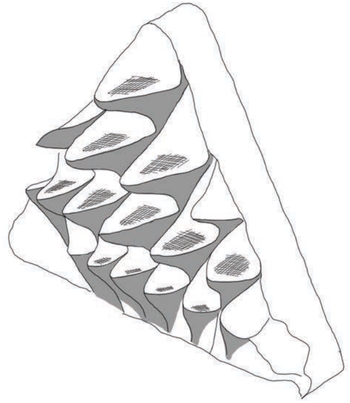
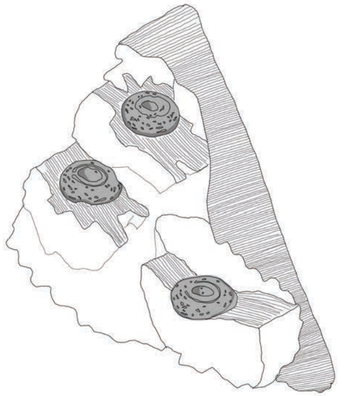




Figure 6.9: Monarch Sanctuary





I really loved the panel iterations and how it took the ecological needs of pollinators and adapted it to suit the built environment of humans, to create a space that aided cohabitation and both species.



I was inspired by the double facade's ability to create this new environment / habitat for butterflies and plants to thrive.

The idea of creating a livable habitat out of nowhere was an interesting concept.

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS

DESIGN ITERATION 04

The 'Surface' As The Whole

PRECEDENT 2 : BIO-CLIMATIC PROTOTYPE OF A HOST & NECTAR GARDEN BUILDING

HUSOS Architects
Cali, Colombia
2015

FROM THE ARCHITECTS

This building becomes a household and work area, surrounded by a facade of host and nectar plants for butterflies and birds in Cali. The green facade not only provides a comfortable micro-climate in the building and reduces energy consumption but also exists as a prototype for cohabitation and biodiversity corridors and awareness (Archdaily, 2015). Through two actions this design aims to strengthen the biodiversity of Cali, both physically and informatively. The first action is the creation of the green facade which creates a habitat for butterflies, birds and other local insects. Using the presence of butterflies as bio-indicators the design is able to gauge the quality of the surrounding environment and visually show the importance of these creatures. Secondly with the assistance of biologists and the local zoo, they have assisted in the dissemination of information about the importance of Cali having the largest population of butterflies in the world and the responsibility they have to preserve them and help them prosper. In essence this design creates a new habitat for endangered pollinators and spreads information on the importance of such biological corridors and the need for continued conservation (Archdaily, 2015).

MY TAKE - AWAY

I loved the simplicity yet extreme effectiveness of this design. The facade or butterfly habitat doesn't exist to support only one species but rather exists in a way that is beneficial to all users. It provides a comfortable internal climate and reduces energy consumption for the human users, while also creating a home for the pollinators of Cali. The design also acknowledges the importance of disseminating information on top of providing a habitat. This inclusion in the buildings program made me realise that my own design program could be added onto and improved.



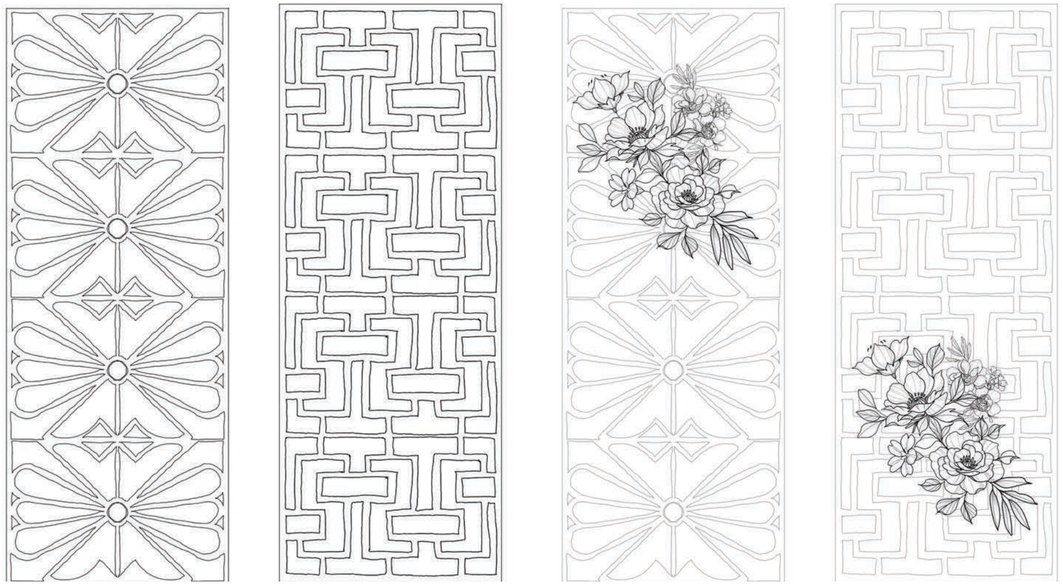




Figure 6.10: Host & Nectar Garden Building

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS

The panel design isn't simply for the benefit of the pollinators but also for the people working in the building, in that the panels also serve as security bars. In addition these panels create a favorable butterfly environment by allowing host and nectar plants to grow up the building creating a larger habitat for butterflies to thrive, while also shading the building in green plants creating a set of favorable indoor conditions for people inside the building. In this way the panels represent the perfect element of cohabitation in that they support both people and pollinators at their own respective scales, which is a design concept that really resonated with me.



DESIGN ITERATION 04

The 'Surface' As The Whole

PRECEDENT 3 : LANDSCAPE OF AMBIGUOUS SPACES

Junya Ishigami (ex-SANNA Architect)
Venice Biennale, Venice, Italy
2008

FROM THE ARCHITECT

This pavilion design consists of a room with ishigami 's drawings displayed along its walls. The pavilion then spreads outside into a series of four ephemeral greenhouses infused with plants. Furniture and plants are placed amongst the greenhouses creating an interior feel. This installation suggests the future possibilities of architecture, wherein it challenges structural norms, as it dissolves the boundaries and divisions between architecture and landscape, into an environment where the two are nearly indistinguishable (Inked in black, 2011). In addition, the boundaries between interior and exterior are also blurred as the overall space is given no definite qualities of a physical object (Designboom, 2008). In this way the Japanese pavilion appears as an element of topography or an imperfect artificial environment, with no definite interior or exterior space in the traditional sense. In this pavilion design Ishigami attempts to marry nature and architecture with each other, to the point where the two seem almost indistinguishable so that everything internally and externally exists simultaneously (Designboom, 2008).

MY TAKE - AWAY

I was really drawn into the ephemeral nature of this design and how the almost skeletal and delicate quality of the structural elements of the green house allowed these forms to sit so gracefully amongst their natural surroundings. I was struggling to figure out how my design could appear to almost be gracefully sitting on the site, in a way that allowed for a minimal foot print, but also one that gave the appearance of a light and almost skeletal structure that was not being obtrusive or harmful to the land it was sitting on and surrounding it. This design, with its skeletal almost scaffolding-like structure, served as the perfect inspiration to achieve that such desire. I loved the concept of blurring the divisions between interior and exterior and architecture and landscape. This idea of almost enclosure vs non-enclosure really resonated with me as I knew that I wanted my design to blend into its surrounding natural landscape and create an 'enclosure' that did not appear as if I was caging in the pollinators or even the humans from the pollinators. A central idea of my design is to have moments of interaction and overlap between people and pollinators and so this design really stood out to me as a way to possibly blur those enclosure boundaries to allow for those moments of interaction.



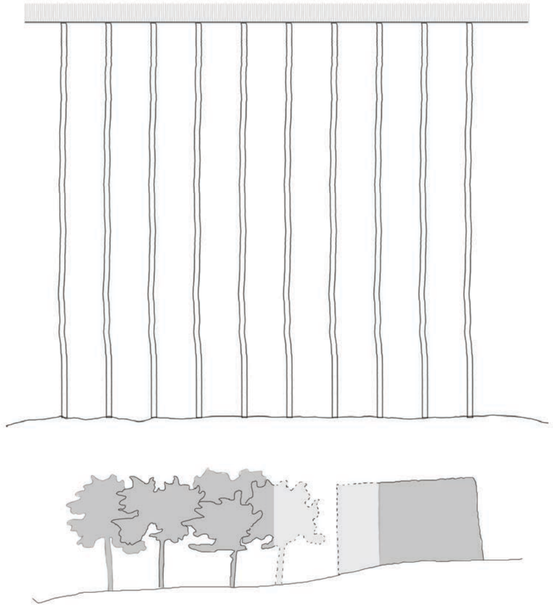




Figure 6.11: Landscape of Ambiguous Spaces

MY TAKE-AWAY SKETCHES

- PRECEDENT ANALYSIS



I was really inspired by the slender nature of the columns and how they helped blur the boundary between structure and nature.

The slenderness adds a sense of whimsy to the design, while also mirroring the natural elements around it (slender tree trunks), further blurring the divide between nature and built.

DESIGN ITERATION 04

The 'Surface' As The Whole

PRECEDENT 4 : SPIDERNETHWOOD

R&Sie(n)
Nimes, France
2007

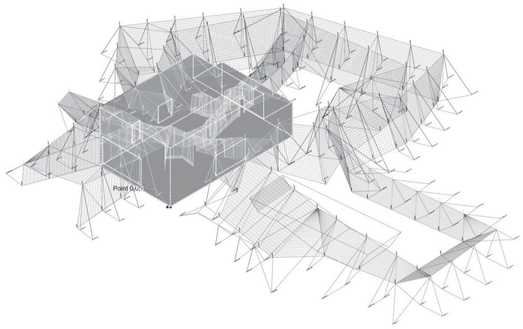








Figure 6.12: Spidernethwood

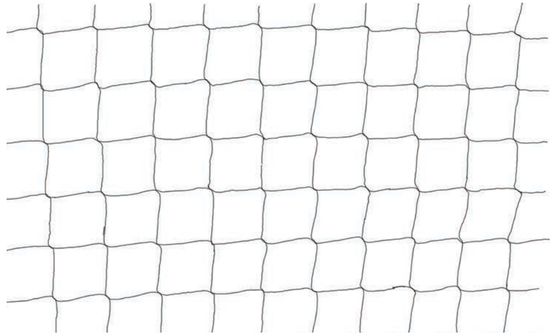
FROM THE ARCHITECTS

This project consists of a labyrinth of netting and mesh, which feeds off of a small house and outdoor swimming pool into the surrounding forest. The project makes a comment on over density, with the nets placed at the height the trees will reach in the next 5 years. The netting and mesh material blur the boundaries between inside and outside and add a level of porosity, while mimicking the movements of the trees in the wind (Archdaily, 2008).

MY TAKE - AWAY

Based on my re-visitation of my model explorations, I knew that I wanted the design to aid the growth of the surrounding landscape and so this design stood as a perfect example to do exactly that, The use of netting and mesh also made a direct correlation to the material used when humans interact with bees and I thought that would be a nice visual connection to have in my design.

I really loved how the netting and the house seemed to effortlessly sit in the landscape in a way that made it appear as if it had always been there. The delicacy of the design gave the appearance that the design was not obstructing the growth of the natural world that encompassed it, but rather it appeared to move around the forest and accommodate it. This mindset was a great source of inspiration, in that I wanted my proposed design to be conducive to future growth on the site, rather then obstructive and damaging.

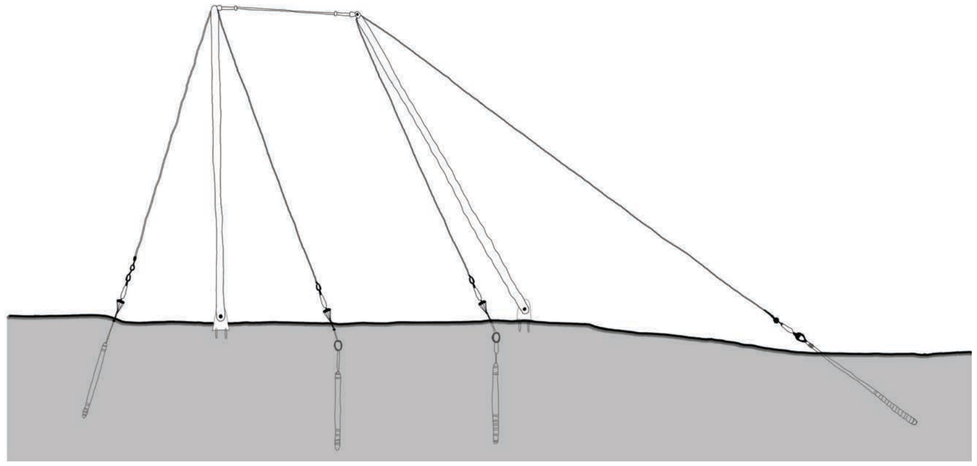


MY TAKE-AWAY SKETCHES

- PRECEDENT ANALYSIS

This design started to show the net as more than just fabric but also as a structural element and an architectural component.

I liked the structural design of the support systems for the net in that just like a tree, it too had multiple elements that rooted it to the ground, and so as the net aided the surrounding environment it also mimicked that same surrounding environment.



DESIGN ITERATION 04

The 'Surface' As The Whole

PRECEDENT 5 : A SCAFFOLDING SYSTEM FOR A TEMPORARY FACILITY

Peris+Toral Architects
Barcelona, Spain
2015

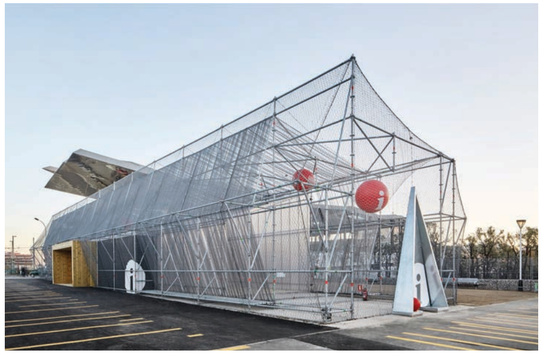






Figure 6.13: A Scaffolding System for a Temporary Facility

FROM THE ARCHITECTS

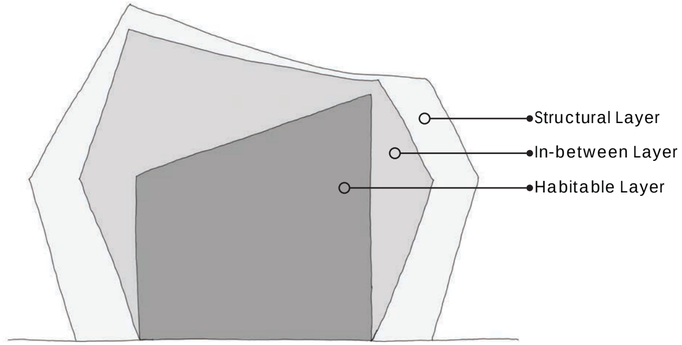
This project exists as part of the provisional urbanisation of Glories Square in Barcelona and exists as an information point, an exhibition area about the proposed developments along Glories Square and a rental point for electric bicycles (Archdaily, 2016).

The building exists in a state of temporality, with the temporary nature of the building enhanced through its linear shape, translucent materials and scaffolding structural system, adding an additional level of permeability and ephemerality. The scaffolding system acts as the support for the three surrounding layers or envelopes; an impermeable and translucent polycarbonate skin, a shade mesh and a metal mesh as a layer of protection. The building becomes a detachable and reusable method of construction, minimising its trace on the surrounding property (Archdaily, 2016).

MY TAKE - AWAY

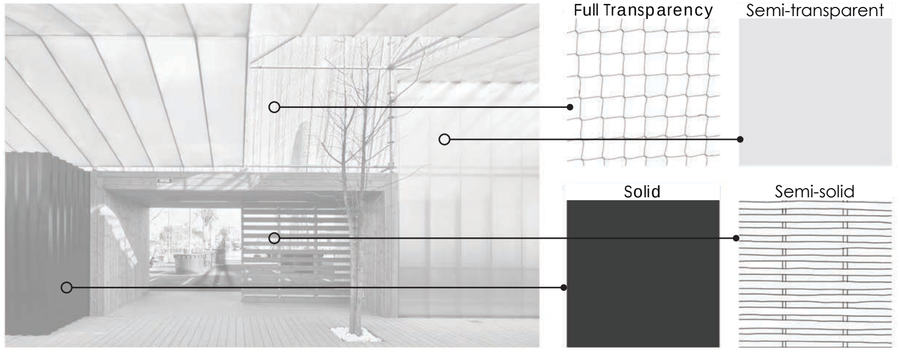
I was beginning to explore a possible level of transparency in the design, with a level of temporality. I knew that I would want the resultant design to slowly fade away as the surrounding environment grows over the design and with it over time. With these ideas in mind this design really spoke to me with its idea of being unobtrusive and temporary. The use of scaffolding together with a mesh like material, really intrigued me and I began to think that this system could be used to allow for minimal impact on the surface of the proposed site and provide the surface onto which surrounding plants could grow up onto. In essence the materials and structural system of this design started to make me think about how I could create a growing and living building.

MY TAKE-AWAY SKETCHES - PRECEDENT ANALYSIS

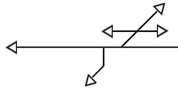


The play on layers (together with the transparency) creates an interesting relationship between the three spaces.

This related to the monarch sanctuary's double facade idea, and I started to think how I could use layers of separation to create moments of interaction between man and pollinator, not only providing visual moments of interaction and overlap but also physical moments as well.



This design plays with levels of transparency in a way that allows for different spaces throughout the design, however always insuring a moment of connection with the outside environment.



01

THE ‘SURFACE’ AS THE GROUND

PROGRAM

Based on the research done in chapter 2, the program developed into three laboratories (plant, bee & butterfly) each focusing on research that would aid its respective subject matter in their fight against survival.

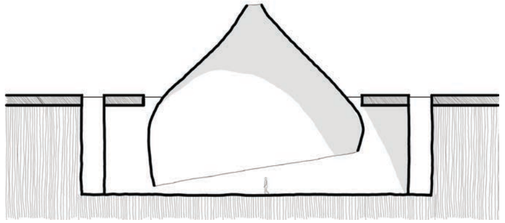
The program also included a museum / education center to educate people on the plight of nature and pollinators, which included a dome of reflection and contemplation, looking up to the sky for hope.

In addition, there was also a sunken performance space to provide an additional attraction to draw people to the site, to be informed and educated on the issue of pollinator extinction.

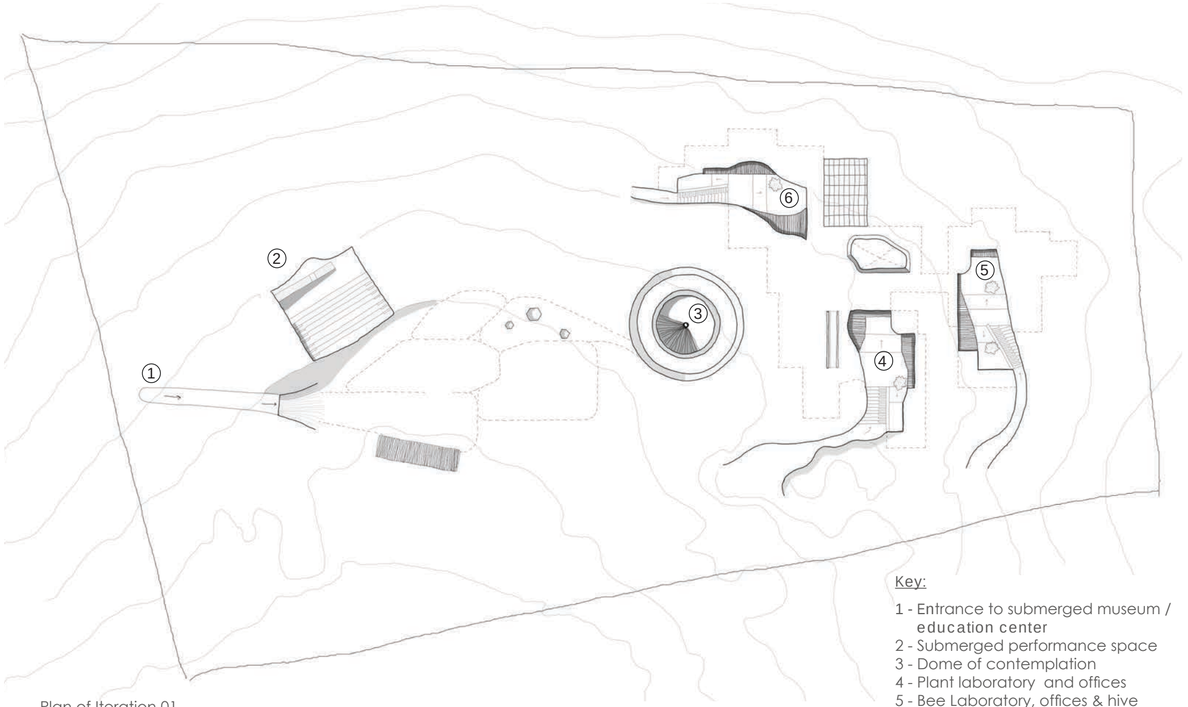
DESIGN ITERATION 01

THE 'SURFACE' AS THE GROUND

This design intended to mimic the action in which pollinators build their own habitats, that being form top down. In this way, people descend down into the ground through open courtyard spaces or cut out entrances, which feed into the main habitable spaces. The subterranean approach also allowed for the idea of giving the surface back to plants and pollinators.



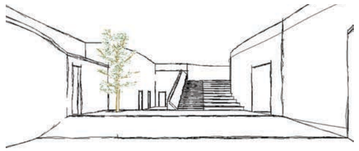
Dome of contemplation - a space to promote reflection



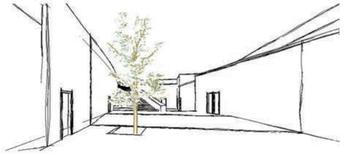
Plan of Iteration 01

Key:

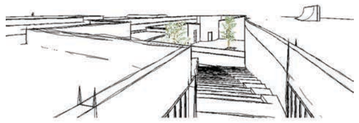
1 - Entrance to submerged museum / education center
2 - Submerged performance space
3 - Dome of contemplation
4 - Plant laboratory and offices
5 - Bee Laboratory, offices & hive
6 - Butterfly laboratory, offices & caterpillar garden



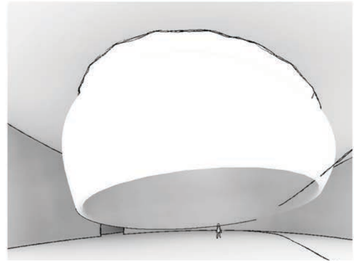
Butterfly Laboratory Courtyard



Plant Laboratory Courtyard



Plant Laboratory Courtyard



Dome of contemplation

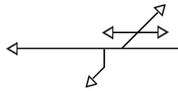
THE TAKE-AWAY - FOR DESIGN DEVELOPMENT

While the action of top down did create some interesting courtyard spaces, the overall placement of spaces was too stretched out and far too scattered along the site. The spaces, other then those created by the courtyards, started to feel awkward and hidden rather than being special or purposeful.

Moreover, the precedents I had chosen, although all emulating this below the ground approach, lacked a contextual relationship to the idea of pollinators and the spaces that the design was made up of (such as laboratories & offices).

I started to realise that the desire to place my building below surface, in an attempt to give the surface back to plants and pollinators not only furthered the separation between man and insect but would also mean that the surface would most likely be destroyed in order to create these underground spaces, which starts to contradict everything I am aiming to achieve.

Moving forward I knew that the spaces in the design needed to be more purposeful and placed in a more tight arrangement, that allowed for a larger piece of the site to be preserved and remain untouched. I also needed to re-evaluate the program of the design and realsied that my precedents needed to have a more contextual relationship to pollinators and to the functions of the design.



02

THE ‘SURFACE’ AS THE WALLS

PROGRAM

As the design developed so did my understanding of who may visit the site and project and as a result what the appropriate program should be. I knew that research was an important component in conservation and issues of endangerment and so the three laboratories remained, with the addition of a greenhouse to grow and test plants in a controlled environment. However, I realised that having all these people on the site may contribute to the damage of this ecosystem, putting the already fragile population of butterflies and bees at further risk, as such the functions of an education centre and performance space fell away.

However, since people still need to be educated and updated about the issues facing pollinators and nature, I knew that there still needed to be some form of education, however in today's age everything is digital. With this mind a data centre was added to compile the date collected by the three laboratories and clinic and disseminate this electronically through social media and a website. In addition to the data centre, I wanted to exhibit how important and useful pollinators are, so I decided to add a clinic and build on the ideas of Susana Soares, using bees as diagnosis tools.

DESIGN ITERATION 02

THE 'SURFACE' AS THE WALLS

This design started to look at the movements of pollinators, looking at the way the movements of their wings and the dances done to inform other members where they have found a pollen source.

By overlapping these circular movements, these curves became a guide for the spacial arrangement, with the form developing into a series of curves that cut into the landscape . The design pulled the landscape up over it, aiding the growth of the surrounding landscape both in its curved up forms and with additional green roofs. Two walls also started to accommodate pollinator habitat panels.

Playing With Movement



Pollen Dance 1: Waggle Dance

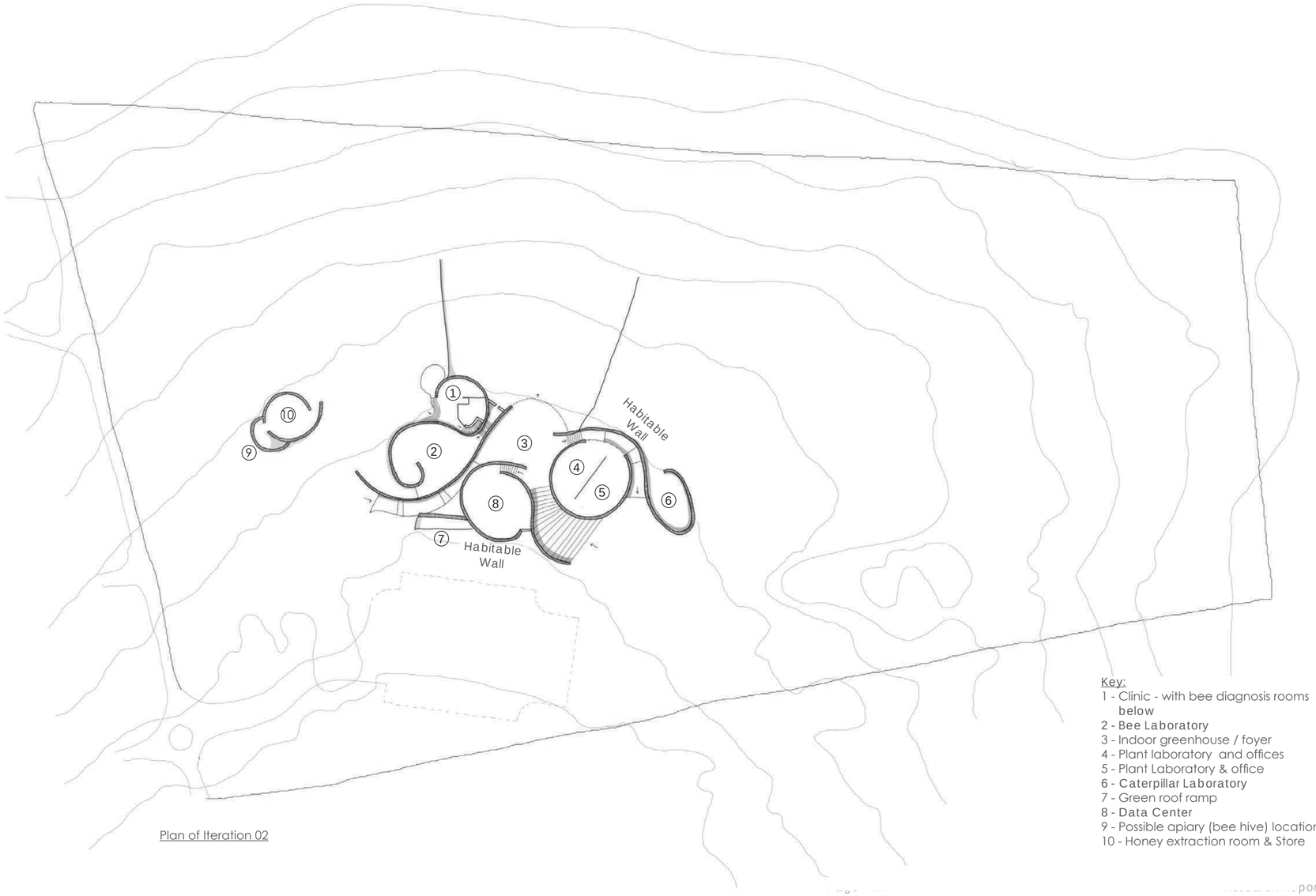
Pollen Dance 2: Round Dance

Movement 1: Bee Wing

Movement 2: Butterfly Wing

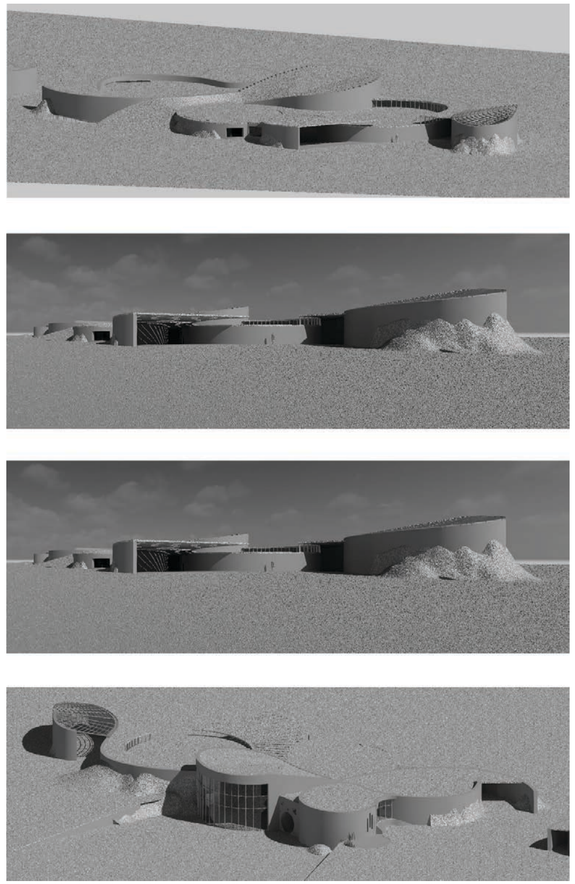


Overlapping Movements



Plan of Iteration 02

Key:
1 - Clinic - with bee diagnosis rooms below
2 - Bee Laboratory
3 - Indoor greenhouse / foyer
4 - Plant laboratory and offices
5 - Plant Laboratory & office
6 - Caterpillar Laboratory
7 - Green roof ramp
8 - Data Center
9 - Possible apiary (bee hive) location
10 - Honey extraction room & Store



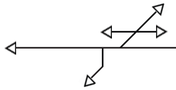
3D Perspectives of Iteration 02

THE TAKE-AWAY - FOR DESIGN DEVELOPMENT

I preferred the exploration that was created in this design, when I began to use the pollinators movements as a design tool and placed the building above ground. However, the design felt ironically both unresolved and too resolved. The form seemed resolved and possibly too finished at this stage, however the spatial make-up of each program function seemed to lack the depth that each function would require.

The design was making way with a more conscious arrangement on the site and I appreciated how it responded better to the topography of the site. However, the implementation felt slightly unfinished because the spaces that each of the main functions required, seemed to be lacking.

Moving forward, I wanted to carry on the idea of a more grouped approach in the overall form, but I knew I needed to explore the spaces each function required and look at precedents that dealt with these functions, such as existing laboratory designs. I also needed to figure out how to accommodate the pollinators more and how I could also design for them more.



03

IN-BETWEEN THE ‘SURFACE’

PROGRAM

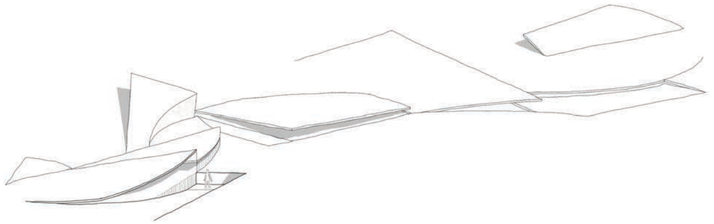
- Three Laboratories:
  - Plant, Bee & Butterfly
- Greenhouse
- Clinic
- Data Centre

DESIGN ITERATION 03

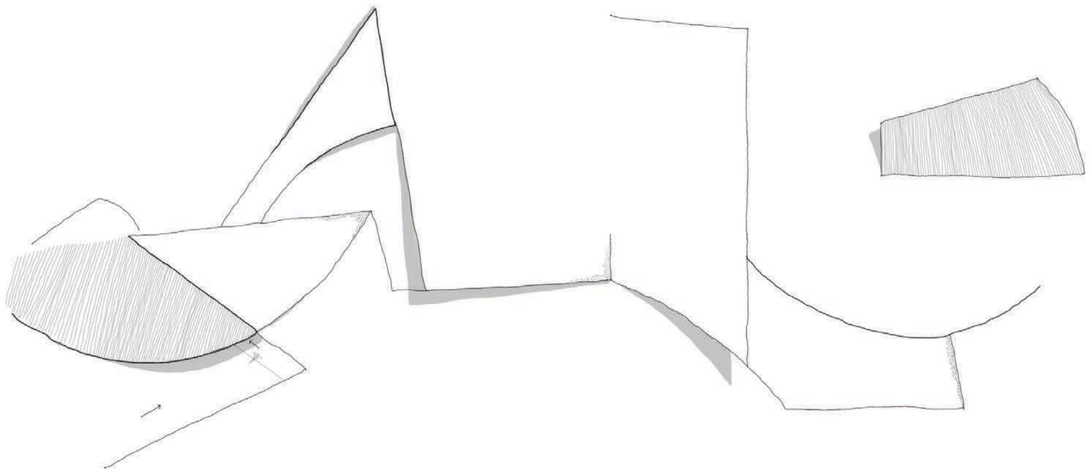
IN-BETWEEN THE 'SURFACE'

This design aimed to give the surface back to the pollinators, while still aiding its growth. Taking the approach of design iteration 01, this iteration started to see the surface as the ground and began to place the habitable spaces below the 'surface'.

I wanted to create a more delicate approach of cutting into the landscape than in design iteration 01 and so the design unfolded into a series of delicate slits, cut into the ground, where the ground became a version of a roof. This roof served as places for pollinators to inhabit and receive food and nutrients, while also serving as an entrance to the habitable spaces below.



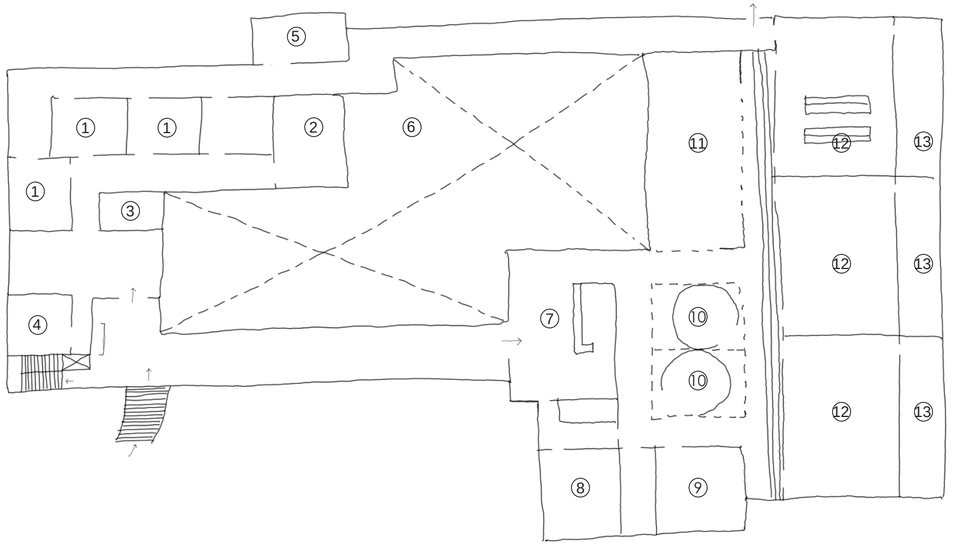
3D Perspective of Iteration 03



Roof Plan of Iteration 03



Concept Sketch



Plan of Iteration 03

Key:

1 - Clinic consultation room
2 - Break room
3 - Clinic reception
4 - Clinic toilets
5 - Clinic's synthetic apiary
6 - Lower level greenhouse, with testing areas and seed store
7 - Laboratory reception
8 - Laboratory toilets
9 - Open plan office space
10 - Seminar / Conference Room
11 - Break Room
12 - Laboratory
13 - Laboratory storage room

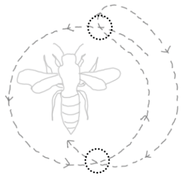
DEVELOPING DESIGN ITERATION 03:

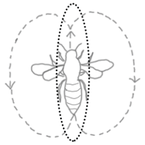
As the design developed I started to merge the roof surface and below surface spaces.

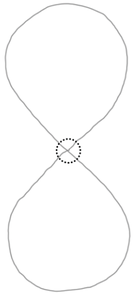
Drawing from the movement of the pollinators from iteration 02, I noticed how these movements always overlapped each other (shown below). I began to look at the negative space that formed between the layers of the 'surface' and the 'below surface' and how it could be adapted to suite pollinators, creating this overlap and intersection of man and insect spaces.

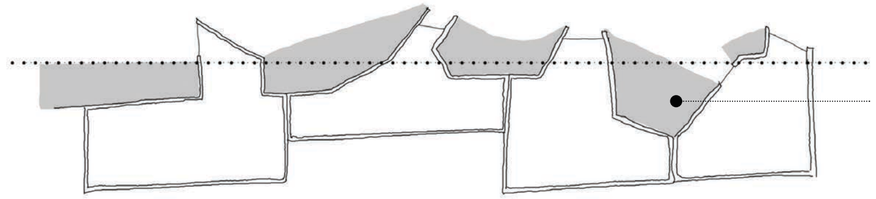
The negative space became pollinator habitable space, from hive chambers, perforated panel homes and tube homes for solitary bees, too water catchment areas with toxin removing powder and perching panel platforms for butterflies. All roofs are covered in beneficial plants to further aid pollinators and allow the design to blend into the surrounding landscape.

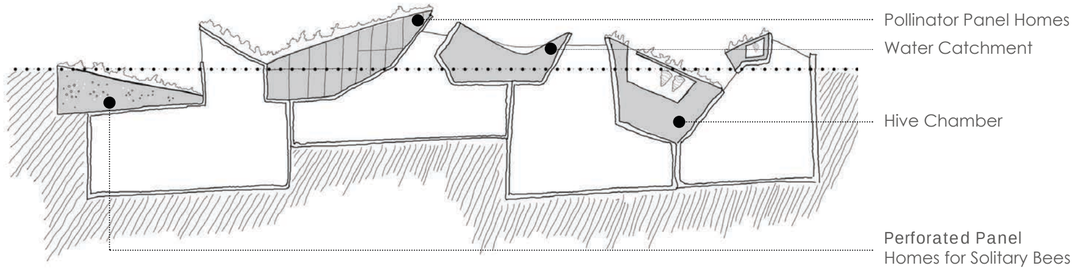
Points of Overlap



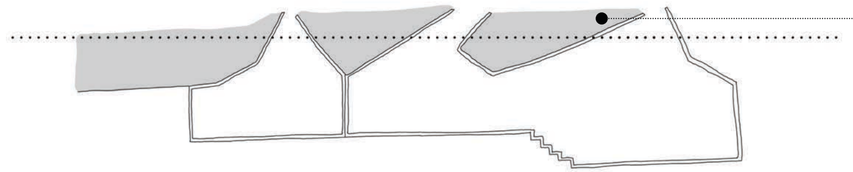


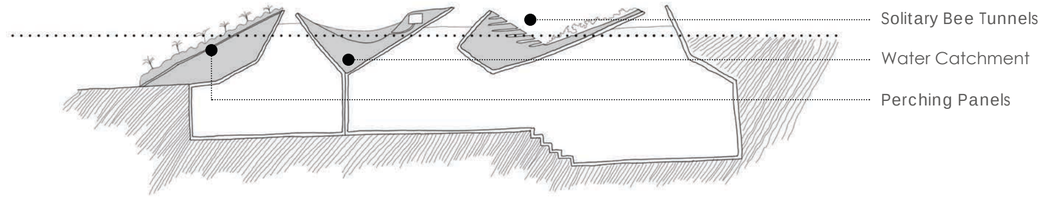






Sketch Section 1





Sketch Section 2

THE TAKE-AWAY - FOR DESIGN DEVELOPMENT

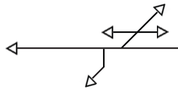
Despite this iteration making strides in accommodating pollinators more and in a more designed and artificial manner, there was still this large issue of disconnect created by placing the human habitable spaces below ground. There was also the re-accruing issue of the design destroying the ground, in order to create the spaces below the roof-like surface.

I appreciated how the spaces of each of the main functions, were more thought out and included all of the required individual spaces and rooms. However, the design lacked a sense of place, in terms of its contextual relationship to the site. I felt that this partly arose due to the lack of orientating my design according to the elements because it was all placed underground.

Moving into the next phase I wanted to keep in mind the follies or pollinator habitats I had created in this design. However, I knew I needed to evaluate the position of placing my design below ground and actually understand why this was needed and resolve all the issues and problems this decisions brought along with it. In addition, I realised I needed to understand what the 'surface' actually was and what it meant to me and to the design.

I knew I needed to bring the design back to the original ideas of man interacting with pollinators and architecture interacting with nature. I also felt I needed to re-look at the model explorations and artificial environments I had studied earlier, in order to bring the design back to the idea of creating an artificial environment that would protect the irreplaceable and sustain the endangered. I also needed to respond better to the topography of the site.

The ideas were all there and slowly starting to take shape, however somewhere along the way I realized that they started to get lost and distorted and so it was import for me to step back and re-evaluate what I wanted to achieve.



04

THE ‘SURFACE’ AS THE WHOLE

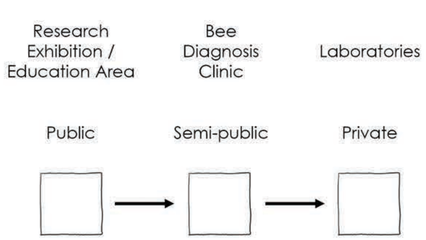
PROGRAM

- Three Laboratories:
  - Plant, Bee & Butterfly
- Greenhouse
- Clinic
- Data Centre
- Education Room:
  - This design brought back the idea of an education centre through the addition of a small auditorium-esque space.

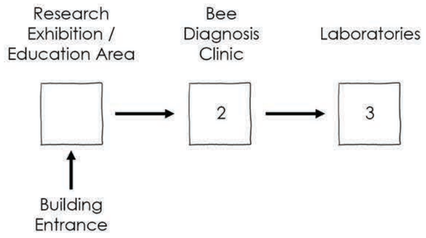
DESIGN ITERATION 04

THE 'SURFACE' AS THE WHOLE

Spatial arrangment & Orienatation

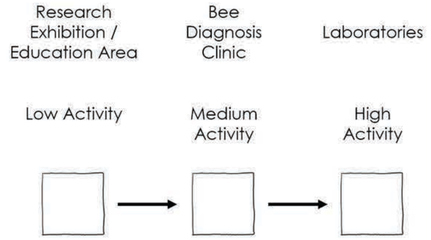


Level of privacy -
determining entrence point

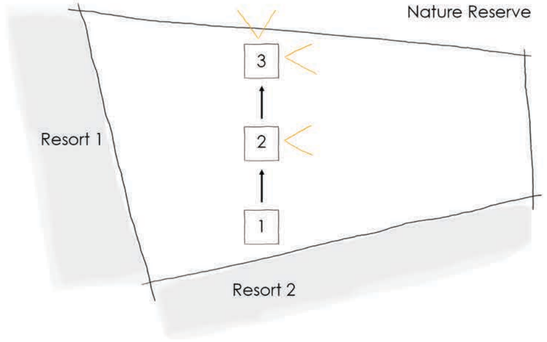


Space Arrangment -
with privacy included

A

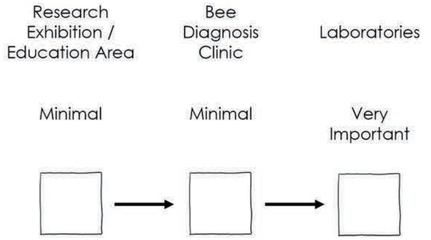


Level of activity -
determining orientation for views

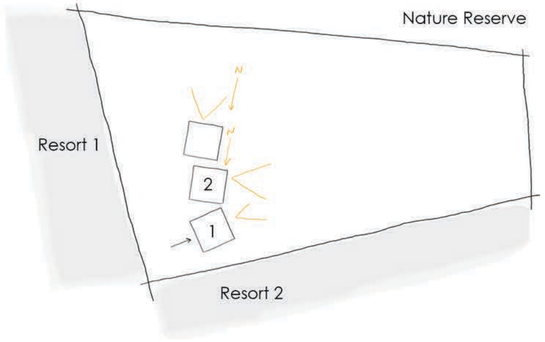


Orientation for views -
with privacy included

B

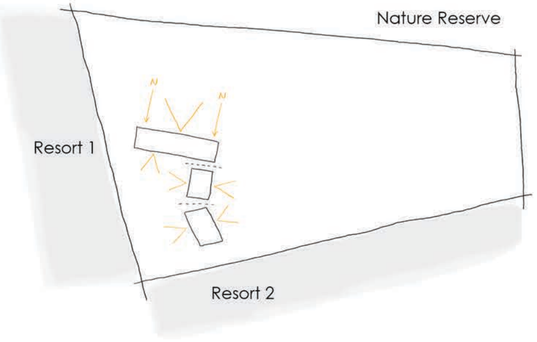


Natural Light Required -
determining north facing orientation



Orientation for north light -
with privacy & views included
- building located insouth western corner to conserve space of natural site

C



Final Orienation -
Spaces extended to suit program requirements

DESIGN ITERATION 04

THE 'SURFACE' AS THE WHOLE

After re-evaluating whether or not the design should be place below or above the ground, I decided that the building should be placed above the ground. This placement would resolve some of the issues brought about by placing my building below the ground but most importantly it would allow for moments of interaction between pollinators and people, while also allowing the surrounding site to grow up onto the building.

The design becomes a linear form that bends at certain points with courtyards placed to define a new function in the overall space and a new level of privacy, with the design moving from public (with the entrance and auditorium) to semi-private (with the bee clinic) finally to private (with the laboratory space). Surrounding the design is a double layered net structure supported by a scaffolding system. The double layer net system has larger openings in the top layer and smaller openings in the bottom layer. In this sense butterflies and bees could pass through the first layer and enter this in-between space, which could become an extension of their environment, as plants both naturally existing and those planted, grow up along the net, with nature becoming the building over time, as the building grows with the site and encourages the growth of the site. The net becomes an extension of the butterfly and bees world, while providing additional space for their habitats to grow.

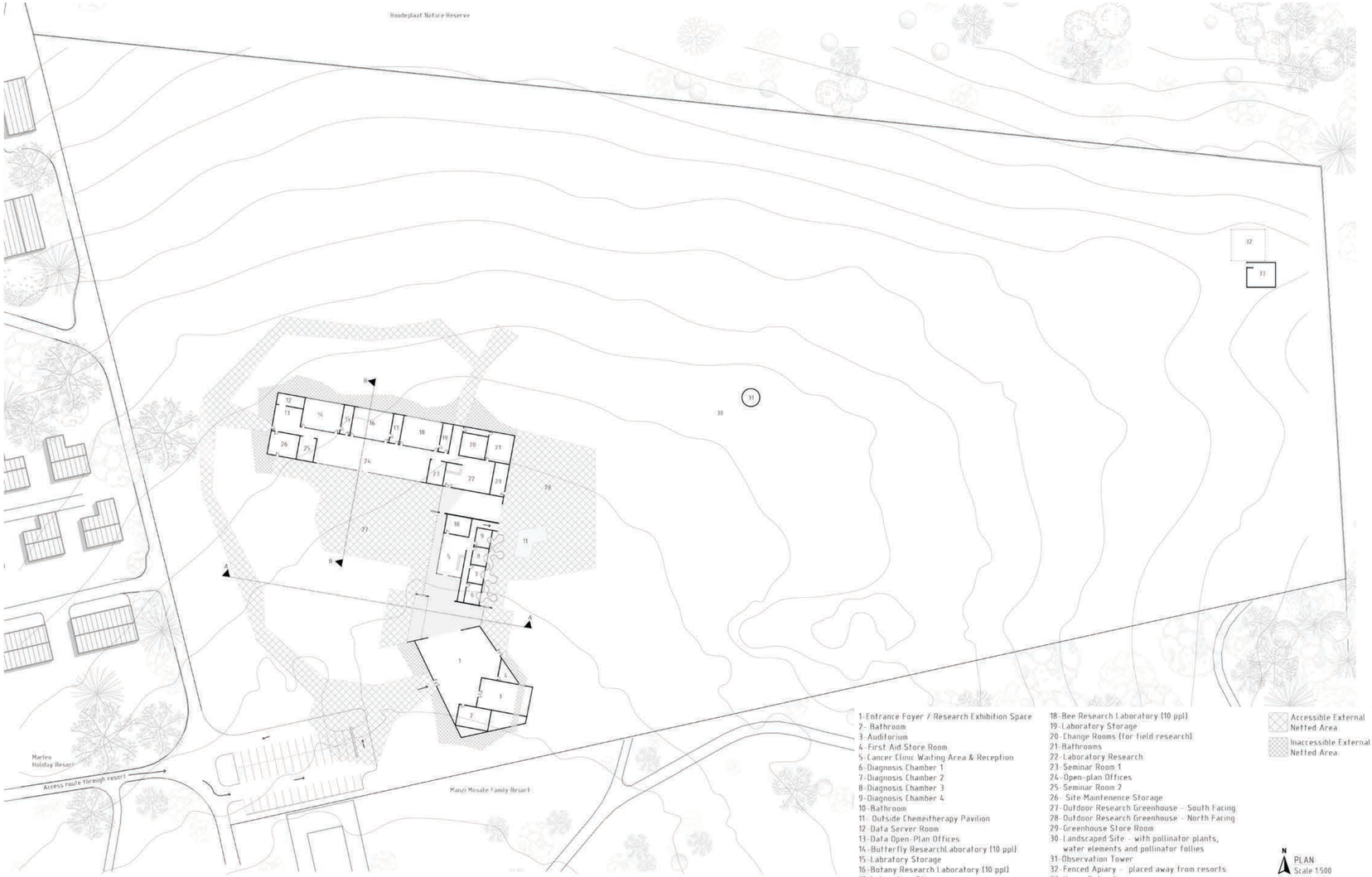
In addition to the net, there are also various pollinator habitat follies designed with the intention that they would be placed throughout the site. These follies provide homes, food and water sources, along with artificial nutrient sources and resting stations.

I wanted to have a greater response to the site and so the labs face north to receive the north facing light and receive the better views of the site and dam (as this is the most occupied space in the building). In addition a north light greenhouse and south light greenhouse were placed in areas to receive their respective light. In this way plants that are sensitive to harsh light and possibly thrive in shade could be experimented on in the south facing greenhouse, while plants that require excessive light could be researched in the beneficial north light green house. The overall building was placed in the far left corner to minimize the damage done to the site and leave as much natural, untouched land as possible. This arrangement also allowed for easier access to the site, feeding of the road that moved through the neighbouring resort.



Context Plan
Scale 1:1500

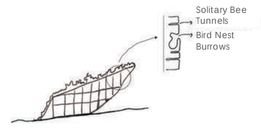
1 - Roodeplaat Dam
2 - Roodeplaat Nature Reserve
3 - Proposed Site
4 - Marleo Holiday Resort
5 - Manzi Monate Holiday Resort



Plan of Iteration 04

Habitat Follies

homes . planters . water catchment . nutrient containers



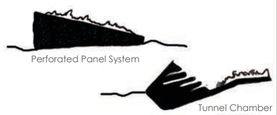
Panel Habitats



Hive Chamber
-with UV paint pattern exterior , to attract bees.



Water Channels



Solitary Bee Habitats



Butterfly Perching Panels



Mud Puddle Container & Artificial Nectar Sponge Holders

Clinic

Diagnosis Chamber



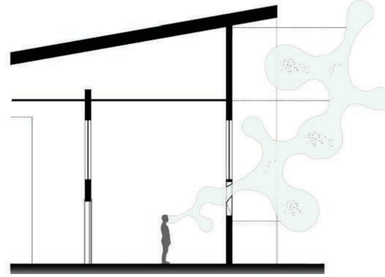
1 - Blow into chamber



2 - Results: Negative



3 - Results: Positive

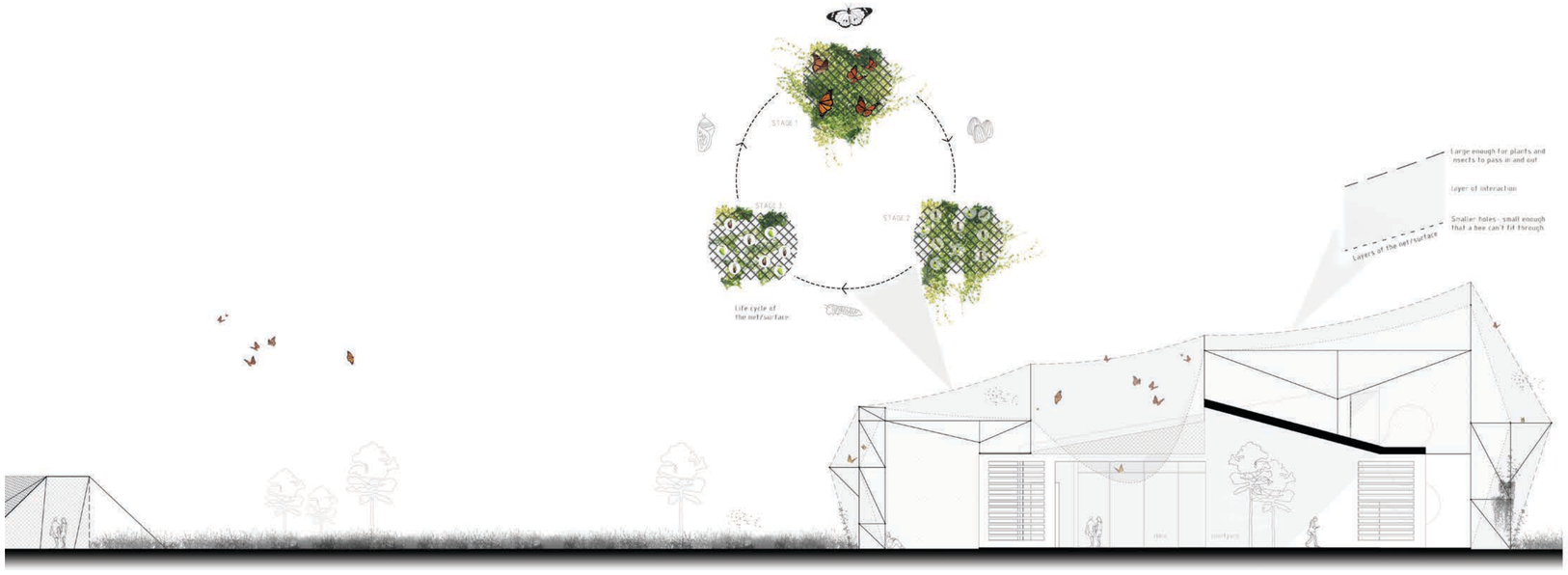


Bees can be trained within 10 minutes using Pavlov's reflex to target a wide range of natural and man-made chemicals and odours, including the biomarkers associated with certain diseases.

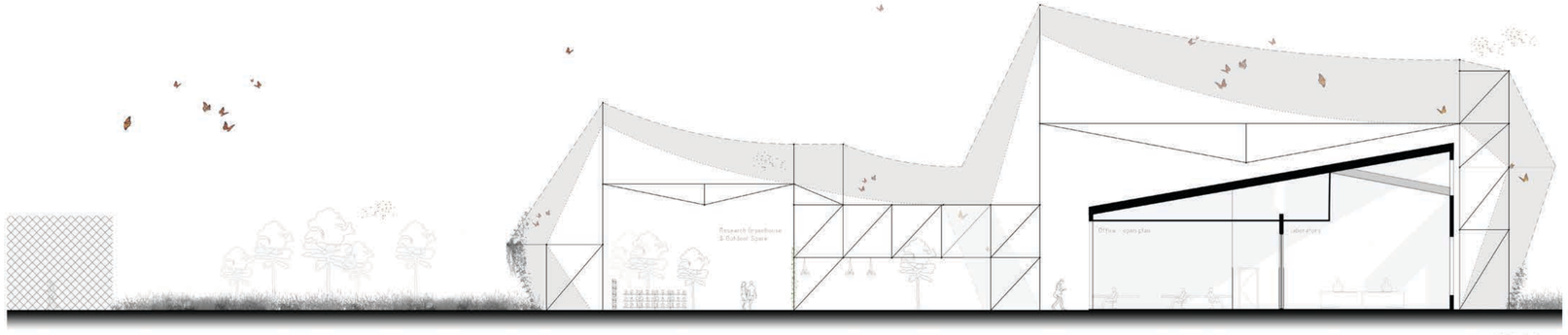
Scientific research demonstrated that bees can diagnose accurately at an early stage a vast variety of diseases, such as: tuberculosis, lung and skin cancer, and diabetes.

Apocrine glands are known to contain pheromones that retain information about a person's health that bees antennae can identify.

The glass objects have two enclosures: a smaller chamber that serves as the diagnosis space and a bigger chamber where previously trained bees are kept for the short period of time necessary for them to detect general health. People exhale into the smaller chamber and the bees rush into it if they detect on the breath the odour that they were trained to target.



Section A-A
scale 1:100



Section B-B
scale 1:100

THE TAKE-AWAY - FOR DESIGN DEVELOPMENT

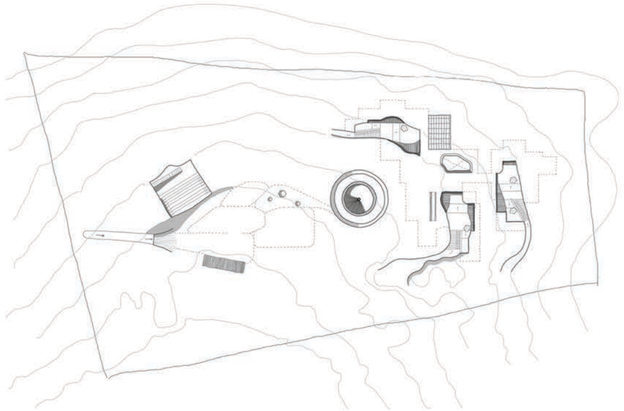
I preferred the design being placed above ground it allowed for a lot more moments of interaction between man and pollinator and building and nature. Despite me not really liking the building design that was developed, I did appreciate the double net concept and the environment that this created. I'm glad I started to explore a stronger connection to the site, and going forward I realised that this could be further explored and strengthened. I like the exploration of the Clinic and the beginning designs of what the diagnosis chamber would look like. I was glad that I started to conceptualise what these habitat follies looked like and the opportunities they could provide, going forward however I knew they needed to be more folly-esque and more integrated into the design.

Post-critique there were a few things I realised I needed to work on going forward. Firstly the building needed to have an even smaller foot print and I should possibly even consider raising certain parts of the building off the ground in order to minimize the impact the building would have on the site, in terms of its coverage. I also had to re-think the placement of the building and its relationship to the edges of the site. It was pointed out that there was really only one built edge (the west edge - with its hard surface and road) and the other three edges were either a fence or simply a cadastrial line and thus not physically present on the site. So with this in mind I needed to consider relating my building more to the harder edges or even the softer edges, but at the moment the placement did not benefit or explore these edges enough.

The net concept was appreciated but should possibly even be taken further. The concept of enclosure vs non-enclosure and transparency vs solidity, with the help of the net, should become the form, possibly looking at aviaries as a sources of inspiration, as there needs to be something that drives the placement and positioning of the net.

With these ideas in mind going forward I knew had to focus on the form and the reasons for its shape and the placement of the building on the site. I needed to explore the concept of the net even further, and together with the habitat follies I needed to shift the design closer to the realisation of an artificial environment.

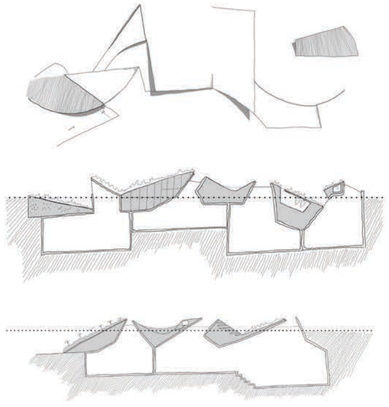
ITERATION COMPARISON



DESIGN ITERATION 01
The 'Surface' As The Ground



DESIGN ITERATION 02
The 'Surface' As The Walls



DESIGN ITERATION 03
In-Between The 'Surface'



DESIGN ITERATION 04
The 'Surface' As The Whole

REFLECTIONS

Iteration 01 was the initial step needed to start tackling the design component, and I think the design reflected this as it was far to spaced out. It made me consider efficient spacing and placement of the form, both with regards to the contours and minimising the buildings reach over the site.

Iteration 02 was the first approach of learning from the pollinators, bedsides being based on their movements, it was more the idea of learning from the natural and translating that into the built or artificial. The curves made me realise the delicacy needed in this design, almost echoing the delicacy and gentle nature of butterflies and bees. This iteration had a more efficient special arrangement both in its span over the site and position above the ground, which I felt was an improvement from iteration 01.

Iteration 03 provided a more in depth look at the spaces required for pollinators, then the previous two iterations. However, it felt like a slight regression in terms of its placement, being below the ground, as this brought back the initial issues of below surface placement in terms of disconnect and natural damage.

Iteration 04 was the most resolved of the four, having built on the previous ideas and lessons learnt. Its placement above ground and the realisation of the surface as this physical net / veil element, were two components I appreciated in this iteration. Both the veil element and the folly habitats needed to be incorporated more into the design, so they could become more of an integral component in the design rather than appearing to be additive and separate elements.

This iteration builds on the ideas of spatial arrangement and placement of the previous iterations, it was more efficiently located on the site. However, it made me realise that I still needed to explore how the form should be placed on the site, in terms of having a minimal footprint, while still including the required program. I did not want to avoid interacting with the ground level because people are not going to stop doing that and so I wanted to explore how I could do this more respectfully.

GOING FORWARD

Going forward I knew I needed to integrate the 'net / veil' component more into the design and make these two components one. I also needed to re-evaluate what the surface was and shift the idea of this surface closer to what the artificial environment needed to be. The individual elements were mostly there in terms of the program, the folly like habitats and the understanding of the pollinators, it just needed to be brought together in a way that allowed for the realisation of the surface as the artificial environment, which is what iteration 05 aims to achieve.

07

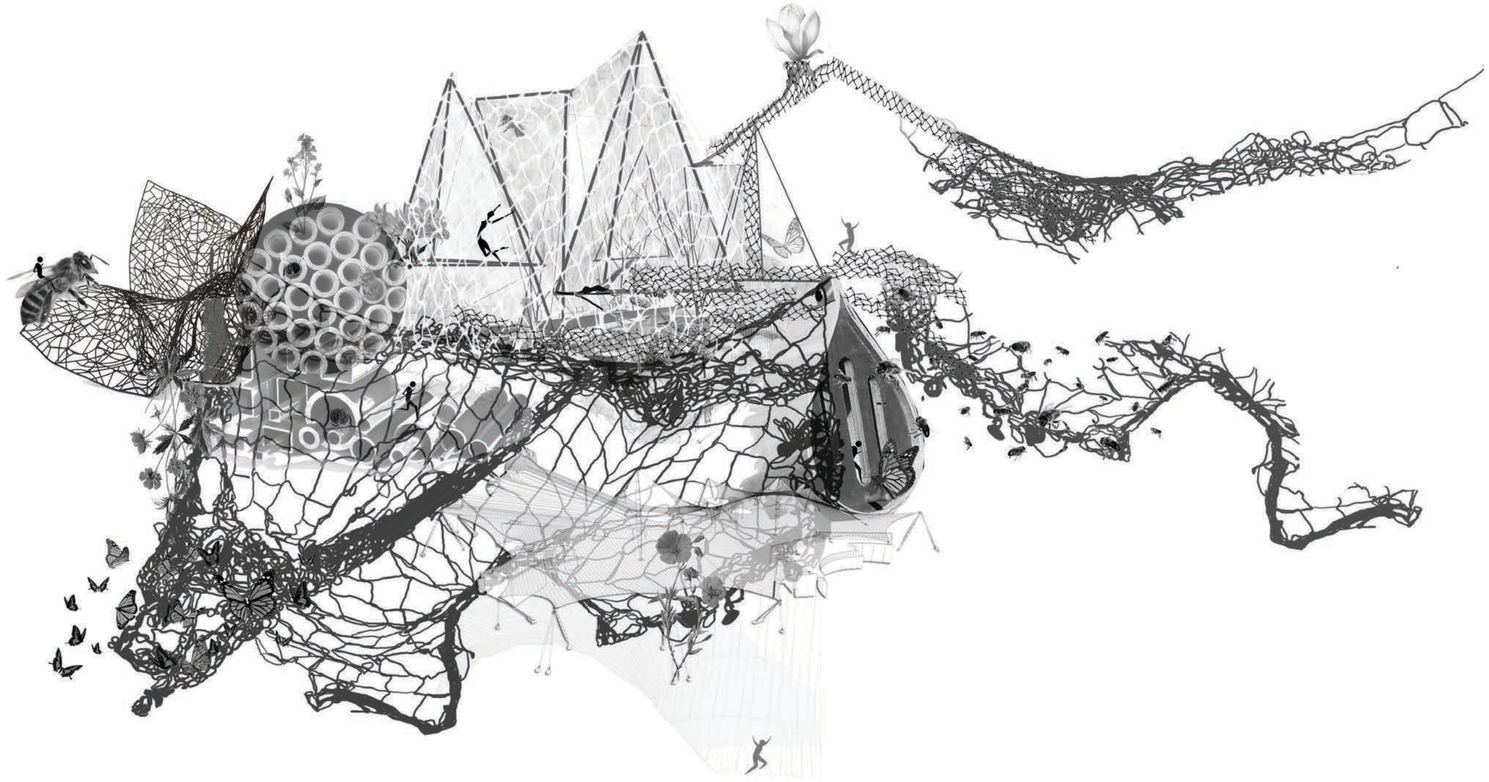
"Things we lose have a way of coming back to us in the end,
if not always in the way we expect"

- Luna Lovegood, Order of the Phoenix

REFINING THOUGHTS

EXPLAINED

_As research unfolded into design, I looked at the way we interact with pollinators and how there is always this layer of separation, a veil, between man and pollinator. When one rearranges or manipulates these layers, we can promote interaction but also give back to the pollinators. The veil becomes the 'surface', an element that helps endangered pollinators thrive. It exists as something that sustains the irreplaceable and revives the endangered. Through various explorations and design developments I knew before going forward I had to re-evaluate what the idea of this surface had become in the context of this design.



Ecology Meets Built . . . Natural Meets Man-Made . . . Artificial Is Born

Figure 7.1: Re-defining the surface - Collage By Author

RE-DEFINING THE SURFACE

The design aims to combine the ecological needs of pollinators with a light weight built form that both mimics the structure and the flexibility of their existing habitats.

The aim is that the structure blurs between open and enclosed, in a way that does not separate pollinator from human but rather brings them together and defines spaces in an unobtrusive way.

The form aims to embody the ideas of a veil or net, mimicking the means of separation used by beekeepers to both separate and connect with these creatures.

Artificiality aims to re-think the existing and how the natural can be assisted, in this case the natural is not solely the environment or natural surfaces of these pollinators habitats but also the natural or more traditional surfaces of built structures. Surfaces like the ceiling, floor, wall and roof will hopefully become an extension of the veil orf 'the surface'. In this way artificial spaces of habitation can be created for pollinators within habitable / usable spaces for the people working on the site, and so at times the surfaces permeability is challenged and altered continuously morphing in and out of enclosure.

The aim is for this surface to be alive, encouraging the growth of the natural landscape and beneficial pollinator plants, in this way it adds surface to the site and creates an elevated habitation. As the veil spreads from enclosure to open, natural spaces, it interacts not only with the human spaces and site landscape but also with folly-like habitations that further aid pollinator growth

The veil / surface rethinks the boundary between man and pollinator and hopes to bring the two together in a way that benefits both species.

THE SURFACE CONTINUED

Imagining the 'surface'/ veil as the surfaces of traditional built structures, like a floor, wall, ceiling or roof, started to change the way I thought about incorporating the idea of the 'surface' into the design. Unlike the latest design development (design iteration 04) which saw the net as a separate covering, this new thinking views the 'surface' as components of the built form itself. This thinking however starts to seem too flat or one dimensional, as it morphs the surface into a flat traditional element.

As the development continued I reffered back to the model explorations of how there is this moment of interaction and overlap. So instead of a single surface of floor, wall, ceiling and roof, it becomes more 3 dimensional, when one considers the points of where the floor meets the wall, and meets the ceiling and meets the roof, to become a 3 dimensional volume or form.

Taking the approach of design iteration 04, where the veil / the 'surface' is a covering but combining it with this new thinking, takes the surface from a separate, simple covering and transforms it into the form itself. In essence the 'surface' is now the form in which everything sits and takes place. Rather then acting as an separate covering or a panel, the surface becomes the form, the artificial environment itself.

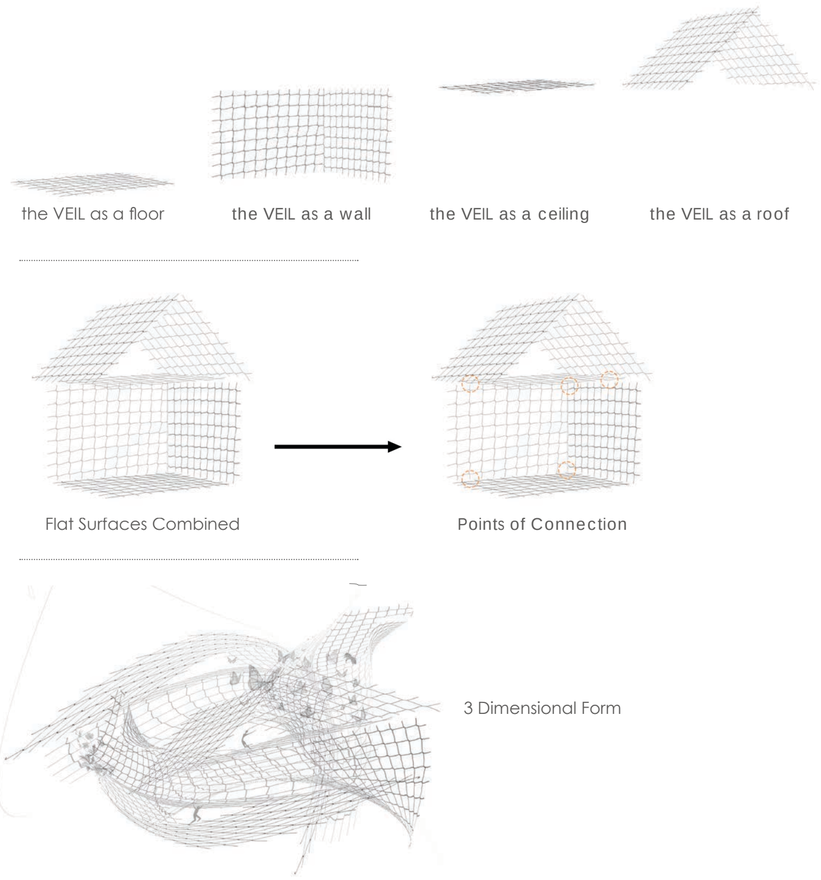


Figure 7.2: Exploring the surface sketch series - By Author

SURFACE TO MEMBRANE

With the 'surface' now being defined as the 3 dimensional form - the artificial environment itself, I wanted to figure out how I could create a fluid 3 dimensional form, while still using the idea of the 'surface' or beekeepers veil as the source of inspiration. This lead me to membrane architecture and tensile structures as a form of fluid and fabric constructed architecture.

Membrane structures or tensile structures interested me in that they made use of fabric allowing for the echo of the beekeepers veil and its fluidity and movement, while still ensuring enclosure.

As I started to explore tensile structures, I began looking at aviary designs before venturing into exploring other tensile structures that dealt with materials other than mesh or netting. I was less interested in the solidity that was created through the use of these fabrics, but rather interested in moments when the levels of transparency and enclosure were challenged and where the lightness and structure of these forms shone through.

The page that follows document the various tensile structures I started to look at.



Figure 7.3: Beekeeper and the veil - By Author



SNOWDON AVIARY, LONDON ZOO
Lord Snowden
London
1964

The juxtaposition of the hard steel structure against the sharp angles of the net create a design that feels purposeful and planned. The net does not appear to move according to its own wishes but rather its movement is designed. The idea of presenting the fluid material of netting as a series of sharp lines really interested me.



PAIGNTON ZOO AVIARY
Base Structures
Torquay, England
2003

Unlike the Snowden Aviary this design allows the net to be more relaxed, embodying its curvature and fluidity. What I took from this design was the concept of having a few simple yet striking elements of structure (that support and raise the net), but then use the net to create the overall form and shape.



BIRD WATCHER FACILITY
X Architects
United Arab Emirates
2016

I enjoyed how this design made use of a solid material in-conjunction with the traditional net mesh. The use of the solid material allows for shading and an aesthetic change, while also highlighting the form visually. The addition of a solid fabric made me start thinking about how I could enclose spaces , with a material that had the same fluidity and characteristics of traditional netting materials.



AVIARY
Group 8
Geneva, Switzerland
2008

With the frame-less net and slender tree like columns, the design appears to almost dissolve into its surroundings. The integration and blurring between the built and the natural is the main concept I took away from this design.



BIOPARK AVIARY
Hampton+Rivoira+Arquitectos
Buenos Aires, Argentina
2012

This design goes against the traditional tent approach with its slender central pole support. Despite its new approach it still echoes the traditional tent idea by having a central raised element from which the net falls down towards the ground. This idea of learning from the old to make the new but still incorporating the old, linked to the approach of learning from the natural to create the artificial and thus resonated with me.



ROLLER-COASTER AVIARY
Kuth Ranieri + TLS
China
2018

This design has a raised walkway bringing people up into the environment of a bird in flight. I was inspired by this concept of lifting the human into the birds world, rather than bringing the bird down to a persons level. This approach of connecting these two species linked to one of the core ideas and aims of my design and thus resonated with me.



2012 OLYMPIC GAMES, SHOOTING VENUE
Magma Architecture
London, United Kingdom
2012
PVC

These forms caught my attention because of their whimsical nature. The pops of colour against the white highlighted these protrusions. The focus on the protrusions allowed the designs to become almost alien or artificial in nature, as they became void of any traditional building element. The use of membrane architecture to add a sense of the artificial was something that really interested me about this approach, given my design concept.



THE SERPENTINE SACKLER GALLERY
Zaha Hadid Architects
London, United Kingdom
2013
PVC

This pavilion design feels like someone dropped a beautiful piece of fabric and just left it where it fell. This approach allows the design to appear almost natural with its fluidity, yet creating an element that appears unnatural in the context of something built. This contradiction allows the form to appear futuristic or other-worldly, almost artificial, and thus caught my eye



2012 OLYMPIC GAMES, BASKETBALL ARENA
Sinclair Knight Merz
London, United Kingdom
2012
PVC

I really loved how this design is largely the backing frame work and yet it only really comes alive when covered in the PVC fabric, as the fabric highlights the protruding steel members. The use of the tensile structure for this form also adds a sense of temporarility, considering the buildings location, a natural environment, I felt this was important and responded well to the context of not intruding on nature but rather respecting it. The use of tensile structures to allude temporality and delicacy in nature, was an idea that resonated with me and one I took away from these designs.



SERPENTINE ARTHOUSE PAVILION
SelgasCano Architects
London, United Kingdom
2015
ETFE Foil

This design looked almost insect in its form, with its undulations and exposed structure, echoing a skeleton. This design caught my attention because it plays with transparency and enclosure. The use of the ETFE adds an transparent feel, which is inhanced with the addition of the lights, which pierce the fabric highlighting the exposed weave work structure. In this way there is blurring of the boundaries between enclosure and openness and inside and outside space, which really interested me in relation to my design concept.

THE TAKE-AWAY

After analysing the various tensile structures and membrane forms, the elements that resonated the most with me were the moments of porosity, when there was a visual connection or echo of a net like weave or when one could see the underlying structure that supported the material.

Despite my design not being a traditional membrane in the tensile structure sense, what I took away from this analysis was the idea of how membranes and skins can challenge the ideas of enclosure through simple structural elements, and how they can allow for the blurring of boundaries.

Figure 7.4: Tensile Precedents

MEMBRANE TO FORM

I started to rethink about the beekeeper wearing their veil and what their view may be from the inside looking out. If the veil /'surface' becomes the form itself, then what would it look like for a person standing inside the beekeeper's veil, looking out, could the two relate? What would it look and feel like for a bee looking out through the veil? (figure 7.6 & 7.7).

A beekeeper may see the thin lines of the mesh at first but then they would slowly dissolve into nothingness. This idea of the visual experience of looking through the veil made me see the form as less of a solid space, but rather one that echoed the fluidity of the beekeepers veil and the visual experience of blurred boundaries between man and pollinator. In this way the surface could become a scaled up mesh, where thin elegant lines of the mesh become the strutural elements making up and supporting the membrane.

Embodying the idea of membrane or skin from the tensile precedents, and adapting the new understanding of the 'surface', I started to think of this veil / surface as being fluid, fluctuating and bending above ground, not constantly defining traditional architectural elements but becoming alien and skin like, in a way that allowed it to dissolve into it surroundings at certain points and pull the surrounding landscape and pollinator habitat up over it at other points.

Similarly to the precedents, by exposing the structure at points and concealing it at others, this surface would be able to blur boundaries, becoming the membrane or surface that fluctuates between the two worlds of human and pollinator. In essence this surface placed above ground, embodies the qualities of a membrane and the ideas of the beekeepers veil, becoming the surface that is the artificial environment.

From the surface as the ground, to surface as the walls, from in between the surface and the surface as the whole, the surface has now transformed into the surface as the artificial environment.

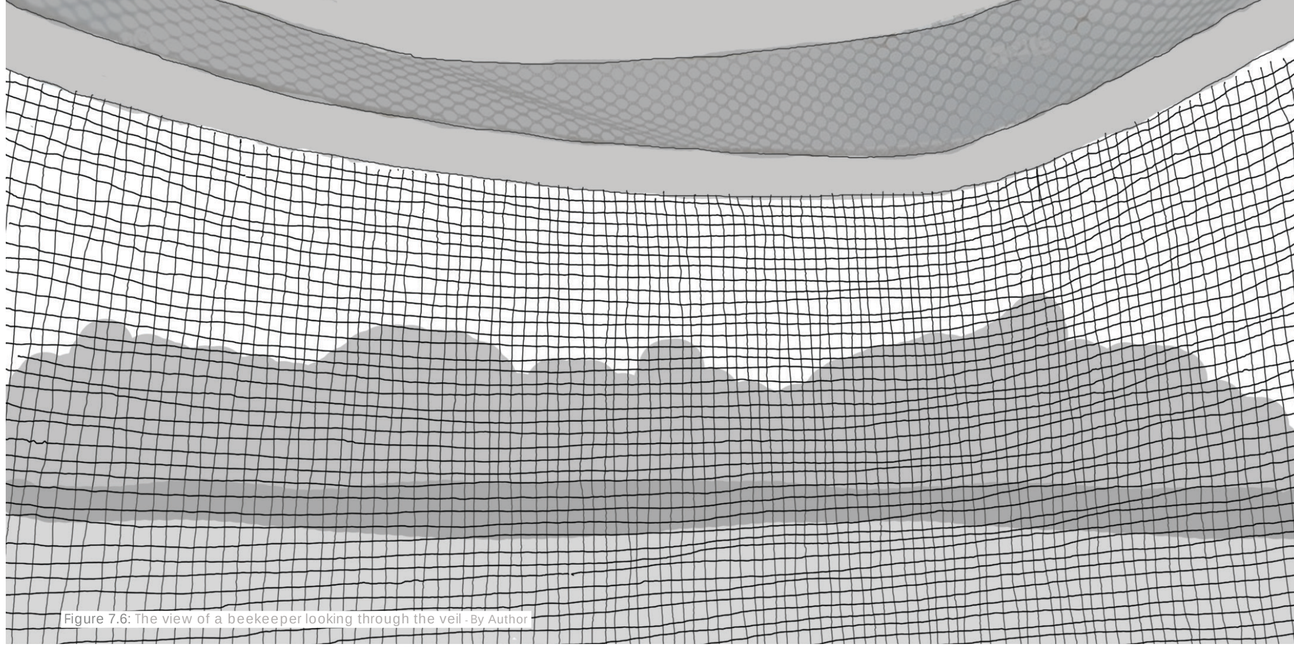


Figure 7.6: The view of a beekeeper looking through the veil - By Author



Figure 7.7: A human (at the scale of a bee) looking through the beekeepers veil - an abstract representation inspired by find(&) MERG - By Author

THE GROUND & THE SURFACE

Exploring the ground - surface relationship and how this relates to my design in terms of placement below or above the 'ground'.

Are the surface and the ground, in the context of this design, the same thing or are they two separate elements?

Initially one might associate the surface and the ground as being unanimous, they both conjure up notions of a level or base layer.

The design proposes the notion of giving back the surface to pollinators and plants, as the ground has been consumed by humanities expansion and the built environment. In this way the ground is seen as having reduced drastically in habitable space and having been transformed into a space that is no longer entirely suitable enough to support pollinators. With this thinking the surface becomes a version of the ground.

The Oxford English Dictionary (2005) defines the ground as the solid surface of the earth. The ground is the base layer of all ecosystems, the layer of plants, the start of the pollinator's world. Defining a surface, as per *The Oxford English Dictionary (2005)*, one can understand it as the outside part or uppermost layer of something. In relation to this context and the above idea of the ground, one can assume that the surface is the ground, with both being a defining layer of space, the surface can be seen as also being the uppermost layer of the solid surface of the earth. The two at this point become interchangeable.

However, the core principle of this design is all about giving back a surface because the current surface is insufficient for pollinators to thrive and so it's here where the two terms can possibly diverge. The surface is no longer able to replace the term ground, as the surface needs to be a movable layer, the uppermost layer of something other than the unmovable ground layer of the earth. In this sense the surface can start to differ in definition to the ground layer by becoming the movable layer, the altered ground layer, the new layer that embodies what the ground was once able to provide. In this sense where the ground remains anchored to the bottom or at the intersection between above and below the earth, the surface becomes a layer that is and needs to be movable, an idea which suggests the design not being placed below ground, as the ground is not the surface.

In defining these spaces, the ground remains the unmovable layer of the top portion of the earth, slowly fading in its ability to support pollinators, where as the surface can then be defined as the movable layer, that will be altered to become the artificial environment needed to support and cultivate pollinators.

08

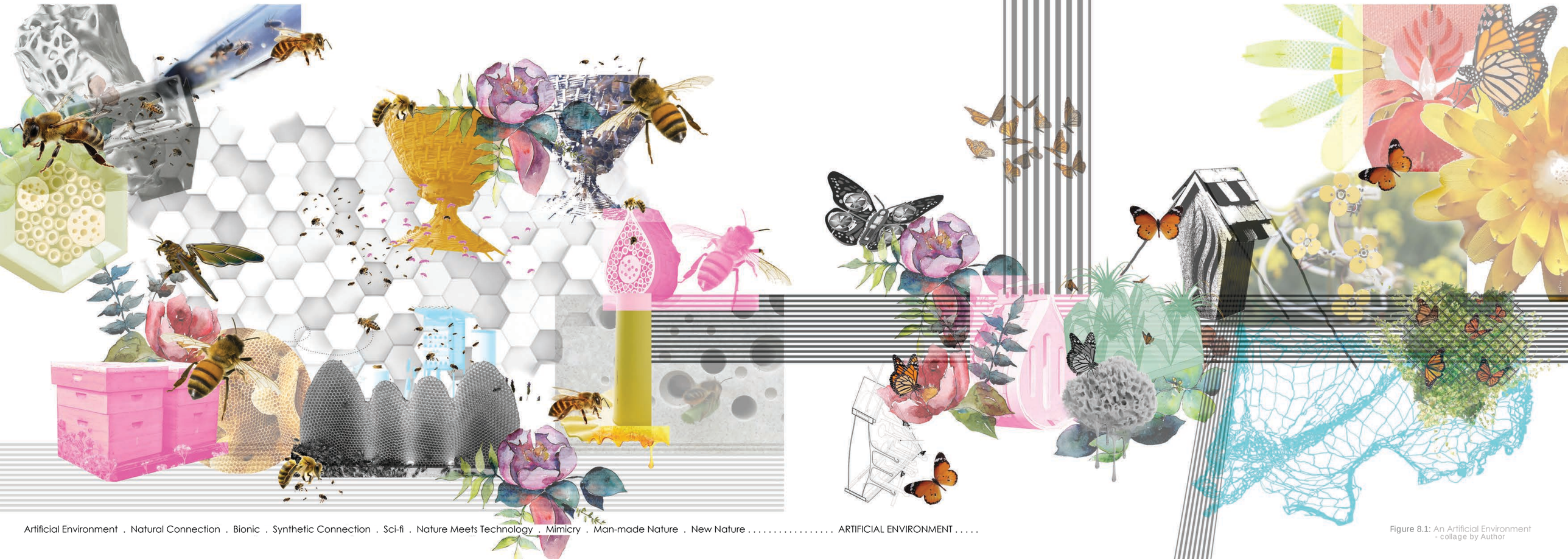
"Anything's possible if you've got enough nerve."

- Ginny Weasley, Order of the Phoenix

DESIGN DEVELOPMENT FIVE

EXPLAINED

_This chapter builds on the information of the previous four design iterations, along with the various site and pollinator analysis, and adopting the new definition of the surface, uses this information to move towards the final design, (including process work).



Artificial Environment . Natural Connection . Bionic . Synthetic Connection . Sci-fi . Nature Meets Technology . Mimicry . Man-made Nature . New Nature . . . . . ARTIFICIAL ENVIRONMENT . . . . .

Figure 8.1: An Artificial Environment
- collage by Author

DESIGN DEVELOPMENT

Linear design progression of
exploring the surface - continued

05 THE 'SURFACE' AS THE ARTIFICIAL ENVIRONMENT

BREAK - DOWN

Developing Iteration 05
- -Sketches
- -Rethinking the spatial arrangement

Development Of The Veil / Surface
- -The Veil
- -The above - below relationship
- -The veil as an architectural element
- -The veil as an ecological element
- -Experiencing the space
- -Model exploration

Re-thinking The Veil
- -The ground connection
- -Materiality
- -Technologies

Process Work
- -Design Principles
- -Spatial Blocking
- -Process Work
- -Going Forward

Final Design

THE SURFACE

Based on the analysis and take away of the ecological needs and life-style studies of the pollinators located on the site, the surface becomes an open space, a new approach to the concept of enclosure. It becomes a hub in which pollinators are free to visit and leave at their own desire.

As the analysis indicated, the lifestyle and environments of pollinators are controlled by the seasons, and so the 'surface' respects that by providing natural elements, specifically host, nectar and pollen plants and overwintering spots. However, as the analysis also revealed the changing seasons can at points negatively affect pollinator livelihoods. It is for this reason as to why the 'surface' will also contain artificial elements, elements that mimic the natural and provide important functions, while being unaffected by the changing seasons.

In this way the 'surface' becomes a space that aids pollinator growth and survival year round while still changing and altering accordingly with the seasons, becoming a version of an artificial environment.

DESIGN ITERATION 05

The direction of design iteration 05
- membrane, veil, skin

After re-evaluating what the surface is, and identifying it as the artificial environment - a membrane, veil like form, the final design unfolded into a series of stages exploring this veil or skin and the form it would take.

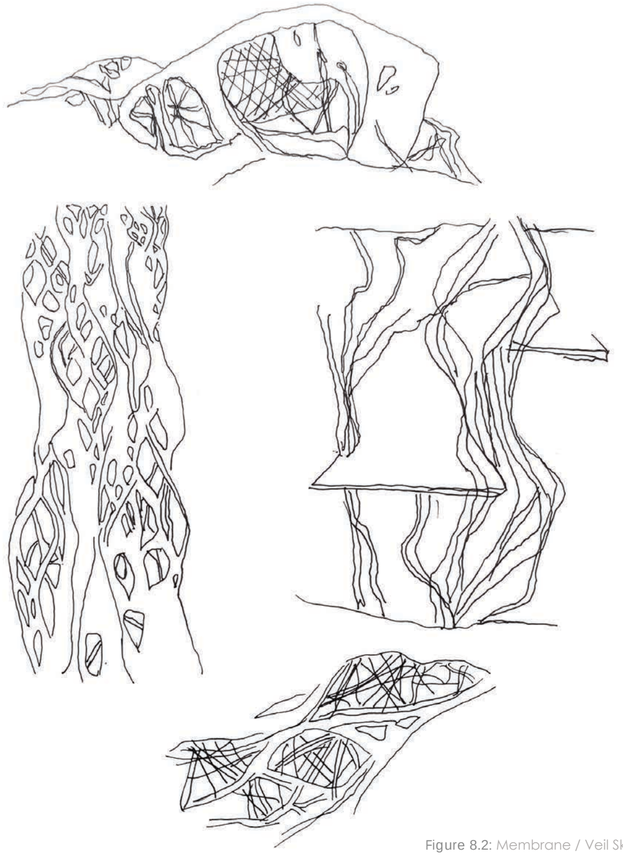


Figure 8.2: Membrane / Veil Sketches - By Author

RE-THINKING THE SPATIAL ARRANGMENT

Design iteration 04 made me re-evaluate the placement of the design, both in terms of feeding off the site edges and minimising the footprint to reduce site impact.

The idea of the edge became the key spatial signifier for the overall building. Circulation, in conjunction with the idea of the view, became the defining spatial arrangement guide for the individual spaces.

With the above in mind, the design is now placed in a band along the only hard edge of the site (the western boundary: Marleo Holiday Resort and its neighbouring road). This placement allows for a minimal footprint and complements the hard built edge with another built form (figure 8.3).

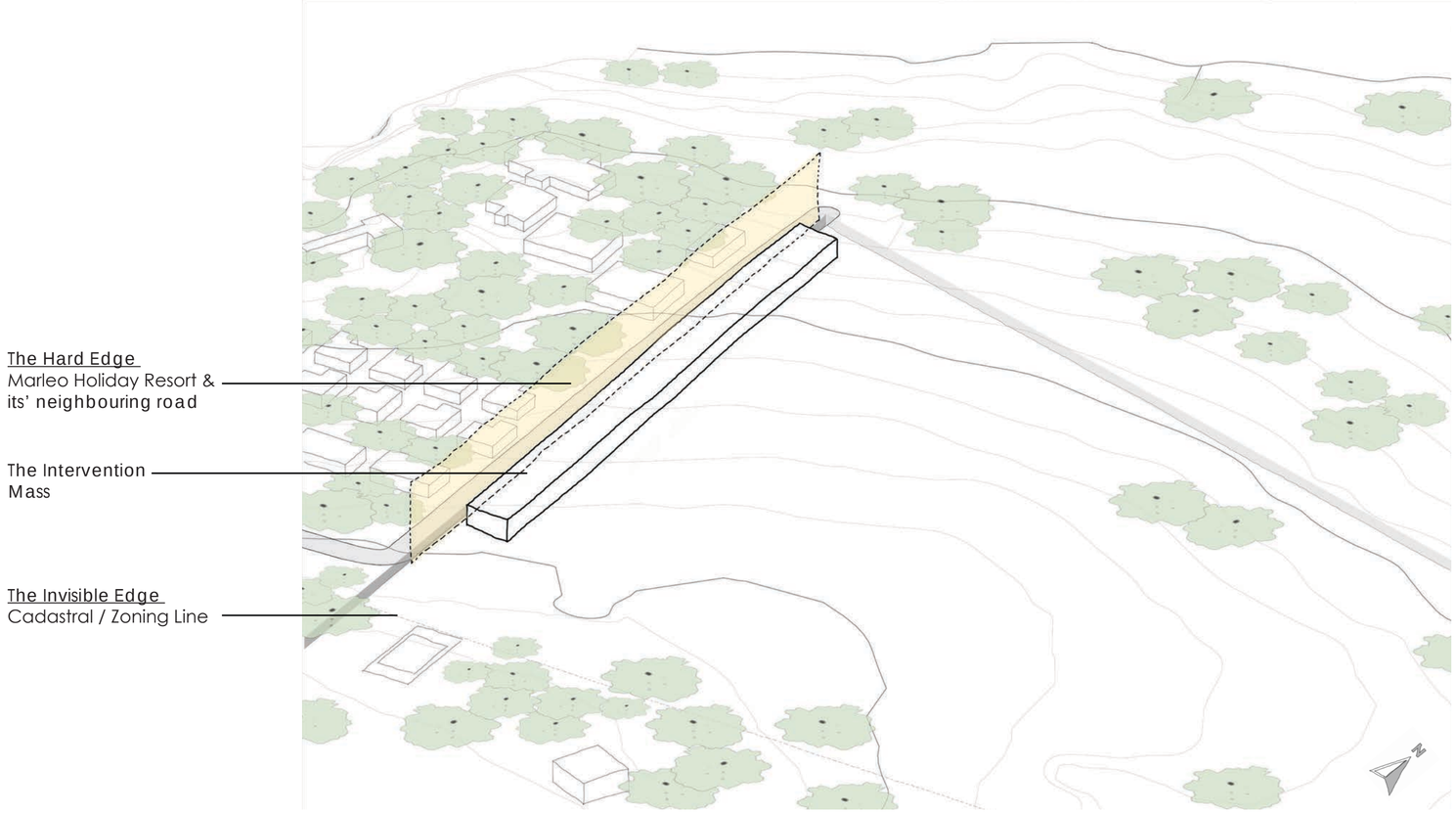
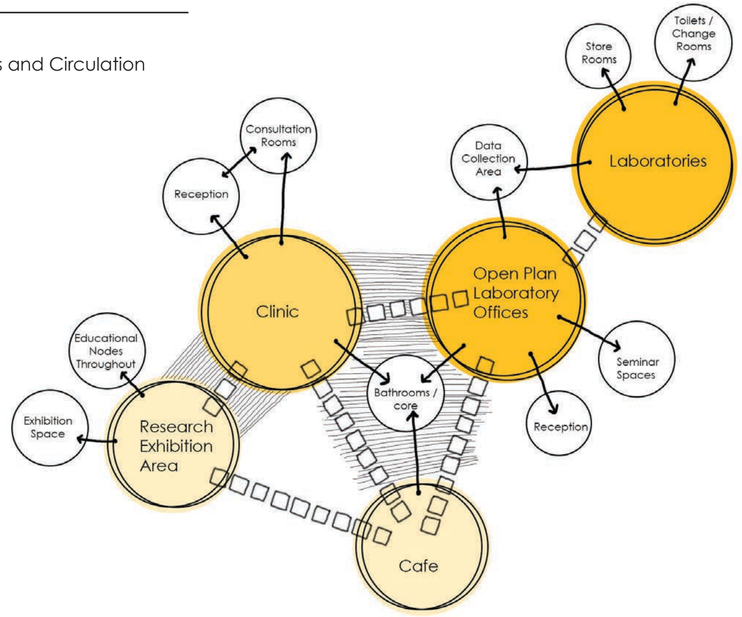


Figure 8.3: Spatial arrangement along the hard edge - By Author

RE-THINKING THE SPATIAL ARRANGMENT

Program Connections and Circulation



Program make-up & connections

Spaces are arranged and connected according to levels of privacy, moving from public to private in terms of functionality and visibility, with regards to exhibiting the research carried out on site.

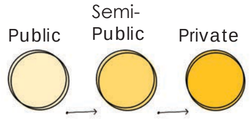
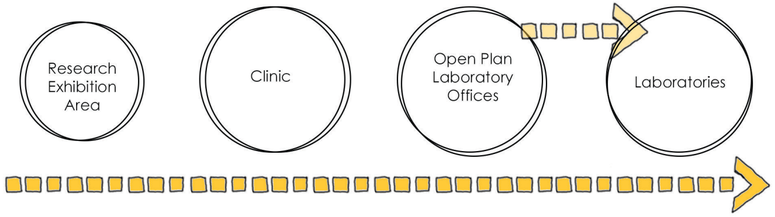


Figure 8.4: Program make-up and connections diagram - By Author

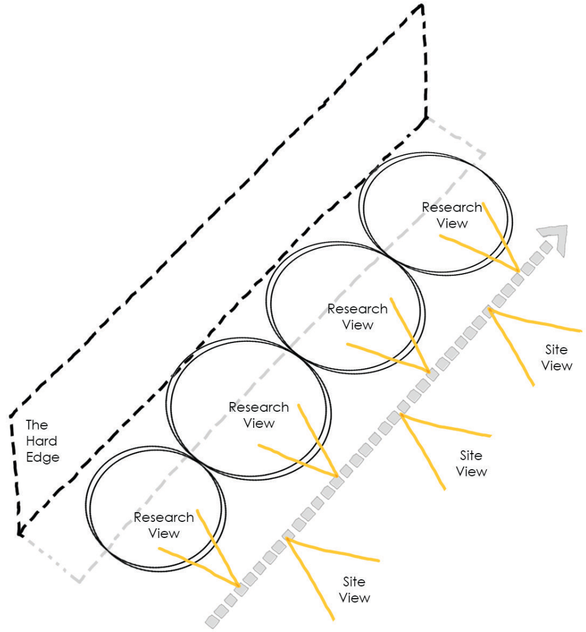


Circulation

Circulation vs Views

Primary Circulation runs along the length of the program dictated by access to views. This allows for people to see the research being done on the site, specifically in the laboratories and write up rooms, while still having views of the site as they move along the band of circulation This placement prevents views of the hard edge as on moves through the space.

In addition there is a secondary circulation route from the office to laboratories for lab technician movement, allowing for ease and preventing direct public interaction, thus still maintaining a level of privacy.



Circulation & Views

Figure 8.5: Sketch series of relationship between Circulation and view - By Author

THE VEIL

The veil / surface, started to become this form which began flat up against the western hard edge, extending over the forms and then cascading down into the landscape towards the eastern boundary.

The buildings blur away as this surface of nature becomes the defining feature interacting with the spaces above and below and serving both architectural and ecological purposes.



Figure 8.6: The cascading veil, amongst the blurred building forms - By Author

THE VEIL

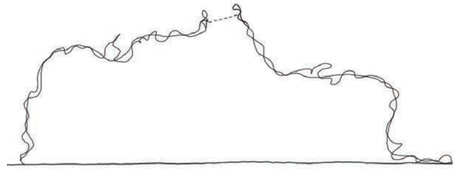
Above - Below Relationship

The Veil as an Architectural Element

The Veil as an Ecological Element

THE VEIL
ABOVE - BELOW RELATIONSHIP

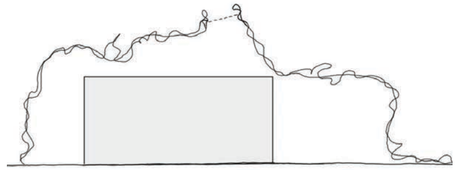




1 - Full Frame

The veil tapers down on both sides forming a sealed and enclosed space, allowing for the boundary and covering to merge into one.

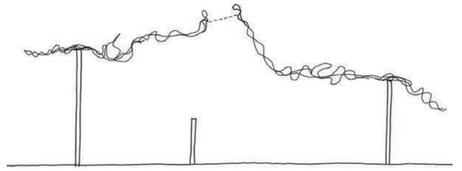




2 - Floating Frame, Enclosed Box

The veil tappers down on both edges, however the space below is not connected to this point of enclosure, rather the space below becomes a secondary enclosed form.



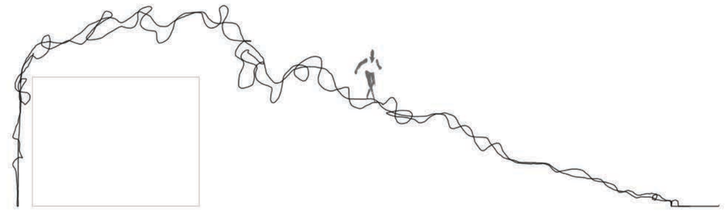


3 - Floating Frame, Enclosed Space:

The veil tapers down but not completely connecting with the ground plane. In this way the use of walls and screens are used to enclose spaces and fill the gap between veil and floor plane.

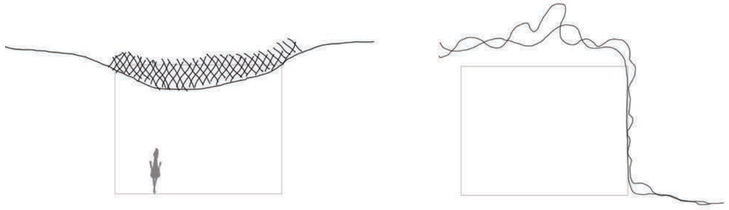
Figure 8.7: The veil's above - below relationship, sketched series - By Author

THE VEIL AS AN **ARCHITECTURAL ELEMENT**



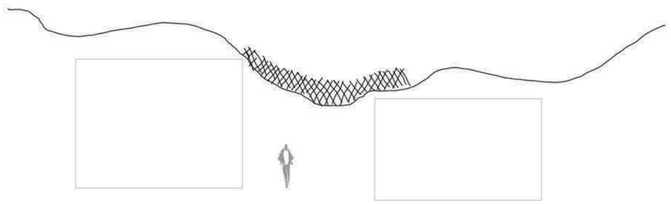
Trafficable

The veil becomes a surface at certain points, on which botanists and beekeepers can walk up onto, to inspect hives and plant growth and formation, along with certain spaces for maintenance access and for visitors to view the pollinators of the site. These spaces will be carefully spaced to reduce the bulkiness of the veil.



Enclosure 1

The veil becomes the roof or walls for certain spaces, providing a greater blur between the boundaries of inside and outside and man and pollinator. This allows for a more membrane and skin level of interaction, as the veil starts to transform into this surface that defines spaces.



Enclosure 2

The veil can lower down at points to from a lower covering for various courtyard spaces, creating a warmer atmosphere, and bringing nature and pollinators closer to man.

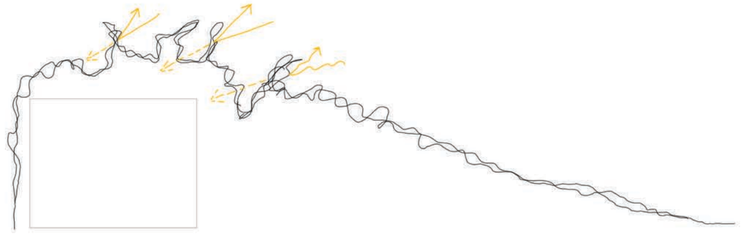
Figure 8.7: The veil as an architectural element, sketched series - By Author

THE VEIL AS AN **ECOLOGICAL ELEMENT**



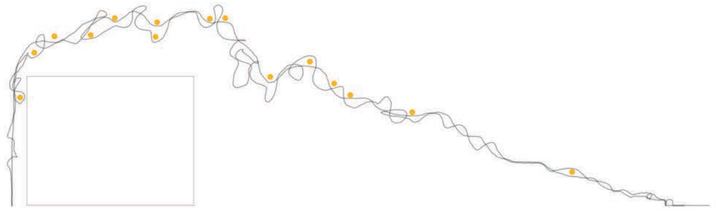
Frame of growth

The veil, by cascading down into the landscape, provides the perfect surface on which plants can latch onto and grow up, extending the surface of the pollinators habitat. It also allows beneficial plants, planted on the veil, to grow down into the site, improving the context of the site



Exterior Surface:

The veil can fluctuate in such a way that it breaks down wind and rain and diffuses light at certain points creating safer spaces for plants and habitats to form, creating spaces that allow butterflies, bees and the site to thrive.



Habitable Surface:

The veil has folly like habitats, artificial feeders and beneficial water and nutrient spaces, placed along the veil to aid pollinator growth and cultivation, as it begins to transform into the surface as the artificial environment.

Figure 8.8: The veil as an ecological element, sketched series - By Author

EXPERIENCING THE SPACE

The veil, taking on the enclosure option of a floating frame with enclosed boxes below (figure 8.7), becomes a space with the veil engulfing it. In this way people start to look through the veil onto the site. This starts to emulate the idea of looking through the beekeepers veil, seeing the mesh and then seeing beyond, bringing with that all of its experiential moments.

Moments of blur and discovery

Moments of temporality and porosity

Moments of fluidity and restraint

Moments of connection and separation

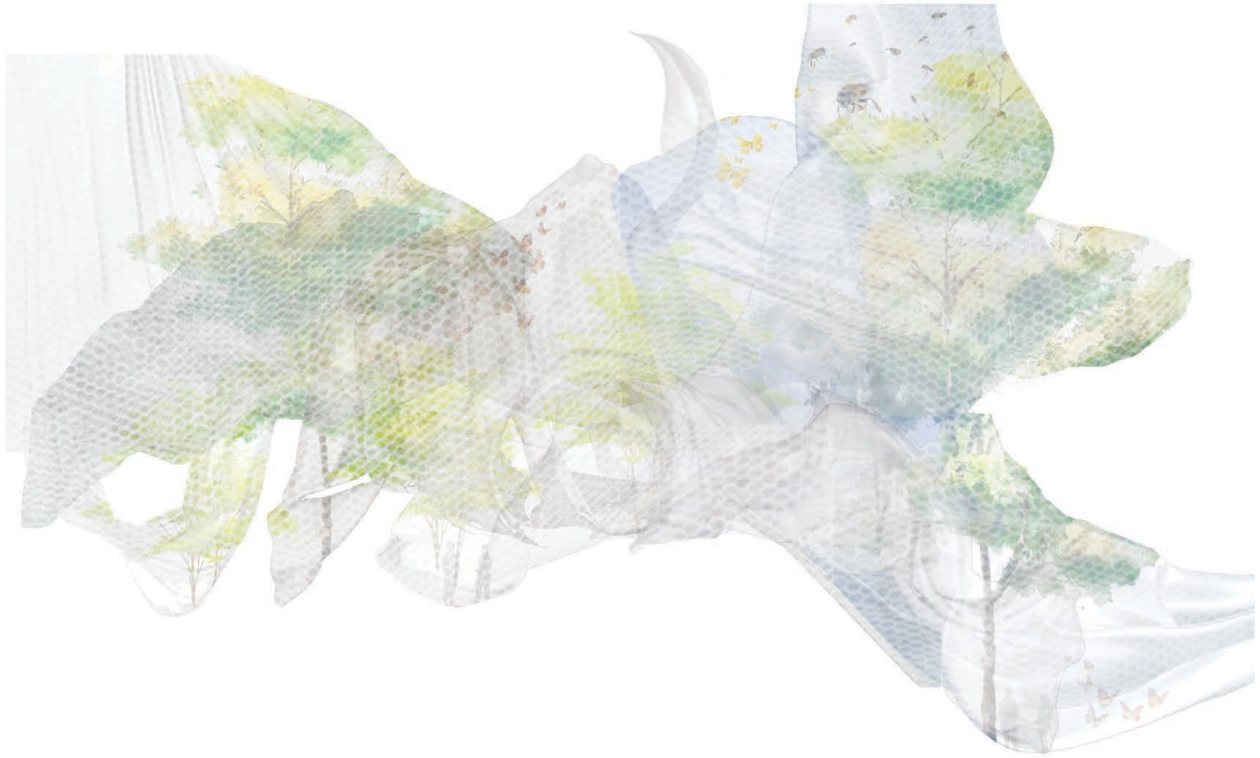


Figure 8.9: Looking at nature through the beekeeper's veil - Collage By Author

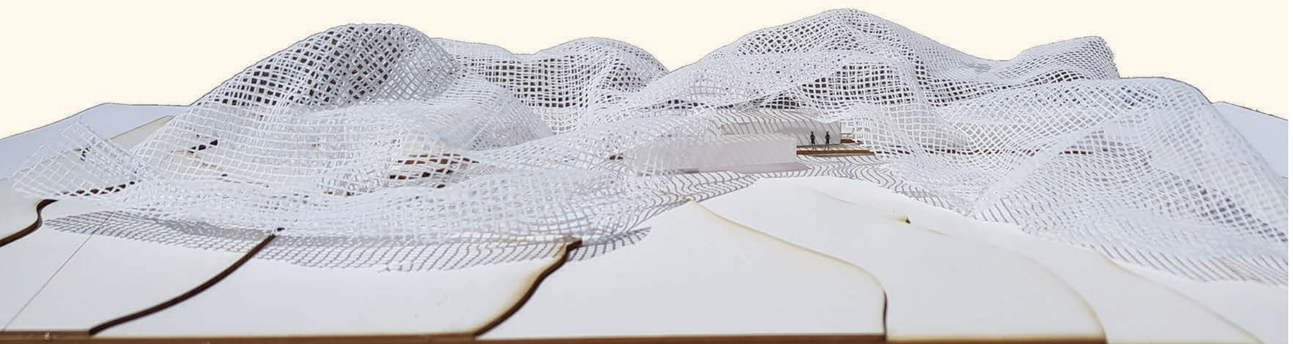


Figure 8.10: Model with massing forms and cascading veil

MODEL EXPLORATION: THE VEIL

These models explored the rough exploration of the form the veil would take. Exploring points at which the veil would split open to allow for unblurred views, points where the veil would drop down forming coverings and how it would cascade over the built form into the surrounding context (figure 8.9).

This exploration allowed me to see both the strengths and flaws in this iteration of the veil. The way in which the veil cascaded down into the landscape had a beautiful delicate feel to it and created an interesting merge between built and natural. However, there was a clear disconnect between the veil and built form below, the two felt too isolated from one another and seemed to emulate the approach of design iteration 04. However, upon reflecting on my 4 design iterations, it was clear that the veil and building needed to become one.

UPON REFLECTION

A large part of this projects program has been about considering scale, in terms of spaces for the human and spaces for the butterfly / bee, at their own respective scales. Looking at the model again through the idea of scale, the building masses started to appear to present themselves as desks or seating spaces (fig 8.10) rather then rooms. In this way the veil seems less extreme in size and reduces its disconnect from the spaces below, and thus promoted a slight alteration in the thinking of the veil.

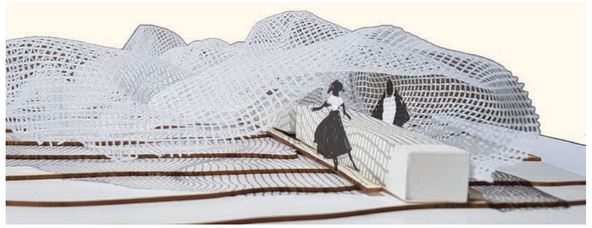


Figure 8.11: Viewing the space with scale - forms as desks

DEVELOPING THE CONCEPT OF THE VEIL

With this new understanding of scale and the relationship between the building form and the veil, the veil / surface altered becoming an embodiment of the idea of a membrane or skin by becoming the enclosure element of all the spaces, from forming the roofs, to tapering down at points forming walls and barriers, enclosing spaces (figure 8.12). In this way the veil is no longer a separate element floating over mass forms and the spaces, used by the people on the site, are no longer separate from the veil.

Rather than taking on the floating frame and enclosed box approach of the previous version of the veil (figure 8.7). This new approach allows the veil to work at a more appropriate scale, taking on enclosure options 1 and 3 (figure 8.7/8.12) and thus prevents the previous issue of disconnect and scale concerns. In this way the veil, as a thin steel frame structure, becomes the structure of the spaces itself. The veil's steel frame is exposed at points echoing the concept of the scaled-up mesh and concealed at points creating enclosed internal spaces.

The veil still embodies the previously explored architectural and ecological characteristics (figure 8.7 & 8.8) tapering down at points and cascading into the landscape, encouraging the growth of plants both off the veil into the site and from the site up onto the veil. In this way, over time the artificial surface becomes an extension of the natural surface and vice versa.

The veil thus becomes the primary design element and the surface as the artificial environment, imbued with elements to aid in pollinators fight for survival. In this way it becomes a double skin, serving pollinators on one side and enclosing spaces on the other side, to serve people (figure 8.12).

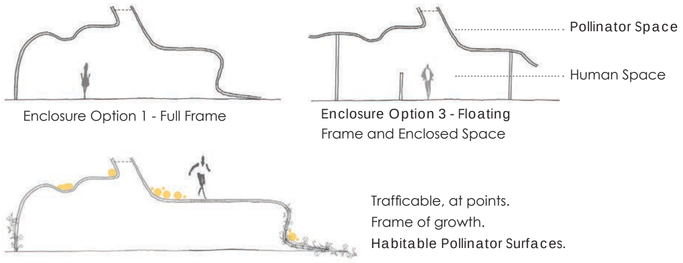


Figure 8.12: The veil still embodying the previously explored architectural & ecological characteristics, while now adapting options 1 & 3 of the above-below relationship - By Author

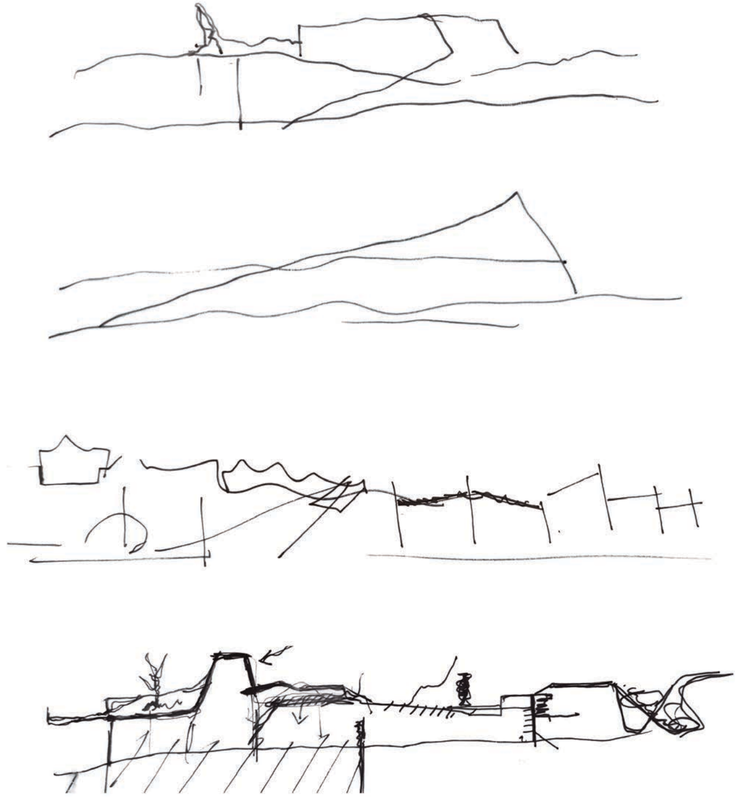


Figure 8.13: Sketches exploring the re-development of the veil - By Author

THE VEIL & GROUND CONNECTION

As the veil / surface, through its embodiment of this idea of a membrane or skin, tapers down and connects to the ground at certain points, the connection to the ground became a very important consideration. This was important in terms of both announcing this connection and having a delicate connection which would encourage the growth of plants off the surface onto the ground and visa versa.

As such I looked at various precedents, exploring the way these designs approached the connection to the ground, to inform the veil-ground connection of my own intervention, primarily along the tapering axis of North - South.

PRECEDENT 1 : HEYDAR ALIYEV CENTER

Zaha Hadid Architects
Baku, Azerbaijan
2013

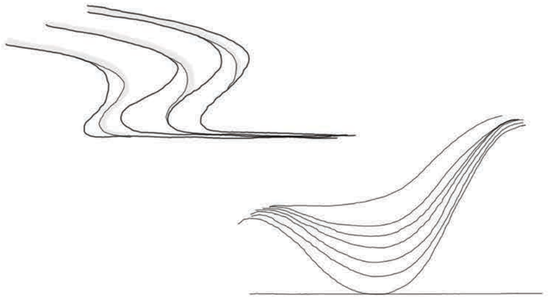




Figure 8.14: Heydar Aliyev Centre, with neighbouring take-away sketches by Author

Despite this project's difference in context, I really love how it explores the ground connection. On one end (along its length) the form curves draping down, blending and melting into the ground, becoming the ground floor surface as it carries the material with it. In the front of the building the form elegantly dips down, allowing for a gentle and delicate point of connection.

These approaches really interested me as it allows for ground connection on both sides, while still having a dominant tapering direction, this being along its length. Both approaches are different but still follow the same style. The front approach allows enough draping to echo this skin like form, while not obstructing views, which I thought was an interesting approach if I were to use this technique on the eastern face of my design, allowing for views of the site. The back-end draping of the form, allows for a dramatic blur between the built and the natural, and could potentially encourage the movement of the landscape over the building. This technique also showed me how I could carry the veils materials onto the ground to further reinforce this blending and blur between built and natural. This design served as a great source of inspiration for form - ground connection, both in terms of shape and approach.



PRECEDENT 2 :
VILHELMSRO
PRIMARY SCHOOL

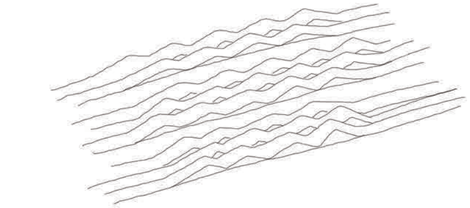
BIG Architects
Asminderød, Denmark
2019





I really liked how these roofs became a very clear continuation of the ground, while still allowing for the blur between the two mediums and levels. Vilhelmsro Primary School takes a more subdued approach then the Heydar Aliyev centre, however, the undulating nature of the design, begins to embody the idea of play and the child-like nature of exploration in allowing the roofs to be accessible, which is both relevant to the context of this design and the reason why I resonated with this design.

Part of my project looks at possibly making areas of the veil trafficable, to allow people to walk up onto the veil for monitoring, maintenance and most importantly to showcase pollinators and their habitat. The simplistic and scale appropriate approach of this design, both in terms of its connection to the ground and walkability, served as the perfect guideline for such a decision.



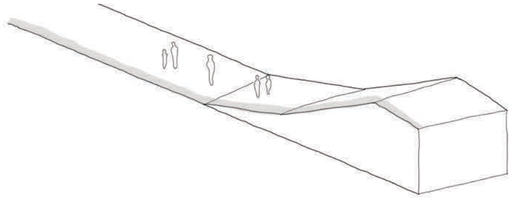


Figure 8.15: Vilhelmsro Primary School, with neighbouring take-away sketches by Author

PRECEDENT 3 :
BOSJES
CHAPEL

Steyn Studio
Witzenberg Municipality, South Africa
2016





The Bosjes Chapel has a similar approach to the Heydar Aliyev centre when it comes to the main form connecting to the ground. I really love how this chapel uses the undulations of the roof not solely to create the form but also as a means to connect it to the ground. The curved dips feel delicate and light despite the material used. Most importantly the points at which the form connects to the ground feel purposeful, rather than appearing awkward and random. This is enhanced by the uniformity of their shapes and sizes.

Its this planned nature that caught my attention, as since I do intend to taper and drape the veil at certain ends, I want it to feel natural but have an underlying planned and ordered approach. This design shows various ideas of how such an approach can be carried out and it is this reason why this design was chosen and resonated with me.

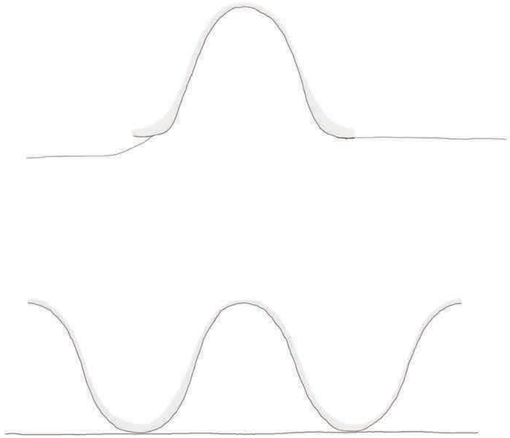
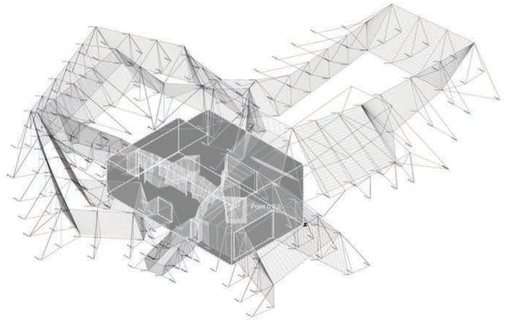


Figure 8.16: Bosjes Chapel, with neighbouring take-away sketches by Author

PRECEDENT 4 :

SPIDERNETHWOOD

R&Sie(n)
Nimes, France
2007



R & Sie's design, as already illustrated earlier in precedents for design iteration 04, still stood out to me in terms of its unique connection to the ground. The use of the netting material creates a delicate connection and provides a surface onto which plants can grow, making the ground part of the connection. This idea of using a newly grown 'ground' as a connective tool really interested me.

The angular placement of the netting appeared to me as options for enclosing the form along the non-tapering axis. In this way materials could become extensions of the veil and placed at angles that together highlight the curvature of the veil, enclose spaces and aid in improving the context of the site and pollinators, by providing additional surfaces for vegetation. This design provides the perfect guideline for an angled, secondary connection and enclosure approach.



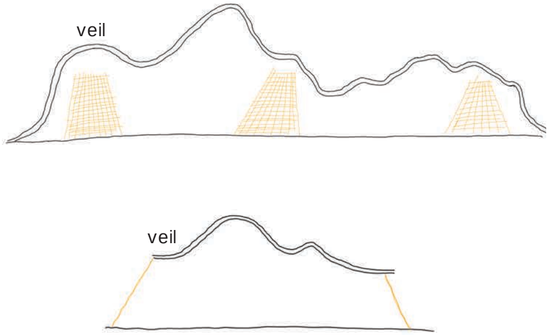


Figure 8.17: Spidernethwood, with neighbouring take-away sketches by Author

PRECEDENT 5 :
THE BUZZ.AR
COMMUNITY CENTER

Eleena Jamil Architect
Selangor, Malaysia
2019



I really loved how this design both exposed the roof structure at its connection to the ground and used this connective moment as an opportunity for place-making. The way in which the roof structure becomes exposed at its connection to the ground allows for a softer and more delicate connection, as opposed to if it were still cladded wherein it may appear heavier. This approach resonated with me as by exposing the structure of my veil, not only could it allow for a more delicate and light weight point of connection and make the veil appear lighter, it could also echo this idea of the scaled up mesh, as the thin steel like frames would now be visible on the outside.

In addition, the idea of place making at these points started to interest me. I had considered what these point would mean for vegetation growth, primarily as an element for plants to latch onto, to feed into the site or up onto the veil, but I had yet to consider what these moments could be for people. Possibly these points could become extensions of courtyard spaces or allow for a more close up interaction with pollinators. Either way this design started making me question these spaces and points of connections as more then just structure meeting ground.





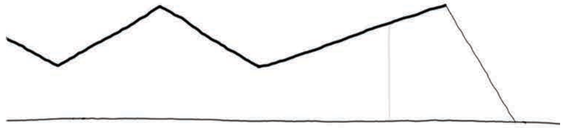


Figure 8.18: Buzz.ar Community Centre, with neighbouring take-away sketches by Author

MATERIALITY

With the designs ideology of enclosure meets openness, along with sustainability and the concept of the beekeepers veil, the materials had to meet certain requirements in terms of structural strength, functionality and aesthetic characteristics. Below are the chosen materials for the design:

Primary Materials:

Steel
Concrete
Tensile fabrics

Additional Materials

Organoid Natural Surfaces
Timber Slats
Versions of Glass

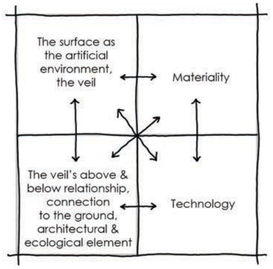


Figure 8.19: Connecting the different elements of the veil concept

PRIMARY MATERIALS

STEEL

Steel was chosen as the primary element for the veil framework, as it is both structurally sound and environmentally friendly. Steel positions itself as one of the leading environmentally conscious materials, being 98% recyclable and not wearing down in strength over time (Bone Structure, 2016). Steel has the ability to be bent and curved allowing it to be a great material to create the undulations and fluctuations of the veil form, while also allowing for the use of thin elements giving the appearance of lightness and a scaled-up mesh and thus presented itself as the best solution for the veil framework. Steel may also be used in screen applications as the design develops.

CONCRETE

Concrete was selected as the second material largely for the use of floor slabs for the parts of the building that touch and interact with the ground. Although concrete is not necessarily the most environmentally sustainable material, I did not want to avoid it as people will continue to build with concrete and so rather, I wanted to see how concrete could be used more sustainable. This approach led me to a product known as Ferrock cement, which replaces traditional cement in concrete. Cement contributes to 5% of the worlds man-made carbon emissions, with 1000kg of cement producing 900kg of carbon dioxide (Templeton, 2014).

Ferrock presents itself as an alternative cementitious binder, to the more traditional Portland Cement (Iron Shell, 2019). Unlike Portland Cement, Ferrock is more environmentally friendly as its made from recycled solid waste, specifically steel dust and glass and unlike Portland Cement, which emits carbon dioxide, Ferrock absorbs carbon dioxide during its curing process, which contributes to 10% of its weight and added strength (Iron Shell, 2019). With the addition of Ferrock, concrete used on the site becomes more sustainable then the traditional material.

TENSILE FABRICS

In addition to steel and concrete, various tensile fabrics form the third primary material. Fabrics such as polyethylene Mesh and ETFE can be used in places to provide enclosure that mimics a beekeepers veil, while also allowing surfaces for plants to latch on to. Polyethylene mesh is light weight, rot resistant and can be recycled, while ETFE can only be recycled to the point where it can be shredded and placed in a landfill (as it contains no chlorine or briomne) (Base Structures, 2019), it is also a light weight material and provides interesting levels of transparency. These materials can be used as additives to the veil, mimicking its cascading effect at points where the veil does not tapper down towards the ground, assisting in enclosure and plant growth surfaces.

ADDITIONAL MATERIALS

ORGANOID NATURAL SURFACES

Organoid natural surfaces is produced by a company know as Organoid Technologies and is a material made from pressed natural raw materials. These materials are mixed with an ecological binding agent and then converted into a thin layer during a careful pressing process (Organoid, 2016). Various panels are produced with plants and flowers, and because of the gentle manufacturing process many of the plants retain their scent, colours and feel (Organoid, 2016) No artificial colours or scents are added, and the surfaces produced are emissions free and manufactured in a carbon dioxide neutral process (Organoid, 2016). I thought this product would be an interesting way to reuse the plants removed to allow fro the placement of the design. In addition, it allows for the context of the site to be brought indoors in the form of floor, wall and ceiling panels, allowing for additional blurring of boundaries between inside and outside and enclosure and openness.

GLASS

Various forms of glass will be used in the design to both aid transparency while still ensuring confidentiality. Products such as textured kiln glass allow for light to pass through into spaces but creates a visual blur with its textured glass surface. This allows for confidentiality, while still ensuring transparency and also mimics the visual experience of looking through a beekeepers veil. In addition, products such as Casper Cloaking will be used to ensure confidentiality while allowing for full transparency. Casper Cloaking is a film for glass that conceals digital screens to the outside world by obscuring the light transmitted by LED displays, causing a screen to appear black to anyone on the outside (Designtex, 2019). In this way Casper Cloaking allows for total transparency while still ensuring confidentiality of the research or write ups being performed.

TECHNOLOGIES

Rain Water Harvesting
Solar Panels
Living Green Walls
UV Paint
Pheromones & Colour

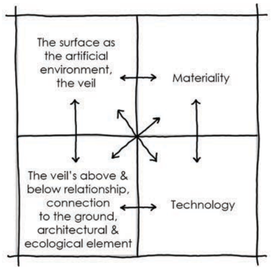


Figure 8.20: Connecting the different elements of the veil concept

RAINWATER HARVESTING

Rainwater harvesting will be used as a means of conserving the water collected by the veil at certain points. This technology is environmentally friendly and can prevent soil erosion, which is necessary for the site and particularly in Pretoria, because of the lack off acid rain runoff in lakes and ponds (Home Insulations, 2018). In addition, this technology allows for the water to be reused for internal functions and smaller irrigation systems, reducing the reliance on various infrastructure (Smart Solar Tech, 2019).

This system will use the veil as the main catchment system at points along its surface, along with a series of pipes as transportation systems, which then transfers the water into a JoJo tank. Water from the first rain is diverted away from the tank by a first flush system, which removes this initial most contaminated water (Smart Solar Tech, 2019). JoJo tanks are one of the best systems as it has a combined filtration system attached, it is made of polyethylene and can thus withstand harsh climates and its' black inner lining prevents algae growth, allowing for water to remain fresh longer (JoJo, 2019). Despite the benefits of such a system, there are obviously some downsides to using this system, such as regular maintenance, cost of the system and storage limits, however the benefits cannot be overlooked and may possibly out way the negatives in the long run.

SOLAR PANELS

Solar panels will be used in this design to minimise the use of electricity on the site and adhere to the environmentally friendly and sustainable ideology of the design. Placed facing north, at certain points along the veil, monocrystalline panels will be used as they have a higher heat tolerance and thus a longer life span then most other polycrystalline solar panels (Smart Solar Tech, 2019). In addition, monocrystalline panels are made up of cells with their comers cut on all sides, which increases its performance and reduces its cost, when compared to other polycrystalline solar panels (Home Insulations, 2019), another reason why this product was chosen. To maximise efficiency the panels will be placed in way that allows cool air to circulate below and around them (Smart Solar Tech, 2019). The solar panels will not completely replace the need for electricity but will however reduce the amount of electricity used on the site.

HYDROPONICS

Hydroponics is a method of growing plants in a water and nutrient rich solution, as opposed to the traditional soil solution (Fullbloom Hydroponics, 2019). Plant roots grow in a basin or trough of water mixed with a nutrient solution and together with contact to oxygen allow the plant to grow properly (Fullbloom Hydroponics, 2019). Unlike soil which supports plant roots, hydroponics makes use of immovable materials such as peat moss, clay pellets or rockwool to support the roots and plant as it grows (Fullbloom Hydroponics, 2019). Since hydroponics do not require soil or a large amount of space, this system presents itself as the perfect system to test plants for laboratory research, as they can be grown indoors and take up less space than more traditional systems. The reduction in space requirements means that these systems can be placed along the veil in various strips and require less infrastructure then traditional roof garden systems.

Hydroponic systems have various advantages over traditional soil planting methods. Firstly, hydroponically grown plants grow faster (25%) and fuller (35%) because their roots do not need to work as hard to locate nutrients (Fullbloom Hydroponics, 2019). In this way the plant focuses on growing foliage (stems and leaves) instead of expanding its roots in search of nutrients, which is what would happen in a soil solution. This direct access to nutrients is an advantage hydroponic systems' have over soils solutions. In addition, the nutrients, mixed in with the water, are derived from the same mineral salts found in soil and so they are natural products (Mr Stacky, 2018).

Moreover, hydroponically grown plants are more vigorous and are thus more resilient to pests and disease (Mr Stacky, 2018). This fact could allow beneficial pollinator plants to become stronger and last longer, ensuring healthier and a longer lifespan of food sources. Hydroponically grown plants can be more controlled then soil based plants, as one can control the nutrient levels and mixture inserted into the water basin (Mr Stacky, 2018). In this way plants can be altered to grown faster in cases when natural food sources are taking longer to bloom, either during winter on just before spring. In this way one can ensure that there is always a stable source of pollen and nectar for pollinators on the site. Furthermore, plants can be altered as per the research done on the site, by altering the PH, nutrient quantities and tending the growing fluctuations (Mr Stacky, 2018), allowing for real-time

testing and exhibition of the research being carried out.

Hydroponic plants are also unaffected by weeds as they are grown in an isolated medium, rather than a large patch of soil where weeds can form (Mr Stacky, 2018). Therefore, there is no need to constantly check the growing area and de-weed it in order to maintain the plants health. As such flowering plants will not be at risk of being dominated or pushed out by weed-like plants, similarly to what has been happening on certain areas of the site.

There are various hydroponic systems that exist, all being based on the general concept of a water basin with nutrients, the two chosen to be used in this design, however, are the deepwater culture method and the nutrient film technique. The deepwater cultue method makes use of a water basin and nutrient mixture, with the addition of an aquarium-like air pump that pumps the sealed box with oxygen to prevent the roots from drowning (Fullbloom Hydroponics, 2019). A primary benefit of this system is that no drip or spray emitters are required (Fullbloom Hydroponics, 2019), allowing for a simpler and more compact system. This space saving, compact sealed box system is thus the perfect system to be used in the laboratories and along deeper sections of the veil taking up less space in terms of length.

The nutrient film technique will also be used, which is a system made up of a slightly tilted tube, with a nutrient mixture running through it (No Soil Solutions, 2019). The angle of the tube allows gravity to move the nutrient water solution down along the tube, as it passes through plant roots, which are situated in inserts of the tube. The nutrient solution drains out on the lowest end and is re-pumped back up to the top of the tube, to continue the cycle (No Soil Solutions, 2019). This system allows for a faster growth rate as only the tips of the root are in contact with the nutrient solution, rather than the whole root, which allows the rest of the root more available surface area to absorb oxygen from the surrounding air (Fullbloom Hydroponics, 2019).

This system was selected as it is narrower along its width (saves space), it allows for a faster growth rate and it requires less maintenance because of the 24/7 pump cycle, thus it can be placed in strips along both horizontal and vertical elements of the veil, with little maintenance required, allowing for beneficial plants to grow faster. Overall hydroponic systems allow for healthier, stronger plants that can be grown in smaller spaces and through more efficient means, allowing for an overall beneficial result for both the plants and pollinators located on the site.

LIVING GREEN WALLS

Living green walls, as a technology, allow for planting of beneficial vegetation (host, nectar and pollen plants) along all the surfaces of the veil. Living green walls can be used as surfaces for planting of vegetation that remove chemicals and pollutants from the air, such as carbon dioxide and benzene, offsetting the carbon footprint of the design (Cape Contours, 2018) and creating a safer environment for pollinators. In addition, this technology allows for the use of green walls as an internal partitions, this not only brings nature into the internal spaces, providing additional habitat space and food sources for pollinators but it also aids in blurring the boundary between enclosure and openness and inside and outside, bringing the world of man and pollinator closer together.

Externally this technology can be used to insulate the design and absorb pollution and surrounding noise, while internally it can be used to regulate internal room temperatures, reduce airborne dust levels and increase ambient humidity (Cape Contours, 2018), creating a healthier and more comfortable environment. In essence, living green wall technologies, from climbing screens to geo-textile pocket panel systems, allow for the creation of artificial vegetation surfaces, increasing pollinators habitable space and food sources on the site and aid in bringing people closer to the world of pollinators.

UV PAINT

Pollinators are attracted to UV patterns and circles along flowers, these patterns inform pollinators that nectar and pollen, their food source, can be found in these particular places. Similarly to the technique applied to Bee Saving Paper, UV paint will be applied as a painted application along the veil, in various patterns around various habitat follies and artificial food sources, to signal to pollinators that these spaces contain food. In this way these artificial nectar and pollen sources mimic the natural qualities of flowers and thus communicate in the same, natural way to pollinators, ensuring that they use these food sources, especially when their natural sources become sparse during various seasonal changes. This application will only be visible under UV light and thus only visible to pollinators and thus it becomes a way in which the veil can communicate to pollinators and aid in their fight for survival.

PHEROMONES AND COLOUR

Pheromones / scents and colour are two tools that can be used to both attract or repel certain pollinators. This method becomes useful when one considers various spaces that have a high level of occupancy such as entrances or gathering spaces, wherein one would try to prevent certain pollinators, particularly Honey bees, from gathering. These tools become both natural and artificial methods to repel pollinators to prevent their harm and the harm of people on site but also methods wherein pollinators can be encourage to gather on the site so that research can be carried out on them and to direct them to artificial food sources (in which they are not usually attracted to) so as to further aid in their protection and fight for survival.

Pheromones are chemical substances secreted by animals, which produce various physiological or behavioural responses by animals of the same species (Bortolotti and Costa, 2014). Pheromones play an important role in the life of pollinators, particularly with Honey bees, who use pheromones as a way of communicating between all social casts, communicating about directions back to the hive to reproduction and defence alarms (Bortolotti and Costa, 2014).

Plants use pheromones / scents and colour to attract and repel pollinators, usually it is a more attractive approach so as to be pollinated, wherein the pollinator is then rewarded with nectar or pollen. Natural lures include favourable scent-releasing flowers such as Salvias, Geraniums, Lavender, Honey Suckle and Guarra (Hecker Nursery, 2019) and attractive colours such as yellow and blues for bees and red and pinks for butterflies. However, there are also artificial means of attracting pollinators to aid in pollen transfer. Such products include Bee-Scent and Pollinus, which are pheromone based sprayable formulas that can be used to direct pollinators to various flowers, improving bee foraging and pollen transfer (Agrigem, 2018). These lures both artificial and natural can be used to aid pollinator visitation to the site, allowing for sufficient research to be carried out along with directing them to artificial food sources by mimicking the scents emitted by their natural food sources, further aiding their survival.

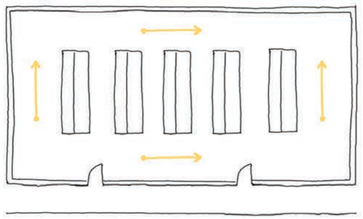
Plants such as rosemary, basil, mint and cucumber skins produce scents which are not attractive to bees (Smith, 2018). In addition, red flowers are not attractive to bees, as bees do not have photo receptors for the colour red, causing such flowers to appear black and thus unattractive (Hodgson, 2017. These plants can thus be planted and located in areas such as entrances and room dividers, primarily as a means of protection by deterring bees from gathering at these points. The use of these plants, however, still allows for a connection to nature, while allowing for a natural, non-enclosure from of protection to occupants on the site. The plants while unattractive to bees, are attractive to other pollinators particularly butterflies who are drawn to red flowers and so these plants do not merely exist as a source of protection, but they also have a beneficial purpose for other pollinators on the site.

In essence these technologies are chosen to aid pollinators on the site by ensuring they have sufficient and healthy food sources. In addition, the technologies are selected to ensure they contribute to the sustainable ideology of the design and prevent further damage to the degrading site. Ultimately ensuring that the design is able to communicate with the pollinators, aid their survival and improve the context of the site.

DESIGN PRINCIPLES

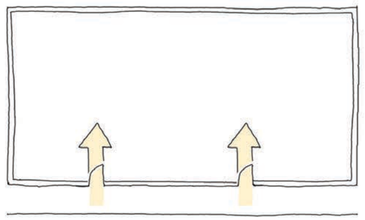
Various design principles were analysed in order to ensure and justify the correct layouts of the laboratories, their offices and the bee diagnostic clinic.

LABORATORY SPACE
DESIGN PRINCIPLES



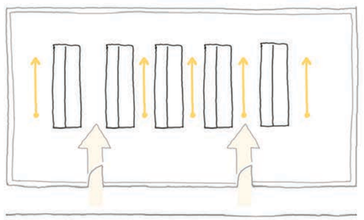
LAYOUT

Workstations in laboratories, are always arranged parallel to the width of the room. This way the primary circulation routes are on the outside perimeter of the desks, preventing any accidents between people and experiments, as people move to and from their workstation.



ENTRANCE

Due to this workstation arrangement, entrances to laboratories are usually placed along the length of the room.



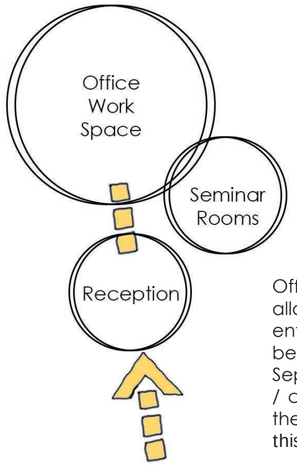
ENTRANCE & CIRCULATION

Entrances are placed along the length of the room, so that when one enters the lab they are in line with the workstation circulation routes and can move to their workstation from the primary surrounding circulation routes.

This arrangement allows people working and people entering to be aware of each other, avoiding any collisions while people carry out their experiments and move from entrance to work space.

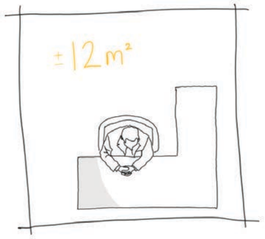
Figure 8.21: Sketch series illustrating design principles of the laboratory, offices & clinic space - By Author

LABORATORY OFFICE
DESIGN PRINCIPLES



LAYOUT

Office layouts are arranged in a way that allows the reception to be the welcoming entrance, with the office work space being the more private back space. Separating the two spaces are seminar / consulting rooms. The arrangement of the laboratory write up spaces embodies this principle layout.



WORK SPACE

The average work space area (as per my precedent analysis) was discovered to be 12m squared. On this principle, the open plan laboratory office becomes a multiple of this square meterage, accommodating the number of people expected to work in the laboratories, in an open plan, unenclosed layout.

DIAGNOSIS CLINIC
DESIGN PRINCIPLES

LAYOUT

Clinic layouts are arranged in a way that allows the reception or waiting area to exist as the welcoming space and entrance for the facility. Traditionally there is a very strong public private barrier between the reception and consultation rooms.

However, this design aims to re-evaluate this barrier in line with the designs underlying philosophy of enclosure meeting openness and blurring this boundary.



Traditional Barrier



Re-evaluated Barrier

SPATIAL BLOCKING

Developing the plan layout:

The arrangement of the main four spaces remain as the primary back bone of the design, placed in a band along the hard edge, shifting at times, in spacing, to make spaces for courtyards.

Courtyards or these external spaces allow people to experience the site and become spaces where the veil can taper down and dissolve into the ground. These elements are also used as a way to space places with different levels of access privacy, starting with the research exhibition space (public) and ending with the laboratories (private), while all spaces are visually public.

The core gets split in half to become two cores, one placed more central to the layout, the other closer to the laboratories.

As the plan develops the additional programmatic spaces of a restaurant / cafe and educational nodes get added into the layout. The educational nodes provide additional spaces to inform people, exhibit the research done on the site and provide places where people can walk up onto the veil, to experience the world of the pollinators.

Throughout the development, all spaces work on a primary linear circulation route and based on the previous spatial arrangement explorations (figure 8.23), allow for views of the site and research being carried out, rather than full views of the road, as one moves along the primary circulation path.

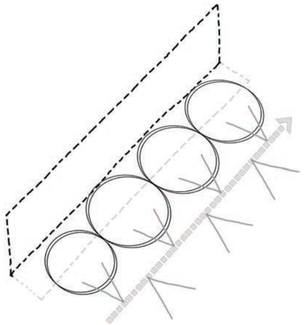


Figure 8.23: Spatial Signifier - By Author



Figure 8.24: Sketch series illustrating the development of the design layout through spatial blocking - By Author

FINAL DESIGN
PROCESS WORK

Developing and exploring the plan layout

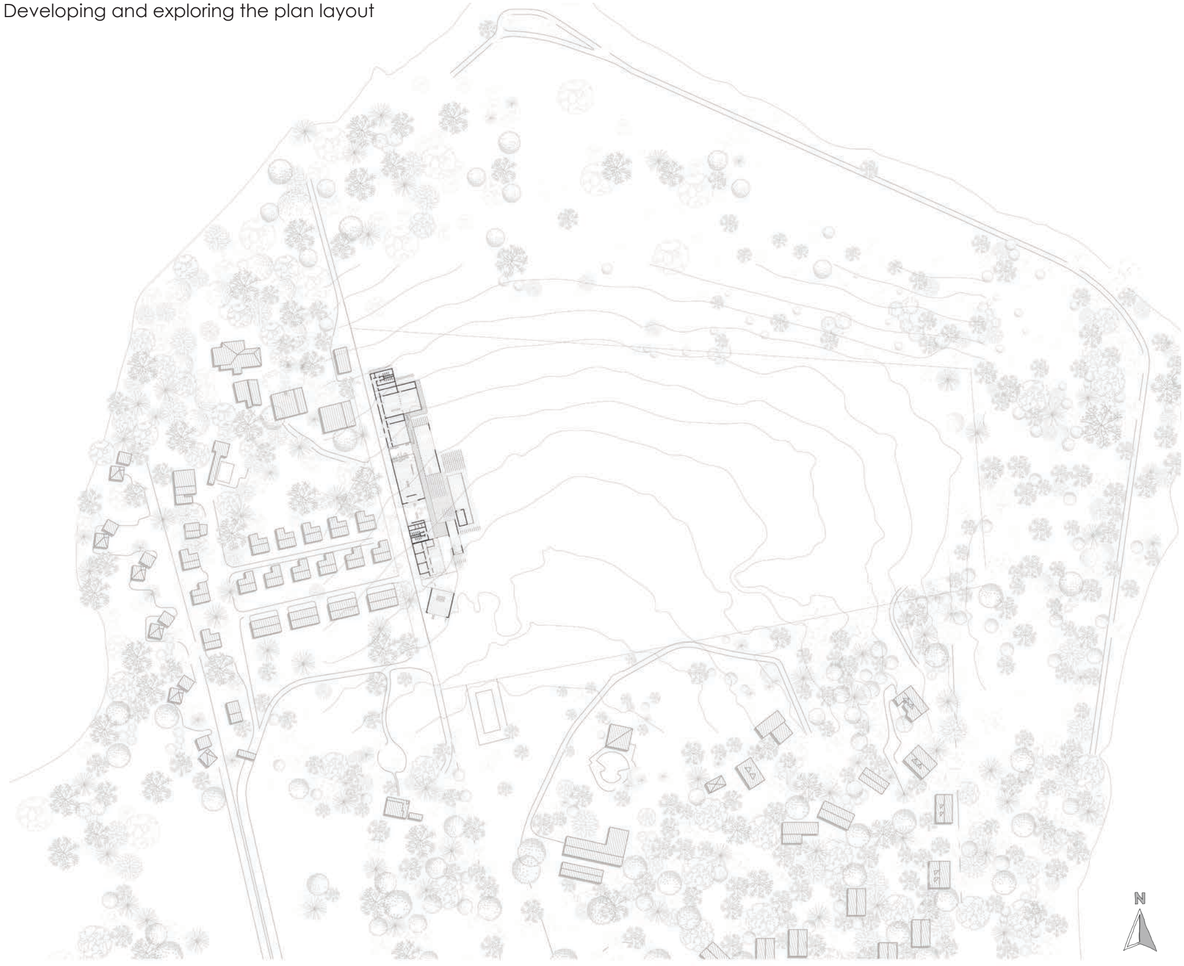


Figure 8.25: Context plan with development Floor Plan



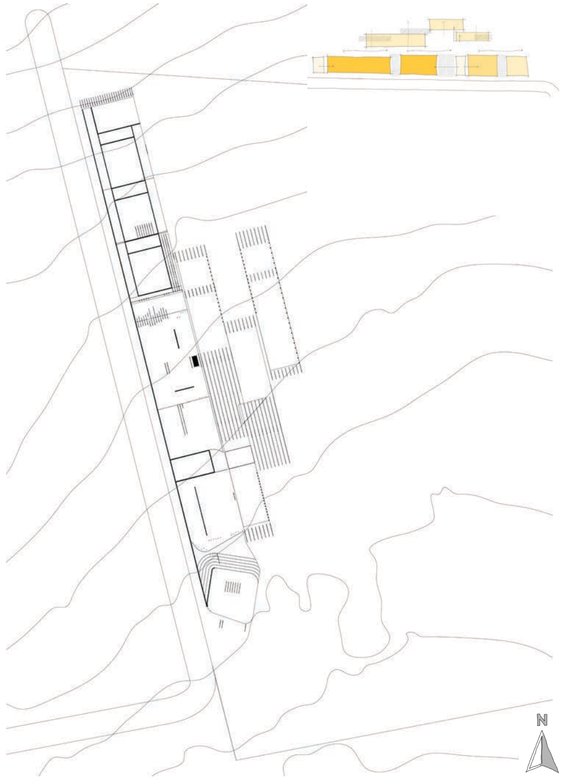
Figure 8.26: Development Floor Plan

DEVELOPMENT

Developing and exploring the plan layout



Plan 1: Linear Band.



Plan 2: Linear band expanding east.



Plan 3: Linear band expanding east, reducing along the northern end.



Plan 4: Further expansion east, extending the laboratory and shifting the educational nodes.

Figure 8.27: Sketch series of plan development

THE VEIL

The underlying steel structure of the veil -based on plan iteration 01 (excluding additional structural and cladding components).

This rough frame design illustrates the veil undulations and how it tapers along the north-south axis.

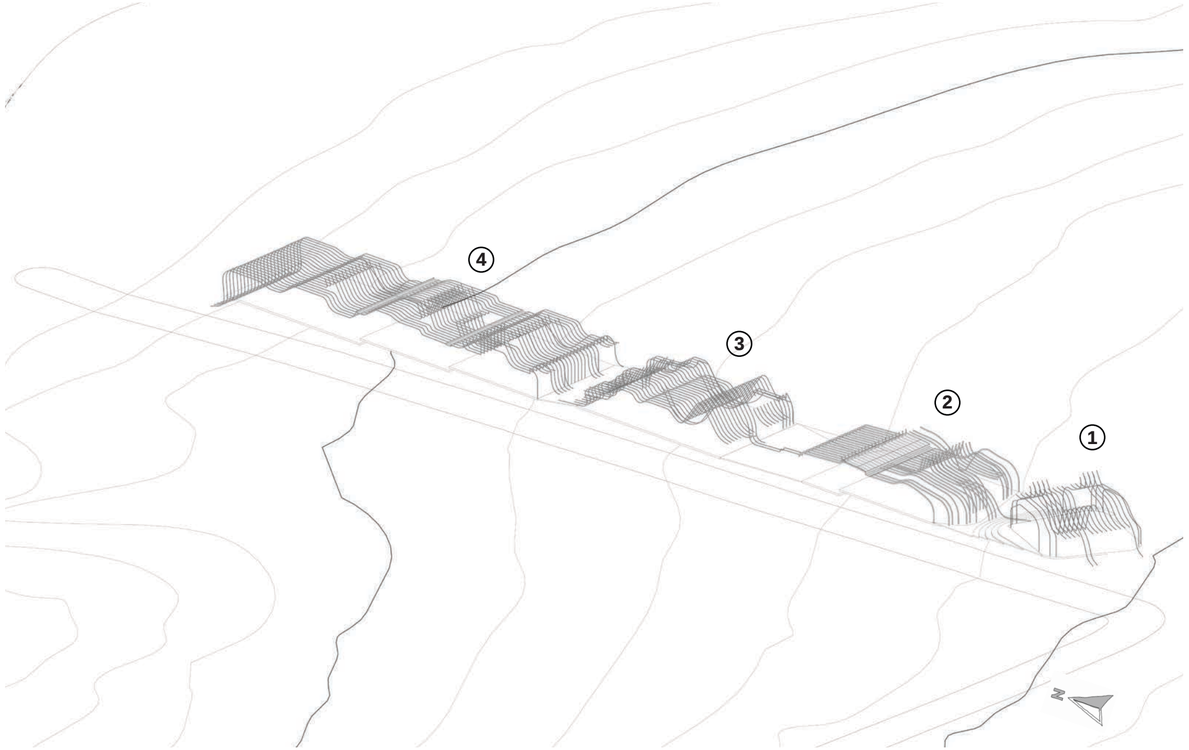
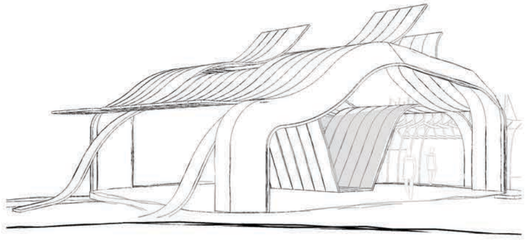
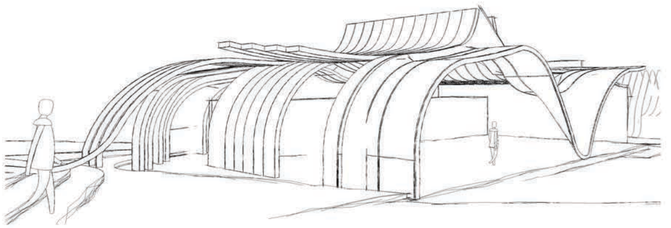


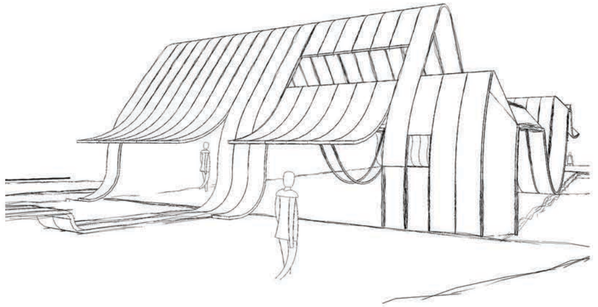
Figure 8.27: Development perspectives of the veil



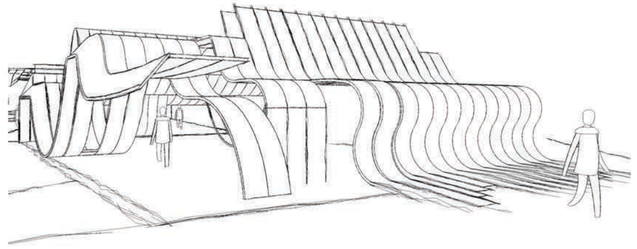
1 Research exhibition space / education area



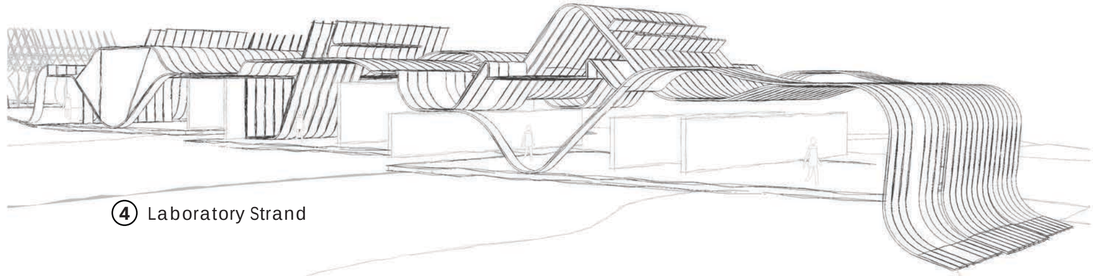
2 Clinic



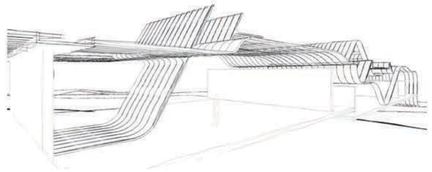
3 Laboratory Office

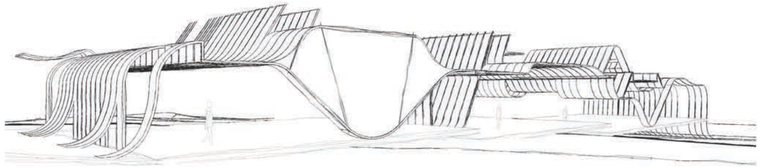


3 Laboratory Office



4 Laboratory Strand



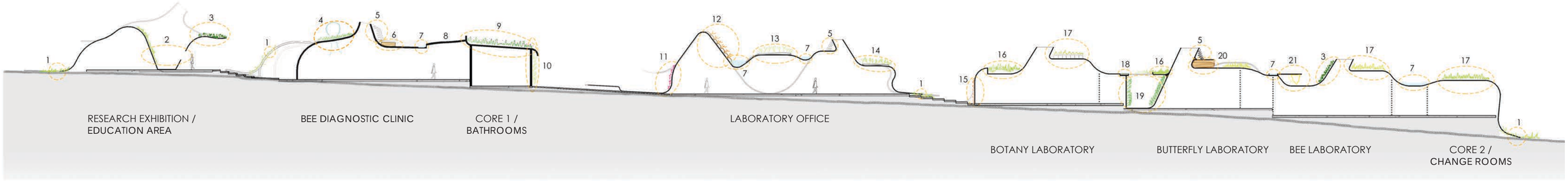


4 Laboratories

4 Laboratories

THE VEIL

A diagrammatic section (of plan iteration 01) exploring the rough series of elements, both natural and artificial, along the veil to aid pollinator growth and survival.



1 - Exposed Frame to pull up landscape
2 - Viewing window opening up into the veil, with projection around it of roof activity.
3 - Toxin absorbing moss
4 - Bee favoured flowers, with clinic bee detention dome
5 - Solitary bee tube habitat
6 - Overwintering space for bees
7 - Drain / water source
8 - Polycarbonate sheeting
9 - Butterfly favoured flowers
10 - Butterfly host plant wall
11 - Artificial flower section
12 - Basking / perching panel section
13 - Hydroponic pollinator plants (sun sensitive)
14 - Hydroponic pollinator plants (sun dependant)
15 - Artificial nectar wall
16 - Pollinator plants (sun sensitive)
17 - Pollinator plants (sun dependant)
18 - Drain / mud source
19 - Hydroponic host plant wall
- accessible from labs
20 - Butterfly overwintering area, shielded by vegetation
21 - Bee comb starting frame
- accessible from lab below

Figure 8.28: Diagrammatic section of the veil (still in development)

THE SURFACE AS **THE ARTIFICIAL ENVIRONMENT**

Artificiality looks at the creation of something natural that is not naturally occurring. This has two embedded strands; on one hand an artificial element can exist as a natural element (such as a flower) placed in an environment where it does not or cannot necessarily naturally appear there. On the other hand, an artificial element can be seen as being a man-made flower, a form that mimics the natural form but one that is constructed out of synthetic materials.

In the case of the surface as the artificial environment, it embodies both strands, imbued with elements that will assist pollinators and help them and the context of the site thrive. These elements look at the issues facing the three themes of environments (the context of the site), insects (pollinators) and enclosure (the spaces below) and begins to interpret possible solutions at respective scales (figure 8.29).

Issues facing the environment of the site
- Dominant wild grass
- A reduction in flowering plants
- Lack of protection from the natural elements, along the western boundary

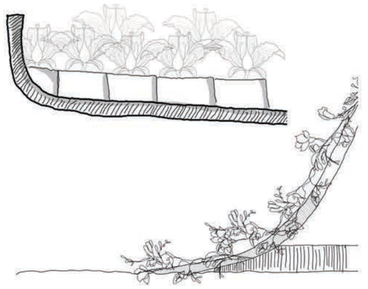
Issues facing pollinators:
- Lack of habitable spaces
- Lack of available food sources
- Infected by pesticides

Issues facing the enclosed spaces below:
- Lack of awareness
- More research required
- Harmful byproducts released

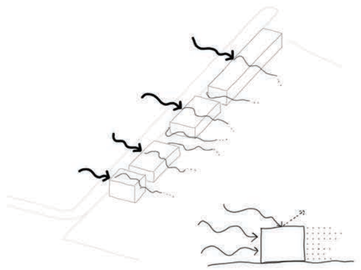
ENVIRONMENT



A layer of mulch where the veil meets the ground stops the weed like dominant grass from latching on and spreading further.

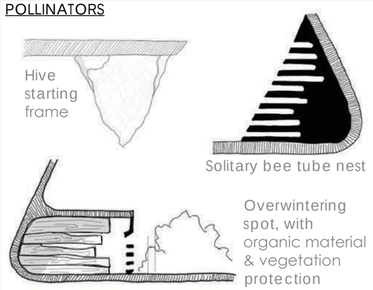


Flowering plants planted both on the veil and along its exposed members will add flowers to the site and allow them to grow down into the site.

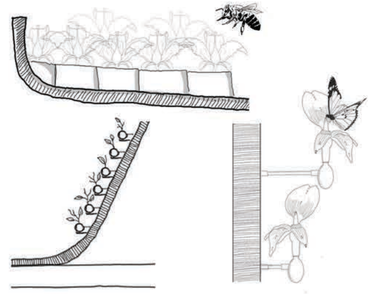


Placement of the design along the western edge, allows the design to act as taller vegetation and provide protection from the elements, allowing more delicate plants to regrow along this boundary.

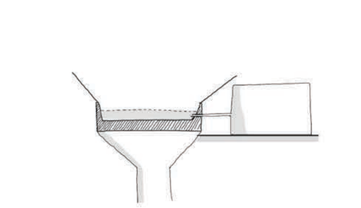
POLLINATORS



Various habitat follies and spaces incorporated along the veil, aid pollinator growth and give them a helping hand in rebuilding their personal environments.

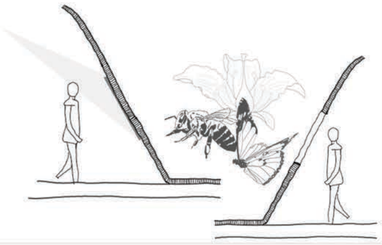


The veil aims to improve food sources through the addition of planted nectar & pollen plants, along with hydroponic sections of host plants. In addition, there will also be artificial flowers, and nectar sources, especially for winter when natural flowers are sparse.

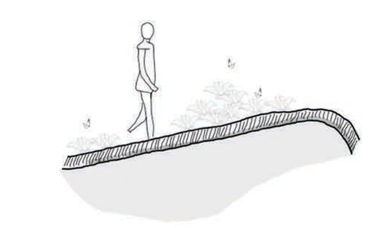


Drain-like water sources provide water for pollinators. These spaces will be connected to a tank that pumps pesticide toxin removing powder into the water to be consumed by pollinators, to improve their health.

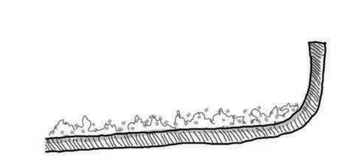
ENCLOSURE



Increased awareness will be created through projections of what is happening along the veil and educational films, along with viewing windows, allowing people to see through the veil into the life's of pollinators



Increased awareness is further created by having certain spaces that are trafficable, allowing people to walk up onto the veil to experience what the veil achieves and what pollinators provide the world with.

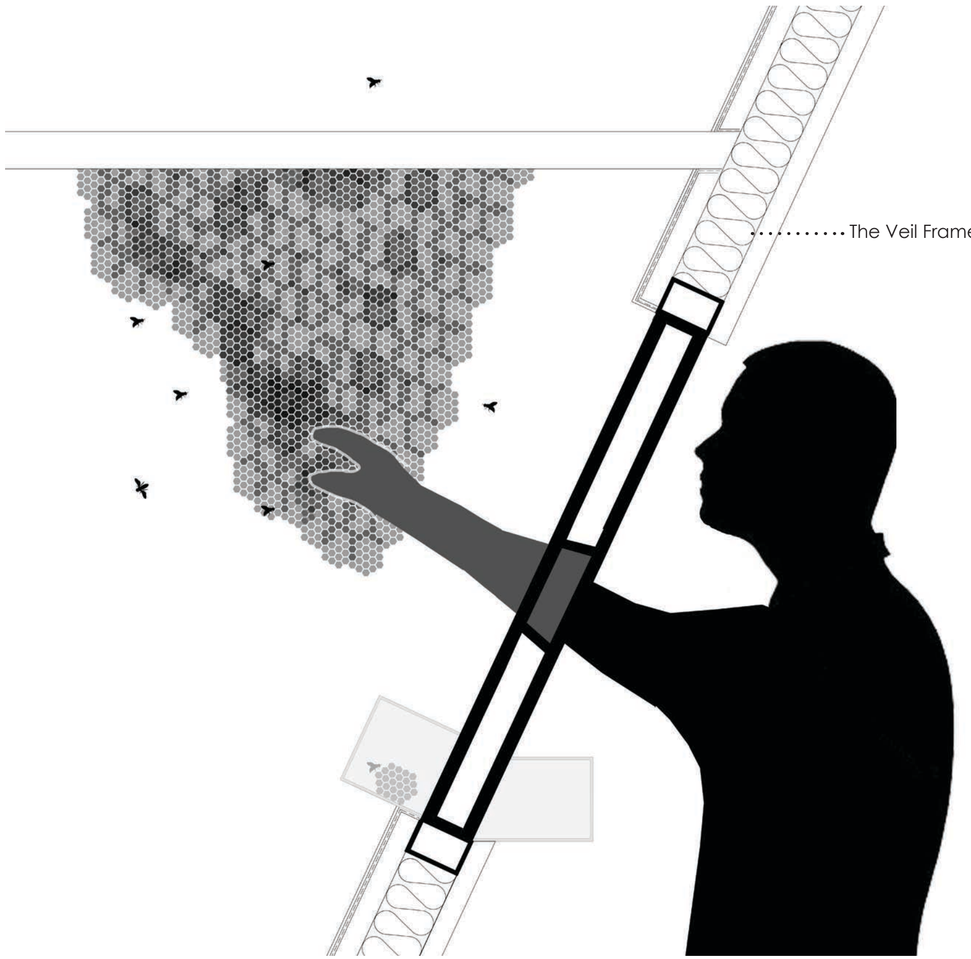


To absorb surrounding harmful byproducts, toxin absorbing moss will be placed at various intervals along the veil.

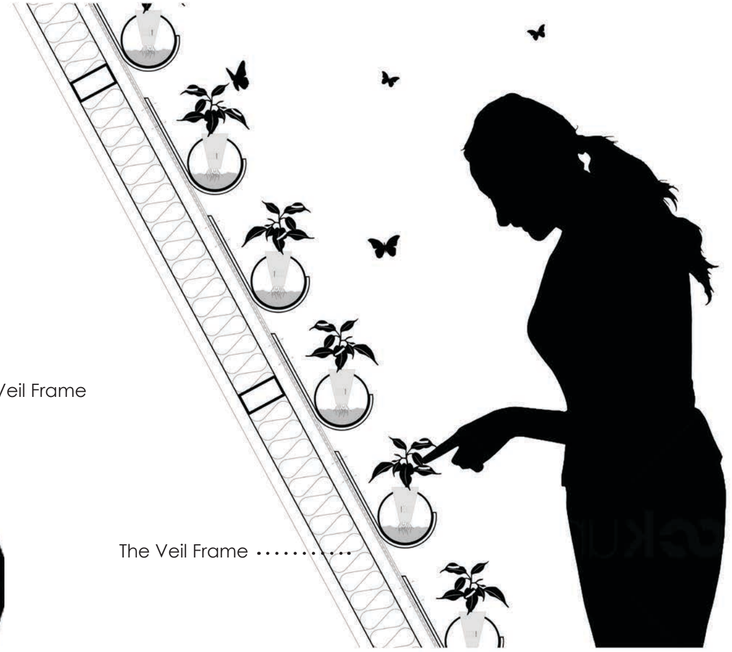
Figure 8.29: Sketch series illustrating the functions of the veil / artificial environment - By Author

THE ARTIFICIAL ENVIRONMENT

Exploring some of the veil's possible functions



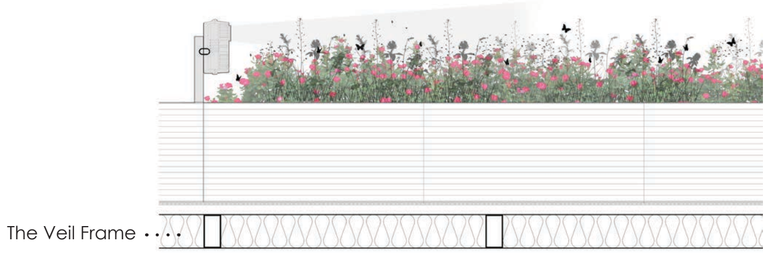
Bee Hive Interaction &
Lab Sampling



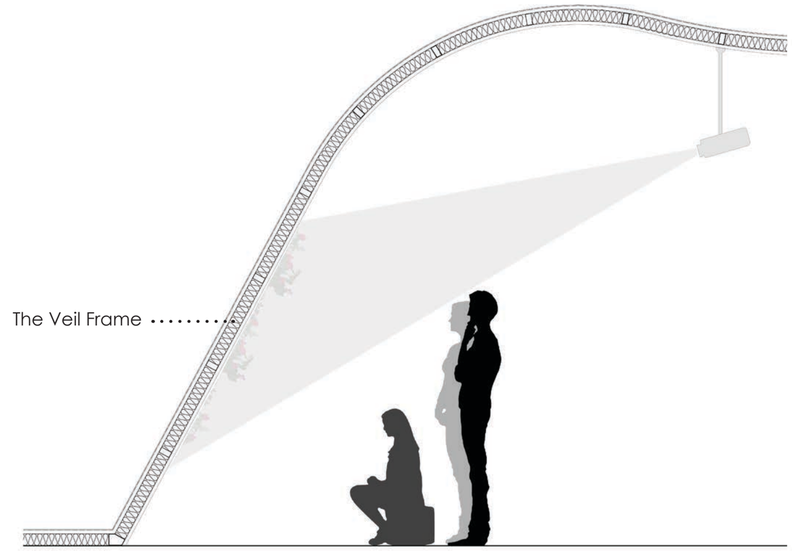
Hydroponic Host Plant Wall



Accessing the live recordings in
the laboratory for research



Recorded 'Above - Veil' Activity

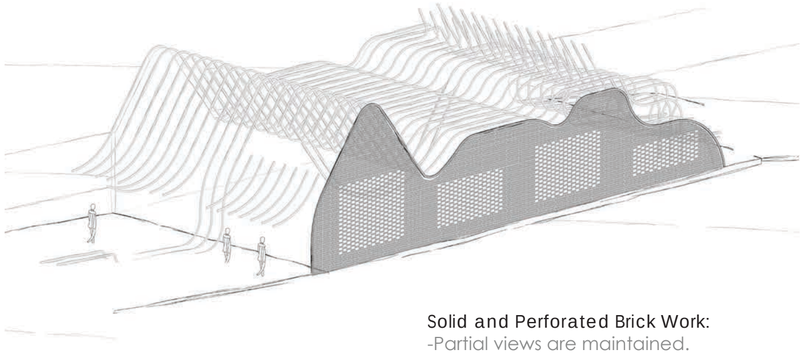


Live pollinator recordings displayed on the veil, for visitors, exhibiting their world

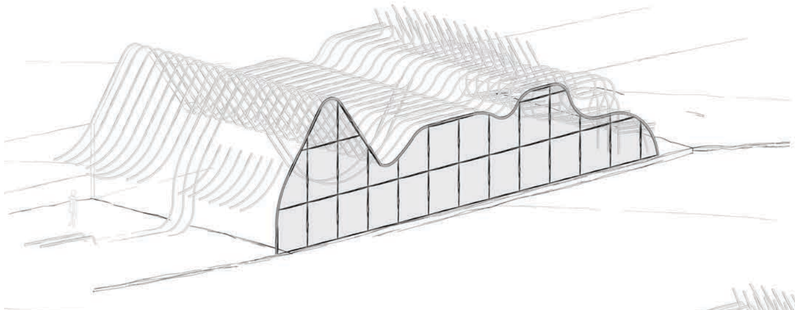
Figure 8.30: Sketch series illustrating the developing functions of the veil / artificial environment - By Author

DEVELOPMENT

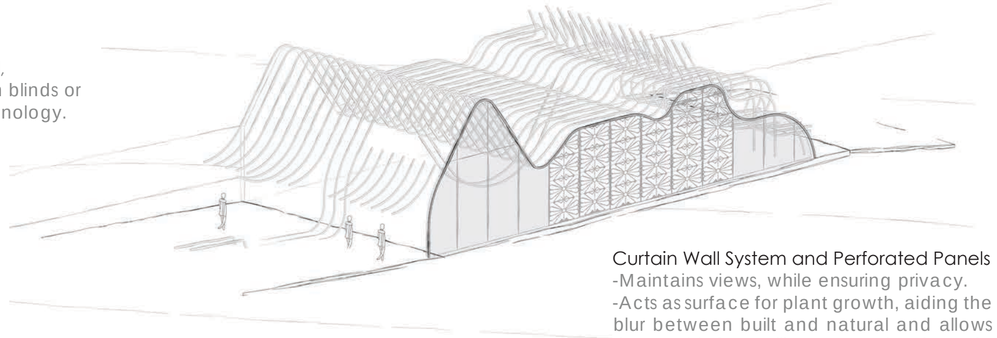
Exploring the enclosure of the veil along the non-tapering axis, ensuring views are maintained, while still allowing for privacy and a blur between the inside and outside, between enclosure and openness.



Solid and Perforated Brick Work:
-Partial views are maintained.
-Provides a sense of 'opened' privacy.

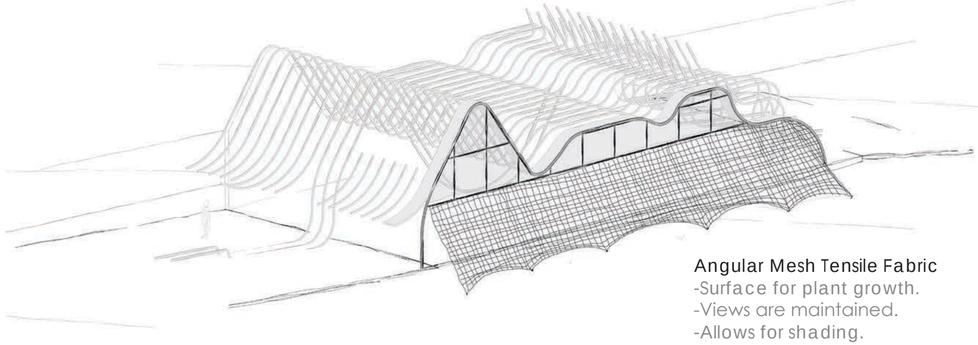


Curtain Wall System
-Views are maintained,
-Allows for privacy with blinds or Casper Cloaking technology.

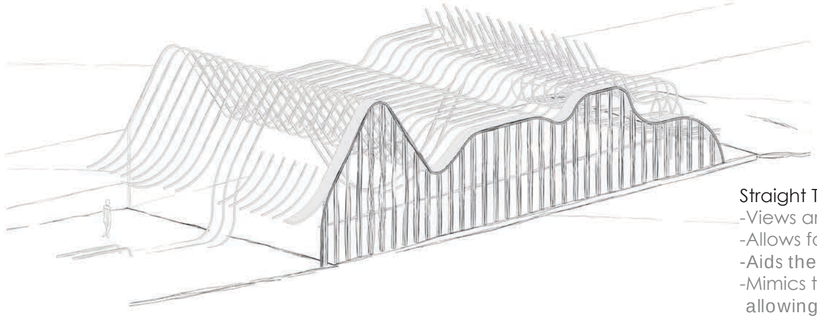


Curtain Wall System and Perforated Panels
-Maintains views, while ensuring privacy.
-Acts as surface for plant growth, aiding the blur between built and natural and allows the world for pollinators to be brought closer to people.

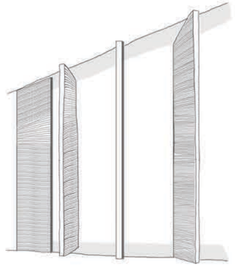
Figure 8.31: Sketch series exploring the closure of spaces, along the non-tapering axis of the veil



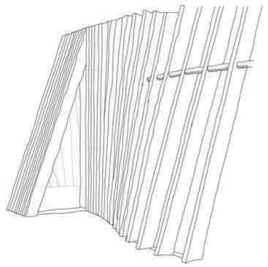
Angular Mesh Tensile Fabric
-Surface for plant growth.
-Views are maintained.
-Allows for shading.
-Visual connection to the beekeepers veil.
-The mesh could potentially be applied in a panel format for better enclosure.



Straight Timber Slats
-Views are maintained
-Allows for a sense of 'open privacy'.
-Aids the blurring between enclosure and openness.
-Mimics the structural members of the veil, allowing for visual unity.
-Has a more earthy, natural appearance.
-The slats could probably be placed vertically to aid in sun shading from the east.



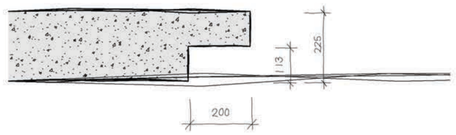
Possible Alternatives:
Rotating Timber 'Fins'
-Allows one to alter their boundary to the outside.
-When open they allow for views and opens up the space to the outside.
-When closed they allow for a sense of privacy.

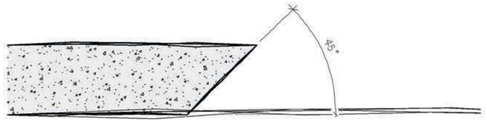


Possible alternatives:
Angled Timber Slats
-The side inlets allow for additional points of entry.
-The timber members mimic the veils structural elements and curvature with the angular placement.

DEVELOPMENT

Exploring the ground floor to ground connection - early rough developments.





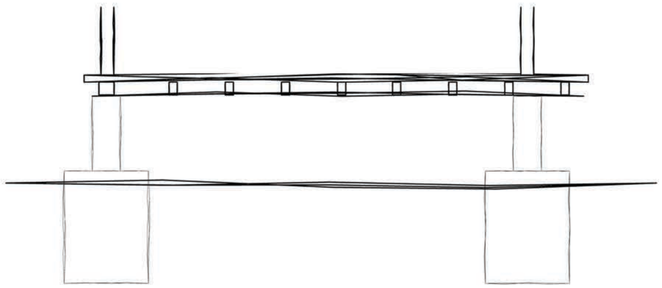


Figure 8.31: Sketch series exploring the ground floor to ground connection - sketches by Author

Farrock concrete slab on ground, with shadow line

- This treatment of the slab would highlight its connection to the ground and announce the boundary between the two surfaces. The shadow line could give the appearance of the slab floating, echoing a butterfly or bee hovering in flight.

Farrock concrete slab on ground, with an angled finish:

- Similarly to the above, this treatment of the slab highlights its connection to the ground and announce the boundary between the two surfaces. It may also allow for a softer point of connection as opposed to a solid flat edge.

Raised Platforms:

- The floors as raised platforms, either made of timber or steel, would allow for a minimal footprint and prevent the building from obstructing and damaging the flow of process that occur along the ground such as water paths and existing vegetation. In this way the raised platforms allow nature to pass unaffected, below the intervention.

* There could potentially be a combination of both on ground and raised platforms, allowing for different points of contact with the site. This may also allow for different opportunities of moving along and against the slope and viewing the world of the pollinators along the veil.

GOING FORWARD - FOR DESIGN DEVELOPMENT

"And suddenly, their wardrobes were empty, their trunks were packed, notes were handed out to all students, warning them not to use magic over the holidays; Hagrid was there to take them down to the fleet of boats that sailed across the lake; they were boarding the Hogwarts Express; talking and laughing as the countryside became greener and tidier; eating Bertie Bott's Every Flavor Beans as they sped past Muggle towns; pulling off their wizard robes and putting on jackets and coats; pulling into platform nine and three-quarters at King's Cross Station..."

Like the brief break of a summer holiday, the students of Hogwarts would soon return to grow and continue to learn, and so too shall the design continue to grow and develop further, for the work presented here is still in the process stage.

FINAL DESIGN

Protecting the irreplaceable by creating a Bio-sanctuary to cultivate and sustain South Africa's endangered pollinator species.



Figure 8.32: Final Design -
Clinic & Educational Node Perspective

The final design embodies the surface as the artificial environment, as the veil takes on the notion of a timber structure/ shell that acts as both a roof and wall. Whereas in earlier developments the veil consisted of individual pieces, here it merges to become one unified timber structure. It embodies the notion of the surface as the artificial environment as it reaches up from the ground, extending and moving above the spaces below, then tapering down at its ends, cascading into the surrounding landscape. The veil becomes an oscillating timber roof, with its undulations mimicking the figure eight geometry of a bee's pollen dance and the infinity movement of a butterflies beating wing. The veil/roof rises to allow for larger volumes of space below or falls to ensure more intimate environments, depending on the spatial function below (figure 8.37).

On its outer skin the veil is imbued with elements along its surface to aid in pollinators fight for survival. In this way, the roof/ wall-esque veil becomes a double skin, serving pollinators on one side and enclosing spaces on the other side to serve people. Four roof mounted elements and follies transform the veil into the surface as the artificial environment (figure 8.36). Firstly, there are roof mounted planter trays (both flat on the roof or titled to accommodate the change in curvature), filled with sedums, low lying wildflower plants and artificial flowers. These plants not only provide vital food sources and host sites but also act as places of refuge for pollinators, while the artificial flowers ensure a food source year-round. Sedums and wildflowers require very little water and maintenance and since sedums are evergreen, this ensures a year-round green aesthetic. Secondly, the follies include basking panels, which rise at points to allow for the placement of artificial flowers ensuring a long lasting perching platform for butterflies. The basking panels are cast from clay and thus absorb the suns heat allowing for a warm surface from which butterflies can absorb heat necessary for them to fly. These panels either lay flat along the veil or are elevated to cap off overwintering chambers placed below. These chambers are filled with organic material to allow for a place of refuge for pollinators during cold months, with the basking panels above absorbing additional heat and transferring it to these chambers below, allowing for additional warmth. Thirdly, the follies also include roof mounted beehive chambers fitted with sensors for remote monitoring and capped with removable lids and planters for additional heat and nearby food sources. Lastly there are clay-cast panels with shallow indentations along its surface to act as both natural water catchment points (to serve as drinking sources for pollinators) and placements for sponges soaked in an artificial nectar substance (sugar water). These panels provide additional food sources and ensure a year-round nectar source, irrespective of what season it is.

On the underside of the veil's double skin, one enters the building through a gallery which exhibits the research done on the site and the general plight of pollinators. Upon exiting the gallery, the programme unfolds into a bee diagnostic clinic (which uses bees as diagnostic tools to determine if a person has cancer through smell), an educational node, with a media station and observation hives for additional educational moments (enclosed by curtains allowing for a constant connection to the outside and mimicking the beekeepers veil), a discussion space and café (figure 8.34). The programme continues, moving into the three primary laboratories namely a plant, butterfly and bee laboratory, with an adjacent 'greenhouse'/ researching testing space. This 'greenhouse' / research testing space is sealed on one side by a hanging mesh curtain and the other by a series of rotating aluminium fins. Throughout the building are a series of observation beehive chambers fitted with glass sides for viewing, an easy to remove honey chamber and bee access chimneys that extend up though the roof to minimize people interfering with the honeybees. In this way, the outside environment can be brought in at points along the building, while also providing spaces where people can observe how bees live in a non-obtrusive manner. In addition, there are various ladder platforms that allow staff to ascend up onto the roof/veil for research and maintenance purposes or to retrieve herbs (above the café) or medicinal plants (above the clinic), further ensuring a connection between the two sides of the veil.

The spaces of the veil above relate to the spaces below the veil and echo the activity taking place at both points, ensuring both sides of the veil's double skin are constantly connected. For example, the bee diagnostic clinic is all about smell and health and so too are the spaces above the clinic, in that the planter trays above the clinic are filled with aromatic and medicinal plants. Furthermore, the entire primary circulation pathway is roofed with planter trays ensuring that the movement of people below is mimicked by the movement of butterflies and bees above. In addition, above the café (a place of food and gathering) are food related panels, from water catchment and artificial nectar panels to planter trays of wildflowers (for pollinators) and herbs (for pollinators and the cafe food).

Thus a beneficial design is created, one that exists as this new surface / artificial environment. A design that negotiates between the two worlds of pollinators and humans, at the intersection of the built form and the natural environment, creating a space that benefits both people and pollinators, at their respective scales.



N

Context Plan

1 - Roodeplaat Dam
2 - Roodeplaat Nature Reserve
3 - Site
4 - Marleo Holiday Resort
5 - Manzi Monate Family Resort

Figure 8.33: Final Design - Context / Site Plan



N

Ground Floor Plan

1 - Building Entrance / Research Exhibition Gallery
2 - Bee Diagnostic Clinic
3 - Educational Node
4 - Cafe
5 - Meeting / Discussion Space
6 - Work Space
7 - Botony (Plant) Laboratory
8 - 'Greenhouse' - Research Testing Area
9 - Butterfly Laboratory
10 - Bee Laboratory
11 - Marleo Holiday Resort

Figure 8.34: Final Design - Ground Floor Plan

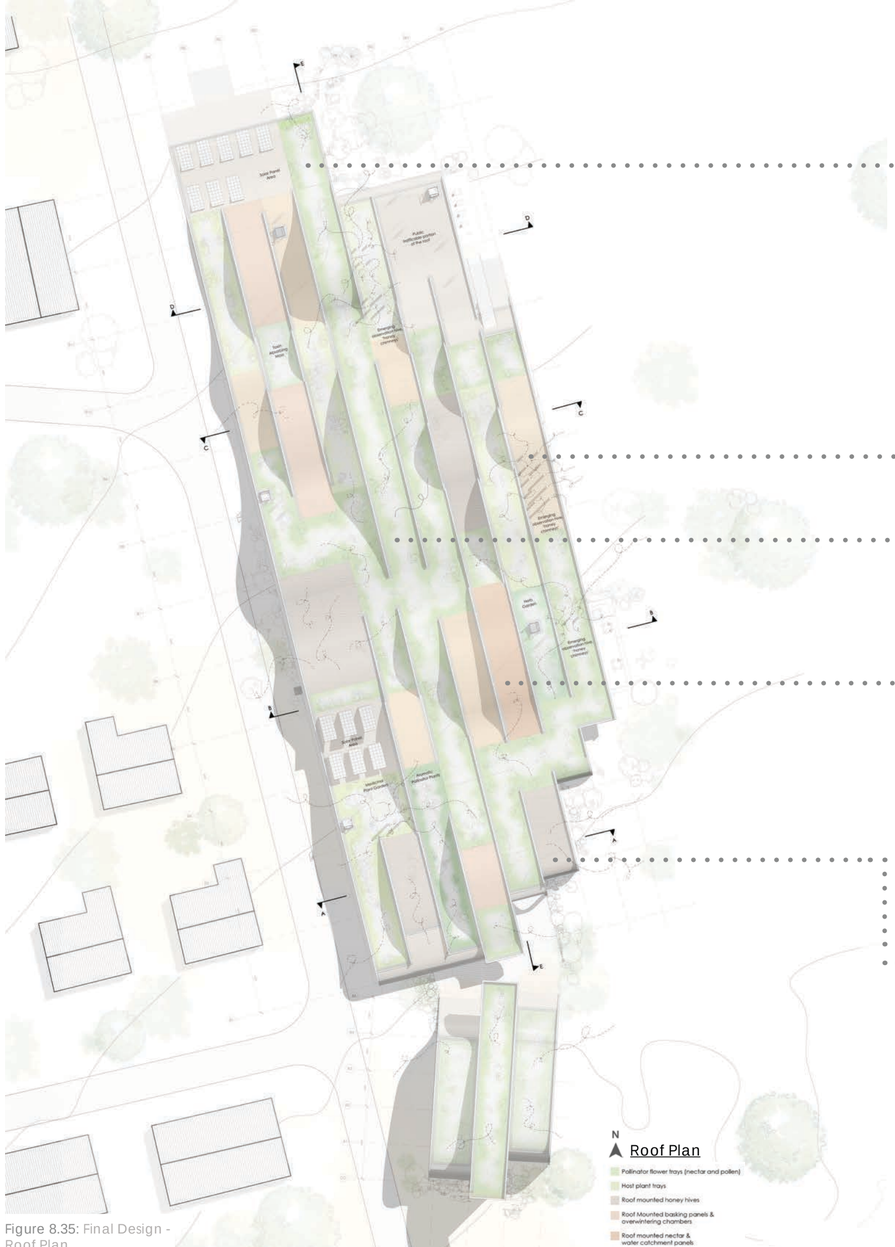
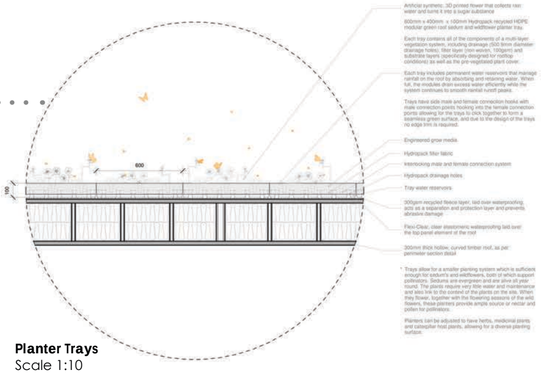
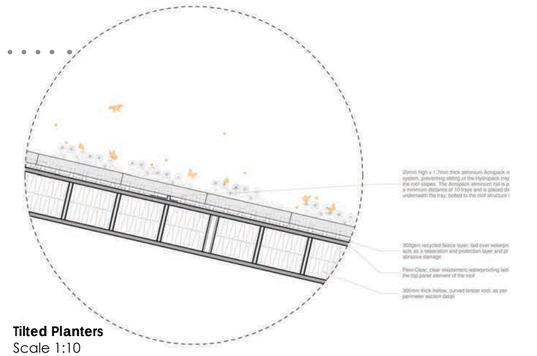


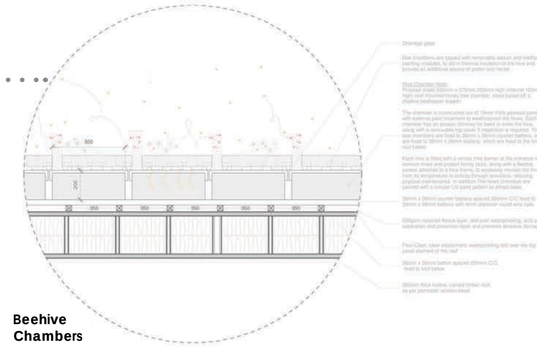
Figure 8.35: Final Design - Roof Plan



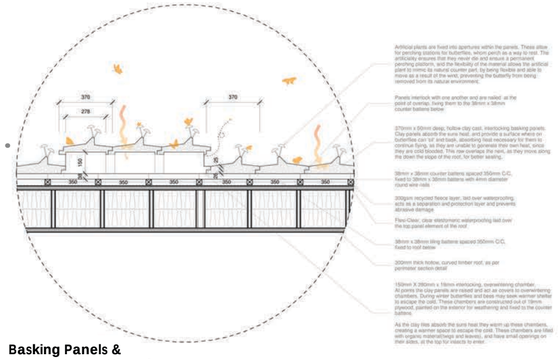
Planter Trays
Scale 1:10



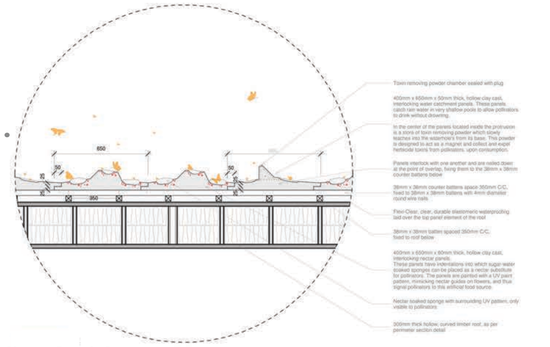
Tilted Planters
Scale 1:10



Beehive Chambers
Scale 1:10



Basking Panels & Overwintering Chambers
Scale 1:10



Nectar Panels & Water Catchment
Scale 1:10

Figure 8.36: Final Design - Roof Mounted Follies

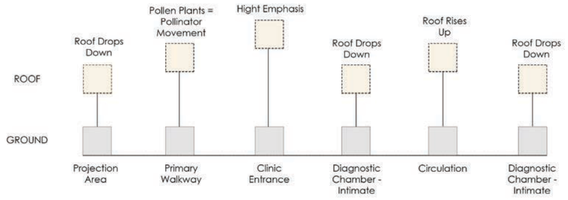


Figure 8.37: Bee Diagnostic Clinic - Above Below Relationship Diagram



Figure 8.38: Bee Diagnostic Clinic - Section A-A Scale 1:100

Diagnostic Clinic - Chamber Process



1. Breathe into chamber



2. Negative Result



3. Positive Result



Figure 8.39: Bee Diagnostic Clinic - Interior Perspective



Figure 8.40: Cafe & Discussion Space Walkway - Interior Perspective

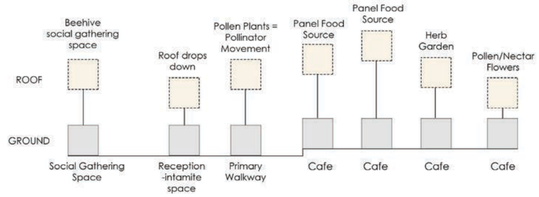


Figure 8.41: Cafe & Discussion Space - Above Below Relationship Diagram

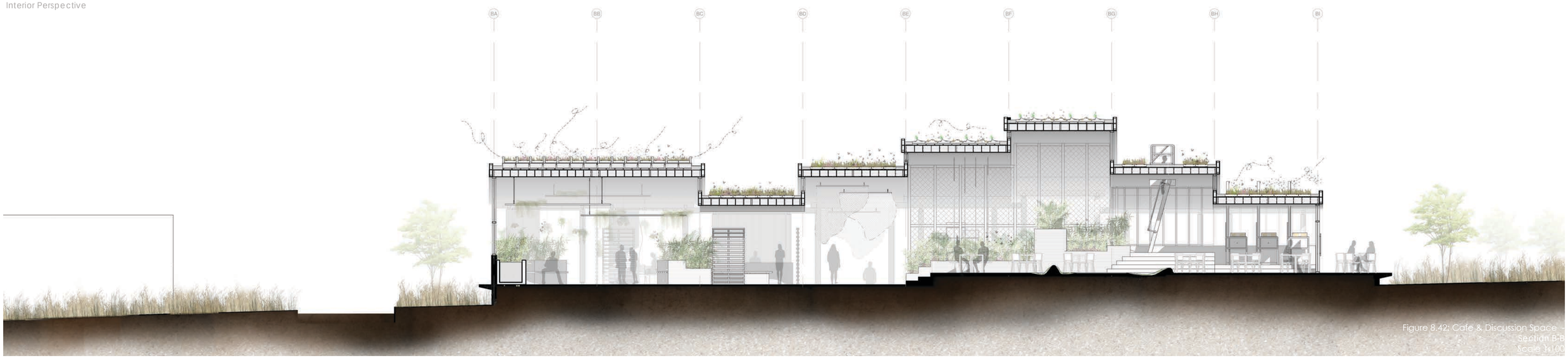


Figure 8.42: Cafe & Discussion Space - Section B-B Scale 1:100

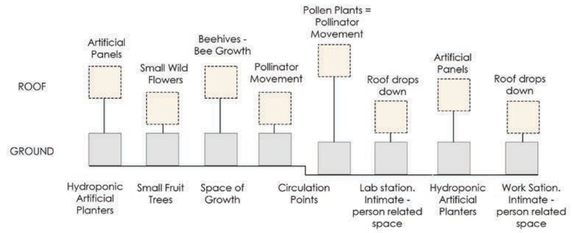


Figure 8.43: 'Greenhouse' / Research Testing Space - Above Below Relationship Diagram

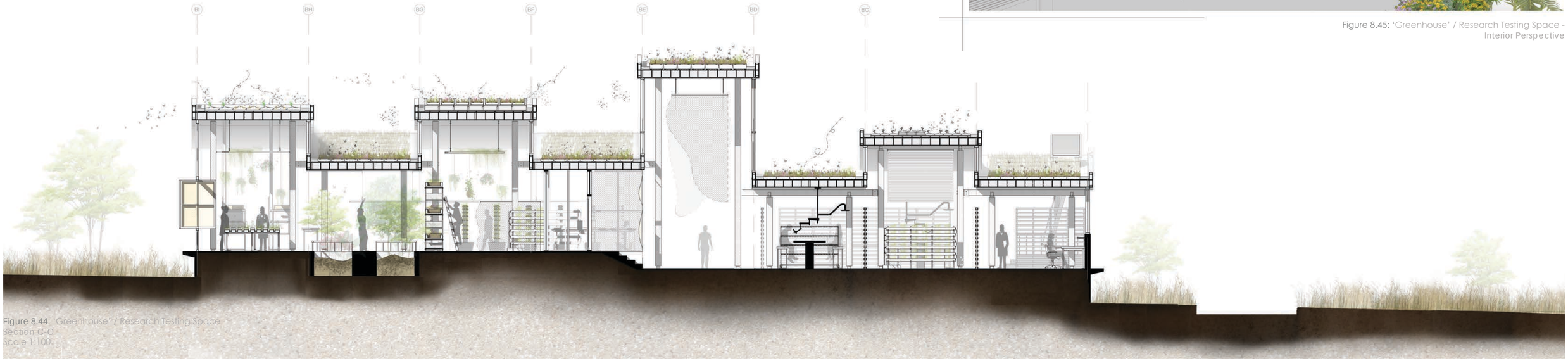


Figure 8.44: 'Greenhouse' / Research Testing Space - Section C-C Scale 1:100



Figure 8.45: 'Greenhouse' / Research Testing Space - Interior Perspective

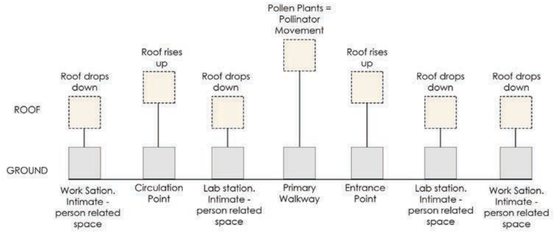


Figure 8.46: Butterfly & Bee Laboratory - Above Below Relationship Diagram

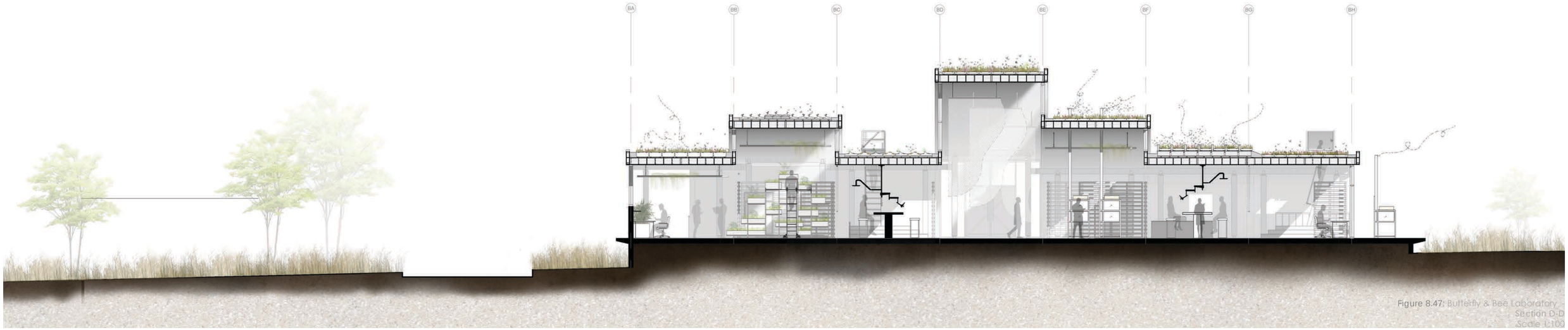


Figure 8.47: Butterfly & Bee Laboratory - Section D-D Scale 1:100

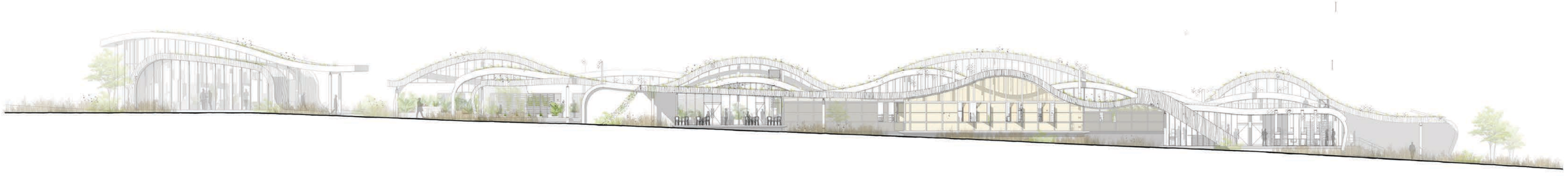
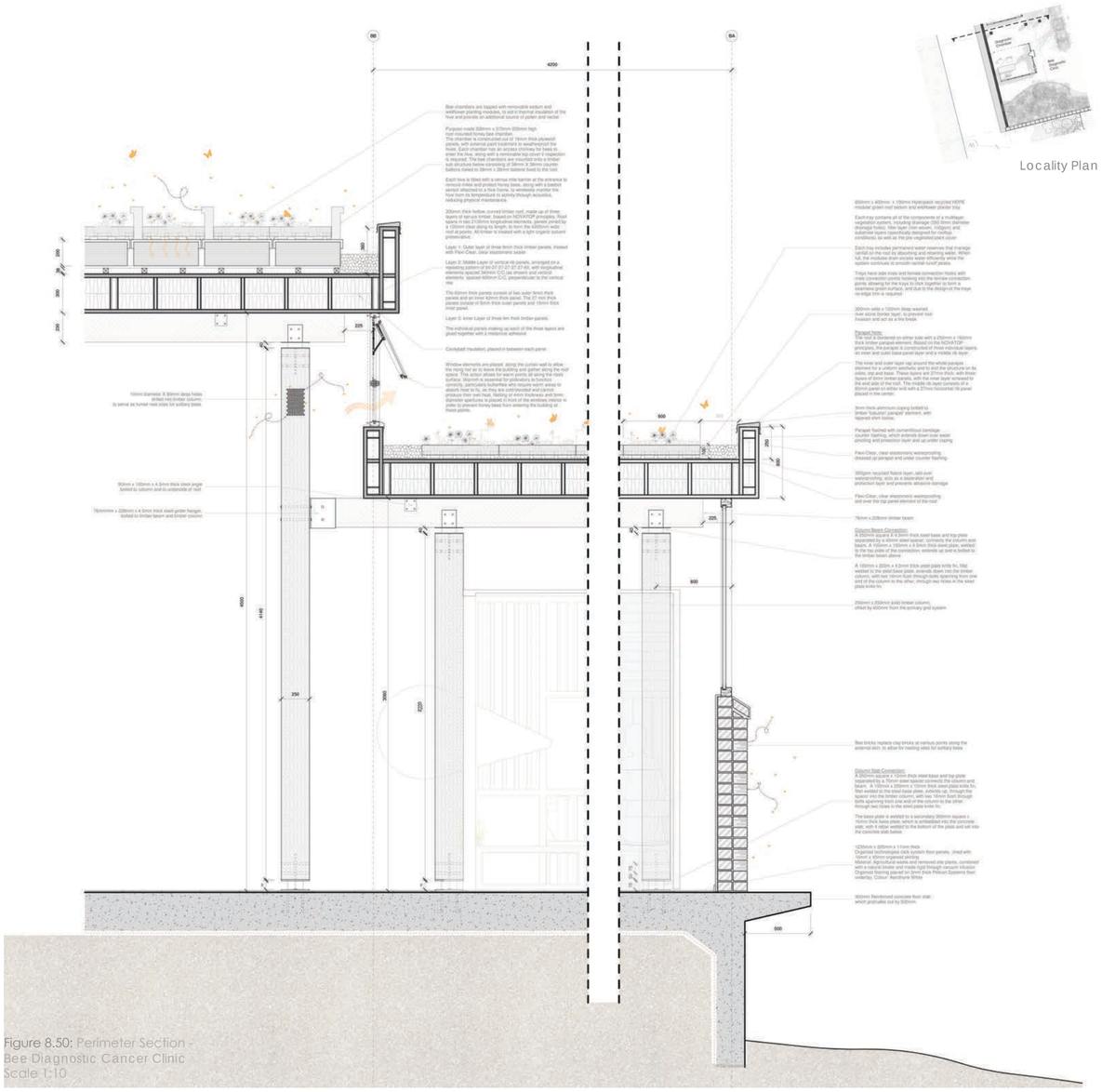


Figure 8.48: East Elevation

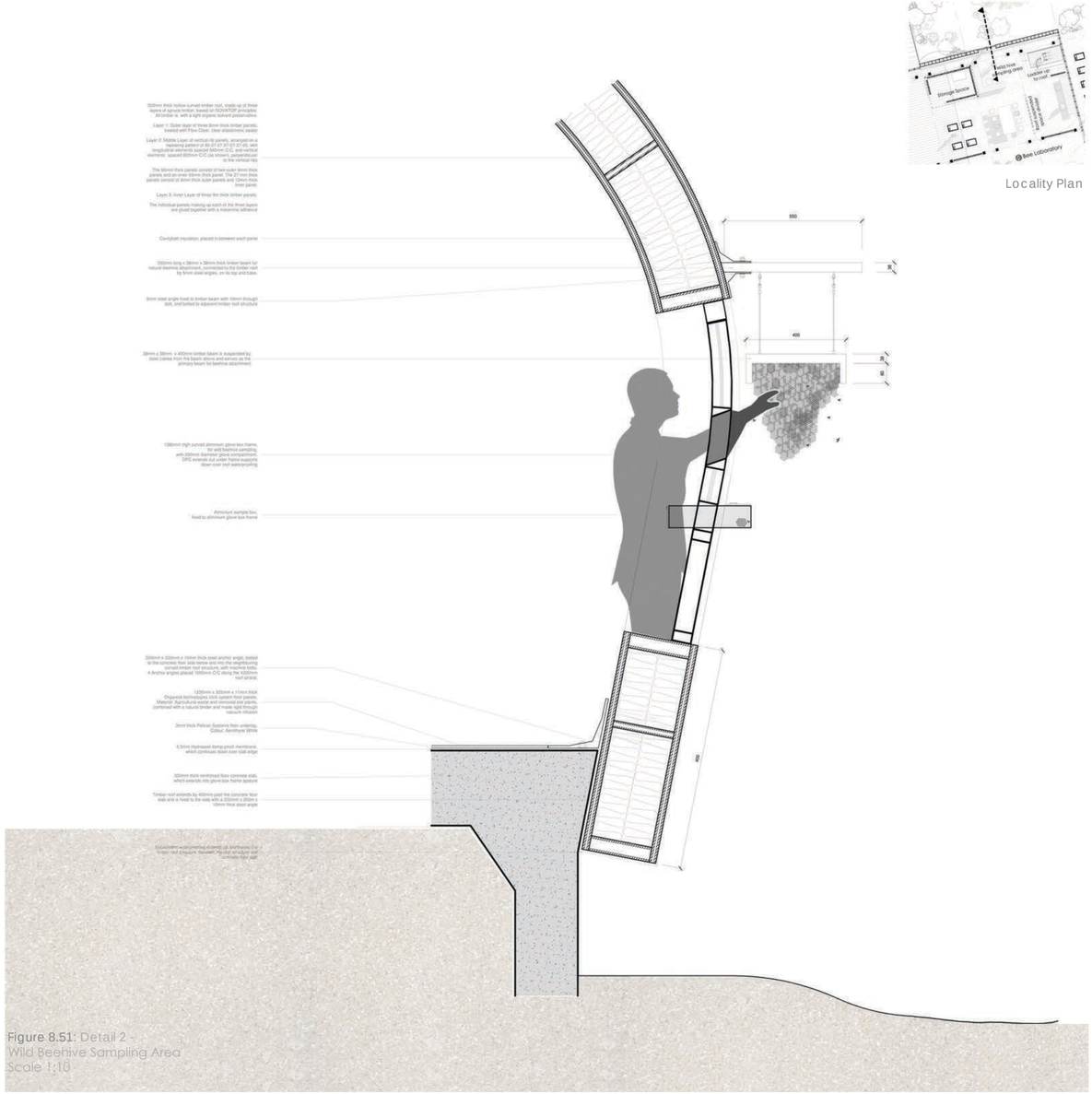


Figure 8.49: Primary Walkway - Section E-E
Scale 1:100



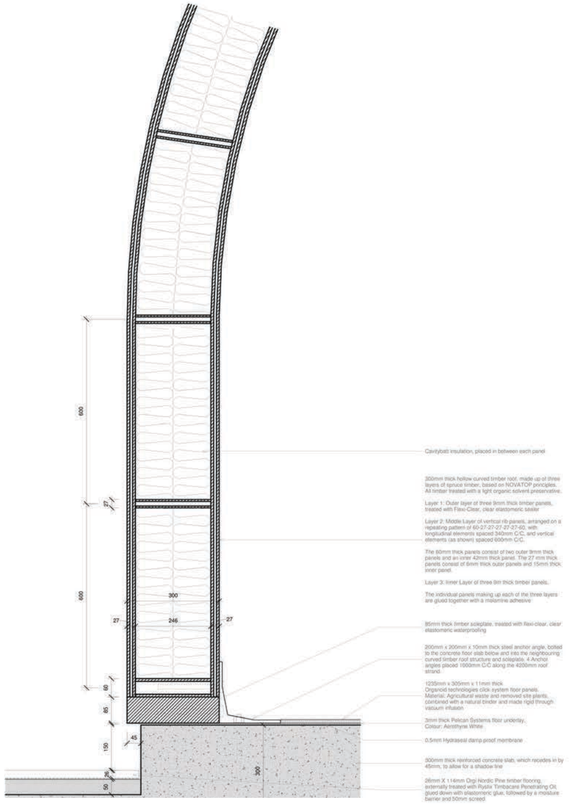
Locality Plan

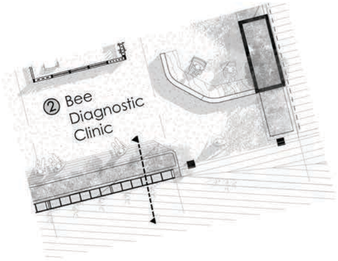
Figure 8.50: Perimeter Section - Bee Diagnostic Cancer Clinic Scale 1:10



Locality Plan

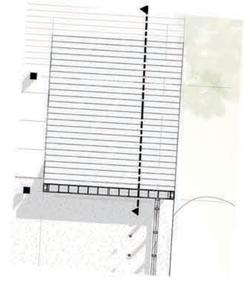
Figure 8.51: Detail 2 - Wild Beehive Sampling Area Scale 1:10





Locality Plan

Figure 8.52: Detail 3 -
Sloped Roof/Wall-esque Detail
Scale 1:5



Locality Plan

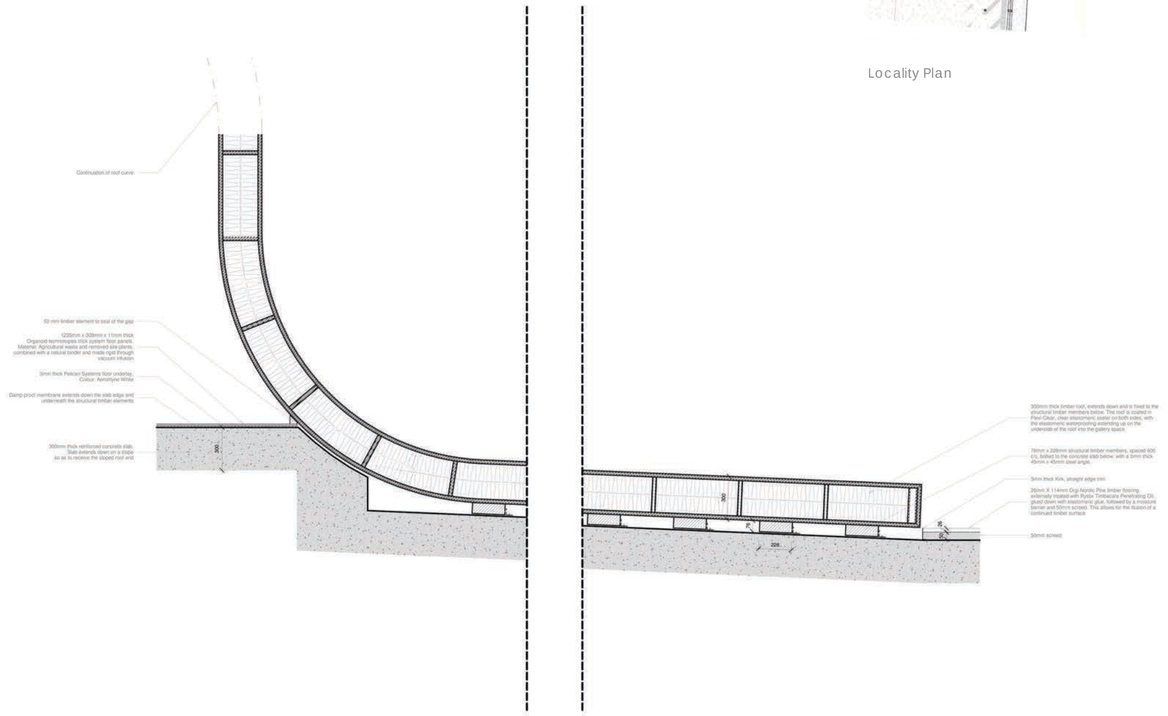


Figure 8.53: Detail 4 -
Sloped Roof Ground Connection
Scale 1:10

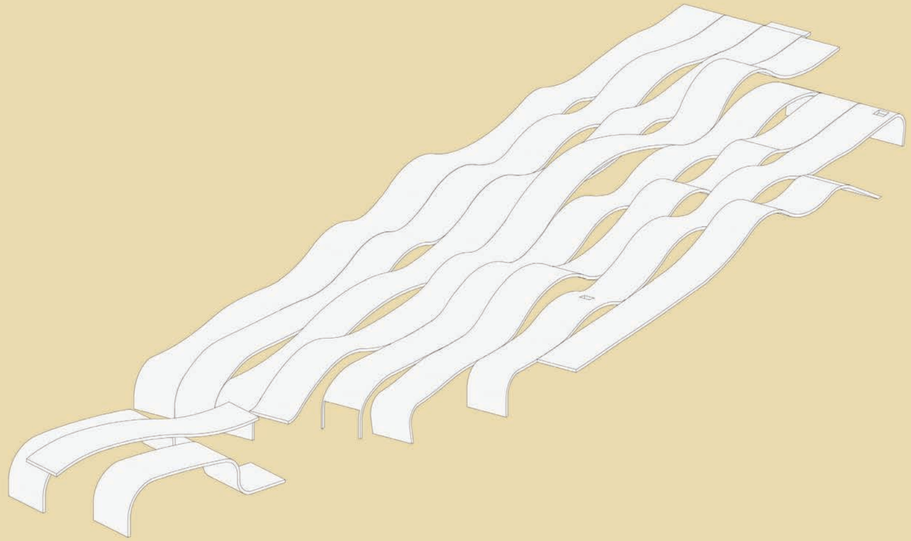
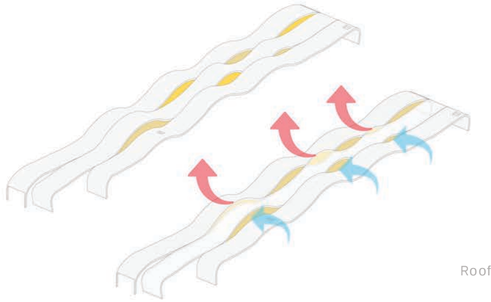
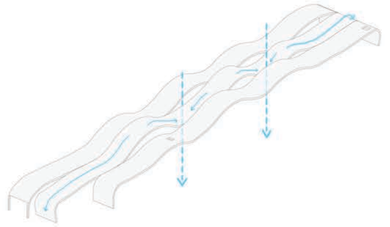


Figure 8.54: Overall Roof Form

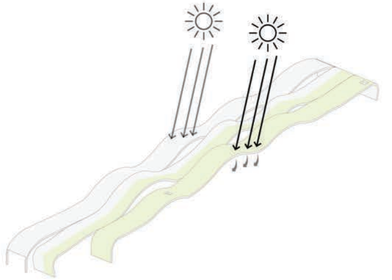
Direct Roof Access



Roof Ventilation



Roof Drainage



Thermal Benefits
of a Green Roof

Figure 8.55: Roof Diagrams

MODEL PHOTOGRAPHS

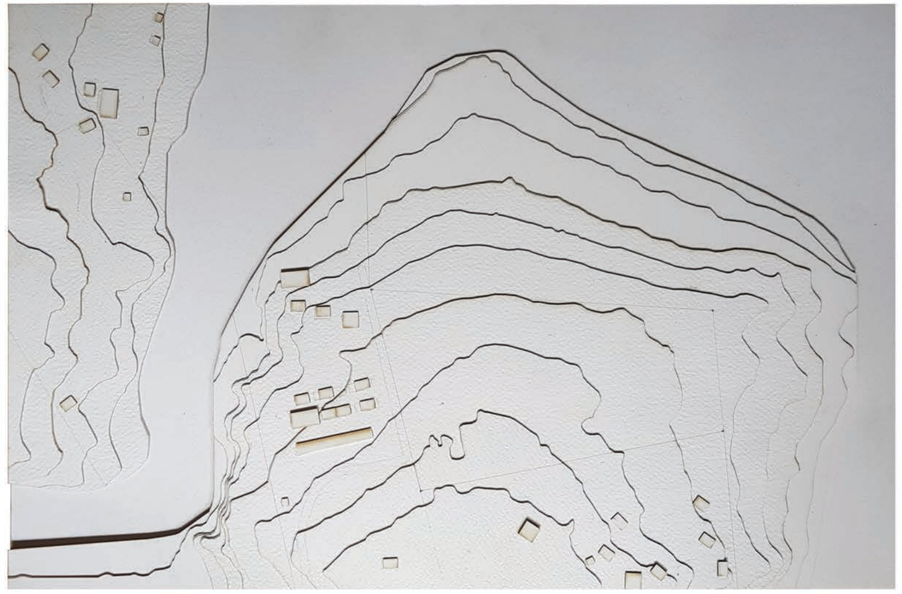


Figure 8.56: Context Model



Figure 8.57: Aerial View

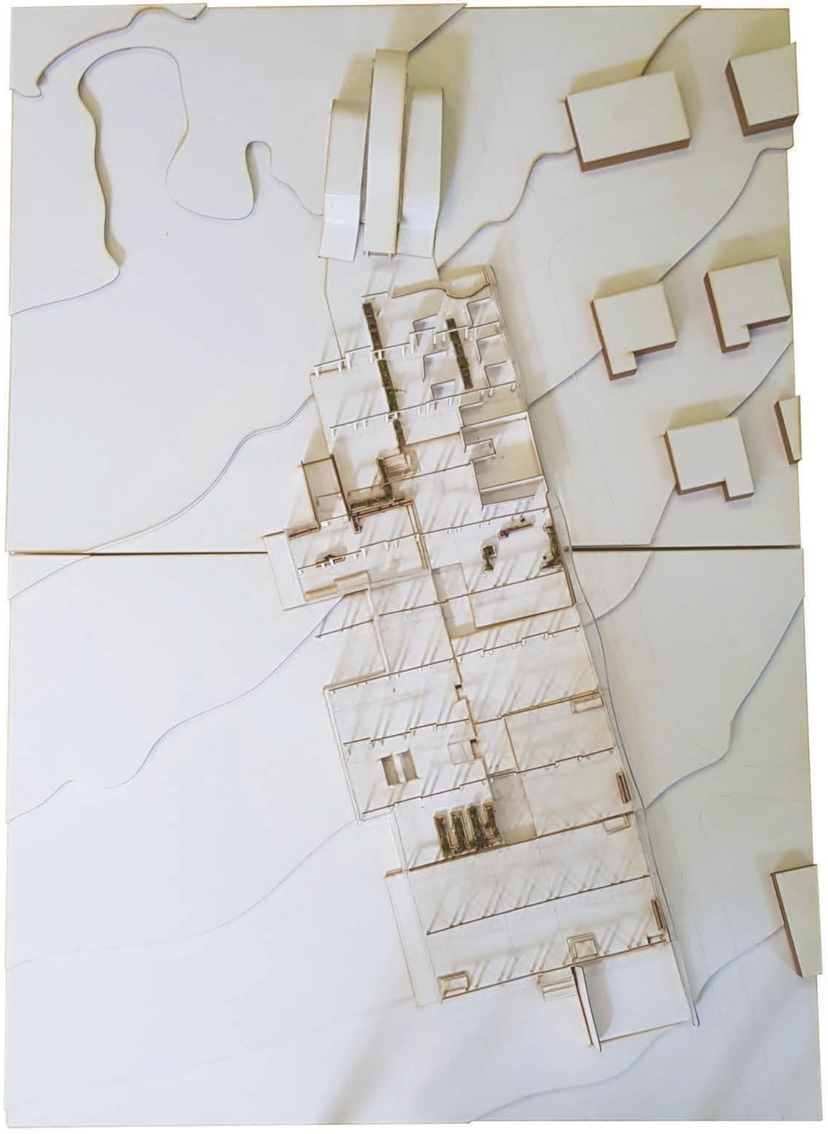


Figure 8.58: Aerial View, Roof Removed

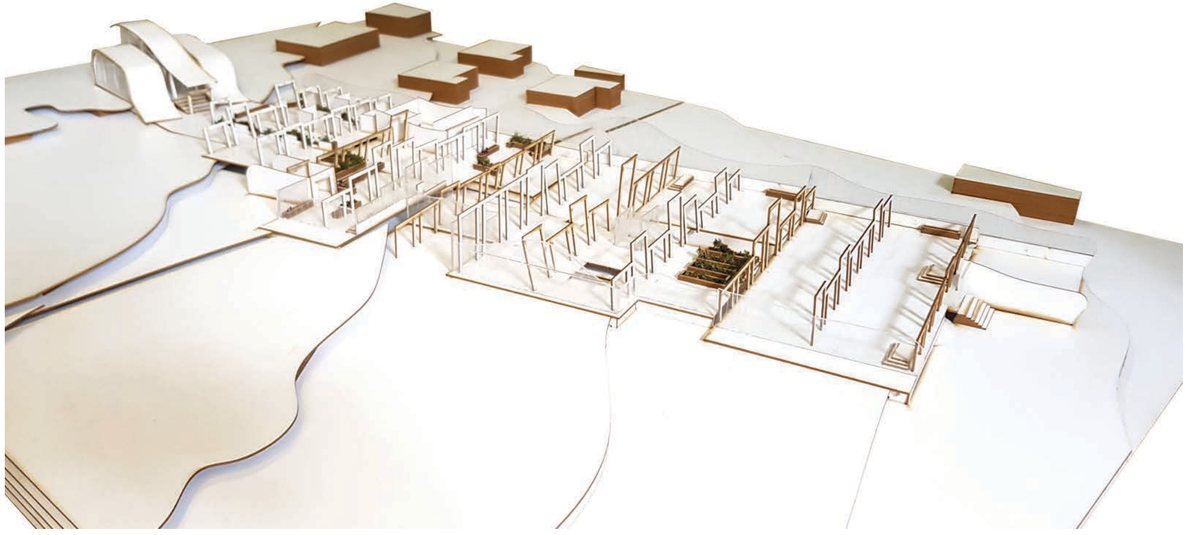


Figure 8.59: North East Perspective

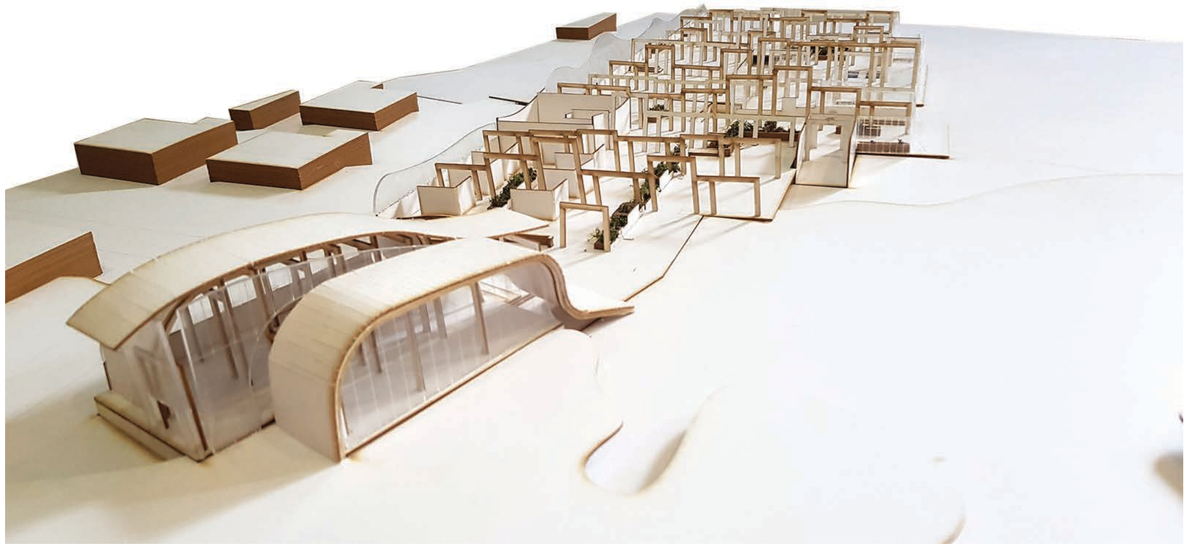


Figure 8.60: South East Perspective

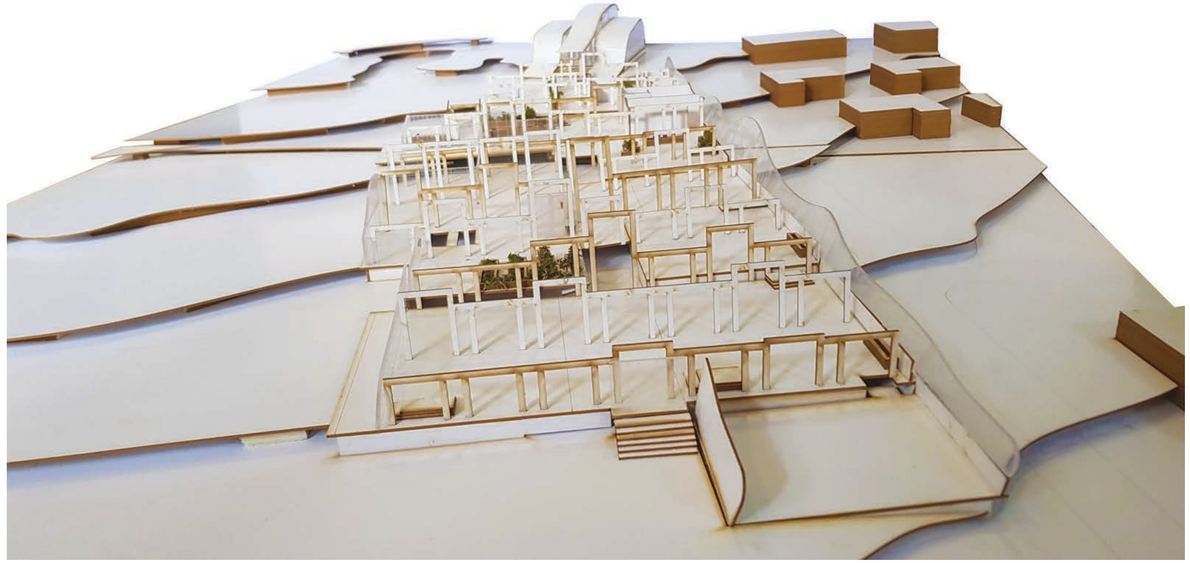


Figure 8.61: North Perspective

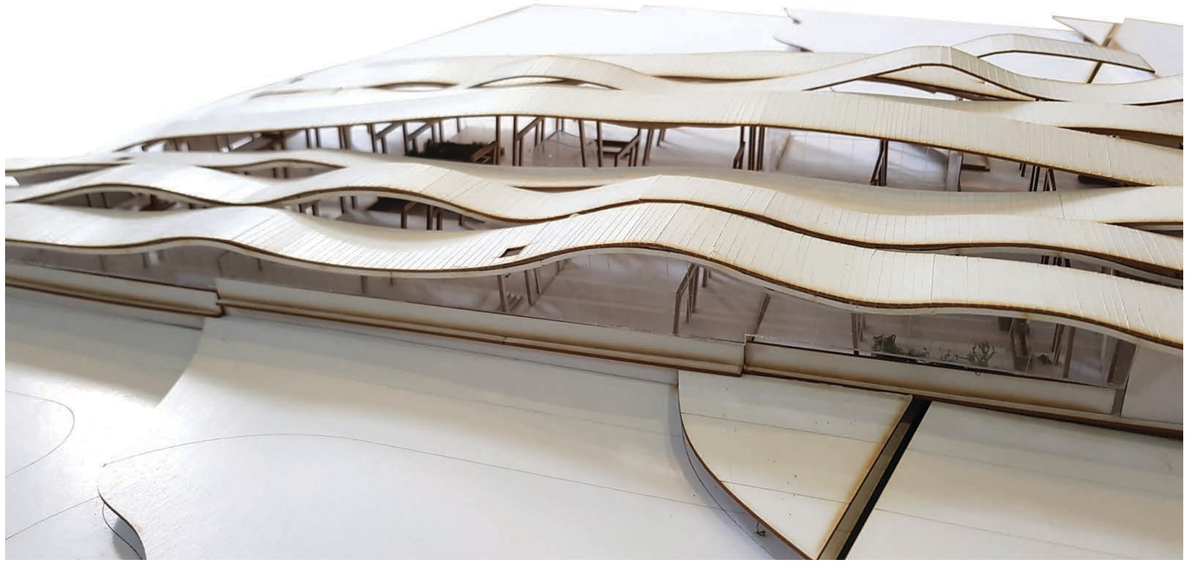


Figure 8.62: Curved Roof Perspective



Figure 8.63: Oscillating Timber Roof Perspective

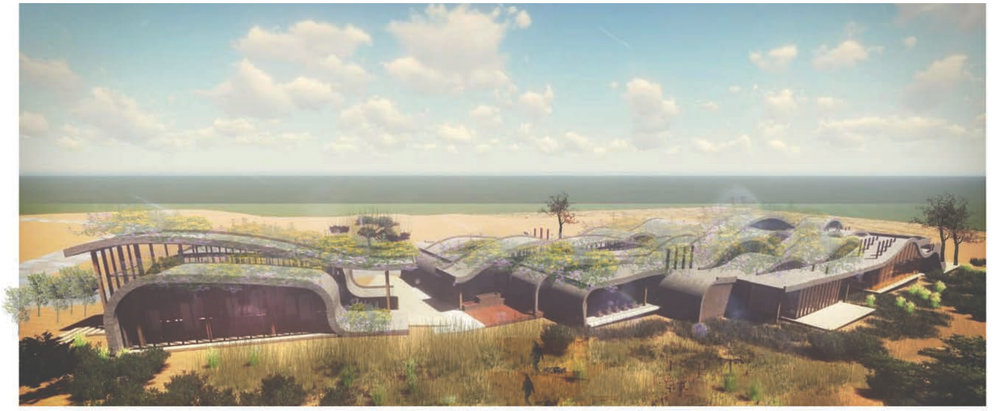


Figure 8.64: Rough Overall Scheme Perspective

09

"It is time," he said, "for me to tell you what I
should have told you five years ago, Harry.
Please sit down. I am going to tell you everything."

- Dumbledore, The Order of the Phoenix

OUR END, THEIR BEGINNING

EXPLAINED

_This chapter provides a concluding story of the future civilisation of humanity, along with a bibliography, list of figures and accuracy of online sources, ending off this thesis.

Our End, Their Beginning . . .

Story by Author



Figure 9.1: The Earth and The Galaxy

If every beginning has an end and every end marks a new beginning, then this is the story of the future generations beginning and the story of our end...

149 years ago, a cascading collapse of nature, known as the event, killed everything on earth, leaving the planet barren and uninhabitable. Fortunately, humanity had foreseen this devastating event, unable to stop it, they prepared for it, and so not everyone was on the ground when the final wave hit. At that time 5 space stations forming ORION, were in orbit, on which the surviving members of humanity lived for the next 149 years. Everyone dreamed of one day returning to the ground, breathing in fresh, un-filtered air. Life on ORION had been manageable, it had been the only life I had ever know, this was my reality.

Today marked year 150, and the day I would leave ORION. I had been selected as part of an exploration team to return to the ground and see if it was finally safe for us to return home. Anxiety and adrenaline swirled inside of me like a swarm of bees. I looked behind me as I stepped onto the shuttle, looking back at the only home I had ever known. First came the pulse of the rockets as we launched off ORION, next there was a burst, as we passed through the earths atmosphere and then a thud, we had landed...

We all stood in silence as passenger 35 pulled the lever to open the shuttle door, unsure if the air was even breathable. As the shuttle door opened, what I saw could only have been described as a sanctuary - a haven. We all carefully stepped out of the shuttle onto the soil below us, afraid to even speak, as if breaking the silence would somehow kill us all. Around us were so many trees and plants. To a first-generation member, this may have seemed sparse but to us, forth generation members, who had never seen a proper tree, to us we were surrounded by forests. We all glanced at each other exchanging looks, slowly stepping out the shuttle, breathing in fresh air for the first time. Passenger 3 burst into an infectious cheer. We were home...

We made our way towards the nearest shelter, that had been marked as a safe zone in the first few years of the event. As we passed through a mixture of trees and desolate wasteland, the excitement only grew, our world was fighting back to survive. When we arrived at the supposed location, what could be seen were plants for miles, surrounding a dam, with water that was not too blue and not too green but the perfect combination. This was the first time I had ever seen so much water.

We began searching all over for something that resembled an entrance, hoping this shelter could become the starting point for our new lives. Passenger 45 pointed out a small buzzing sound, to which passenger 15 suggested that we were all still acclimating, and that noise disorientation was normal. We were all willing to accept that until passenger 23 started to push away some vines, revealing what appeared to be some sort of cavity, as the vines were parted to reveal the cavity out came a swarm of honeybees. The last colony of bees alive.

A few of us descended into this dark enclosure. With our torches on, we all started to move towards a door, the first room. In this dark room was an old bed and a few shelves of canned food, with the floor lined with a muddy rug. To our surprise we noticed fungi and weeds growing along the frame of one of the shelving units, assumingly feeding of the artificial sunlight produced by the old ones tech. Passenger 7, a botanist, pointed out that the weeds were milkweeds and noticed various species of daisies growing around a bed frame. As we moved further in, we noticed how the plants had wrapped themselves all around the structure, appearing as a spiderweb of green intertwined with yellows and reds. Further in, the buzzing became louder, we were nearing the hive. As we turned the corner into what may have been a work area, passenger 6 jumped, as a winged creature flew passed her, with the help of light from our torches, the winged creature was identified as a monarch butterfly. As the torches moved around frantically to find this beautiful creature, someone spotted a beehive up in the far end of the room. This shelter appeared to have once been inhabited by the old ones, however all that remained now was an ecosystem of a few insects and plants, the last of their kind.

This space became the starting ground of BIO-SANCTUARY, a space once developed to help these species thrive and would now be used to help our species thrive and allow our world to be reborn. We discovered a room filled with research that must have been accumulated over decades. Following the research by growing plants, breeding these insects and researching all we could, BIO-SANCTUARY became the cure to protect our irreplaceable world and revive the endangered species of humanity.

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Figure 4.12: Bee Spotter
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CHAPTER 06

Figure 6.2: Warren of Subterranean Services
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Figure 6.9: Monarch Sanctuary
Joachim, M. (2019). *Monarch Butterfly Sanctuary Perspectives.* [image] Available at: http://onarch Butterfly Sanctuary. [online] Terreform.or [Accessed 27 May 2019].

Figure 6.10: Host & Nectar Garden Building
Host and Nectar Garden Building Perspectives. (2015). [image] Available at: Avail-able at: https://www.archdaily.com/772039/bioclimatic-prototype-of-a-host-and-nectar-garden-building-husos [Accessed 27 May 2019].

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Figure 6.12: Spidernethwood
Archdaily (2008). *Spidernethewood Perspectives.* [image] Available at: https://www.archdaily.com/1878/spidernethewood-rsien [Accessed 25 May 2019].

Figure 6.13: A Scaffolding System for a Temporary Facility
Archdaily (2016). *Scaffolding System Perspectives.* [image] Available at: https://www.archdaily.com/796646/a-scaffolding-system-for-a-temporary-facility-peris-plus-torarquitectes [Accessed 18 Jun. 2019].

CHAPTER 07

Figure 7.1: Re-defining the surface - collage by Author, edited images from:
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Figure 8.1: An Artificial Environment - collage by Author, with images from:
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Figure 8.6: The cascading veil, amongst the blurred building forms - collage, and pollinator sketches by author. Additional images from:
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Figure 8.18: Buzz.ar Community Centre
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CHAPTER 09

Figure 9.1: The Earth and The Galaxy
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ACCURACY & VALIDITY OF ONLINE SOURCES

*Excluding precedent sources, peer-reviewed sources, government websites and product websites.

Carolina was founded by Dr Thomas E. Powell, a geology and biology professor of Elon University. Having partnered with NASA, doctors and schools across America, Carolina has become a worldwide and trusted leading supplier of science teaching materials. Their staff include members who both formerly and currently work in the field of science. The selected article tilted *Bees, Butterflies, and Flowers* was written by Brent Atkinson, a biomedical product development consultant, who studied at Columbia University. The information provided by this company's website can thus be considered both trustworthy and valid as the information published is written by people educated in the field of science and biology, who have both the experience and knowledge.

Base Structures is a tensile architecture firm based in the United Kingdom. Having worked not only in the UK but also with projects in America, France, Denmark, Brazil and Iraq, Base Structures has established itself as leading contractors for complex tensile architecture. The information provided by this firm, with regards to tensile architecture and its required materials, can thus be considered both trustworthy and valid due to their years of experience and expert knowledge.

The Beecology Project was founded by Dr Robert Gegear as a means to increase ecological knowledge of pollinators, in order to develop effective conservation and restoration strategies for threatened species. Dr Robert Gegear is an assistant professor for the Department of Biology at the University of Massachusetts Dartmouth, who studies animal sensory and cognitive systems within the contexts of evolutionary ecology and conservation biology. The Beecology Project is backed by the National Science Foundation. With all this in mind, one can take the information provided by this source, with regards to pollinator decline, to not only be accurate but also reliable.

The definition of habitat degradation, provided by **Biodiversity A-Z** is accepted as being accurate and trustworthy as Biodiversty A-Z compiles the information depicted on its website from various sources including the official documents of international conventions, academic publications and reports from a number of relevant international organisations. The information depicted on this site is both written and reviewed by experts in the relevant fields before being published. In addition, Biodiversity A-Z is also affiliated with The UN Environment Programme World Conservation Monitoring Centre. This centre is a world leader in biodiversity knowledge and similarly to Biodiversity A-Z, works with scientists and policy makers all over the world. This association adds an additional level of prestige and accreditation to the validity of the work published on Biodiversity A-Z.

BioKIDS is an educational research group aimed at improving biology and science learning throughout schools, particularly those located in high-poverty, urban areas. BioKIDS consists of various members with educational and science degrees, such as Phil Myers who is a Professor in the Department of Ecology and Evolution at the University of Michigan and Doctor Tricia Jones, who has a Ph.D. in Educational Technology from the University of Michigan. The author and editor of the selected article is George Hammond, who has a Master of Science degree in Biology from the University of Michigan and has done both filed research with insects and over 10 years of undergraduate teaching experience. BioKIDS is thus able to provide accurate and valid information with regards to the information published on their website, due to the expert knowledge provided by their educated and qualified members.

BONE Structure consists of over sixty architects, engineers, industrial designers and interior designers and focus on steel construction. BONE Structure create high-performance homes through a patented steel construction system, produced through an industrialized process inspired by the aerospace industry, producing minimal waste. In addition to the large number of educated members, BONE Structure is a member of the builder's association across Canada and has won numerous awards including the 2008 Contech Innovative technologies trophy and The Dunamis Award for innovation and sustainability. Together with the large number of educated members, years or experience and professional accreditation and acknowledgment, one can accept the information on steel construction, provided by BONE Structure, to be both accurate and trustworthy.

Butterfly Conservation, as an organisation, aims to improve the dire consequences facing butterflies and moths on a global scale. This organisation is the world's largest research institute for butterflies and moths and consists of over 31000 members, including 80 highly qualified scientist, with Sir David Attenborough existing as the president of this organisation. Sir David Attenborough has been at the forefront of global conservation for more than 60 years. This level of prestige and knowledge together with the expertise of their educated members allows one to accept the information published by Butterfly Conservations as being accurate and valid.

Contours Landscapes is a landscaping firm with over 14 years of experience and was awarded the SALI gold award of excellence in 2018. They have carried out over 700 projects and won 22 awards. Thus the information provided by Contour Landscapes, with regards to various planting methods and living green walls, can be considered to be both trustworthy and accurate, due to their expert knowledge and years of experience.

The Guardian is a British daily newspaper founded in 1821 and is world renowned and the same can be said for their Online edition. The articles selected from The Guardian Online edition are written both by Damian Carrington, the environment editor for the Guardian and John Watts, the global environment editor for the Guardian. Damian Carrington has a PhD and post-doc research in geology from Edinburgh University and has written over 2000 stories for the Guardian since his start in 2008. Damian's education together with his and John Watts's years of experience in the world of climate change and environmental issues allows for their work to be considered both accurate and trustworthy.

The Eden Project is a botanical garden consisting of two biomes of plants collected from many diverse climates and environments and aims to demonstrate the importance of plants in humanitY's survival. As a project with a botanical garden focus, the Eden Project conducted extensive research and sought out advise from multiple individuals educated in various fields of botany, entomology and biology in order to create biomes that would survive both naturally and through human intervention. This necessity, in addition to being a place of plant education, ensures that the definition of pollination provided by the Eden Project's website can be considered accurate.

Sciencing, started out as a trusted math textbook and then developed into an online platform providing the latest news in the world of math, science, biology and nature. The team at Sciencing consist of writers with degrees from molecular and cellular biology to degrees in chemistry. The selected article, titled *What is the Life Span of a Honey Bee*, was written by Claire Gillespire. Claire is a writer and editor with 18 years of experience, and together with writing articles for Sciencing, she has also written for Reader's Digest and Health Central. Claire's years of experience and gained knowledge, together with the educated editorial and writing staff of Sciencing, allows the information published on this company's website to be considered both trustworthy and valid as the information published is written by people educated in the field of science and biology, who have both the experience and knowledge.

With over 20 years of experience and numerous education awards, **ThoughtCo** is a website focused on creating education driven content. ThoughtCo produces content from science and math to religion and architecture, written by writers, experienced instructors and experts relevant to the chosen field. The selected article, titled *How Honey Bees Keep Warm in Winter*, was written by Debbie Hadley. Debbie has over 25 years of science education experience and has written entomology-based articles for over

a decade. In addition, to her experience, Debbie has a degree in political sciences, a background in marine science and has volunteered for 13 Earthwatch programmes. Earthwatch is a non-profit environmental organization uniting scientists and individuals for global betterment. Her level of experience, together with her expert knowledge ensures that the information published on ThoughtCo, is both accurate and trustworthy.

Laidback Gardener is a blog run by Larry Hodgson, who has over 30 years of experience in the world of horticulture. His career includes editor-in-chief of HousePlant Magazine, Fleurs, Plantes et Jardins and Houseplant Forum Magazine, all of which are renowned and respected gardening magazines. He has written over 50 books about various horticulture topics including The Garden Lover's Guide to Canada, Complete Guide to Houseplants and Houseplants for Dummies. His dedication to gardening and plants has allowed him to learn a lot about pollinators and their interaction with various plants and flowers. The information provided by Larry Hodgson with regards to pollinators and their interaction with flowering plants can thus be considered both trustworthy and valid due to his years of experience and expert knowledge.

Founded in 1990 **Home Insulations** has established itself as a leading and trustworthy insulation installer and supplier, with offices in Johannesburg, Pretoria and the Western Cape. Home Insulations currently has over 25 years of experience, 22 780 completed projects and 28 employed skilled professionals. Their experience and acquired knowledge ensures that the information published on their website is both accurate and trustworthy.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body, established by United Nation members in 2012. The aim of IPBES is to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development. With over 100 government members and a continued growing membership of experts, IPBES has established itself as a body responsible for providing a high level of expert driven knowledge that is both accurate and credible.

Iron Shell Material Technologies was founded by Doctor David Stone. Doctor David Stone studied environmental iron chemistry at the University of Arizona and is the creator of Ferrock. He has spent 8 years doing various field tests, along with the assistance and advisement of Dr Narayanan Neithalath. Doctor Neithalath is a Professor in the School of Sustainable Engineering and the Built Environment at Arizona State University. He is also Senior Sustainability Scientist in the Julie Ann Wrigley Global Institute of Sustainability. Due to the level of expert knowledge and skill, together with Iron Shell Material Technologies' founder having developed Ferrock the information on this company's website about Ferrock, can be accepted as both accurate and trustworthy.

Popular Mechanics Magazine, together with its Online edition, provides their audience with latest news spanning a wide range of topics from the automotive industry and technology to science and outdoor spaces. Since 1902 Popular Mechanics publishes work with the aim of explaining how the world works and does so by ensuring the writers of such articles are well versed in the subject matter and have the necessary skills and credentials. The selected article titled *The Staggering Worldwide Decline of Insects Is a Warning of Ecosystem Collapse,* was written by Jill Kiedaisch. Jill is a regular contributor to Popular Mechanics and graduated with a BA in Environmental Science from Middlebury College and is thus well versed in issues facing the environment. Together with Jills credentials and the prestige of Popular Mechanics the information presented in the selected article can be accepted as valid, accurate and reliable.

The British Broadcasting Company (BBC) news division is world renowned and valued for its high factual reporting due to proper sourcing of information. The selected article titled *Can tech keep the world's bees buzzing,* was written by Zoe Kleinman. Zoe Kleinman is a BBC Presenter & Senior Reporter, specialising in technology and business, with years of experience reporting on technological innovations. Kleinmans's experience together with BBC's proper sourcing of information, allows the information presented in the selected article to be understood as both factually accurate and dependable.

The Kloof Conservancy BioGuide serves as an Online reference site and mapping project aimed at improving peoples experience of the Krantzkloof Nature Reserve. This project and the online information it provides' is done so to educate people on topics of biodiversity through easy-to-use technology. The Kloof Conservancy was founded in 1993 in order to promote environmental awareness and increase conservation efforts throughout South Africa. The years of experience has allowed the Kloof Conservancy members to garner important, first-hand knowledge on the lives of butterflies, allowing the information published on this website to be both accurate and reliable.

Techworld has been a leader in technology publishing for more than a decade and exists as a digital platform providing the latest news and opinions on technological innovations. Techworld analyses these innovations providing expert advice on various topics, ranging from mobile apps to cyber security. As a subsidiary of IDG (the world's leading technology media, marketing and data services company) Techworld's articles carry with them a high level of status and ensured accuracy with regards to the chosen content.

Mason Bees for Sale is an online shop that specialise in bee related products, from nesting materials and bee houses to live mason bees for agricultural purposes, along with providing information on bees from becoming a beekeeper to the qualities of both solitary and honeybees. Years of professional experience and the required knowledge that is required to work with live bees, ensures that the information provided on this website, regarding the characteristics and lifestyles of bees, can be regarded as being both truthful and reliable.

The Conversation is a non-profit, organisation and exists as an independent source of news from various academic and research communities. The Conversation consists of a team of professional editors who work closely with university and research experts to compile their knowledge in an easy to read and accessible format. Some of their affiliations include The University of Sheffield (UK), Pretoria University and The University of Cape Town.

The selected article tilted *Artificial environments are turning the world outside in, but that's no way to save the planet*, was written by Simon Marvin and Jonathan Rutherford. Simon Marvin is the director of the Urban Institute at The University of Sheffield and has contributed considerably to major issues within the urban and planning realm, addressing important research around sustainability and ecological security, to name a few. Jonathan Rutherford is a visiting research fellow at The University of Sheffield, whose research focuses on infrastructure and urban technology. Together these writers, with their levels of expert knowledge and years of experience, along with the professional editors of The Conversation, ensure that the information presented not only in this article but on The Conversation's website is both reliable and valid.

Mr Stacky is a hydroponic planting company who is invested in approaching the ideas of food production in urban areas from a new perspective. This company's mission is to align food production with charitable causes to establish and develop communities and provide food security to vulnerable and underprivileged communities, all while educating people on the benefits of hydroponics. Mr Stacky's specific expertise in the filed of hydroponics, (which has allowed the company to flourish and succeed) allows for the information published on the companies website, about the pros and cons of hydroponics versus traditional growing methods, to be regarded as valid and reliable.

The National Geographic Society is a globally recognised organisation dedicated to exploring and defending the planet we, as humanity, call home. As an organisation they fund hundreds of research and conservation projects globally and have established themselves as a globally trusted and credible institution in the areas of science, education and exploration. It is because of this status and the years of experience and knowledge of their educated members that the information on key stone species, provided by their website, can be regarded as precise and truthful.

No Soil Solutions is a blog-like website set up by a garden enthusiast turned hydroponic expert, who uses his blog to exhibit his experience in hydroponics and provide valuable information on the aforementioned subject matter, based on his many years of practical experience. This invaluable knowledge gained though years of practical experience allows the information provided on this website, about hydroponic growing systems, to be regarded as both accurate and trustworthy.

Khan Academy is a non-profit, online educational organisation with the goal of providing quality education on an online platform through practice exercises and instructional videos. Khan Academy covers various subjects such as math, science and history, with the material produced for these courses being created by educated individuals, with degrees and practical experience in the required field. Since Khan Academy's videos are created by experienced and educated individuals one can trust the information produced by Khan Academy and accept it as being accurate and reliable.

The Rewilding Earth Institute was founded by Dave Forman, an American environmentalist and was established as an organisation to develop and promote ideas of conservation in North America. This organisation consists of a large number of influential scholars, activists and conservationists in the rewilding field with years of practical experience and professional expertise. This organisations website provides essential information about rewilding and conservation efforts currently being carried out across America. The years of experience coupled with the expertise of the organisations members, ensures that the information published on this website is both reliable and valid with regards to rewilding and nature conservation.

Rewilding Europe is a non-profit organisation, registered in the Netherlands and aims to create more places across Europe for nature to flourish and return to its natural process, currently overseeing eight large rewilding projects across Europe. Frans Schepers, the managing director and co-founder of Rewilding Europe, has over 30 years of professional experience in developing conservation strategies, species conservation, ecological networks and working in the field of rewilding. With a degree in forestry, land and water management, Schepers has had various conservation and nature based jobs, from working as a conservationist in the Dutch Government to working for the World Wildlife Fund for 14 years, with an interest in rewilding natural landscapes and providing the opportunity for nature and wildlife to bounce back in an environment that benefits all. Together with Schepers professional experience and knowledge, Rewilding Europe has established itself as trusted and formidable member in the fight against environmental collapse and rewilding projects, which is the reason why the information provided by Rewilding Europe on the topic of rewilding, can be considered both valid and accurate.

The South African National Biodiversity Institute (SANBI) is branch of the Department of Environmental Affairs and exists as an organisation who coordinates and leads research and monitors and reports on the state of biodiversity in South Africa. SANBI contributes to South Africa's sustainable development by enabling access to biodiversity data and generates information and knowledge based both on their research conducted and expertise of their expert members. Affiliated with The Botanical Society of South Africa, The National Research Foundation and The World Wildlife Fund, to name a few, SANBI has established itself as a leader in the exploration and exhibition of South Africa's unique Biodiversity. It is because of SANBI's prestige, expertise of their members and the wealth of knowledge that they both procure and produce that one can accept the information published under SANBI, with regards to the environment and pollinators, to be both reliable and correct.

Smart Solar Tech is a solar and renewable energy company located in South Africa, specialising in solar technology, insulation, roofing and rainwater harvesting. With expertise in solar technology and rainwater harvesting, together with over 5 years of practical experience in the South African climate, the information provided by Smart Solar Tech with regards to solar panels and rainwater harvesting in South Africa, can be regarded as both valid and accurate.

Phys Org is a branch of Science X, a leading online science, technology and research news service. Science X was founded in 2004 by two PhD students, with the aim of publishing science related news for educated and informed readers and covers a full range of topics from medicine and biology to nano-technology and engineering. Science X writers and editors include members with degrees from bio-chemistry too nano-engineering, ensuring that the articles published include accurate and trustworthy information, with relevance to what is happening in the world of science. One such member, the author of the selected article titled *Can Solar Energy Save The Bees*, is Argonne National Laboratory. Argonne is a renowned multidisciplinary engineering and science research centre, where leading researches and scientists work together to answer some of society's greatest questions. Working in tandem with universities, leading science industries and national laboratories. Argonne strives to improve the environment and society through its innovations. Considering both the level of knowledge and prestige surrounding both Science X and Argonne, the information provided by Phys Org, with regards to solar energy and bees, can be accepted as both valid and reliable.

Ehrlich is a pest control company founded in 1928, and after 85 years of professional experience, today includes over 750 pest control specialists. Ehrlich makes us of an in-house research and development team along will skilled and experienced entomologists. With their many years of experience and professional expertise one can trust the information provided by Ehrlich on plants favoured by bees, to be both trustworthy and accurate.

The True Nature Foundation leads and supports various conservation and ecological restoration efforts, efforts that benefit both people and their environment. With their headquarters in the Netherlands and branches in Germany, Spain, Portugal, Ukraine and Romania, together with their educated team who have backgrounds in life sciences, genetics, endangered species and protected area management, the True Nature Foundation can be understood as having expert knowledge and valid opinions when it comes to issues on the environment. This level of expert knowledge coupled with their years of experience allows the information published on their website, about the environment and related issues to be considered both accurate and trustworthy.

The Huffington Post is an American news and opinion blog which launched in 2005. The Huffington Post works on the ideology of putting people first, writing stories that they believe their readers are interested in, considering the curiosity and needs of their readers. The Huffington Post strives to be accurate and transparent in their reporting, ensuring a fair and independent analysis of the facts and being thorough with their sourcing. In addition, this publication aims to ensure accuracy in their reporting by collaborating information via multiple sources. This level of fact checking and sourcing of information allows one to understand the articles published by The Huffington Post to thus be accurate and reliable. Moreover, the selected article, tilted *The Rapid Decline of The Natural World Is A Crisis Even Bigger Than Climate Change*, was written by John Vidal, who has written for various publications, including serving as the environment editor for the Guardian newspaper for 27 years. The Huffington Post's prestige and rigorous fact checking, together with Vidal's experience in the realm of environmental issues ensures that the information published in the selected article can be accepted as both valid and trustworthy.

10

"Until the very end."

- James Potter, The Deathly Hallows

APPENDIX

EXPLAINED

_This chapter includes additional documentation , specifically ethical clearance and a plagiarism report.

ETHICAL CLEARANCE



SCHOOL OF ARCHITECTURE AND PLANNING
HUMAN RESERCH ETHICS COMMITTEE

SCHOOL OF ARCHITECTURE PLANNING

CLEARANCE CERTIFICATE
PROTOCOL NUMBER: SOAP033/03/2019

PROJECT TITLE:	Expecto Patronum: Protecting the irreplaceable by creating a Bio-sanctuary to cultivate and sustain South Africa's endangered pollinator species
INVESTIGATOR/S:	Kyle Eldery (Student No: 731523)
SCHOOL:	Architecture and Planning
DEGREE PROGRAMME:	Masters of Architecture Professional (MArch Prof)
DATE CONSIDERED:	12 July 2019
EXPIRY DATE:	12 July 2020
DECISION OF THE COMMITTEE:	Approved

CHAIRPERSON B C Boshoff
(Dr Brian Boshoff

DATE: 16/7/19

cc: Supervisor/s: Kirsten Doermann

DECLARATION OF INVESTIGATORS
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to endure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

Signature K Eldery **Date** 18 July 2019

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