



rehabilitation + resilience

A MEDIATION BETWEEN LANDSCAPE & SOCIETY

by Verney K.W Moyo

Year: April 2021



Figure 1 (Cover) : An Introduction to Site

Figure 1 is a working drawing that sought to bring to light potentially design informing aspects of the site. A later iteration, the design was overlayed ontop of it to explore the array of relationships that could be created. Drawn by Author

Figure 2 (Above): A Troubled Landscape

The above sketch shows the main problems currently affecting the witwatersrand landscape today: namely erosion & pollution of soil & open water sources. Drawn by Author

REHABILITATION & RESILIENCE

a thesis for the school of the built environment
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Johannesburg, South Africa

Written by: **Verney K.W Moyo** (BAS) & (BAS Hons)

Year: 12th April 2021

Course: Masters in Architecture

DECLARATION:

I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong. I confirm that ALL the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise. I have followed the required conventions in referencing the thoughts and ideas of others. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signed.....

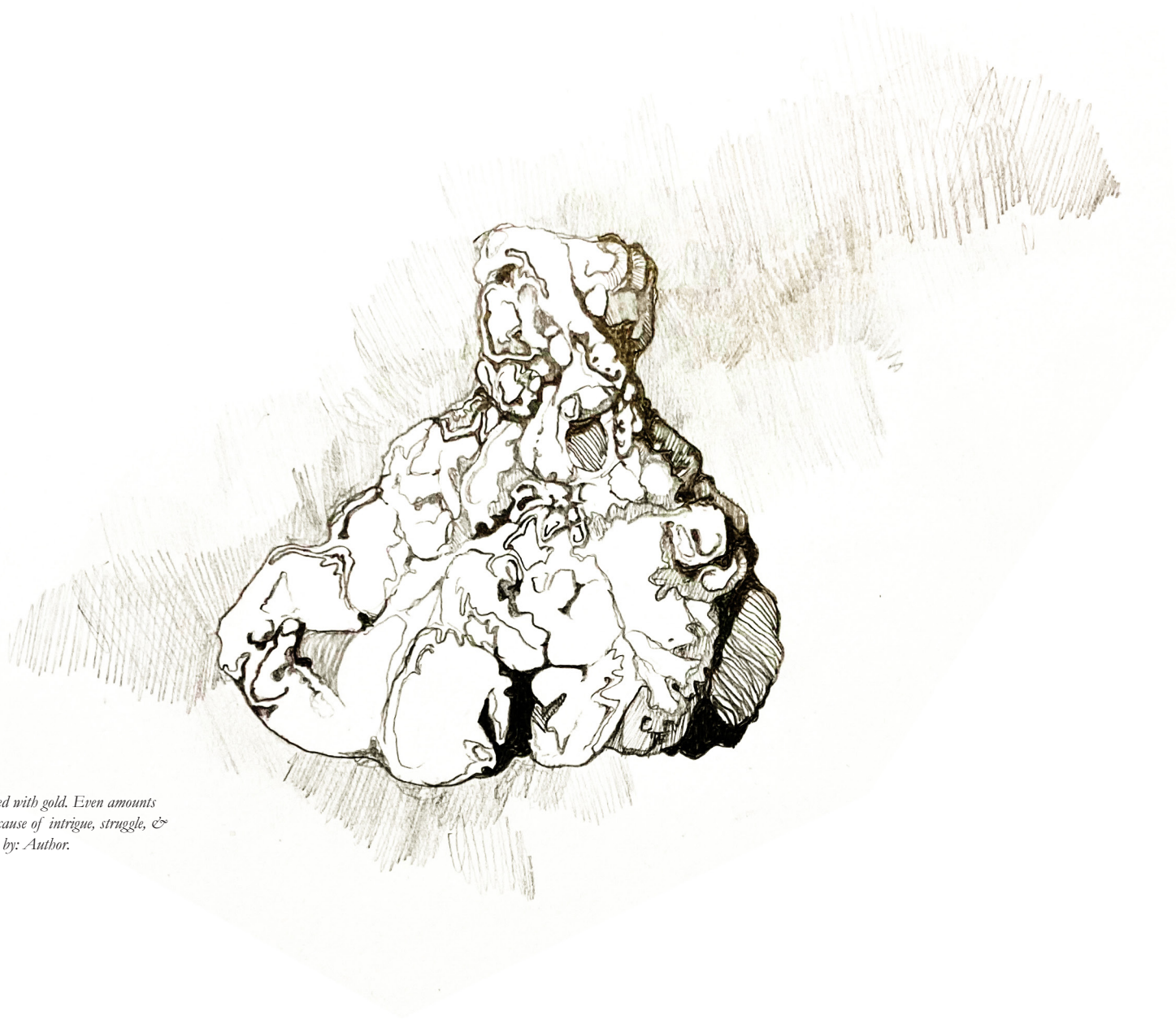


Figure 3 : A Nugget of the Story

Johannesburg's history is inexplicably linked with gold. Even amounts as small as that pictured above can be the cause of intrigue, struggle, & fortune; as witnessed in years past. Drawn by: Author.

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FOREWORD

As many who have come before me acknowledge; the relationship between Johannesburg and gold is a long and complicated one. The two are hopelessly and inextricably linked. Gold is Jo-burg and Jo-burg is gold. It's baked right into names such as Egoli, meaning “place of gold” in the language of the Sotho. Love and hate, war and peace; gold has found its way into all the forays and climactic events of this city's past. Though we owe it much, like all relationships it has its fair share of issues and problems. When our direct relationship with gold ended in 1970, we were left with 90 years of accumulated baggage...baggage that still haunts us today.

On a personal note, this all began from a desire to realise architecture's potential in effectively rehabilitating troubled landscapes; landscapes similar to the one that the legacy of gold here in Johannesburg has left us. It came from a place of responsibility; from a desire to inspire society to pick-up after itself, to think of the future and not solely of the immediate. The first, and perhaps most difficult step was coming to grips with the realities of the problem; an exercise that pushed me far beyond my own common and accepted boundaries. I had to learn new things quickly, and after that, present a solution to a problem we have been scratching our heads about for at least the last 50 years. It is my hope that the theories and interventions herein are – if not a rigorous and faithful response to these pressing issues– at least the beginning of a conversation into how buildings can reframe our relationships with this particular dead landscape.

Thank you for taking the team to read it. I hope you will find it inspiring.

Kind Regards

Verney K.W Moyo

AKNOWLEDGEMENTS

THE MAJORITY OF INSPIRATIONS for this thesis arose from sometimes ad hoc conversations with my peers regarding landscape and architecture. Chief amongst these contributors is a colleague I have come to deeply respect over the years; Michael Kevin Watson, whose untiring interest in the topic helped me develop a good share of my ideas. Another is Jonathan Melamdowitz, whose own thesis is based in the same area and whose deep knowledge helped me lay the ground work for this thesis. Lastly, and perhaps most importantly is doctor Sechaba Maape, my appointed supervisor, who rolled up his sleeves and got his hands dirty in the attempt to help me develop my ideas. Absent his reprimands, recommendations, and most of all encouragement this thesis may not have been realised.

Another individual

I thank you all!

ABSTRACT

An overview:

This thesis is centred around 2, pivotal questions. Firstly, what is architecture's agency in the rehabilitation of troubled landscapes, and secondly, how can it retain agency past this initial remit. We live in an age where the planet is threatened by climate change and other man-made environmental disasters, an age of consumerism where few things remain untouched by capitalist centred materialisms.

By designing a structure/structure of systems that challenges broken landscapes this research poses the idea that we have a chance of stopping our steady march toward the brink of oblivion – indeed, perhaps even to turn back the hands of time to right some of the ecological harm we have already effected; often for economic gain. As such, the choice of site in the exploration of this statement was both poignant and pivotal: an abandoned belt of gold fields lying just south of the Johannesburg CBD. The area – as outlined in this study - is a roiling powder keg of conflicting sentiments and ideas, and a most potent embodiment of the consequences of vice and economic greed one can find anywhere in the world. From it come questions of how society has come to interact with landscape, questions of extraction, of usage, and re-usage, of exploitation and reciprocity.

By acknowledging buildings as the main avatars/ mediums/ and conduits through which we converse with landscape, this thesis will posit the design of such a structure that will serve as an austere critique of the current status-quo within the Witwatersrand mining area while simultaneously setting a brighter, more sustainable precedent for the coming years.

A common theme in the structuring of this particular narrative, we will be forever trying to search for golden mean, a steady middle-way between vying extremes in everything we investigate and propose. Towing the line between the fantastical, the futuristic and the eminently grounded and practical, between the extreme and the mundane, this thesis will attempt to cover as many bases and theories as fiscally possible within a year of study. Through this process of data distillation and refinement will our final structure be born.

RESEARCH QUESTION:

How can architecture act as a mediator between society & troubled landscapes

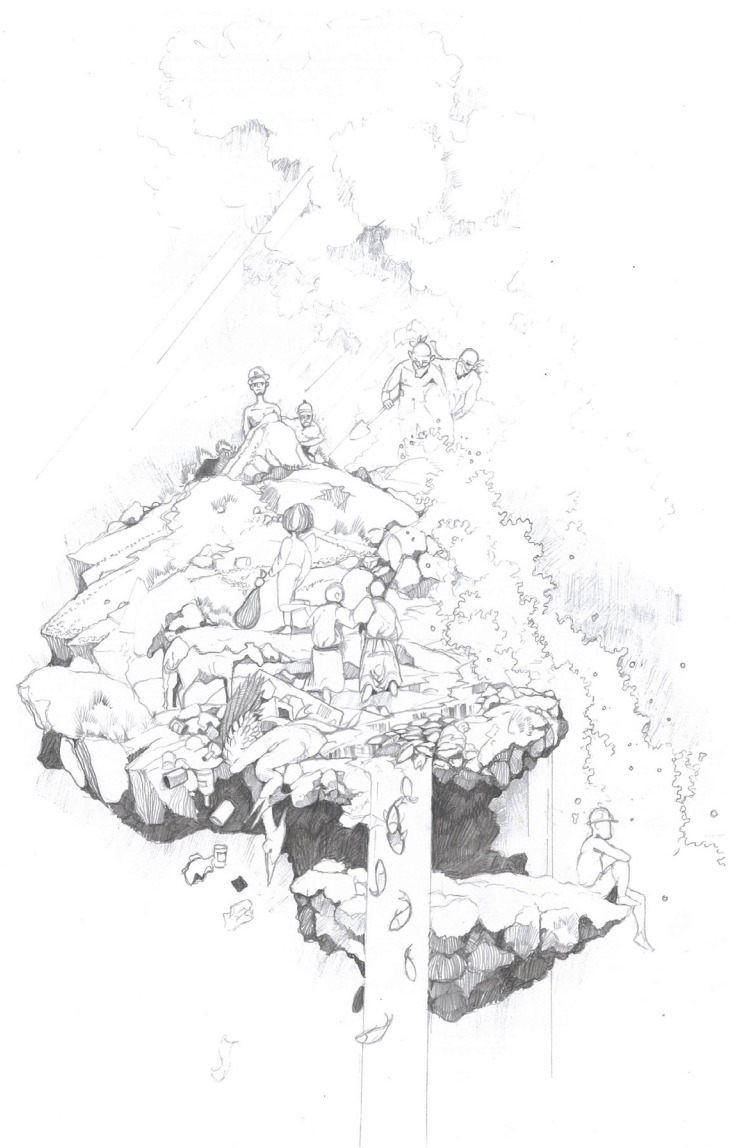


Figure 4. A Panolpy of Struggle

The above collage is a representation of the various issues and topics this thesis shall seek to grapple with. Particular emphasis is placed on the roll of architecture as a mediator between society and landscape.

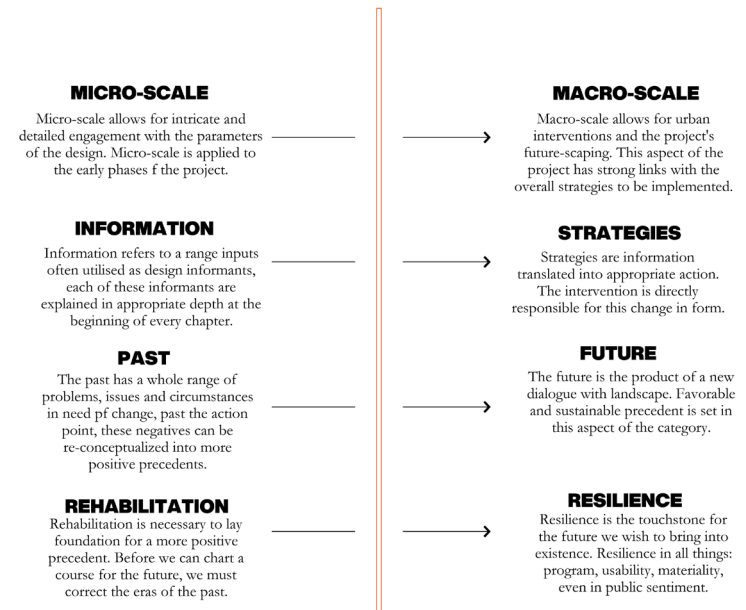
Drawn by Author

SEEING DOUBLE : THE INTENDED & UNINTENDED DUALITIES OF THE WORK

The undertaking of this thesis has, as the title states, exposed a stark duality that bleeds through near its every facet and attribute; from the thesis' title (Resilience & Rehabilitation), the two-way building strategy so vital to the end project's conceptualisation (consisting of main-building & fit-out) or the very structuring of this research report (into introductory pieces concluded with methods of application).

Duality seems to hold the key to the appropriate and wholistic consideration of some of this thesis' deeper and more complicated problems, allowing us to view both the macro and micro scales as we endeavour to offer probable solutions.

This is an aspect of the work that made itself apparent in the doing as opposed to being an active strategy I saw fit to impose at the onset. It was only after taking a step back to document the process that this play on doubles became apparent. Yet it holds a certain poetry and utility, for in the end, to know light one must also know darkness, and to have the prospect of a brighter future one must know what ills and vices to avoid from our past.



EXPLAINING THE DUALITIES

The most vital part of this diagram is the pivot point where different stimuli and inputs are converted or re-conceptualized. Dubbed the diving line, it is the essential point difference between the two disparate parameters on either side of it, and represents the intervention itself as an agent of mediation

Figure 5. Explaining the Dualities
Drawn by the Author

PART 1

PART 2

PART 3

PART 1 EXPLAINING THE PROBLEM

The initial part of this document serves to introduce the problem of mining, namely those issues as posed by old tailing dams, and acid mine drainage. The old philosophy of original mining practice is also discussed and critiqued.

PART 2 REHABILITATION STRATEGIES

The second part of the document explores the wide array of remediation/rehabilitation strategies that could be used to solve the problem of mining waste. A few are zoned in on as likely candidates to shape the end intervention of this thesis, i.e the building.

PART 3 RESILIENCE STRATEGIES

The 3rd part of the document seeks to propose likely scenarios of what will happen to the final building after it has served the process of rehabilitation. Resilience will allow the building to serve whatever functions the area will need.

PART 4 THE BUILDING

The end building is designed in this section, the site and design development are also documented here.

INTRODUCTION

STRATEGY EXPLORATION

IMPLEMENTATION

Figure 7. Document Outline

The above collage is a representation of the various issues and topics this thesis shall seek to grapple with. Particular emphasis is placed on the roll of architecture as a mediator between society and landscape (drawn by the authour)

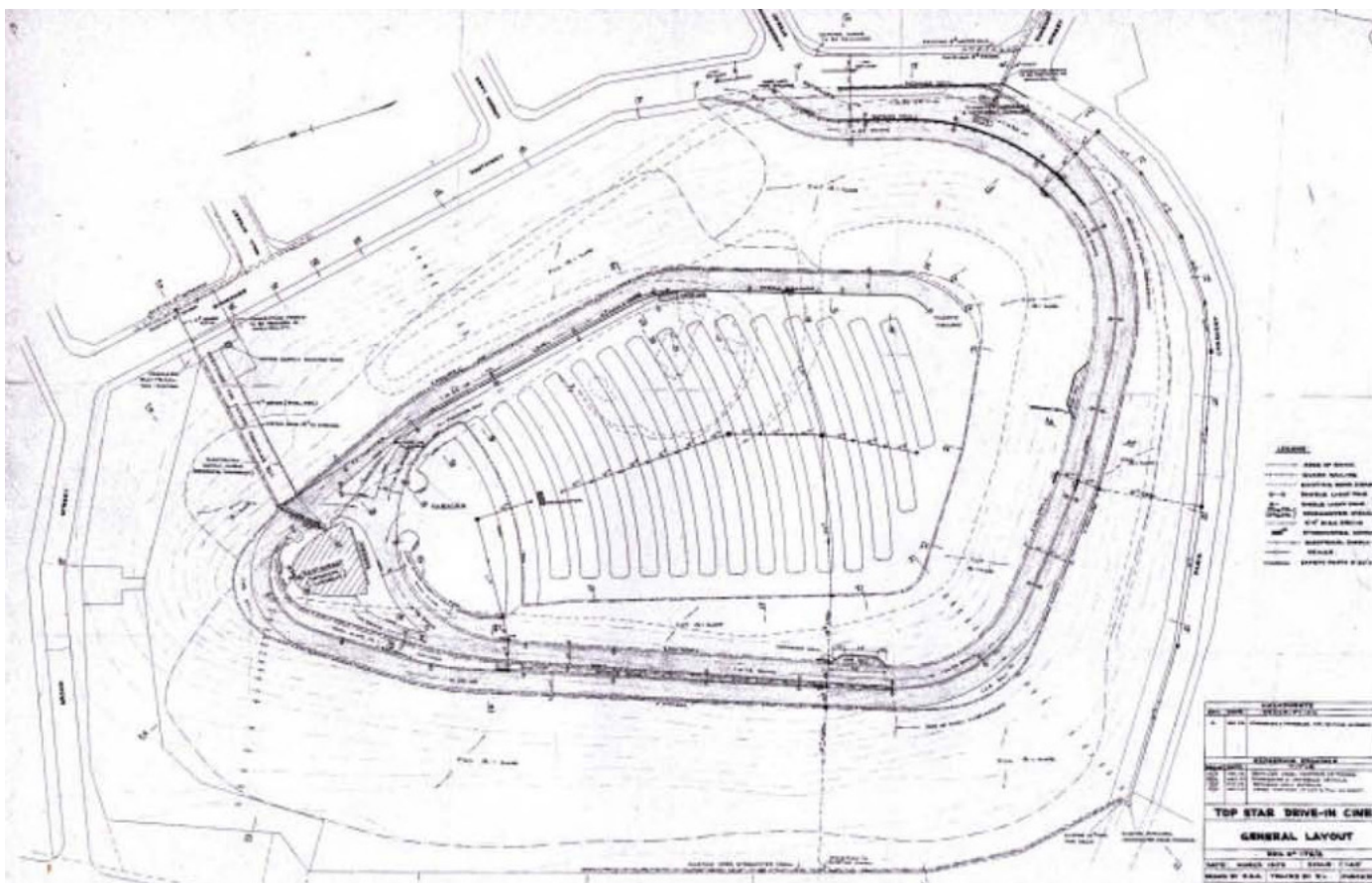


Figure 8. Mapping the Past
The above maps are gathered from the many years of mining practice in Joannesburg.

PART I - AN INTRODUCTION TO THE PROBLEM

Gold is perhaps the sole reason why the city of Johannesburg exists at all. Devoid of open water sources, and with no obvious ecological markers to encourage human settlement, the only pull at the open of the 20th century was the promise of gold & riches beyond repute. Yet the problems that have befallen our society as a result of mining practice are vast and complicated. In this, the first part of this book, a formal introduction to the legacy of mining is conducted, from humanity's historical relationship with gold down to the specific history and ecological issues plaguing us today.

- Chapter 1 - A TROUBLED LEGACY.....**The history of humanity's relationship with gold is briefly touched on. Johannesburg's own story - even from its most seminal beginnings, is recognised as being closely tied to gold. The central ideas of Johannesburg's mining legacy are also presented here.
- Chapter 2 - OUR GREAT INERTIA.....**The problems that gave rise to the need for action - and sparked my initial interest in this topic - are explored here. Inertia is expressed in our slow, distracted approach in solving the issues caused by Johannesburg's mining legacy.
- Chapter 3 - TAKING THE LEAP.....**A dual, holistic strategy to approaching the problem is proposed.

CHAPTER 1

A TROUBLED LEGACY

"Continue to contaminate your bed, and you will one night suffocate in your own waste," Chief Seattle

1A. The Universal Mean - Our History with Gold

Humanity has created relationships with all manner of materials over the millennia, oft infusing them with lifelike vitalities or imbuing them with deep and consequential meaning. Otherwise inanimate, by various means we have developed the ability to raise the concept of material into a living language. Material, at least for our society, is what feels and relates most directly, it is tactility and texture, lustre and allure. We are always pushing the limits of what is possible here, ever seeking the most homogeneous, intuitive experience with the physical fabric of the world we inhabit.

Yet, not all material translates equally between our vast array cultures. Grass and timber, stone and iron are just a few of the more readily available materials that are often viewed differently by different culture groups. Here, perhaps, is the best example of the saying "Another man's trash is another man's treasure," for in our eyes not all materials are made equal.

This imbalance of perceived value is a consequence of many, coalescing factors however, ranging from humanity's proclivity to often teeter more toward the side of the subjective as opposed to the objective, assigning value to different objects by different and sometimes opposing standards. down to circumstances as dictated down to us by the rigours of the climate, by the availability of said materials, and even with their associations with the mystic side of every civilisation...namely, religion.

To level the playing field, we developed artefacts and craftsmanship, various processes by which mundane and relatively low value materials could be transformed into art, into tools; the very embodiments of everything we value, of everything that sets us apart. Man-made objects became the physical manifestations of our ability to create, to invent, and to engineer.

-
1. - The golden aeneas of this time period was often used exclusively by the upper Ecebelons of Roman society for the largest of purchases. Hardly any of the ordinary citizens of the time had such a large amount of money at any one time.
 2. - The golden rhino of Mapungubwe was so intricately carved that early archeologists (in the year 1933) doubted it had been made on the site. Later research revealed that a great kingdom, and associated trade network once existed in the area, complete with it's own goldsmiths and local quarries.
 3. - Incan civilisations both mined gold and stole it from the grave sites of enemy tribes where it was oft interred with the respected dead.

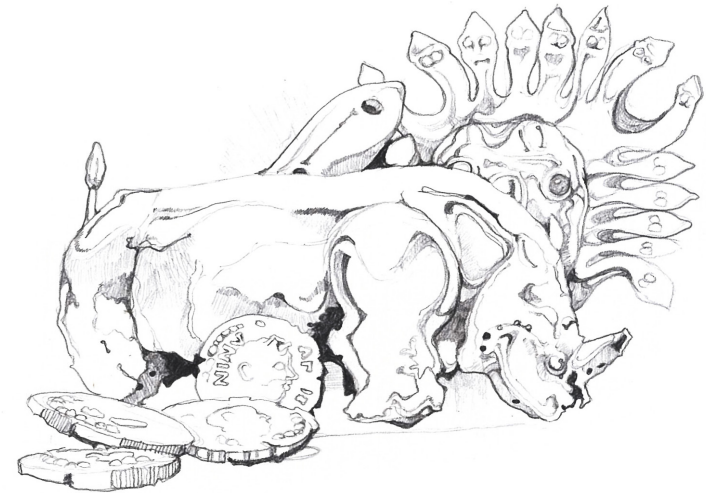


Figure 9. Gold Transcends All

Gold seems to transcend culture, race, even religion. Above is a an array of artifacts from our past that show how gold has been ubiquitoesly associated with high value across the world, indeed, it is the very material of currency. The coins in the foreground were minted in the reign of Marcus Aurelius, in the mid Imperial era of Rome's run as empire (121 - 180 AD). Behind these is a golden rhino, found at the archeological site of Mapungubwe in South Africa [2], and likely created during the medieval period. Further still is a bullion and pendant-like figurine crafted by the Incan civilisations of South America.

Yet there are some materials that we - as the entire human race - have collectively assigned great value. Water and fertile soils are perhaps some of the most obvious examples of these universally treasured materials, their necessity in regards to our survival speaks for itself.

Gold, on the other-hand, is a completely separate story. It seems to transcend culture, race, even religion. It has been ubiquitously associated with high value across the world, indeed, it is the very material of currency. It has en-flamed us to warfare, defined our sense of hierarchy, and shaped the precepts and suppositions that are the very buttresses of civilisation and society as we know it today. Yet we cannot eat it, it cannot be used to grow our food or produce our water. The reasons we treasure it are mystical, not always easy to pin down: and are intricately tied to the human condition, and to how we percieve value.



Figure 10 - Fortune Seekers.

Gold seems to transcend culture, race, even religion. Above is a an array of artifacts from our past that show how gold has been ubiquitously associated with high value across the world, indeed, it is the very material of currency. The coins in the foreground were ica.

1.B A real-world Eldorado – Johannesburg's conflicted relationship with gold

Before the turn of the twentieth century, on a windy winter's day in June, the year 1884, Jan Gerit Bantjes; mining-prospector, explorer and hardy frontiers-man, tentatively descended into the Kroomdrai Caves a few kilometres North West of present-day Johannesburg. With him was a friend and associate; one Johannes Stephanus Minnaar, a similarly experienced prospector and explorer in his own right.

The caves had been the site of weeks of work, and although they might not have known it at the time, would later become a place of profound significance in coming decades. On this day however, as they sifted through the rock and dust of the reef, a tell-tale glint caught Bantjes' eye. Gold. Relatively small and insignificant to the great finds that were about to follow, this singular moment marked the beginning of so many things in this far-flung corner of a yet distant, ill-understood world.

Widely and falsely, the claim of the first gold find in the Witwatersrand is sometimes attributed to another prospector: . George Harrison, who made his find in 1886 on Langlaate farm. Widely is perfectly apt, for it was after this find that the rush begun. Africa had long held the identity of a real-world Eldorado in the collective consciousness of the west, offering riches and boundless land to those brave

enough to risk its frontier, and on that cold winter's day it is interesting to imagine that this aspiration had never felt more plain and true for Bantjes and Minnaar as they continued to dig and expand their operations, or when Harrison sold his finds for £10; a substantial amount of money at the time.

Upon the site of the latter find – within the Witwatersrand – grew a camp of miners and prospectors. With time the camp calcified and stagnated into a minor settlement which took the name of another nearby farm: Johannesburg, and the brave and hopeful continued to flock to it in search of fortune. Fast forward another 123 years and today Johannesburg is a sprawling metropolis; chief in sub-Saharan Africa with a diverse population, impressive industry, and a vast, tenuous history. And all from a lonely find made by a few, fateful individuals.

Their relationship with this yet virgin landscape was one of extraction. They took from the land, tentatively at first, gently. Their age passed, and technology – that indomitable, ever advancing force – expanded; hand in hand with our means and ability to exploit this relationship for monetary gain. Love turned to rape, reciprocation into exploitation, and higher did our fortunes rise with scant care as to what would follow. Whether they realised it or not, Harrison, Bantjes, and others like them - by that

act – had set a new precedent. The mining operations quickly grew in scale, and the gold rush -the largest in recorded history- began.

By extraction those with rights to the land grew wealthy, jobs were created, infrastructure was built, and so deeper we delved; struck by a greed-induced vertigo, tunnel-visioned. There seemed a pervading thought that nature, in all her impossible vastness, could contain our activity...the same as has been believed all across the world for many years. From the exhausted fishing fields of the West Atlantic to the relentless logging of the Amazon, we have always viewed nature as mother; as the inexhaustible bounty from where we draw that which is necessary for life. Today's truths are far more sobering. By 1902 – a mere 7 years later - the fervour had already begun to falter and die, and the hint of nightmare steadily began to crescendo.

Awakened as if from a dream, we looked around us and saw for the first time a world transformed. As it turned out, the landscape had felt – and most keenly - the price of this extractive relationship. Gold mining is a waste heavy processes, and was even more so back in its earliest days. The collateral residues from the processing of its ore rose like mountains around us. Nothing grew upon them, and when it rained, the run off they produced laced our soil and poisoned our water, diseasing and killing everything it came in contact with.

To further compound the issue, it was discovered that dangerously high amounts of uranium were located in these mounds of yellow dust. So not only was their seepage toxic, it was also concerningly radioactive. The consequence of land-exploitation, of extraction, had fast snow-balled to create an urban hellscape.

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CHAPTER 2

OUR GREAT INERTIA

“Even if you are on the right track, you’ll get run over if you just sit there,” - Will Rogers

2A. Today’s Great Rush

Though the height of the world’s greatest gold rush ended over a 100 years ago, its initial call and draw has precipitated through the years. Thousands of people – many of them poor, and disenfranchised – continue to flock to the Witwatersrand in the hopes of achieving the next big find, filled with the lingering legacy of riches beyond repute.

Today, however, this growing wave of fortune seekers has taken on various forms: as foreign nationals streaming in from all over the continent to find success in one of Africa’s greatest metropolises, in the stream of rural communities making the leap toward city living, and finally (and perhaps most poignantly) as the living scions of the by-gone mining era in the form of men and women seeking wealth in the Witwatersrand’s abandoned mine fields.

It is this group that embodies the initial ideals that shaped the great gold rush which birthed Johannesburg. Yet, the world they now inhabit is a far cry from the one inhabited by the very first prospectors.

Called “Zama-Zamas”, a Zulu colloquial term whose closest translation in English would be “The try-hards,” or “the chance-takers,” these individuals can be seen, ever so briefly, scouring the tailing dumps and abandoned gold fields before they duck for cover behind some scrub or high-tail it for the nearest camp. With many of the tailings either owned by government or large mining corporations, their actions border on the illegal.

Recent studies have shown that trace amounts of gold still exist in several of these tailing dumps, as well as in the old shafts where it may have been sprinkled on the floor as processed ore was cartwheeled to the surface, or in the concrete troughs where it was pulverised and cleaned. ‘Trace amounts’ however is a description that belies the overall value of just how much gold is to be found



Figure 11



Figure 12

Death of an urban Landmark

Top-Star Drive-in was a cultural landmark in Johannesburg, built upon an old, abandoned mine dump. Movie goers would drive up a road that coiled up the dump’s slope, eventually coming to rest upon its tarred plateau in front of a great broadcasting board upon which movies were beamed. In accordance with national reclamation frameworks, the dump upon which this historic landmark was built was removed by 2010 (Figure XX) and the spot remained vacant as of 2018. (Images courtesy of the Heritage Scoping Report compiled by Matakoma Heritage Consultants in 2006 (Figure X2) and Google Maps (accessed in 2018) (Figure X1))

in these dumps, however. In fact, there’s enough gold left in Johannesburg’s tailings that government and corporate interests alike have begun sifting through them once again, in some second-rate gold rush lacking all of the lustre and spirit of its predecessor.

The Kleinfontein Mine Dump alone contains an estimated 3 ½ tons gold (left there by the less than efficient methods of the earliest miners in the area) (the Heritage Portal, 2017). Wherever there is money to be made – for better and for worse - fast follows the impetuous of capitalist interests. Money is perhaps our greatest incentive to action, as is shown in the work of remediating the landscape which has been damaged by mining practice. As shall be seen

1. - The golden aereus of this time period was often used exclusively by the upper Ecebelons of Roman society for the largest of purchases. Hardly any of the ordinary citizens of the time had such a large amount of money at any one time.
2. - The golden rhino of Mapungubwe was so intricately carved that early archeologists (in the year 1933) doubted it had been made on the site. Later research revealed that a great kingdom, and associated trade network once existed in the area, complete with its own goldsmiths and local quarries.
3. - Incan civilisations both mined gold and stole it from the grave sites of enemy tribes where it was oft interred with the respected dead.

2B . Why we're slow - A tale of Dying Incentive

As mining practice advanced and evolved over the years, the processes by which tailing dumps were created steadily grew in efficiency. (Aken M., Beukes J., Botha B., Cogho V. 2007) The amount of wasted gold deposited within these dams subsequently decreased, substantially lowering their latent value to would-be second-wave interests looking to appreciate their value in our current times.

And here is presented the problem with incentivising the work of remediation.

WHERE THERE IS NO PROMISE OF PROFIT, WHERE THERE IS THE DENSE WEB OF GOVERNMENT BEAURACRACY TO NAVIGATE, IT IS HERE THAT THOSE WITH THE KNOWLEDGE AND MEANS TO SOLVE THE PROBLEM MAY NOT BE WILLING TO COME TO THE TABLE. THIS IS OUR GREAT INERTIA, THIS IS OUR DYING INCENTIVE THAT PREVENTS US FROM ACCOMPLISHING TO THE FULL THE WORK OF REMEDIATION.

The problem of derelict mines and the waste produced by their now dormant functions was originally planned to have been solved by the year 2011 (McCarthy, T. , 2010) yet 9 years later the problem persists.

If you take a walk to the dumps of the Main Reef, chances are you will see an assorted assemblage of huts and makeshift houses cloistered against them, or strung out along the nearest road. These places are often home to people with no where else to go, and so, they have made themselves a place where none can object.

The consequences of living in this hellscape plague their existence. High winds in the months of August and September whip up the residue of tailings into a swirling toxic storm, covering everything in a fine coating of brown and yellow. Those with vegetable plots and cattle on site (many are people who have left the rural settings on the fringe of the city to seek better economic opportunities) report that the dust kills their produce and diseases their livestock (Bobbins K. and Trangoš G, 2018).

They too feel the effects of exposure; a lingering cough that worsens over the years as their lungs fill up with toxins and residues that can never be disposed of.

For those living close to the oldest mine dumps - the ones with tailings that contain large amounts of left-over gold – there is still hope. For those living next to the dumps that are not well appreciated, or have no value at all, however...

There are over 50 derelict, ownerless mines in Johannesburg that the government has offered to take over and actively rehabilitate (McCarthy, T. 2010). Having come to realise the human cost that would be paid by not addressing the problem, a government task force has been set up to do the business of remediation,

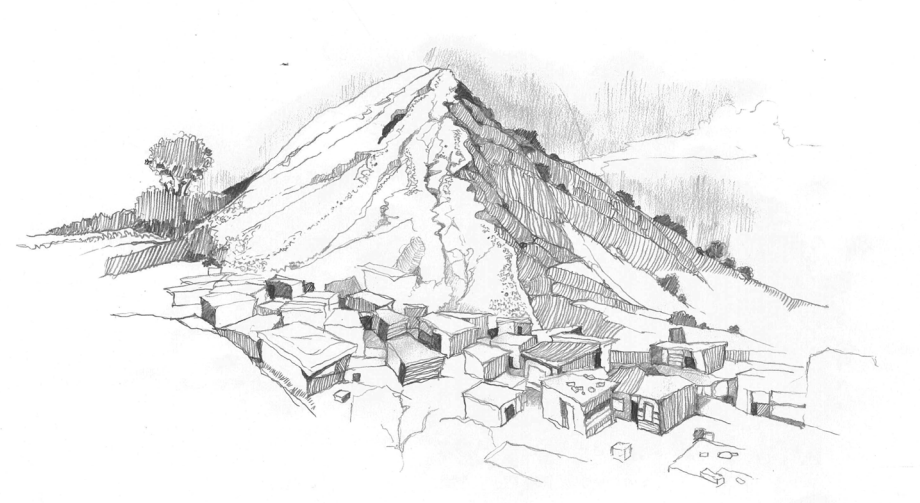


Figure 13. Taking Risks

The above drawing shows the proximity that some poorer communities experience in relation to living next to the mine dumps. Health concerns are rife, with many people complaining of bronchial and lung complications from breathing in the dust.

not for profit, but to avert likely disaster. These words are not used lightly. The need for change is immediate; additionally, heightened by the problem of acid mine drainage, which is discussed below.

2C. The Problem of Acid Mine Drainage

Iron Pyrite (FeS_2) - also called fools gold - is a major component in gold-mine waste residues. When it comes into contact with oxygenated water, mostly in the form of rain during the wet season months, it produces sulphuric acid. This acid then comes into contact with other minerals, causing them to also break down and dissolve, this releases heavy metals into the water which seeps down into abandoned mine shafts beneath the surface of the earth. Owing to all the heavy metals, sulphates, and its mostly toxic pH level, the water from this process is potentially acidic and corrosive (McCarthy, T. 2010).

Across successive rainy seasons, the water level in the mines steadily rises, creeping ever closer toward the entrances of these mines.

In 2002 this toxic tide finally reached the surface and “decanted,” onto the property of Harmony Gold Mine (Pty) Ltd (Randfontein Operations). The site was dangerously upriver of the Krugersdorp Game Reserve, which would surely be devastated if the contaminated water was allowed to reach it.

Harmony Gold, though initially caught flat-footed by the crisis, quickly sprang into action. R28-million's worth of emergency funding later they had built infrastructure capable of damming and then cleaning the polluted water, though the final result still contained higher than normal concentrations of sulphates. Wholly adamant that the problem was solved, it was later recorded that fish and mammalian life in the Krugersdorp Reserve was dying. Harmony Gold, of course, denied all accountability.

I tell this story to highlight the conflicts that arise when the work of rehabilitation meets capitalism. If remediation is not worthwhile from a monetary stand-point, then those with the responsibility of carrying it out will not fulfil their duty, or failing that, will execute it by cutting corners and taking short-cuts. There is no room for half measures here. They can be deadly.

The problem is seen in the public sector as well, with the government failing to fulfil its own remit of completing the work of remediation between 2011 and 2018, dates projected by its own task force at the beginning of the project. The issues again, trace back to money and incentive: no one seems willing to solve those tailings that hold little to know value.

Perhaps the most baffling part of the debacle is the liability the city holds should those affected by the mine dumps decide to take their grievances to the courts. As per the promises they made to the city, their position would be most precarious were they to be found wanting.

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CHAPTER 3

TAKING THE LEAP

“Action speaks louder than words but not nearly as often.”

- Mark Twain

3A. A Fusion of Strategy

As we have seen, the issue of tailing’s reclamation & remediation is not a simple one. Neither the government nor private sector can solve the entirety of cleaning up the mine dumps. As with many things where opposites are involved, however, the answer may lie in compromise. The two may not have the ability or will to solve the issues alone, but together they may be able to find the answer.

WITH PUBLIC SENTIMENT SOURED AGAINST THE MINING INDUSTRY, THE WORK OF REMEDIATION MAY OFFER A WAY FOR THESE COMPANIES TO RESTORE THEIR IMAGE AND GIVE BACK TO THOSE COMMUNITIES RESIDING IN AFFECTED AREAS.

The ways in which they may go about doing this are varied. Through the structuring of new branches in their production lines they can reclaim heavy metals and sulphates for re-use in green practice industries (Wang, J. 2018). To this end they could employ people from the communities neighbouring the dumps, educating them in green practice and empowering them to set-up re-use businesses of their own.

The city could then work to build-up systems of supply and distribution to support this new, burgeoning industry; constructing inroads and other such infrastructure that they might need. And wherever the private sector begins to fall short, legislation could offer subsidies and incentives to keep the wheels rolling.

The solutions demand radical action, or else we are doomed to suffer the consequences of this problem for many more years to come, with greatly exacerbated effects. With the gradual, snail-like pace we have currently assumed with regards to this problem, this ugly scenario may soon become reality.

3A. A Critique of Old Mining Infrastructures

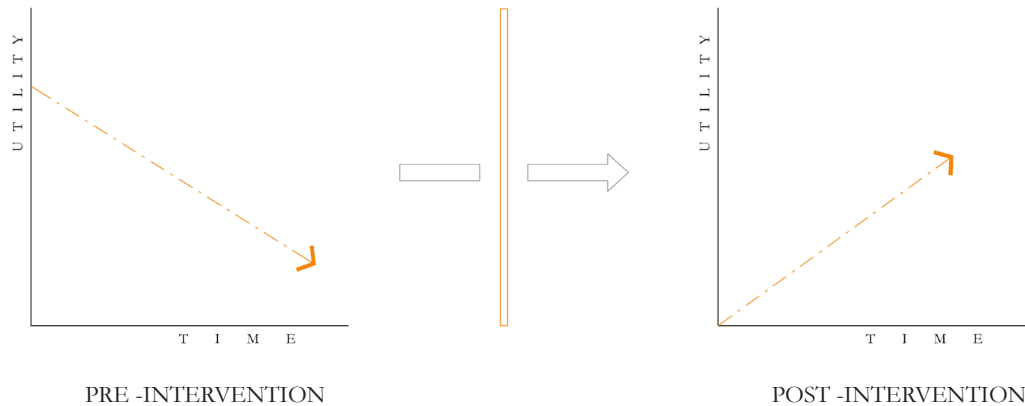
Mining, as we have known it for centuries, has always been an extractive, one-way process. The responsible practices that take into account the nature and state of mined lands after these processes have run their course are a relatively recent development (Aken M., Beukes J., Botha B., Cogho V. 2007).

Their infrastructures were hardly ever built with a thought to

In a continuation of this spirit of responsibility, the interventions we design as architects to address the problem should account for an end of process, for a death of initial utility. I

IF WE ARE TRULY TO SET NEW PRECEDENT, OUR DESIGNED INFRASTRUCTURE SHOULD BE ABLE TO OUTLIVE IT’S INITIAL PROGRAM, TO ACCOMMODATE WHATEVER WILL COME AFTER, WHETHER IT BE DIRE OR HOPEFUL.

Anything short of this, risks us falling into the patterns of yester-year, with the same troubling consequences as likely to befall us. There is a philosophy in architecture that could help us chart this path. Known as “Resilience Practice” by some, and “Adaptability,” by others, it is this philosophy that will allow our infrastructure to outlive it’s initial function, namely the rehabilitation and remediation of Johannesburg’s derelict mine scape, and thereby help us prepare for whatever follows.



Graphs of Utility- Figure 14

The above graphs illustrate how the end intervention will challenge the norms set by old mining practice. No longer will infrastructure's value depreciate with time, instead, the designed building will retain its value from resilience strategies implemented at its very inception, allowing it a flexibility not experienced in Johannesburg's early mining era.

THE DIVIDING LINE: represents the architect, the end product/ designed intervention that acts as a mediator between the two disparate parameters on either side of the divide

REHABILITATION

Rehabilitation will solve the issues of present mining waste, with strategies designed to allow for the slow rate at which remediation practices are presently advancing.

KEY CONCEPTS:

- Remediation
- Lowered toxicity.
- Restructuring
- Relation to the past

RESILIENCE

Resilience will try to account for what comes after the work of rehabilitation is concluded. It utilizes strategies that ensure a brighter, more sustainable future.

KEY CONCEPTS:

- Reusability
- Self-subsistence
- Sustainability
- Net Zero
- Relation to the future

Outlining the strategies- Figure 15

The best solutions always assume a wholistic approach to the problems they seek to address. A fusion of the two strategies as displayed above will allow for as wholistic a solution to the issue as we can ever hope to conceive. By addressing the problems of the past while charting a course for the future, we can hope to reach at least a theoretical solution to the problem of mining waste.

3A. Summarising the Solution

In the diagrams above is outlined in general broad strokes the strategies this thesis will propose to solve the problem of Johannesburg's disused mining landscapes. In them, and in all diagrams after, the rustic orange-red colour will be used to represent the point of action, the place where problem encounters intervention, and is thereafter transformed into solution. It must also be stated that the overall goal of this thesis is not to outline a definite solution, but to demonstrate an engagement with the incumbent issues deep enough to propose *possible solutions*. This course of action has also displayed itself in a duality that only became apparent after the fact, and is detailed in the following paragraphs.

The interstice of the strategy: A rift between the fantastical and the grounded.

As we have agreed, this thesis is more of an exercise in engagement as opposed to the proposition of a definite solution. It shall seek to go down several avenues in a quest to proffer possible solutions, yet to have this maximal engagement, it shall have to consider a whole range of sometimes disparate scenarios in the structuring of an argument. Utopia and dystopia, short term, and long term...these are but a few of the scenarios, circumstances, and outcomes that it shall seek to deliberate upon. Yet we cannot live forever in the realm of possibility. Potential is all well and good, but it must be realised in definite, concrete terms for it to be of any value. In light of this it is necessary for us to select a likely scenario upon which we will delve and deliberate in detail.

This divide - between the eminently promising *fantastical* with its endless, burgeoning potential, will be complemented by an indepth delve into a singular, hopeful narrative where the problems of Johannesburg's derelict mine land are solved by a single architectural intervention. These two approaches are again, expressed as a duality and can be neatly aligned with the categories we have already defined - namely Rehabilitation & Resilience.

Likely, design informing precedents shall therefore need to be drawn from two separate sources: namely, from "futuristic" projects for the thesis' more fantastical elements (archigram movement, the works of Peter Cook, e.t.c) and more grounded, real - world projects dealing with the similar issues for the thesis' more detailed side.

This duality will hopefully allow for a wholistic view in how the issues are dealt with overall.

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PART II - STRATEGY EXPLORATION

REHABILITATION STRATEGIES

In the second part of the document we begin to map out a solution. In this section we shall explore the range of options likely to help us structure a solution to the problem of mine waste, utilising the double strategy (Rehabilitation + Resilience) as proposed in the previous chapter.

The theory sections of these chapters are closed off by paragraphs that explore their possible applications in the resolution of the problems discussed in the first part of the thesis. Rehabilitative theories are discussed first, and are rounded off with a summary diagram that shows their coordinated implementations, followed in like manner by the Resilient strategies.

PART II-A-REHABILITATION STRATEGIES

The past has a powerful influence upon our future. Pollution, land degradation, poor health; this is the legacy that mining has left us here in Johannesburg. In this first set of possible solutions we shall explore how to appropriately engage with this legacy. The predominant ideas are:

- The use of built form as a tool with which to read & engage with the landscape.
- To find the answers within the solution. Mine residues are the source of so many problems in Johannesburg's current context, but can they be part of the solution; both physically & metaphorically?
- To formulate a new, lasting legacy that will warn us of the past; a type of cautionary heritage that will inform our new, symbiotic relationship with landscape.

Chapter 4 - A CONVERSATION WITH LANDSCAPE.....	In this chapter the means and tools by which buildings may interact with the landscape are proposed and explored. A theory of elemental language (wind, water, & earth) is formulated as the primary mediums of this conversation. Means of remediation & reclamation are also explored herein.
Chapter 5 - THE NEED FOR HERITAGE.....	Recognising that many remnants of Johannesburg's mining legacy are now part of Johannesburg's collective heritage, the concept of creating iconic, cautionary touchstones to this troubled past are explored & developed.
SUMMARY.....	Diagram detailing the coordinated strategies of the discussed theories and applications to achieve a holistic, rehabilitative approach.

CHAPTER 4

A CONVERSATION WITH LANDSCAPE

“‘Earth, water, fire, and wind. Where there is energy there is life.’”

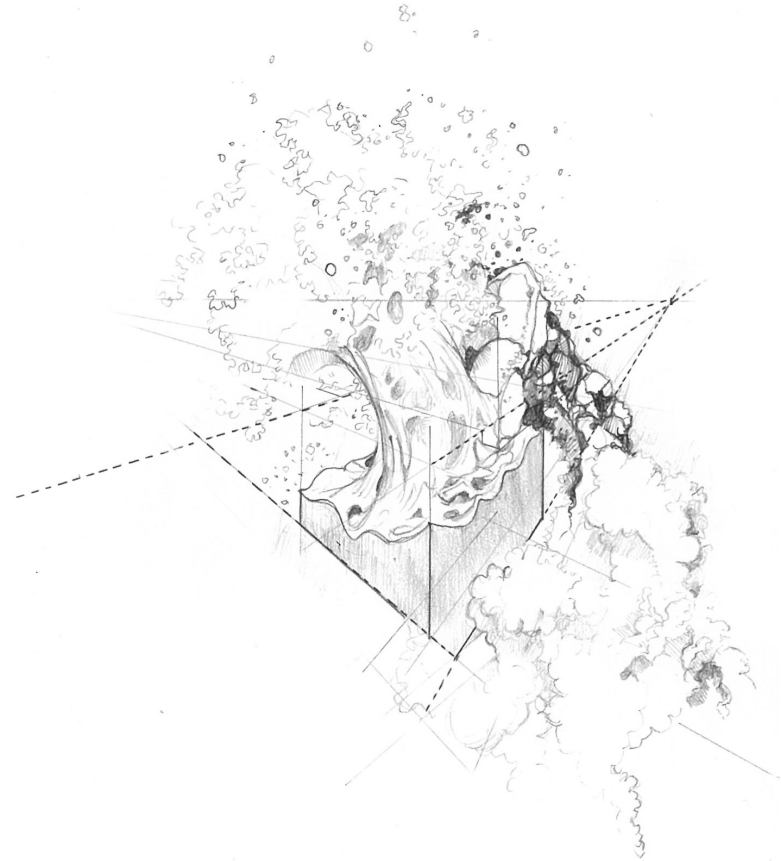
- Suzy Kassem, *Rise Up and Salute the Sun: The Writings of Suzy Kassem*

4A. Defining a Language

I shall propose the notion that Johannesburg’s unfortunate mining legacy can be seen as the result of a large, catastrophic breakdown in communication. Often, we reserve our definition of communication as the exchange of information between two animate entities or groups, yet this definition can be limiting. One only needs look at the most historic touchstones in humanity’s history to hear the conversation: it is told in our taming of fire, in our first forays into agriculture and husbandry in the middle east, in our indomitable drive to map and explore - in short, to challenge and limit the unknown. We have been in conversation with our physical environment since time in memorium, though to say these conversations were always cordial and amicable would be to turn a blind eye to the recent turn in current events.

Breakdowns in communication are detrimental to any relationship, often leaving one or both parties feeling disgruntled, frustrated, or ignored. They cause a deal of discomfort and in some cases, may even insight a desire for reprisal. Things quickly get ranched up when the relationship is at a planetary level, however. The stakes take on grand, imposing heights, with the consequences of disfunction likewise drastic and catastrophic in proportion. It is a downward spiral that leads to no less than the extinction of entire species, to earthquakes, volcanic eruptions, in short it is the untold chaos exhibited when mother nature shows her wrath. There is a reason why near every religion on earth envisions the apocalypse as some cataclysmic event involving the dark, vengeful aspect of the elements: earth, water, wind, and fire. They are in a sense, the mediums of this communication we share with the earth; words in physical form through which we may be able to gauge the status of our relationship and thereby make amends or offer just tribute.

Buildings are our active avatars in a large, and sometimes hostile world; they are physical extentions of our place on the planet, as well as of our psyche and relationship with the environment. They offer us the opportunity to fully engage with these mediums (earth, wind, and water) at a scale far more appropriate and impactful than that of the human body. We do this firstly and perhaps most obviously in our choice of material, which are often the result of elemental fusions fabricated through man-made processes. This concept is embodied in brick, concrete, glass, and mortar.



The Three Great Elements- Figure16

Water, Earth, & Wind are the three main languages, or mediums through which we will conduct a conversation with landscape. The idea is to use them as indicators of the landscape’s ecological condition throughout the project’s rehabilitative phase.

These fusions are part of the conversation, and are how we choose the tone and attitude of the relationship, either skewing it toward reciprocation or exploitation. Each choice however comes with its own frightful, and immediate consequences

When we get things right we often tend to be rewarded. Clean water, breathable air, fertile soil... these are all words in physical form speaking of a planet that is happy to have us around. When we get things wrong however, the conversation often has the potential to turn ugly, even world ending.

The Witwatersrand is the result of a colossal breakdown in our communication with the environment. In the past we could claim ignorance of future consequence (even though the societal rifts should have been warning enough). Yet in the more recent past, we have continued to turn a blind eye to the signs, refusing to accept the rebuke and ridicule the earth levelled against us; egged on by opportunities for profit.

Tailing's dust kills and poisons all it touches. It is the heated, frustrated response of a world that has endured great injustices at our hands, and has now risen up against us in a noxious fusion of earth, wind, and water that is designed to repay us for all the harm we have done. If we wish to survive, we must change the present conversation we are having with the landscape.

COMMUNICATION IS KEY IN REHABILITATION. BY ESTABLISHING ELEMENTAL QUEUES THAT BETRAY THE LANDSCAPE'S CONDITION, WE HAVE THE NECESSARY INDICATORS WITH WHICH WE CAN FORM DIAGNOSIS & STRUCTURE WORKING INTERVENTIONS. THE FIRST, & THEREFORE MOST IMPORTANT STEP IN ESTABLISHING MEDIATION BETWEEN SOCIETY & LANDSCAPE THROUGH ARCHITECTURE IS TO LAY A FOUNDATION OF HEALTHY, WORKING CONVERSATION.

An actuation of native fauna

Near everyone is familiar with the "canary in the mine shaft" analogy, but for those who are not, I shall take a moment to explain it here. As the story goes, miners -most often from the coal industry - oft encountered lethal fumes as they delved deep into the bowels of the earth. These gases, being both scent and colourless, brought death invisibly and without warning, the alarm often being raised when it was already too late. (National Research Council (U.S.) 1991).



Figure 17 *Rhus Lancea* (Close-up)
Image courtesy of PlantZAfrica.com



Figure 18 "Searsia pendulina"
Image courtesy of PlantZAfrica.com



Figure 19 *Rhus Lancea*
Image courtesy of PlantZAfrica.com

Hyperaccumulators

Pictured above are a range of recognised plant species especially suited to the work of phytoremediation. The number of indigenous species bearing this trait is yet relatively small, but the list is growing.

It was John Scott Haldane, a Scottish physiologist and physician, who - in 1913- proposed a solution (David A. Bengston, Diane S. Henshel.(1996.)) Observing that smaller organisms - birds, mice, e.t.c - often showed adverse symptoms to exposure to these gases long before humans, he proposed that workers re-enter the mines with canaries as a type of indicator to warn of danger.

The solution - for all its morbid utility as the canaries often died - was a success. A new category of bio-indicators was born, namely sentinel species (National Research Council (U.S.) 1991), and we got the the now widely known analogy.

This concept has ready application in our own scenario. In an environment where toxicity remains a serious and ever constant threat, the use of sentinel species would be a ready solution to the problem. Yet, thanks to recent advances in remediation practice, we may be able to do one better. There is the promise that sentinel species can not just warn us of the prescence of toxins and contaminants, but remove them entirely. It is a step-up from the practices of yester-year, and is detailed below.

The contributions of Phytoremediation to the Rehabilitation Story.

On the ground, remediation has been actively carried out through a wide slew of means, including often expensive and intensive processes (pneumatic fracturing, solidification or stabilisation, vitrification, excavation and removal of contaminated soil layers, physical stabilisation with grasses, and washing of contaminated soil with strong acids or heavy metal chelators, among others) (Joubert K.M (2017) that are high in their demand for resources. Recently, however, a new passive technology has come to the fore offering new and unprecedented solutions.

Garbisu and Alkorta (2001: 273), described phytoremediation in the falling way: “an emerging green technology that uses plants to remediate soil, sediment, surface water and groundwater environments contaminated with toxic metals, organics, and radionuclides.”

Needless to say, it is a technology that has wide and promising applications for this thesis. Pair this with the fact that phytoremediation offers simultaneous decontamination and ecological rehabilitation of sites (Joubert K.M (2017)) and it might be the most feasible solution to the current problem.

Indigenous plant species capable of stabilising, removing, transferring, stabilising, and/or degrading contaminants are yet in short supply, but the list is growing as research into this field intensifies.

APPLICATION

To change the past conversation mining practice had with the Witwatersrand landscape, it is necessary to establish the terms of engagement, in this case the mediums we will use to facilitate the exchange of information. With the primary phase of the scheme revolving around the program of soil remediation, it seemed necessary and apparent that the use of three elements in particular be considered: earth, water, and wind.

Strategy No. 1 - Earth & Wind

High winds often sweep up unbound material from the tailings to form toxic dust storms that sweep over a good portion of southern Johannesburg (. Carrying for kilometres, (intext citation) this disturbed material is a mix of the various soil and alluvial constituents within the area, and can be harnessed as a medium through which a remediation team could assess the ecological condition of soil in the area over time.

A building – well designed to trap and harness this wind-blown dust, could hereby be used as a tool with which to read the landscape. By orientating the structure against the area's predominant wind direction, (northwards in this case), a critical interface can be identified and developed to actively catch dust from the surrounding area, especially in the month of august which often tends to be the windiest time of year in the city.

Reflecting the Dynamism of the Elements

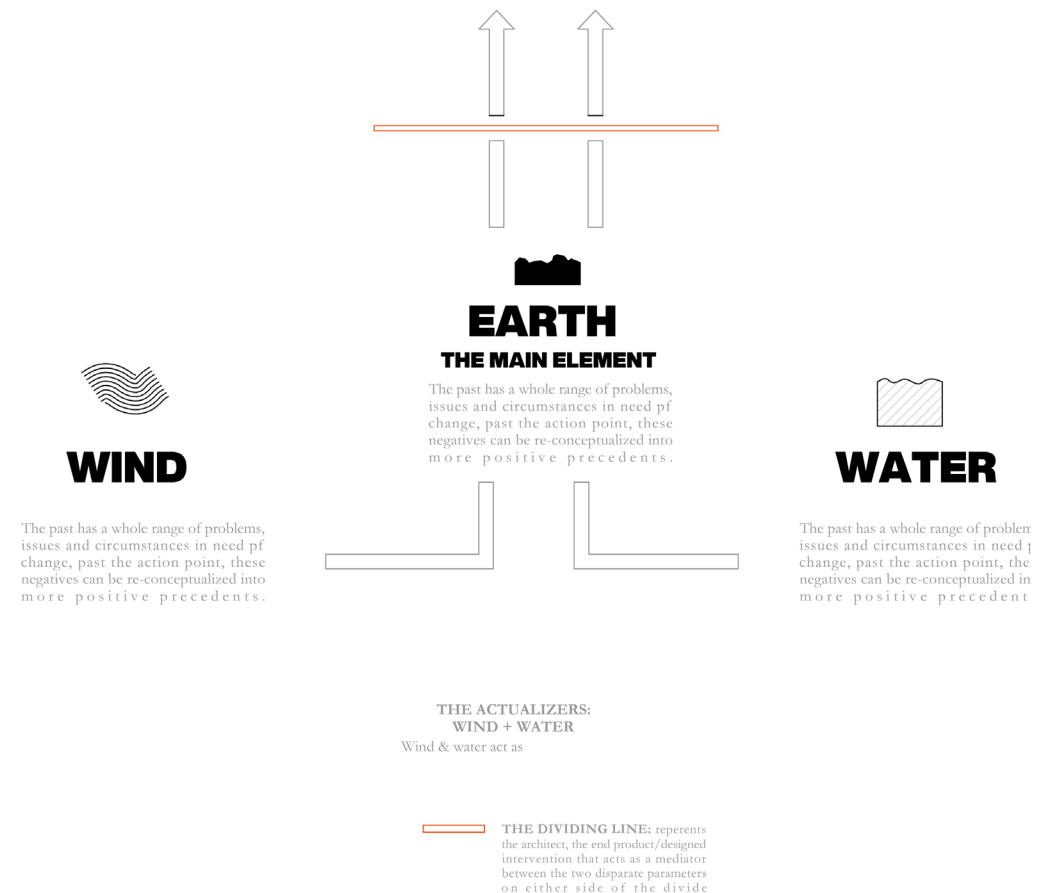
The concept of an elemental language has further application in the determination of building form. Buildings are static, but water and wind are not. They are possessed of a certain kinetic dynamism. They flow, and rush, and blow, perhaps being the very

BUILDINGS ARE OFTEN STATIC, BUT WATER & WIND ARE NOT. THEY ARE POSSESSED OF A CERTAIN KINETIC DYNAMISM. THEY FLOW, & RUSH, & BLOW, THEY ARE PERHAPS THE PUREST EMBODIMENTS OF THE VIBRANT IMPETUS OF OUR ENVIRONMENT.

It therefore follows that whatever building/intervention this thesis designs should reflect this relationship with landscape through a similar dynamic form, perhaps even via a similar kineticism and impetus.

A place for things to grow.

As we have seen, phytoremediation is a key strategy in the work of rehabilitation. As such, it is vital that conditions on site are conducive for its easy implementation. It's accomodation in the building program is essential, perhaps by the use of seedbanks and gardens where hyperaccumulators can be grown enmasse for use not just on the chosen site, but in the entire Witwatersrand basin as well.



The Three Language- Figure 20

Water, Earth, & Wind are the three main languages, or mediums through which we will conduct a conversation with landscape. The idea is to use them as indicators of the landscape's ecological condition throughout the project's rehabilitative phase.

Likely partners in this regard could be the Millenium Seedbank initiative, which is described as “an international ex situ plant conservation project aiming to collect and conserve seeds from 25% of the world’s orthodox plant species by 2020.”

Through the use of indegenous hyperaccumulators, we can not only participate in the work of rehabilitation but participate in a global effort to encourage biodiversity.

With this in mind, it is necessary to identify the individual species that will be vital in the phytore-mediation process so that any special seedbank or landscaping considerations can be taken into account from the onset.

An identification of Species

The selection of species was based off the frameworks detailed in “Rehabilitation of Mined Lands” by Aken M. *et al*, namely prioritising those hyperaccumulators that are also native species. They are also selected in favor of greater biomass, as larger accumulators can absorb more comprehensive quantities of contaminants(Joubert K.M (2017)). Rapid growth, and dynamic root systems that both stabilise and revitalise stripped soil are also favoured.

Using these criteria, a brief list of likely candidates can start to form:

- Celtis africana
- Combretum erythrophyllum (QuaQua),
- Combretum erythrophyllum (Uppington)
- Dombeya rotundifolia
- Dovyalis caffra
- Olea africana
- Rhus lancea (Botubela)
- Rhus lancea (Uppington)
- Rhus pendulina
- Schinus molle
- Tamerix usneoides
- Ziziphus murcronata.

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CHAPTER 5

THE NEED FOR HERITAGE

"What you remember saves you." W.S. Merwin

Hard learnt lessons lose their value once they are forgotten. We have a history here in Johannesburg rife with cautionary tales, perhaps most profoundly from the days of apartheid. A common thread ties all of them together however: inequality, the eternal struggle of disparate classes separated by a multitude of factors and circumstances (Mhlauli M., *et al* 2015). The great drum beats in this historic struggle were first tribal, then racial, and are now financial and economic.

Johannesburg's mining history is not excepted from this tainted legacy. From its early days when the mining belt caused the divide between north and south, and subsequently of the poor and wealthy (Philip Harrison & Tanya Zack 2012), down to the Marikana Massacre that occurred near 8 years ago, mining has long been linked with hints and sentiments of inequality.

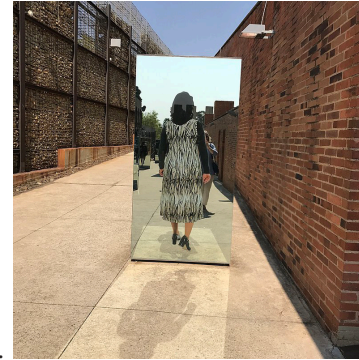
Inequality, by its natural progression morphs into greed, and greed into vice and exploitation (Peterson, J. B., *et al* 2018). The exploitation of people, namely the disenfranchised and poor; the men and women who performed the physical act of digging deep into the earth in the pursuit of gold, was a practice that became reflected in the landscape, as evidenced by the fast rising mounds of waste and slag that grew around the mines.

Today, the government has set out to remove/remediate all of the tailings, dams, and infrastructure of the by gone mining era (their remediation program was scheduled to reach its completion in the year 2011 (McCarthy 2010). The desire was to free up all of the valuable land presently occupied by the tailings for economic and ecological use, a program that would essentially see the major removal of the dumps that have become figures and emblems of Johannesburg's troubled past.

And so we come full circle, back to the question of cautionary tales. The apartheid era may be twenty odd years gone, yet it's effects still linger amongst us today. Furthermore, there are several, nationwide memorials that seek to capture the horrors and injustices of this turbulent time [1]; reminders of the paths we went down as a society, of the paths upon which we dare never tread upon again. These are our cautionary tales; the danger markers that keep our society and safe.

So too does mining need it's own set of touchstones warning us against the consequences of greed and exploitation. The landscape too is in need of it's own memorial, a place, structure, or gesture that embodies it's difficult and conflicted past, and teaches us reminds us to remain responsible and

1. - Other, similarly grim monuments came to mind as I constructed this study; namely the remains of ethnic cleansing victims from the Rwandan Genocide, and the preserved concentration camps from the Second World War Period. Such monuments to the great suffering of multitudes hold with them a certain aura and reverence that is not to be ignored, and keeps the warnings against past transgressions uncomfortably close.



1.



4.



2.



3.

Difficult Memories Figure 21

The apartheid museum reinvoles hard and painful memories Yet it is a structure of widely recognised cultural & historic import. Hard learnt lessons lose their value once they are forgotten. If we lose our sense of memorial with regards to the issues of Johannesburg's post -mining landscape we risk losing the value that these lessons taught us - namely in how we relate to the environment. Image Credits:

1) J. Trudi 2) Katangais 3) The Apartheid Museum 4) The Apartheid Museum

SO TOO DOES MINING NEED IT'S OWN SET OF TOUCHSTONES WARNING US AGAINST THE CONSEQUENCES OF GREED AND EXPLOITATION OF THE LANDSCAPE. IT IS IN NEED OF IT'S OWN MEMORIAL, A PLACE, STRUCTURE, OR GESTURE THAT EMBODIES IT'S DIFFICULT AND CONFLICTED RELATIONSHIP WITH OLD ENTERPRISE & CAPITALIST INTEREST

APPLICATION

Over the years, and despite their toxic relationship with their immediate surroundings, several tailings in the virtually exhausted Witwatersrand Reef became iconic symbols of Johannesburg's identity. Perhaps foremost among these is the dump upon which the Top-Star Drive-in was established: a very old tailing, perhaps even one of the earliest created when mining operations began in the area around 1886 (www.theheritageportal.co.za, n.d).

The flat-top of this dump was tarred over and thereafter a large screen upon which movies were beamed was erected in beautiful transposition with the Johannesburg skyline and emotive, passion-hued sunsets that made for a stunning backdrop. The site became a landmark, and was much loved by those who frequented it, so much so that when reclamation interests voiced their desire to remove the dump and process its contents the idea was met with public outcry. (www.theheritageportal.co.za, n.d)

A 4 year battle to keep the landmark alive ensued (between 2006 and 2010), but in the end - as often does - the final decision followed the money. The dump was reclaimed by 2011, but as of 2018, despite talks of redevelopment, the site upon which it once stood remained in derelict vacancy (www.theheritageportal.co.za, n.d).

Perhaps most poignantly was the lost link to the practices and activities that had birthed Johannesburg: indeed, it seemed to be a squandering of heritage from the earliest days of the mining period, more than a hundred years of history in effect. There is a lesson for us here.

As Micheal Bierut once said "The problem contains the solution," and it this principle that guided an articulation of heritage using the mine dumps themselves. We can change the connotations we have come to associate mining relicts like tailing's dumps and show - just as in the case of Top Star Drive-in - that they can become landmarks and icons of the city.

There is also a chance here for us to imbue the actual physical materiality of mine dumps with a cautionary sense of heritage; a solemn commemoration of paths best not taken ever again. By preserving select portions of whatever site we choose - remediated to solve for their toxicity - they could be reimagined as positive elements and reminders of our past.



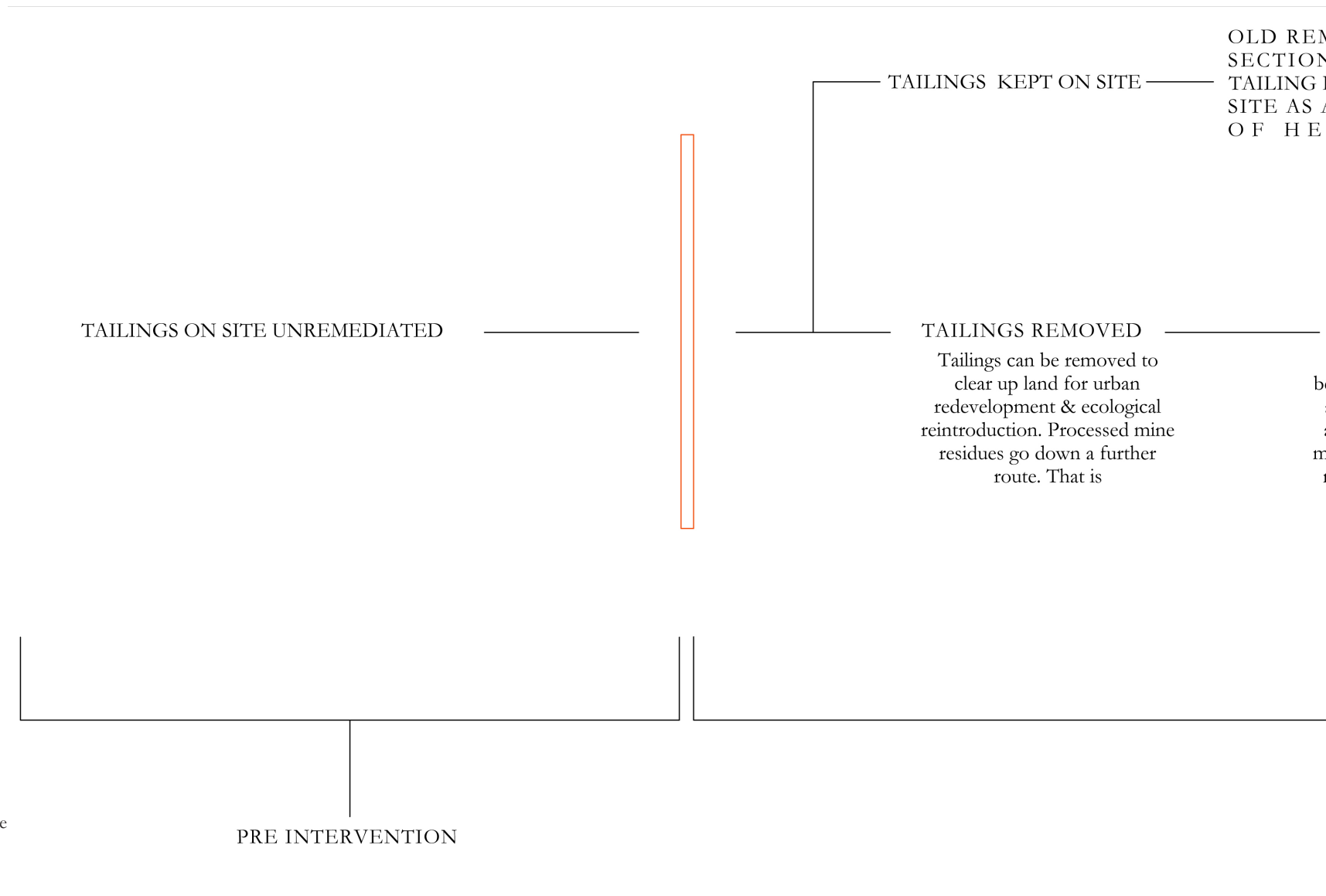
Death of an Icon. Figure 22

A 4 year battle to keep the landmark alive ensued (between 2006 and 2010), but in the end - as often does - the final decision followed the money. The dump was reclaimed by 2011, but as of 2018, despite talks of redevelopment, the site upon which it once stood remained in derelict vacancy (www.theheritageportal.co.za, n.d). Image courtesy of Martin Hausmann

SUMMARY

FIGURE 23

The diagram to the right outlines the Rehabilitative approach we will take when processing the mine residue at Wemmer Pan.



MEDIATED
NS OF THE
REMAIN ON
ARTIFACTS
R I T A G E

MATERIAL SORTING
After the tailing material has
een removed in the form of an
aqueous slurry, those materials
and components still of value
may be removed. Such materials
may include: trace amounts of
gold, uranium, pyrite, even
heavy metals

CHEMICAL PROCESSING
The remaining slurry is cleaned
by a catalyzed chemical process.
The resulting material (largely
silicone) is stored away for use
as a construction material
(rammed earth)

USE AS A BUILDING MATERIAL
The material is used as a
building material, significantly
lowering the overall project's
cost and carbon footprint.

POST INTERVENTION

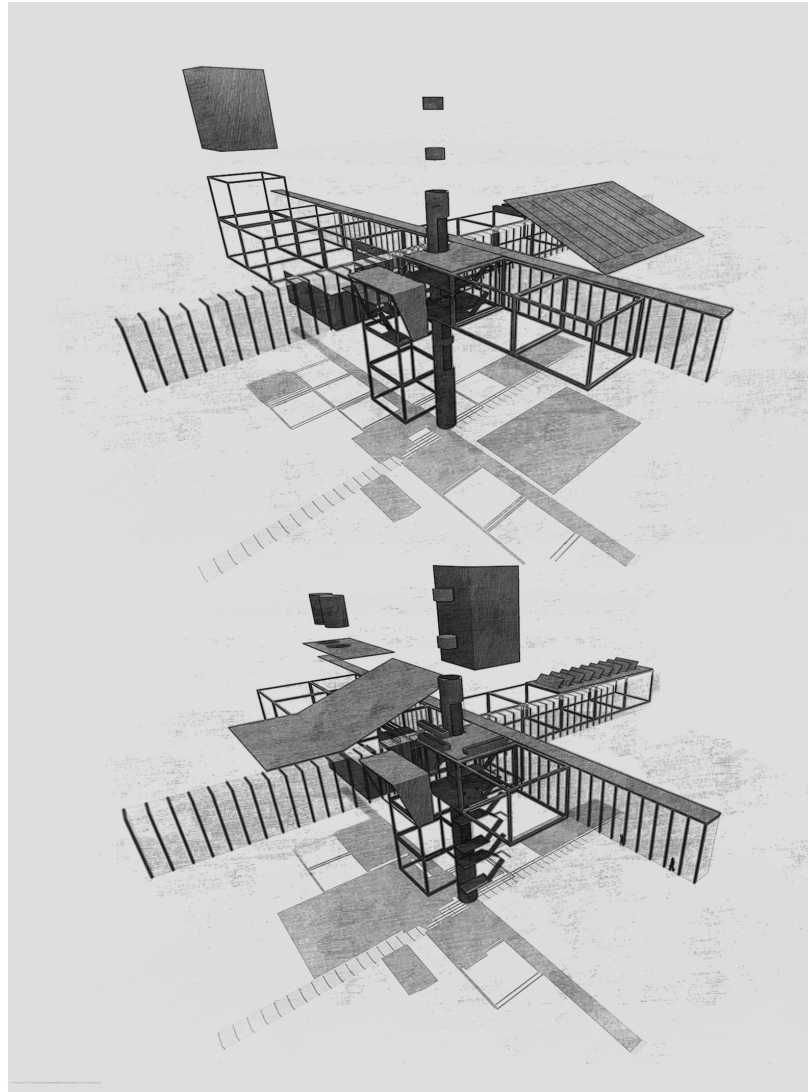


Figure 24 : EARLY MODELLING

Resilience as explored in this thesis relates to the a multivalency in use. The pictured diagram explores how changeable structural elements can be reconfigured to house seperate, disparate uses. Drawn by: Author.

PART II-B - RESILIENCE STRATEGIES

Mining infrastructure had a central problem: an inability to accommodate future use, a blindness to future consequence and the end of present function. We would be unwise to follow suit in how we approach a solution to solving this problem. The intervention we implement - apart from symbiotically acting as a mediator between society and landscape, should provide a contrary, more foresighted precedent.

This is the work of Resilience: to grant agency to the infrastructure of our intervention; even past the initial work of rehabilitation.

Chapter 9 - WHY RESILIENCE.....	The core principles of how and why resilience theory is important to this study are proposed and explored. Resilient building strategies; namely in the form of the open building strategy (Kendall S. 2004) are presented as offering possible agency to a designed intervention.
Chapter 10 -DRAWING PARALLELS: LIFE ON MARS.....	Johannesburg's disused mining scape is a polluted, barren, and inhospitable environment...not unlike the one we see on the surface of Mars. Concepts of resilience seemingly carry through, and although atmospheric and contaminant parameters may defer the means by which we cope with these bare apparent similarities.
Chapter 11 - THE DEATH OF UTILITY.....	Resilience through self-sustenance will allow our intervention to be independent (or at least be pseudo-independent) of traditional public infrastructures and utility.
Chapter 12 - THE NEED FOR METRICS.....	The means and methods by which architectural resilience can be measured are explored here, with an emphasis placed on expressing why such measures are necessary and important to this study and the future of architecture.
SUMMARY.....	Diagram detailing the coordinated strategies of the discussed theories and applications to achieve a holistic, rehabilitative approach.

CHAPTER 6

WHY RESILIENCE?

“The oak fought the wind and was broken, the willow bent when it must and survived,” Robert Jordan, The Fires of Heaven

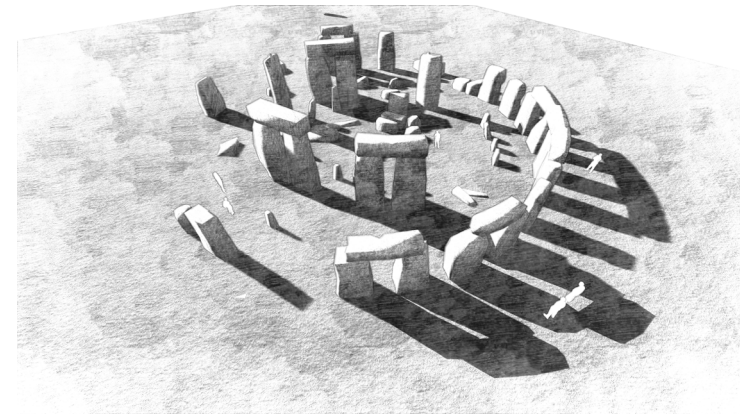
Reflecting the Dynamism of the Elements

Today - as ever - our world exists in flux, a constantly changing paradigm marching to the dictates of technological advancement and ever-increasing convenience. Once upon a time – when our ancestors existed in a greater, wilder world - we lived in caves or took refuge under trees against the vicissitudes of the elements. Our greatest foe could not be negotiated or reasoned with, relentless in its assault against our senses. We ran from environmental perturbation, from nature not as mother but as the senseless fury of the storm and the blizzard, and as the unknown danger lurking just beyond the ring of light cast by the campfire. To seek refuge was to seek a constant : an alignment of circumstance in which we felt most comfortable and safe.

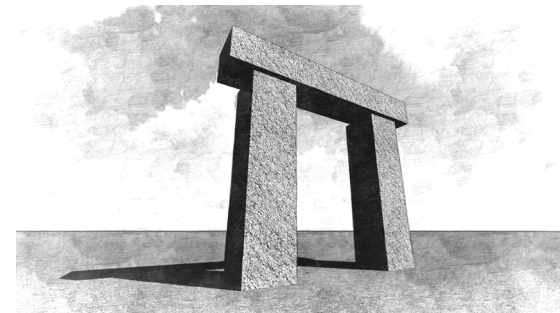
Thus buildings were born. For all intents and purposes, for better and worse they are our oldest and most primal artifacts of resilience. They are the statement of a species bold enough to raise a hand in defiance of the evolutionary march; demanding that, instead of changing ourselves to fit the environment, the environment instead should change to fit our needs, to march to our rhythm. Step beyond the open threshold and the rules are our own. All manner of fauna scheme and construct dwellings of their own, yet nothing else on the planet has changed the environment so drastically nor near as boldly as a building. Hone and propagate a good thing – as we humans are so found of doing – and in no time you have a village, push it a little further, and the concept of city is born.

Over these millennia however, our relationship with buildings has stratified into a web so complex there are aspects within it that do not even relate to its most seminal founding principles. Built form became a unit card for the identity of whole nations [1], for the establishment and preservation of power, and as a signifier of the zeitgeist of every phase and epoch of civilization's passage through time...all sideshows to the main play of why and how we truly build: spatial agency to resist the changing drum beats of the world outside. Dull and mundane this may seem, but try sleeping in a structure without four walls and a roof that society has bestowed great cultural importance to and the inadequacies are soon starkly apparent.

1. - Architecture and the practice of hiring architects has also gone beyond the mere idea of identity representation, it is also used as a segregative tool with which the elites have come to use to symbolise their power and wealth. These sentiments are expressed in an online article by website “The Greats” recounting the ethos and works of Japanese architect Shigeru Ban.
2. - The Post and Lintel system experienced a unilateral application across the globe, and amongst our earliest civilisations, even beyond England. It is used in many Minoan structures (1925 – 1380 BCE), buildings from ancient Egypt, and as far south as Great Zimbabwe in Southern Africa.



Stonehenge Figure 25



The Beginnings of Architecture - The Post and Lintel.

Figure 26

The Post & Lintel system was where our long story with architecture began. Evident in our earliest structures [2]- such as Stonehenge - it marked the first of our defiances against the dictates of evolution. We dared no longer to live according to the rules of our environment, but instead endeavoured to change our environment to suit our own needs.

Image by Author

Not anymore.

Today the realm of architecture is left scrambling to streamline in a world of ever heightening restriction. Efficiency, both in design and use has replaced the fetishized ideals of aesthetic (Neutra 1984). Now, more than ever, buildings have been granted agency as far more active participants in the story of our existence. By mandate, whether or not we are ready as society, buildings must do as much as possible, for as many people as possible, and as passively as possible to retain their utility and re-usability. Through-out the course of this study this central motiph will rear it's head again and again, for, as all great sayings, it sums up what our future relationship with buildings and by extension the environment needs to be going forward. It is rallying cry to wake the gentle-sleepers amongst us; to shake the knowingly ignorant into action.

In this brief study I shall seek to propose methods for a new age of resilience in the building industry, constructing a theoretical framework that lies at the nexus of spatial multi-valency, and sustainability to create a scheme that could offer answers to a turbulent future, and heal the troubled past of Johannesburg's minefields.

The World in a Grain of Sand

Next 21 sits along a quiet street in Osaka, Japan, bedecked in planted bushes and brambles so high you may be forgiven for thinking it a botanical centre or some odd, experimental greenhouse. Driven by curiosity, you see people come and go out the main entrance so you take a few steps closer to get a better look. It is only after glimpsing the placard standing out front – you would have to be able read Japanese calligraphy for this part - that you realise the building is actually a housing complex.

At first, nothing immediately jumps out as surprising. Apart from the bushes and brambles nothing seems to stand out all that much, but being the thoughtful, perceptive architect that you are you have this itch that tells you - more by implication than overt protest - that there is more to what you are seeing here. You decide to go inside and have a look at the neatly drawn fire-escape plan, tethered adjacent a black and white letters box, a feature wall in relief behind it.

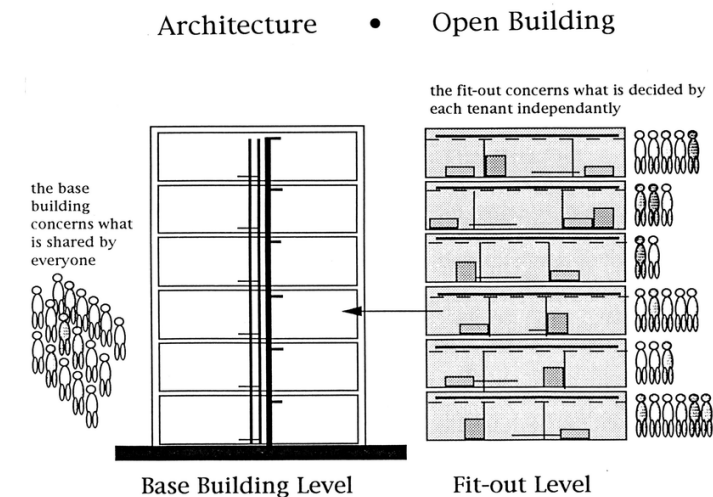
And – as the proverbial light-bulb twinkles to life inside your head – you finally see it.

Next21 is not your everyday housing complex. With wide-set columns and open foot circulation, the plan has its liveable units swimming in a sea of dynamism and movement, independent of each other by means of service and structure. Designed by Yositika UTIDA, Shu-Koh-Sha of the Architectural and Urban Design Studio, Next21 is an experimental structure utilising something called "The Open Building Strategy."



NEXT 21. FIGURE 27

NEXT 21 is an experimental structure - much like the final iteration of 'this thesis' intervention will be. The open building strategy itself saw a proliferation in its exploration and application between the 1960s - 2000.



The Open Building Strategy Figure 28

The Open Building Strategy emphasises something called the the "autonomy of living units," i.e allowing the living spaces in a building like NEXT 21 to function independently of each other. Image courtesy of Kendall S.

The strategy posits that any building structure can be split into two, distinct forms, as first proposed by John Habraken [1]; a Dutch architect, educator, and theorist. The first is the “Main-Building,” which in a sense is the “bones” of the structure; static, necessary, and unchanging. In it utility and circulation are accommodated; the essentials needed for life in the second, contrasting part of the structure.

This area, termed the “Fit-out,” or “tenant work” is the flexible, dynamic section where the life of the occupational aspects of the structure are housed. The theory maintains that all buildings utilizing the strategy will retain a certain adaptive, re-usability (Kendall S. 2004), as the living spaces relate to each other in what Kendall and Habraken termed the urban planning analogy, where the individual living spaces experienced an autonomy in relation to one another that allowed for a heightened level of customizability.

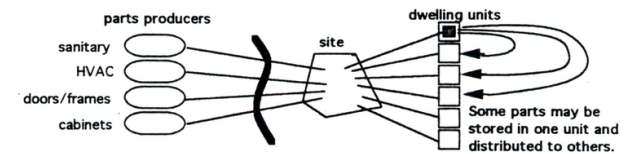
It is within this play; between the Micro and Macro-scales, that gave birth to the idea of having the state of the greater world reflected in a grain of sand; a principle that would allow a structure to maintain the agency of its physical structure as use and program change.

A Comparison of Traditional vs Experimental (Right) . Figure 29

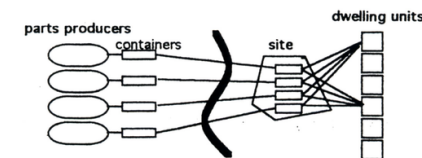
The Open Building Strategy betrays the restricting limitations of highly specialized and traditional buildings. The hope and focus is to provide new, lasting precedent that will allow our structure to be more adaptive and resilient.

1. - Soon after Habraken first articulated the forms and definitions of the open building strategy, it became widely experimented, resulting in an array of several iterative models erected across several continents. Though it all started in the Netherlands, it soon spread to the UK, the USA, and Japan to name a few.

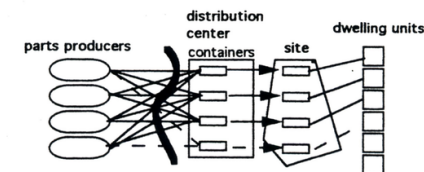
Comparing Logistics Strategies: Traditional vs. Fit-Out



The Traditional Supply and Logistics Chain



Intermediate Strategy



New Logistics Strategy

APPLICATION

Though initially an experiment confined to the realm of housing, the main principles of the open building strategy hold incredible weight and promise for this study. Transitioning between changing programs, namely from the use of our designed infrastructure as a tool to remediate and heal a broken landscape, the strategy gives the *how* to the *why* of our original critique of the mining infrastructures of Johannesburg's past, as discussed in Chapter 3, "Taking the Leap".

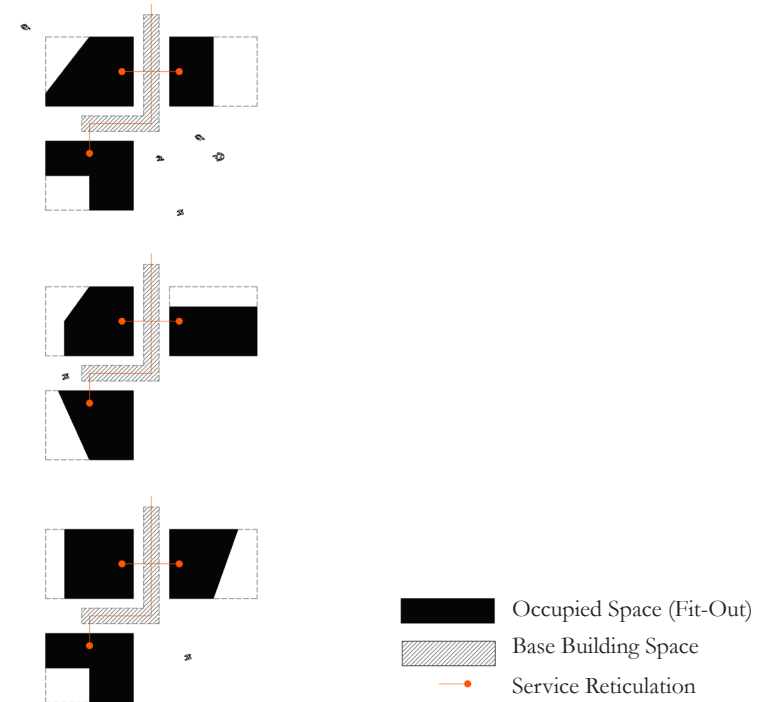
If we begin with the idea of establishing a backbone - namely a queue through which the interventions's utility is supplied and maintained, then we give the living spaces a freedom of form and changeability that will allow our structure to morph into a new identity after its initial function has been resolved.

The Open Building strategy also has a great bearing on the materiality of the end intervention, and further implies an "architecture of detachment" that leans heavily toward to modulation and easy, user-manipulated flexibilities.

The exact mechanics of this desired goal are explored in further detail in this section of the discourse, in the Chapter 8, "the Need for Metrics."

Illustrating the Strategy (Right) . Figure 30

As time marches on, the strategy allows the occupational spaces to morph and change. The predominant idea is to allow for change through the tenant driven customizations, thereby granting the structure resilience through the financial and social buy in of users. (Image by the Author)



CHAPTER 7

DRAWING PARALLELS : LIFE ON MARS

"Mars tugs at the human imagination like no other planet. With a force mightier than gravity, it attracts the eye to the shimmering red presence in the clear night sky..."

John Noble Wilford, Mars Beckons

7.A Resilience - the Most important Quality

In the year 2017, Elon Musk's SpaceX unveiled its plans for the possible colonization and settlement of Mars (SpaceX, n.d.). Today the idea of planet colonisation is a familiar and promising prospect, yet in our not too distant past, it had been viewed as ludicrously impossible. With a surface that is repeatedly scorched then frozen, a bleak lack of surface water and a thin atmosphere saturated with carbon dioxide (web.archive.org, 2007), it is not surprising why we once viewed the idea of life on this distant outpost as wildly beyond the realm of possibility, and that is not even accounting for the colossal leap in distance and space we would have to make to get there. Yet this recent realisation – at least for the daring, the brave, and the attentive – has been a long time coming.

Beginning in 2001, Musk had conceptualized the "Mars Oasis;" (SpaceX, n.d.) a mission that would land a small to medium sized space craft on the surface of our distant neighbour. Containing a small greenhouse, and a gel system that would fertilize Mar's native soil, Musk famously posited the idea that this would "be the furthest life had ever travelled;" a notion as daring as it was inspiring.

Today we are well on track to developing the necessary systems that would facilitate inter-planetary travel, and the idea of leaving the earth for distant shores has never before loomed so large in the zeitgeist of our age. Often it is linked with the story of dystopia...man-made, and self-inflicted; the duces ex Machina to save humanity from the consequences of a dysfunctional relationship with nature.

When the world we have always known is too far gone, when the resources that make life possible have dwindled to the point of threatening societal collapse, it is then that we picture a select group of the brave and daring few entering the fuselage of some futuristic Noah's ark; destined for the continuation of humanity's story amongst the stars. [1]

1. - Proof of how prevalent this idea is in current society is evidenced in Christopher Nolan's epic space drama "Interstellar," the notion neatly encapsulated when the main protagonist; a talented astronaut named Cooper, says : "Mankind was born on Earth ... it was never meant to die here."

2. Mars is suspected of once being earth-like in earlier times, complete with a habital atmosphere, and surface water. The story of how it came to lose these hallmarks, and its current state today, stand as cautionary tales of the fate that awaits planet earth if climate change and pollution are not addressed.



Worlds Apart - Figure 31 (Top) Figure 32 (Bottom)

The above pictures are strikingly similar, yet they have been taken in two worlds more than 65 million kilometers apart. The higher image is from the surface of Mars, and shows an inhospitable landscape where no water flows and no organisms grow. The lower image is from the Johannesburg minefields, and shows the decantation of acid mine water onto the surface. The similarities are both fascinating and concerning. If we let the world fall to ruin, we court a similar fate for ourselves.

Yet, by the time our technologies are ready to facilitate (and sustain) these dreams of voyage it may be too late. Present society is stuck in a race, with the aggressively increasing in-hospitality of our planet pitched on one side against our growing knowledge of space and the means by which to traverse it. So far – and sadly so - it seems that planetary degradation, in all its impersonal and righteous indignation, is in the lead.

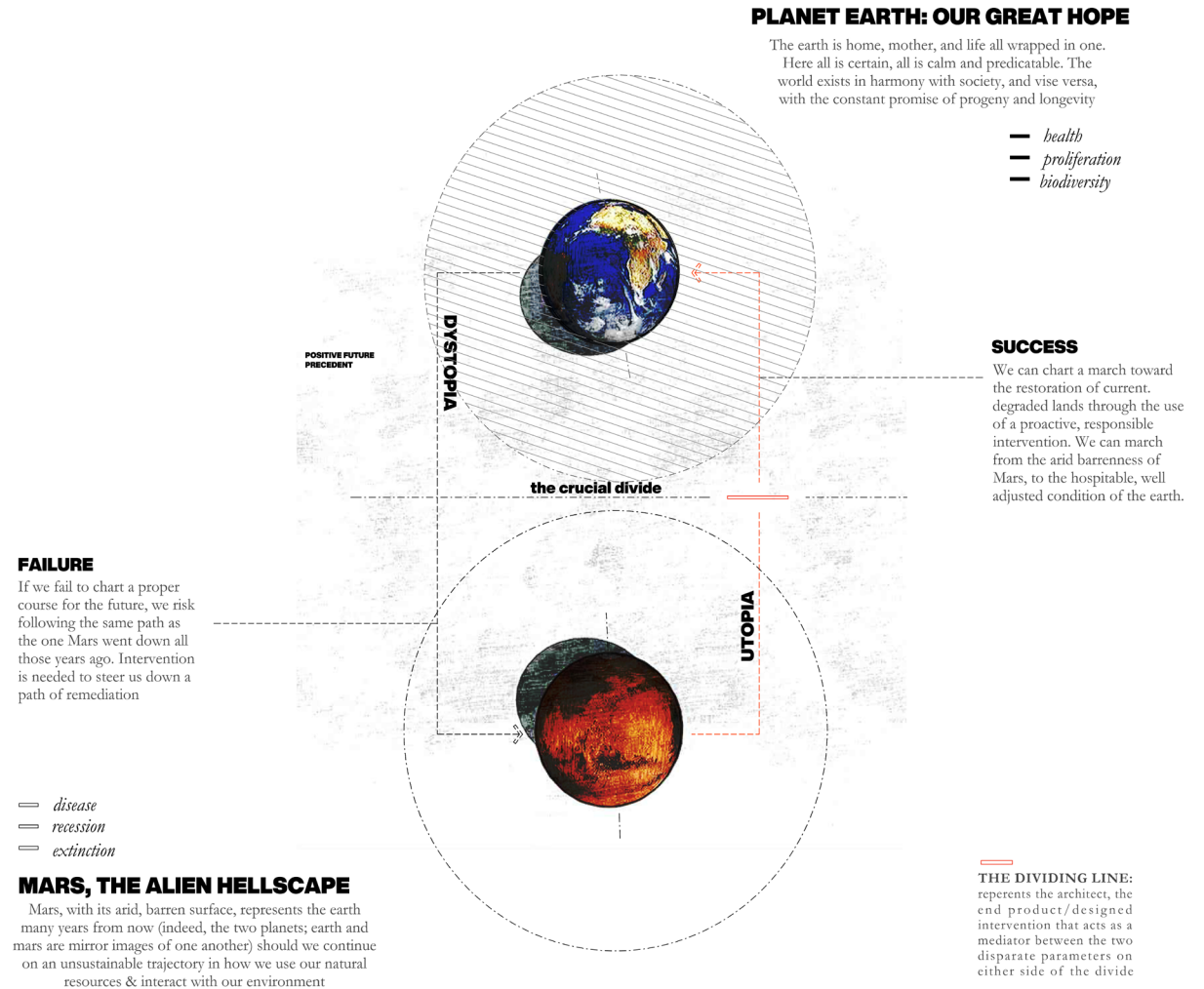
And so, we are left asking the uncomfortable questions: what's next for us should innovation fail to close the gap? What happens when we tilt hopelessly and irredeemably toward the brink? The answer, at least in evolutionary terms, is that we would go over that horizon and into the genetic abyss; never again to return. In short, extinction. But, as we have already seen and discussed, the human species is special in this regard. When we built our first structures, we changed the rules of the evolutionary game, and we have continued this trend into almost every other facet of our existence.

The idea of using innovation to shield us from the consequences of humanity's malpractice may seem and feel like defeating the ends of justice, but it could likewise be viewed as a means of shielding us from the threat of extinction so that we have a chance to amend and repair that which we have broken. If we cannot leave the earth in time, humanity will need a space of refuge where we can endure the apocalypse: sudden or gradual, as we busy ourselves with the work of remediation.

These spaces would essentially have to exist as micro-climates; the self-sustained and adaptable oasis of human life in a hostile world; not unlike the needed scenarios that would make life on Mars possible. So, in essence, the work of resilient architecture is needful and prescient in either prospect. If the planet becomes inhospitable before we can leave we will need these insulated environments to shield us as we work on cleaning up our mess, and if we do blast off into the cosmos these same insulated environments will give us the ability to live on these planets while we come to understand and adapt to their unique climatic conditions. Resilient architectures, in short – are our ticket card to a future beyond apocalypse.

Figure 33 : A Time Analogy (right)

Near Parallel Worlds, Mars and Earth are vastly differing faces of the same coin. In this analogy, there two paths presented. The one to the right of the image represents a dystopic line where the problems presented in the early chapters of this work remain unmitigated, their effects slowly becoming prolonged and exacerbated with time. Earth becomes Mars; dead and barren. The line to the left of the image however has far more optimistic leanings. With the implementation of a succesful scenario, the conversation between society and landscape changes for the better. Mars cycles up, gaining the key markers for life, adding hues of green and blue and white as it bursts back to life. Drawn by: Author.



7.B Refugia: Islands of survival

This concept of the insulated, resilient existence has a vast application however. The evolutionary story is perhaps the most exemplary proponent of the insulated, existential bubble. Refugia (singular Refugium), is a Latin based term (insert in text citation) dating back to the 1940-45's, and is specifically used to describe:

"those (areas) where special environmental circumstances have enabled a species or a community of species to survive after extinction in surrounding areas." (www.dictionary.com, n.d.)

Refugia are responsible for the survival of a wide array of species that would have otherwise gone extinct without their sheltering, exclusive presence. Prime examples include the desert pupfishes of the arid southwestern USA, (Rolston H., III (1991).) whose populations have survived from the dry phases of the Pleistocene era thanks to extremely specific, localised climatic conditions. These species have a strongly expressed endemism, i.e. they are uniquely adapted to survive in a very specific geographic location, and are relicts of a bygone age.

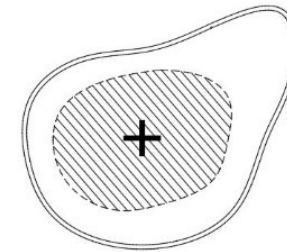
The concept is also exercised (by man-made means) in the functioning and design of green houses, where the qualities of light, heat, and temperature are duly controlled to allow for the growth of plant species that would otherwise perish in the outside world, often owing to relatively adverse climatic conditions.

These concepts of refugia are important in informing a future where humanity has to survive in an inhospitable landscape, whether it be in outer space or here, upon a dystopian earth.

With our abilities to bend and shape our worlds through building and architecture, humanity can dare to take the reins and build those refugia that would help us weather the apocalypse in either scenario. By taking into account those things necessary for life as we have always known it, we can seek to construct self-sustained communities, complete with their own special societal hierarchies (the concept of hierarchy is older than there have been trees on this planet (Peterson, J. B. *et al.* 2018)). Hierarchy is intrinsic to the human experience, as well as to society.

Thus equipped, safe from the ravages of a hostile world, humanity could endeavour to rebuild the earth. Yet, this deeply important societal experiment cannot happen when the events of apocalypse are already upon us. We need a place, a testing ground, where we can begin to stretch the possibilities to see what is possible and likely were we to leave the earth for safer shores or hall-up in anticipation of apocalyptic times.

The Johannesburg minefields, with their high levels of toxicity in water, earth, and air, are a prime location in which to put some of these theories to the test.



An Insulated Safety - Figure 34

Refugia consist of exclusive environmental conditions that allow organisms to survive amid relatively harsher and inhospitable surroundings. This concept is deeply prescient to a discussion revolving around architectural resilience.

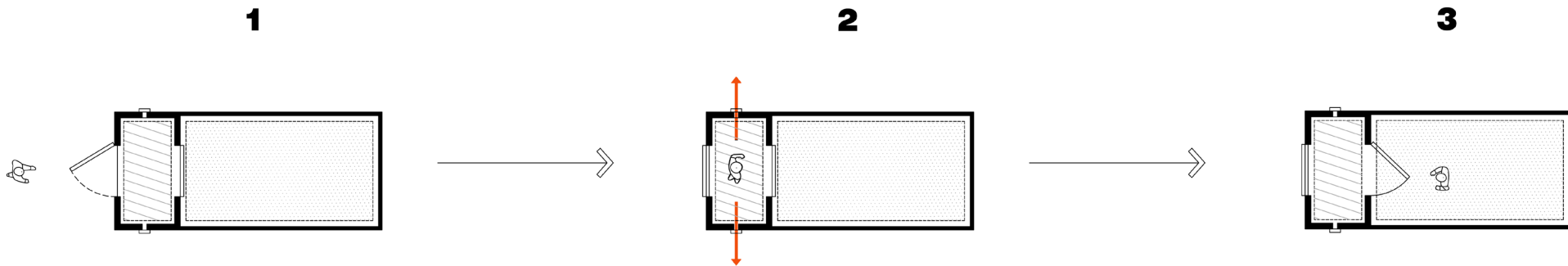
7.C The Rules of Engagement: Lessons from the Fuselage

Space shuttle airlock systems are curious things. Simple in principle yet extremely effective, they allow for "the passage of people and objects between a pressure vessel and its surroundings while minimizing the change of pressure in the vessel and loss of air from it." (Wikipedia 2020).

Airlocks allow for the maintenance of desired environmental constants; (such as habitable levels of pressure, temperature, and air composition) while still allowing for traffic between these spaces and the inhospitable, outside world.

The principle of the airlock holds eminent promise for this study, where our relationship with the environment - as mediated by architecture - can be dangerous and contentious. They show us how we can communicate with the outside world through our refugia; setting the rules of engagement in how we transition between a safe, insulated space and hostile environment.

They allow us the opportunity to live in a hostile environment yet engage with it in a safe and measured way, to have a light-touch, but a firm grip.



A Progression toward safety- Figure 35

The above diagram shows how an airlock system works at a basic, theoretical level. The concept will allow individuals living and working in the hazardous Witwatersrand context to remain safe as they transition between the external environment and their occupational spaces (namely, the intervention.). Image by Author

APPLICATION

Insulation is key in how we approach our chosen site, at least for the project's initial phase when toxicity levels overall site inhospitability are at their highest. Concepts of decontamination and re-entry - same as they relate to the fields of space travel - will be important in how we choose to articulate the interventions interior/exterior thresholds and circulation.

Additionally, the minefields offer us the opportunity to test man-made refugia in a context as near to the apocalypse as we dare ever approach, with many parallels being drawn to far off planets like Mars, which could one day come to accommodate human colonies.

Care must also be taken in our articulation of resilience to provide the necessary tools not just for adaptation, but for whole scale isolation should time and circumstance demand it.

Degrees of Exposure

The air-lock system need not function in absolutes: that is to say, either completely within or without. A nuanced approach to the articulation of this concept could possibly allow the users on site to adjust the degree of their exposure to the hazardous aspects of the context, or to emphasize a hierarchy of space and program.

The main focus at every stage however is to ensure that maximal safety is both emphasized and ensured.

CHAPTER 8

THE DEATH OF UTILITY

“The best things in life are free,” - Luther Vandross

8.A WHEN THE WORLD WENT DIGITAL: AN AGE OF LIBERALISATION

One of the hallmarks of the 21st century are the mass liberalisations we have in regards to knowledge. As society, information that has taken us decades and sometimes millennia to obtain is now scandalously accessible, with an increasing magnitude that has neither slowed nor paused since the advent of the personal computer and the internet. Ours has been coined, the “Knowledge Age”; (Shiftingthinking.org, 2012) one where the very concept of knowledge itself is transforming. No longer is it information retained in the minds of experts or stored in the pages of textbooks, knowledge has become a product, an expendable unit, like power or time. From an impact consideration standpoint, This transformation is equivalent to a revolution, perhaps the most important revolution in the last five hundred years.

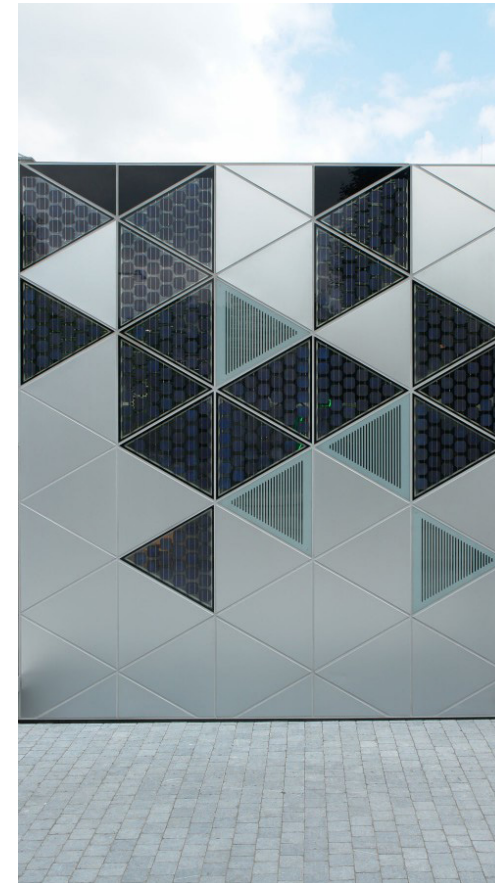
By a domino effect, the knowledge age has precipitated other revolutions everywhere else in the world, and it has been just as (if not more) powerful than the majority of the revolutions that came before. With these liberalisations came strides in our ease of communication. People are more connected today than ever before (Shiftingthinking.org, 2012). We share a new sense of community, one that pervades our social consciousness; made up of video-conferencing calls and per-second speed message sending. It has given a voice to the voiceless, and allowed the plights and struggles of the disenfranchised amongst us to find listening ears. Subsequently and in natural fashion, this weapon of the down-trodden has been the bane of totalitarian regimes, allowing world movers to topple governments (as in the case of the arab-spring) (Howard *et al*, 2011) or prompt those regimes wise enough to read the writing on the wall to move with the times and secure their hold on power (as in the case of China’s iron-grip control on media and public sentiment [1]).

8.B LIBERALISATION IN THE BUILT ENVIRONMENT; A TIME OF OUTSOURCING, SPECILISATION, & RE-DEFINITION

Liberalisation however, is a ripple effect, a tail-note on the deeper undercurrent of invention and innovation that has dictated our march through time, and it is fast being felt past the realm of info-communication. The field of architecture has not been spared it’s touch, for good and for worse.

In these times of change and flux the role of the architect has been re-defined, to the detriment of those relics championing the values and norms of yester-year. We have gone from the drawing

1. - The Chinese Communist Party (CCP) has actually just realised the danger that social media poses to the maintaince of China’s status quo and
2. Mars is suspected of once being earth-like in earlier times, complete with a habital atmosphere, and surface water. The story of how it came to loose these hallmarks, and it’s current state today, stand as cautionary tales of the fate that awaits planet earth if climate change and pollution are not addressed.



New Strategies- Figure 36

The International Centre for Design in Saint-Etienne, France utilizes keen design to achieve a wholistic, artful incorporation of solar panels into its key facades. Sub strategies will allow buildings to become increasingly self-sufficient from a resource based point of view. Image by Cliff Kuang.

board to the computer screen with ever increasing speed and complexity, leaving old and out-dated skill-sets high and dry like fish beached by a receding tide. For the younger generations riding this new wave however, a plethora of new opportunities and challenges have quickly filled their remit, transforming the practice into something fundamentally different from what it was a mere 20 years ago.

We make buildings, but the poetics, tools, and forms we use and generate have changed. Today, potential clients have applications on their mobile phones and computers that generate fast and easy floor plans, which has left many architects as little more than signatories, giving their consent to the work of virtual draftsmen. Increasing stratification in how buildings are designed and built is also changing our role as overseers and masters of the bigger picture. Architects who fail to choose a lane in the highway of specialisation are more and more becoming needless consultants, grasping for relevance.

8.B Building as Organism

The story of life on this planet maintains a narrative of change. As John Henry Newman said, “To live is to change, and to be perfect is to have changed often.” Those organisms that failed to make fundamental shifts in how they engaged with an ever changing world fast died out. Their static proclivities proved in the end, to be a fatal flaw which doomed their entire species.

With their active consumption of energy and resource through construction, function, and program buildings have joined the evolutionary march, though they be avatars of our place in the environment. The dictates of evolutionary knock-out game are becoming increasingly applicable to their role on the planet, with drastic, long-lasting consequences ensuing there from.

It is therefore time for buildings too to embody those qualities that will ensure their survival as parts of our story: to shed the limits of staticity that have ruled them from time in memorium.

We need to recognize the life-like entities of buildings to better design them for the coming age. Through solar panels and grey water systems, structures now have the ability to photosynthesis and osmoregulate. It is from this understanding of buildings as organism that we can begin to chart a new, and better course for the future...and allow buildings to become self-regulating, self-sustaining systems with a significantly lighter footfall on the status of the environment.

8.C Combining the Theories

The death of utility therefore, relates to the confluence of these two pieces of theory. Springing from a desire to liberalize power, water, and other such resources in a fashion similar to that exhibited in our present age of freely accessible knowledge, we can use a new understanding of buildings as organisms to achieve this objective.

If we can design buildings to metabolize: essentially, producing their own power, recycling their own water, and growing food for their own inhabitants on site, then their subsequent reliance on public utility will be greatly lowered. Indeed, in time the large efforts currently made at a logistical and financial level to maintain inter-state gas lines and repair broken sewer pumps will become obsolete.

With each building producing its own resources the built form will become actualised into dynamos producing power and water-springs supplying water to surrounding communities.

The need for utility - if it ever survives this new liberalisation of resource - will be greatly reduced, perhaps solely used now to uplift those communities among us that are disenfranchised or excluded.

APPLICATION

This theory, at least in part, experienced wide, international experimentation between the years 2008 and 2013 under the the joint research program “Towards Net Zero Energy Solar Buildings” under the umbrella of International Energy Agency (IEA) Solar Heating and Cooling Program (SHC) Task 40 / Energy in Buildings and Communities (EBC, formerly ECBCS) Annex 52 (International Energy Agency, 2014).

According to their findings, “Energy use in buildings worldwide accounts for over 40% of primary energy use and 24% of greenhouse gas emissions,” statistics that could be greatly improved by Net Zero Buildings that produce their own power and alleviate dependence on the grid.

As a tool for resilience, net zero concepts have the added benefit of allowing buildings to function regardless of fluctuations in utility cost and supply. They also allow end users the freedom for increased customizability as building fit-out (as expressed in Habraken’s definition of the Open Building Analogy) does not have to house utility such as water and electricity.

Net zero concepts are also vital in allowing us to weather the apocalypse, as they will allow our refugias to power and water themselves without the need for public utility.

CHAPTER 9

THE NEED FOR METRICS

“By bitter experience, the consumer learned that he had no means of judging alleged qualities (of design), he could judge performance only,” Richard Neutra, Survival through Design

QUANTIFICATION OF DESIGN

Great design can be quantified. This is a bold statement when we stop to consider the aura that currently surrounds our understanding of the design process. For many architects, achieving a universally acclaimed building or space might feel like catching lightning in a bottle, or may be the result of the visitation of their “daemon,” as commonly coined by Prof. Frederick J. Carbató - the unseen force that brings perfection into being.

For the rest of us, great design remains within the exclusive purview of the genius architects, the 20% amongst the 80 (Koch, 2018), that vital few who set the trends and rules of practice and precedent for millennia. Think Frank Lloyd Wright, Le Corbusier, or Antoni Gaudí here. Inspiration, in all of its forms and subsequent manifestations, has been an ephemeral, mysterious, and frustratingly inaccessible concept. Recently, however this view has begun to change.

With the turn of the century we are witnessing the heights of qualitative analysis in all fields, as well as in the value assigned to these analyses themselves. It is no longer enough for great architecture to live in, and gain value solely from the realm of the ephemeral. Great buildings need to do *something*. Performance is the new king, indeed; form must follow function far more closely than ever before. Yet, how has this come to be, and what implications does it have for the resiliency and rehabilitative powers of our infrastructure?

Richard Neutra (1892 - 1970) was a prominent modernist architect who began to note and appreciate this changing paradigm. The concept is enshrined in one of his more foundational works: *Survival Through Design*. In it, Neutra states that one of the hallmarks of the last two centuries has been the prolific liberalisation of means and resources, from information to the way we conduct our politics, in our access to travel, and in our ease of communication. He places in centre focus the evolution of architecture as a practice in performance as opposed to a fetishized exercise in idealistic aesthetic.

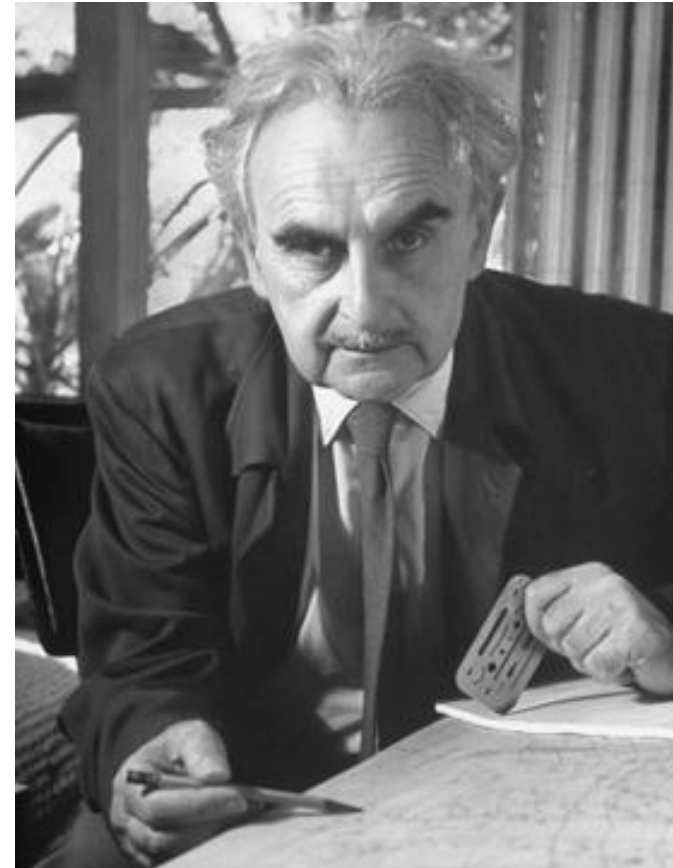


FIGURE 37 - RICHARD NEUTRA

Photograph by Ed Clark.

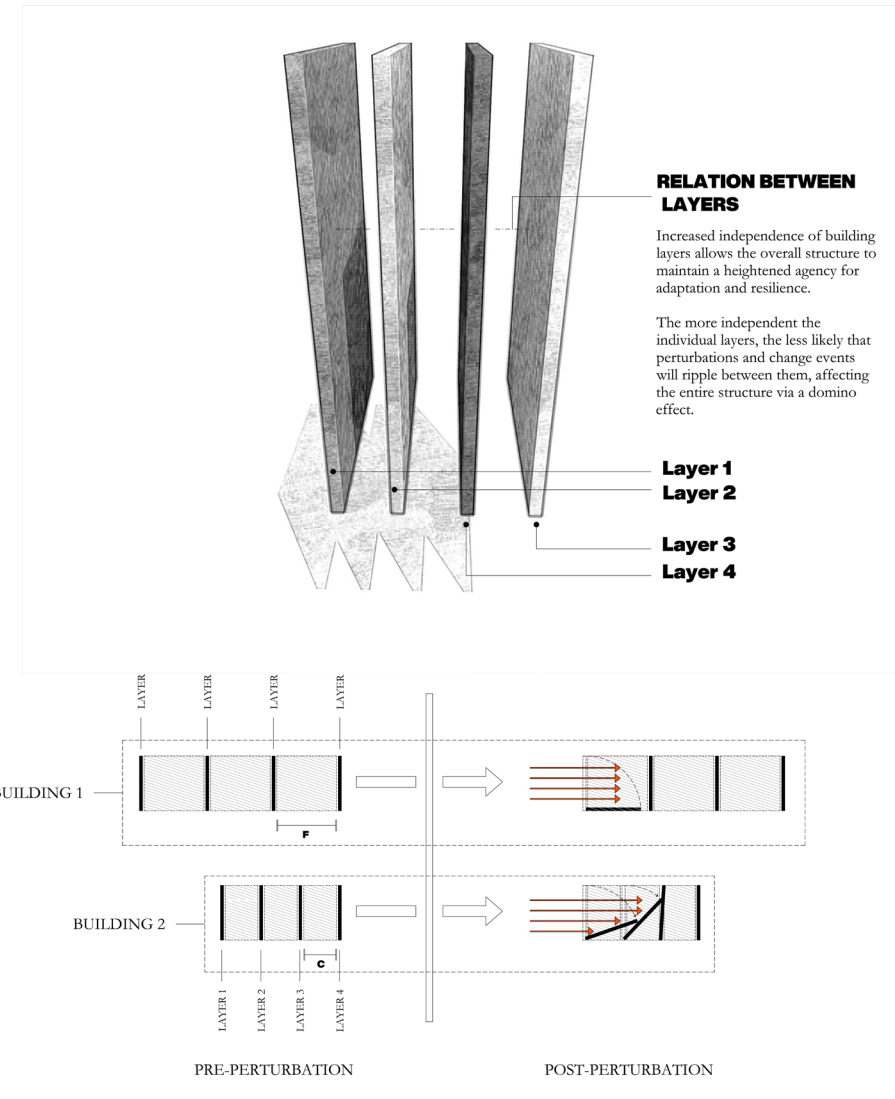
From this standpoint, he removes us from a reality where the affluent and educated alone dictate the standards of excellence and – and as far as we understand it - perfection. This act (another form of liberalisation) took the practice of architectural appraisal away from the niche of the self-proclaimed astute, placing its power into the hands of the laymen using tools and terminology that a wider sect of society could understand.

In short, the understanding of what makes a building great was more commonly understood, though this understanding needed a new set of rules to be beaten out. Furthermore, this shift did not come without drawbacks. By the very act of making great design more accessible we also increased the avenues by which it could be productised, i.e turned into something we thought of as consumable (Neutra 1984).

Just like a product, buildings would be held more and more to account against a set of guarantees and performance criteria. Aesthetic took a back seat, seceding its spot at the helm to green-rating classifications and other such hall-marks of “peak performance”. This new prioritisation can (and has) taken on a fetishization of its own, however. Many architects today are splitting hairs over the minute and pawing over endless spreadsheets and line charts, tuning and stream-lining their projects into non-existence. Though they may argue its merits, this is not the path we will take on our journey. Our objective is to recognise that metrics are important, more so today than ever before... yet also remember that aesthetic is still a necessary aspect to the definition of a project’s critical, regionalistic identity. We must walk this tight-rope, we must provide- as Le Corbusier stated - a machine for living, though in a far more literal and nuanced sense of the statement.

APPLICATION

Resilience, by its very nature, implies a measure of performance. Without a set of parameters, or some reliable way by which to measure the change and ware that a building both experiences and imposes, our exercise will have no basis to measure itself against and will remain lost at sea. We have already discussed (in Chapter 1) what resilience looks like in the realm of architecture, but now we must decide on what exact parameters we will use to measure it, and on what strategies/ tools we will use to attain it.



Reacting to Perturbations: A Domino Effect-

Figure 38

The above diagram seeks to further explain the analogy of buildings as being composed of layers. By pitting two buildings with different levels of layer dissociation between them, the above diagram shows how both deal with environmental perturbation, whether it be user or environment driven. Building 2, with its more closely associated layers experiences disruption across all of its layers when perturbation occurs owing to the close association of its constituent layers. Building 1 on the other hand, with its incorporation of adaptive design principles, has larger dissociations within its layers that limit the effects of perturbations upon its structure. Image by Author

ADAPTATION: A DEEPER DELVE INTO THE METRICS OF RESILIENCE

So far, we have focused on resilience in its broader strokes, and in its general application in referring to the “timeless built-form”. Yet the more strategic details of how a building may achieve this timelessness have not yet been beaten out. The 2016 publication “Adaptable Architecture – Theory and Practice,” by Robert Schmidt III and Simon Austin posits a few interesting ideas. In it, the inter-mechanics of resilience are revealed to revolve around a single notion: adaptability.

Under the predilections of this idea, the built form animates, it shakes of the shackles of stativity and grows and breathes and morphs to accommodate an ever-changing programmatic schedule. It becomes time-less through measurable, feasible, and more easily understandable means. It shows how - through careful design - we can come to imbue buildings with the necessary capacity they need to anticipate and accommodate change. Herein lies our great flail against the one-track practice of Johannesburg’s mining origins. There, in the hell-scape it created for want of foresight, will be a loud and challenging statement of how we – as society – should interact with our environment going forward. The future is renewable, the future is reusable; it is neither tied to singular function or idealisms. If we play our cards right, the age of demolition crews and hollowed-out ghost-towns will eventually become a thing of the past.

TYPES OF ADAPTABILITY

Even skim-level research fast reveals that adaptability has multiple strata in its application to built form. The term has become a buzzword in circles where this discourse is presently happening; losing all of its once attendant weight and specificity. It is my express intention to reverse this trend and avoid its propagation. In recognising these different modes of adaptability, we may come to realise its nuances more keenly, for they are not be all end all tools where the effect of change and uncertainty need to be addressed. They have specific applications, and will not work optimally – even at all - in every instance.

i) Adjustable – change of task/user

As Robert Schmidt III and Simon Austin state it, Adjustable alterations concern themselves with the “stuff” within a building. This relates to furniture in the most part, and how it can be reconfigured to accommodate a range of functions. This particular type of alteration is especially appropriate for use in

ii) Versatile – change of space

Versatility is a change/flexibility in spatial layout. Plan depth, column placement, location of services, movable walls can all play a part in the versatility of a space. Versatility is especially useful where variations in activities, organisational structure/philosophy, ownership or occupant are anticipated.

iii) Refitable – change of performance

This type of adaptability anticipates a change in performance via the alteration of a building’s skin, space, or services. Refitable buildings can trade walls with poor thermal properties for better alternatives when technological market strides/government regulations shift and change, for example. It is important to differentiate service layers from skin layers in this particular example.

This particular version of adaptability has far-reaching consequences as it is starting to command a premium over more static/fixed building types.

iv) Convertible – change of use

Convertible buildings are designed to easily accommodate changing program/functions i.e, a shop that can easily be turned into a religious/residential space. Conversion is easiest between programs that share a common structural typology (ware-house, short-span, wide span). The capacity for multiple conversions depends on the capacity and location of various physical elements (e.g. services, circulation, acoustics, floor loadings and fire design). Providing a higher than necessary (for first use) floor capacity is a simple tactic that can allow for increased loading later. Other critical parameters include storey height, structural grid, plan depth and total usable area. The conversion of offices to residential or hotel also requires consideration of the location and number of cores when first designed, as they will require more points of penetration (e.g. additional service risers).

v) Scalable – change of size Movable – change of location

Scalability is the answer for building users unsure of just how much space they might need in their building. Capable of adding, and subtracting to usable floor area, this adaptation method is also desirable in that it allows companies and corporations to change their spatial needs in accordance with the fluctuations in their markets, allowing them to shrink or increase their work force at will.

SEEING BUILDINGS AS SETS OF ASSOCIATED/DISASSOCIATED LAYERS

The theory of adaptability can be simplified as seeing buildings not as monolithic entities, but as an assemblage of interconnected systems. These systems, described as layers, work in tandem to render a building usable, with varying degrees of inter-dependency. What we need to achieve our goal in this particular study, is to provide maximum independence between the layers. Inter-dependency ruins resilience, because if one part of the building changes it causes a ripple effect in other layers that is not eminently desirable.

For example, you should be able to change the physical structure of a building (columns, slabs etc) to perhaps accommodate a new without also having to rewire your electrical supply or re-route your water pipes, and if there is not other way but to effect change, then at least it should not be as drastic as this.

By differentiating a building into layers, we can track, isolate, and accommodate changes to our structure. The rule of thumb is: Inter-dependency is bad, Independence is good.

DSMs as a barometer of Resilience Performance

Having divided our building into a set of layers, we need a tool that will help us weed-out and prevent over-dependency between these layers. The Design Structure Matrix (Schmidt, R. and Austin, S.A. 2016), often abbreviated to “DSM,” is a compact, simple, representation system often used to reveal interdependencies in complex systems.

The term “Design Structure Matrix” was coined by Don Steward (Schmidt, R. and Austin, S.A. 2016), and this tool has been used to measure interdependencies in buildings in several instances where adaptability was desired. Consisting of a $N \times N$ cell with a single domain, dependencies are mapped out by filling the boxes between different criteria.

By using DSMs across a range of projected timelines, we may be able to see which interventions will yield maximal resilience.

DSMs can be implemented at each of the end building’s phases to ensure that the structure is multi-valent and resilient between its layers.

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PART III - IMPLEMENTATION

The third part of this thesis shall seek to finally embark upon the path of implementation. Now that we have assessed a comprehensive set of strategies we can implement for the Rehabilitation & Resilience of the Witwatersrand's troubled mine-scape, we can begin by looking for a worthy site within its confines. This section shall include the early phases of the design, which developed through a set of iterations. The structure of this delivery is explained in the diagram below. The questions of program, relevant design concepts, and accompanying precedents are also handled herein.

ADDITIONALLY, PLEASE NOTE THAT THE DESIGN IS STILL A WORK IN PROGRESS. THE DRAWINGS HEREIN ARE TO BE REGARDED AS PRELIMINARY, AND SECTIONS HAVE BEEN LEFT OPEN TO ACCOMMODATE THE FINAL DESIGN ON THE DATE OF ITS COMPLETION (NOVEMBER 16, 2020)

Chapter 9 - SITE ANALYSIS.....	An appropriate site is identified & analysed. An assessment is made of available Infrastructures & surrounding land-use programs.
Chapter 10 - DESIGN CONCEPTS.....	The utilized design concepts are explored in this chapter, namely the main theories with regards to project phasing and tailing's extraction methods. Ideas positing these two functions happening simultaneously are also explored.
Chapter 11 - DESIGN DEVELOPMENT.....	It is here that the iterations of the design are cycled through & explored. A set of critiques from peers & supervisors are also explored & effected between the different iterations.
Chapter 12 - SITE & BUILDING PROGRAM.....	In this section the main functions of the intervention are developed in further detail. The wider implication in relation to the site are also taken into account.

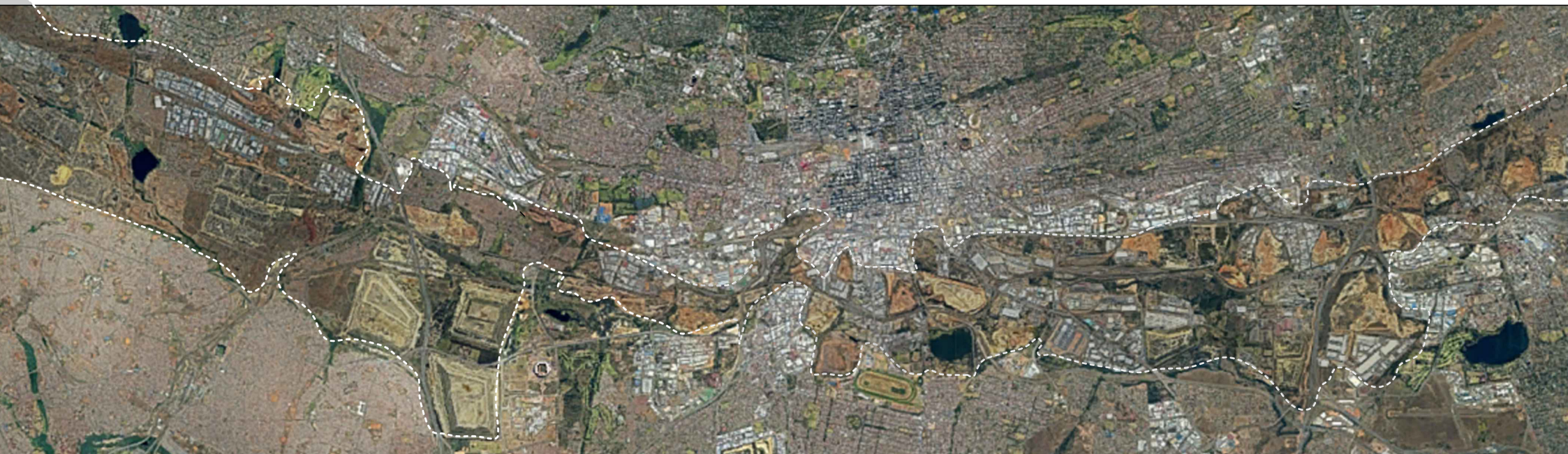
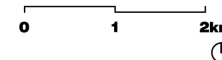


Figure 39 - THE GREAT NORTH-SOUTH BARRIER.
The old mining landscape dissects Johannesburg's urban scape in two, namely between north & south. The division transcends mere geography however, acting as a definer of class, wealth, and social groups. Image courtesy of Google Maps, edited by the Author.



CHAPTER 10

SITE ANALYSIS

9A. IDENTIFYING A SITE

The Witwatersrand mining belt is dotted in a plethora of old tailings dams, disused shafts, & open quarries which made the choice of site difficult at best. The number of areas, and subsequently populations affected by them is large and varied. From the onset it was important to decide upon a set of criteria to guide my decision. In the end, it was the idea of thresh-holds - primarily between north and south, (Figure 39) - and the intercises between different land use types that proved pivotal.

As illustrated in figure XX, the mining belts form a bold barrier between north and south, and the initial idea was to break through this terrains-vague and reconnect north and south. Via a series of abstractions, I highlighted those areas of the belt covered in water bodies and old tailings, seeking those areas where breaking through the barrier would be easiest.

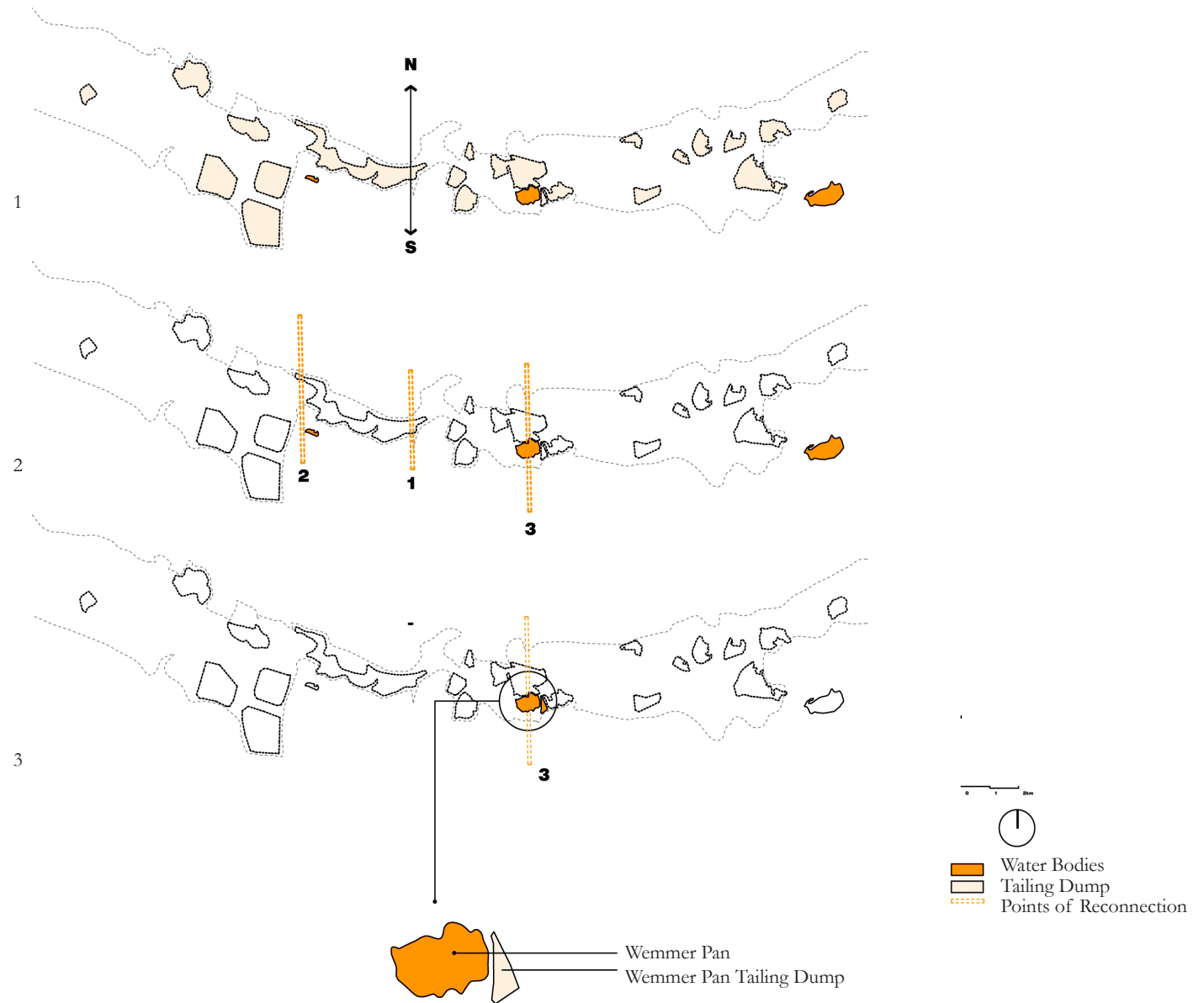
9.B ZONING IN

Three locations where the barrier was at its thinnest were identified and analysed. The first and most central aligns with the Gold Reef City Precinct; an area of public theme parks and weekend attractions; a place that already enjoyed a certain sense of celebration and financial investment. The second and most central was around the Mooifontein area, A district of industry an recreational playing feilds (the FNB stadium is located along this axis) - an area, similarly not nearly as abandoned as drssically as this thesis demanded.

It was the third axis, relatively indiscinct, and overlooked, that became my chosen site. Occupied by a massive old tailing dump and a contaminated dam - Wemmer Pan offered the opportunity to utilise the elemental language of wind, water, and earth for a mediation between landscape and society.

Figure 40 (Right) - AN ABSTRACTION OF THE REEF

- *Drsawing 1 identifies the location of old mining residue and their associated water bodies. The divide between north & south is also acknowledged.*
- *Drawing 2 identifies likely points in the belt where the intervention could likely break through, reconnecting north and south.*
- *Drawing 3. The Wemmer Pan site is chosen for the criteria discussed in 9.B (All drawn by the Author)*



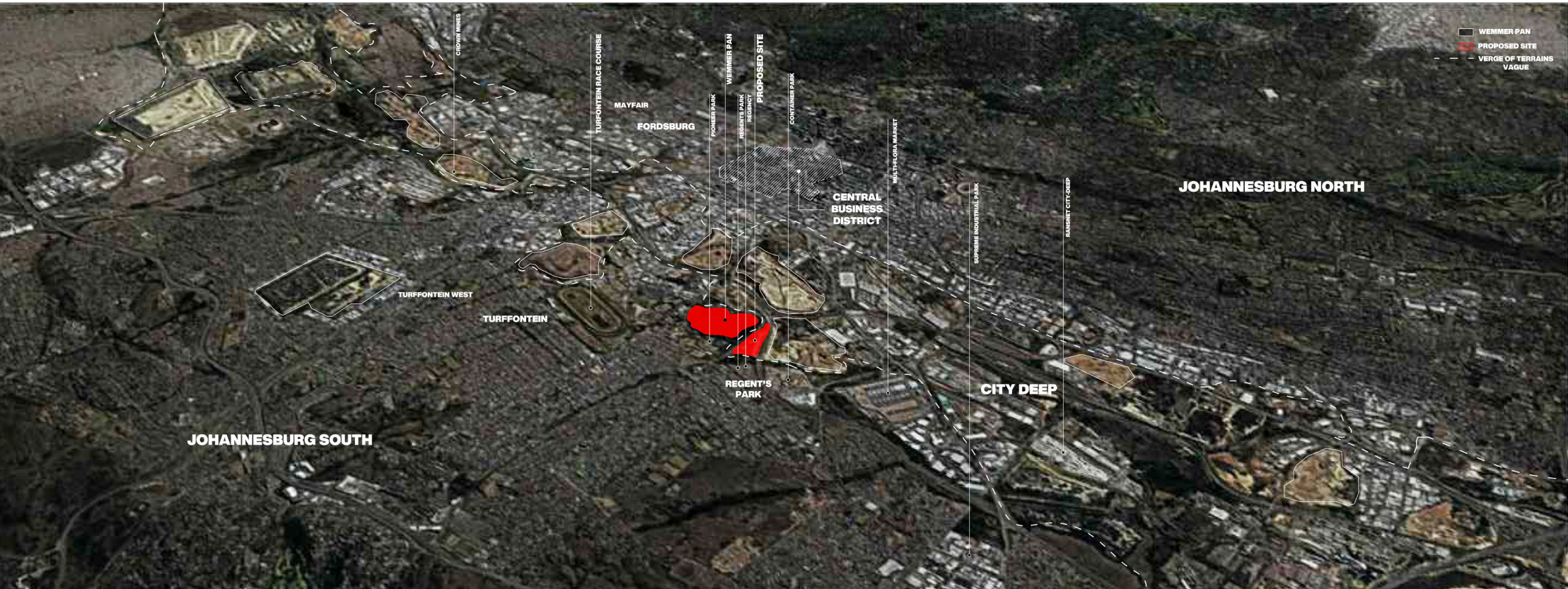


Figure 41 - Identifying an optimal site
The final choice of site was influenced by a proximity of various informants and landscape features.

9A. THE SWEET SPOT

Further investigation revealed that the Wemmer Pan site sits in the midst of 3 land use types; namely recreational, industrial, and residential. The site occupied by the mine dump offered the opportunity to allow for these land use types to interact more directly - a program that could only be developed in the later stages of the project after the issues of toxicity and pollution had been solved.

It also became apparent that the site sits adjacent to large factories such as the Multi-foods market, an area to its north

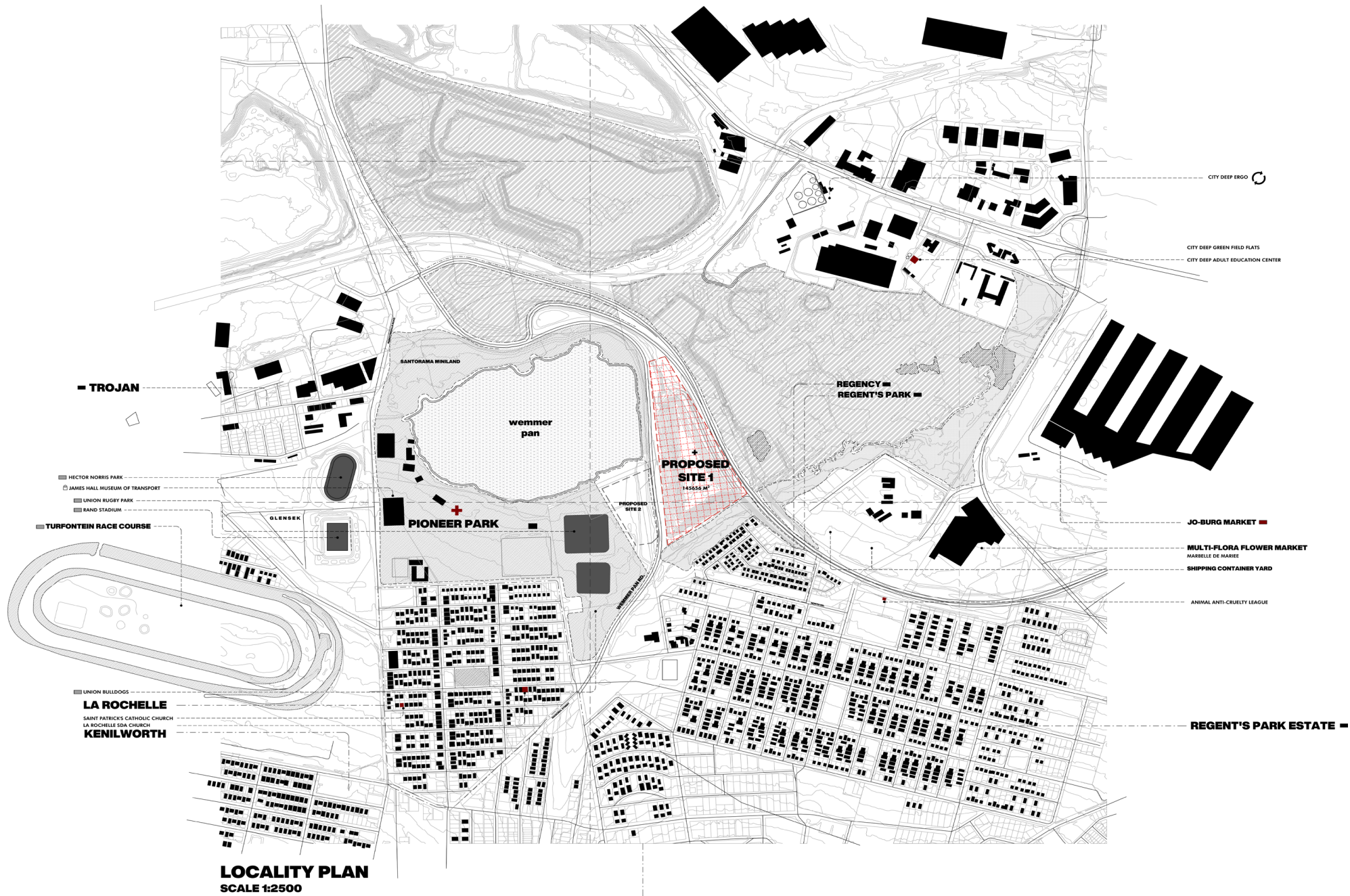


Figure 42 - The Wemmer Pan Mine Dump

The aerial views of the dump betray its close association with the nearby Pan, as well as its expansive size. It sits over 10m tall, and covers an area about 145000m² in size. Alluvial deposits now sit on top of the dump, allowing trees and shrubs to grow on top of it.

A VIEW FROM ABOVE - RECOGNIZING THE CONNECTIONS

Wemmer Pan and its associated dump are linked to each other through relational links of contaminations. Water runoff from the tailing dump washes across the main access route (Wemmer Pan Rd.) to pollute the pan, which is not inhabited by local fauna (fish, etc.) on account of the water's toxicity.



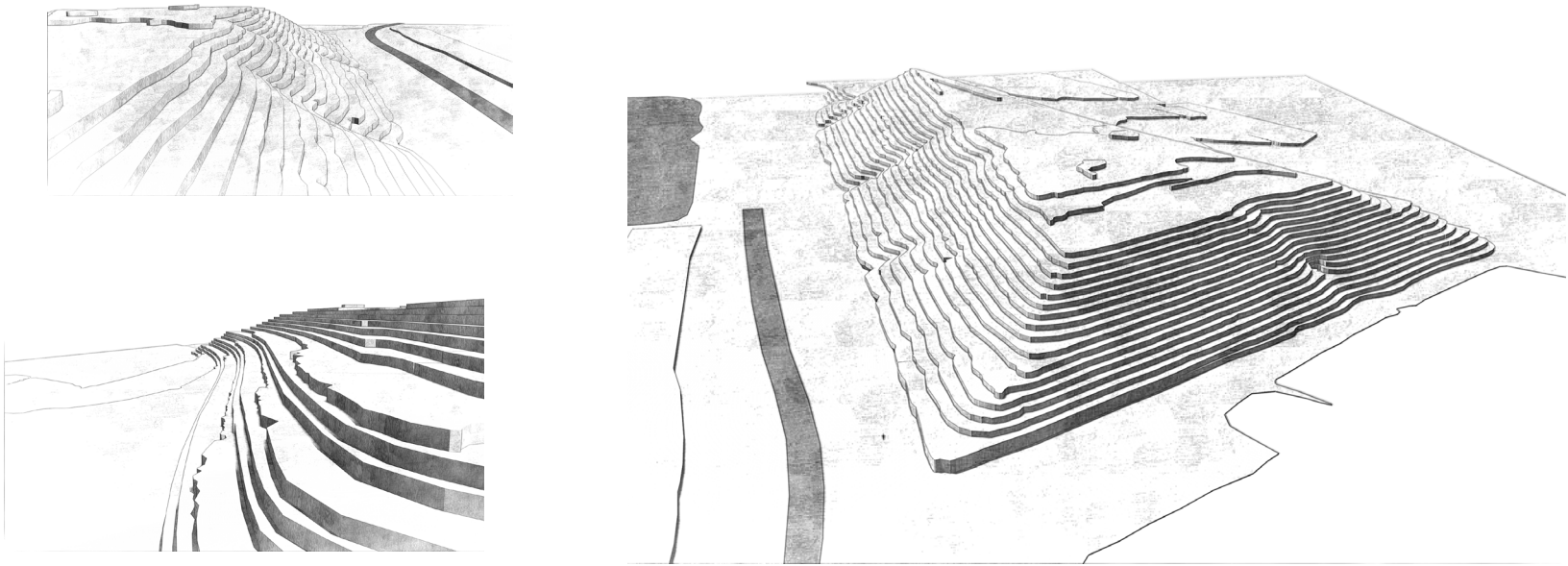


Figure 44 - UNDERSTANDING THE SLOPE

The importance of understanding the slope and gradient of the dump could not have been over-emphasized in this project. The ability to build into it's mass, to extract from it, and to retain its mass was of the greatest importance to the final design, and to achieve an appropriate level of understanding with regards to this, I resolved to build the site in 3D.

CHAPTER 11

DESIGN CONCEPTS

REHABILITATIVE CONSIDERATIONS

10A. A PATIENT WORK OF GRADUATION

As we have already discussed, the frameworks proposed by the South African government to solve the problem of mine waste have been toilsome and slow in their implementation. (Bobbins K. and Trangoš G. 2018). We have a situation where we are forced to live with this problem over many more years than was intended, with the health and ecological consequences of this great inertia being large and drastic.

In light of this, it is readily apparent that a steady, patient approach must be utilised in solving the reclamation and remediation of the Wemmer Pan mine dump, as well as of its associated dam.

The dump itself is huge in physical size; a mountain, no less. In the structuring of an actionable solution, it seemed apparent that a proposition in which the entire dump was reclaimed and remediated in one go would fast sap already waning incentives, and be monstrously expensive to undertake.

An alternative approach was needed to address the problem; one that accounted for time as well as expense.

10B. KEEPING THINGS BITE-SIZED

In architecture, the concept of project-phasing allows us a certain, logistical flexibility. When time is short, or funds low, dividing the work into sections that can be built in the future allows us to have our cake and eat it too, so to speak.

In a situation where government and private interests alike are presented with the daunting task of remediating a large number of derelict mines, keeping things at decent, bite-sized proportions may allow for easier engagement with the problem.

Phasing may be slow, but it accounts for cost. The time aspect still needs to be addressed however, and this leads us to the next concept developed in the approach of remediating and reclaiming the Wemmer Pan mine dump.

10C. THE CONSTANT COMPROMISE

The delay in solving the problem of derelict mines possess serious concerns for public health and the ecological well being of Johannesburg cityscape. We cannot afford to leave this particular wound to fester much longer, as every year that passess results in more people as well as geographical areas being adversely affected.

In addition, dumps like the one at Wemmer Pan occupy valuable real estate right at the edge of the city's confines. To therefore address both the issues of time and cost, a phased system of balanced compromise must be effected.

THE MAIN FOCUS OF THIS COMPROMISE WILL BE TO EXPLORE HOW NEWLY CLEARED MINE LAND CAN BECOME PRODUCTIVE AS SOON AS IT IS CLEARED, EVEN AS OTHER PHASES IN THE OVER-ALL STRATEGY ARE PENDING IMPLEMENTATION

This dual, compromising approach will allow phased extraction and infrastructural development to continue hand-in-hand. The technical challenges of this approach became clear with successive reviews, both with appointed supervisors and my peers.

The predominant concerns revolved around catering for the high levels of toxicity on site, and the technical logistics of building and extracting material from the dump at the same time.

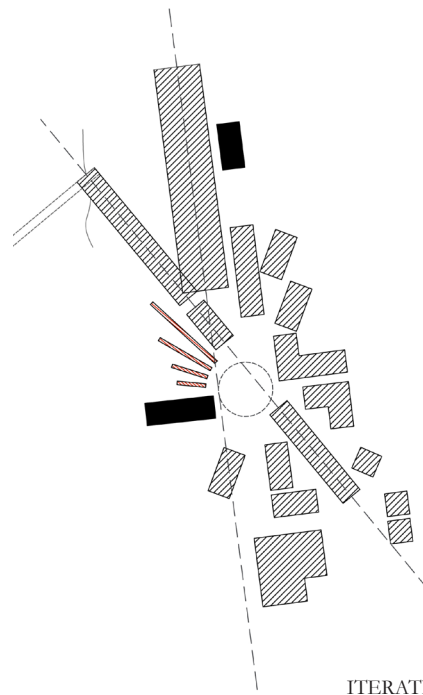
The first strategy to solve these issues revolved around the articulation of the architecture itself, namely through the creation of refugia-type spaces insulated from the harsh aspects of the outside world. The initial building program in the early phases of the intervention would also have to concern itself chiefly with the work of cleaning the landscape of harmful toxins while simultaneously producing the construction material used to build the intervention (in the form of cleaned soil for use in rammed earth construction. See chapter 4).

Thus the building would spring forth from the landscape, made up largely in part of the same material already present on site. As the study continued, vertical articulations of the scheme were also explored to offer users/tenants protection from the harsh conditions of the site by elevating them above the landscape. `

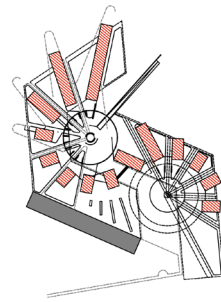
TIME	RISK	COST	
Timelines are significantly extended in this strategy as the processes of reclamation and redevelopment are occurring one after the other, respectively.	Risk is lower here, as only specialists remain on site until toxicity level are low enough to allow for redevelopment	Costs are lower here, but the return on investment window is much wider as the land only becomes usable after all reclamation/remediation processes have run their course.	STRATEGY 1 (REMEDIATE FIRST, BUILD LATER) The strategy that emphasizes remediation as the first and foremost priority prepares the site before infrastructural development can occur. Immediate risk to the people who will live and work on the site after the necessary processes have run their course are relatively low, but the land itself remains unproductive for a longer period of time.
The overall timeline is shortened in this approach as the land becomes useful even as the work of remediation is occurring;	Higher, though the overall problem is solved faster. People living / working on the site need adequate briefing on the risks involved to exposure to mine waste, as well as the processes running on site.	High, but project phasing through the build/reclamation stages will allow this cost to be divided into manageable stimulus packages to kickstart each phase. Additionally, returns in this strategy start streaming in sooner to compensate initial investments.	STRATEGY 2 (BUILD AS YOU GO) In this strategy, the newly cleared mine land is developed as soon as the land becomes available. High in risk, the constant issues of lingering toxicity and continued work on site (builders + remediation experts) are the predominant challenges. The pros however, are an overall shortened timeline and faster economic return as the land immediately becomes useful once again. Concepts of refugia will be strongly implemented here, and the initial building program will be significantly restricted to housing those processes that deal with residue remediation and reclamation.

Figure 45 - OUTLINING THE STRATEGIES

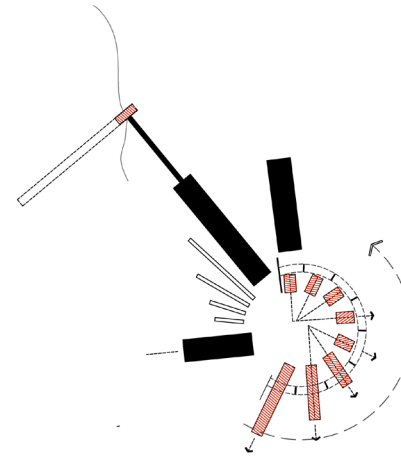
The two strategies explored above are disparate approaches in how our design concept will be structured. The overall factors as they relate to each strategy are also drawn up in stark comparison to one another, so that a single decision can be made in light of the major parameters involved.



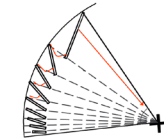
ITERATION 1



ITERATION 2



ITERATION 3



ITERATION 4

10D. GRADUATION & THE RADIAL FORM

Apart from the pervading dualities that manifested themselves as the making of this work progressed, a tendency toward radial form - especially in the articulation of the building's plan - seemed to be a running motif throughout all of its iterations. It seems to have grown mostly from the desire to find a form that could engage with the site at a maximal level, without reservations or implication of singular direction.

Linear forms with directionally biased facades seemed to be blunt tools in the articulation of a forms that could well engage with the landscape. It was only after further research that the subliminal connotations of radial forms and subsequently the reasons why they are well suited to the articulation of this intervention became apparent.

Radial forms are universally acknowledged to symbolise unity, and security from every direction - an idea that seems to be prevalent in all cultures. The concept in the use of radial forms in this study is to invert this initial premise of protection, and thereby use them as tools for maximal engagement with the outside world.

Figure 46 (TOP)- THE QUADRALETIC CONNECTION

The above drawings are abstracted versions of the ground floor planes of each successive design iteration. The common link seems to be the articulation of a radial form that allows maximal engagement o between the architecture and its surrounding landscape.

Image by the Author

Figure 47 (Right)- A FORM THAT TRANSCANDS CULTURES

Examples of how the radial form's articulation spans across cultures. Image 1 depicts A reconstruction of a Viking settlement Trelleborg near Slagelse on the Isle of Seeland (Denmark) as it existed between 1000 and 1050 AD. The circular form has been used to provide the ultimate protection against attacks from all sides.

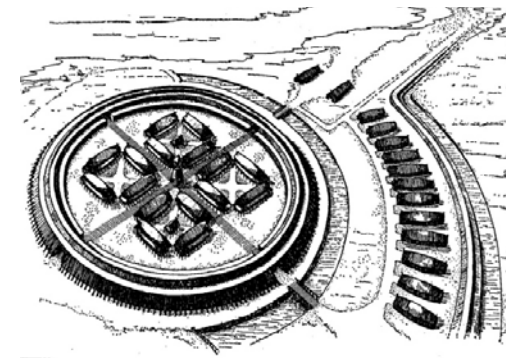


Figure 47.1



Figure 47.3



Figure 47.2

Image 2 show rock carvings on the Spanish island of La Palma might indicate circular living quarters - although a more universal expression of doodling cannot be excluded. Image 3 shows The rectangular plan of the complex Dashby-3 in Central Asia . All images courtesy of

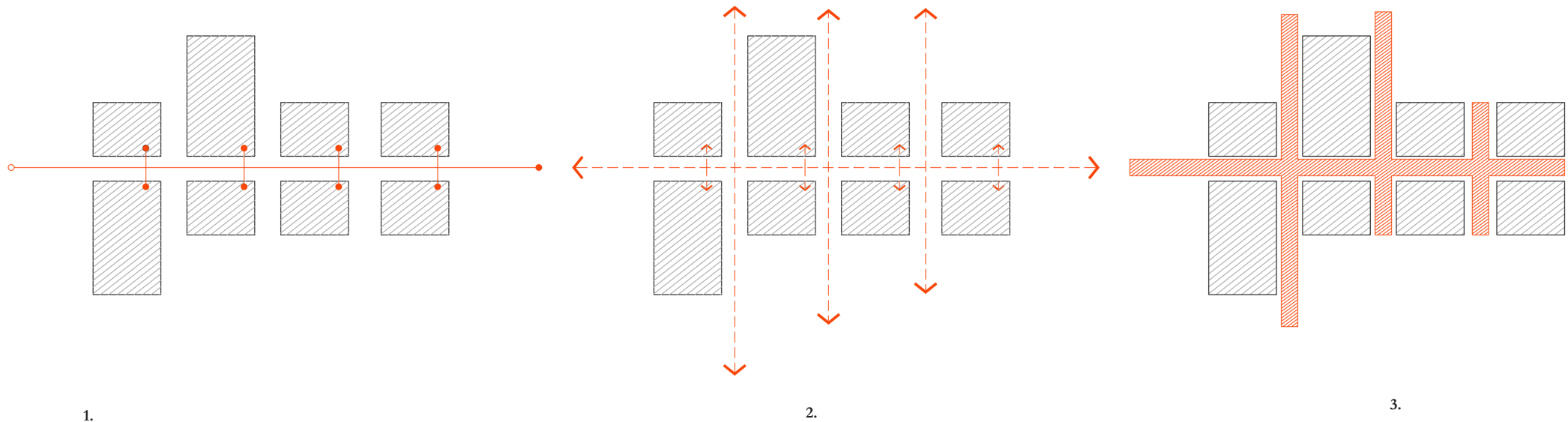


Figure 48 - UNDERSTANDING THE STRATEGY

The above diagram shows how the opening building strategy splits and articulates fit-out and base-building spaces, with service reticulation (image 1), circulation (image 2) and common space accommodated between the individual fit-out units.

RESILIENCE CONSIDERATIONS

10E . IMPLEMENTING AN OPEN BUILDING STRATEGY

The main issues relating to resilience encompassed the end flexibility of the intervention, allowing it to maintain agency past its initial use (namely the work of rehabilitation and reclamation.) This consideration centered my focus on the open building strategy, net zero concepts as discussed in the earlier chapter (the death of utility) and adaptive architectural strategies as discussed in “Adaptable architecture theory and practice,” by Schmidt and Austin.

The initial expressions of this strategy were expressed as what Kendall S. called the “urban planning analogy” with each unit of space, i.e. rooms/occupied spaces being able to express a degree of autonomy relative to each other.

The only links between these spaces - similar to those between different buildings in an urban planning scheme - would be those in which utility and circulation ran: much like how roads, plumbing, and powerlines behave as links between buildings and neighborhoods. xwould

10E . MODULATION

The idea of modulation arose from the need to mitigate the financial and logistical aspects of the design, while simultaneously allowing for the easy transformation of spaces by users and landlords alike. Modulation will allow many of the spatial elements in the scheme (namely the housing areas) to be express desired levels of adaptability.

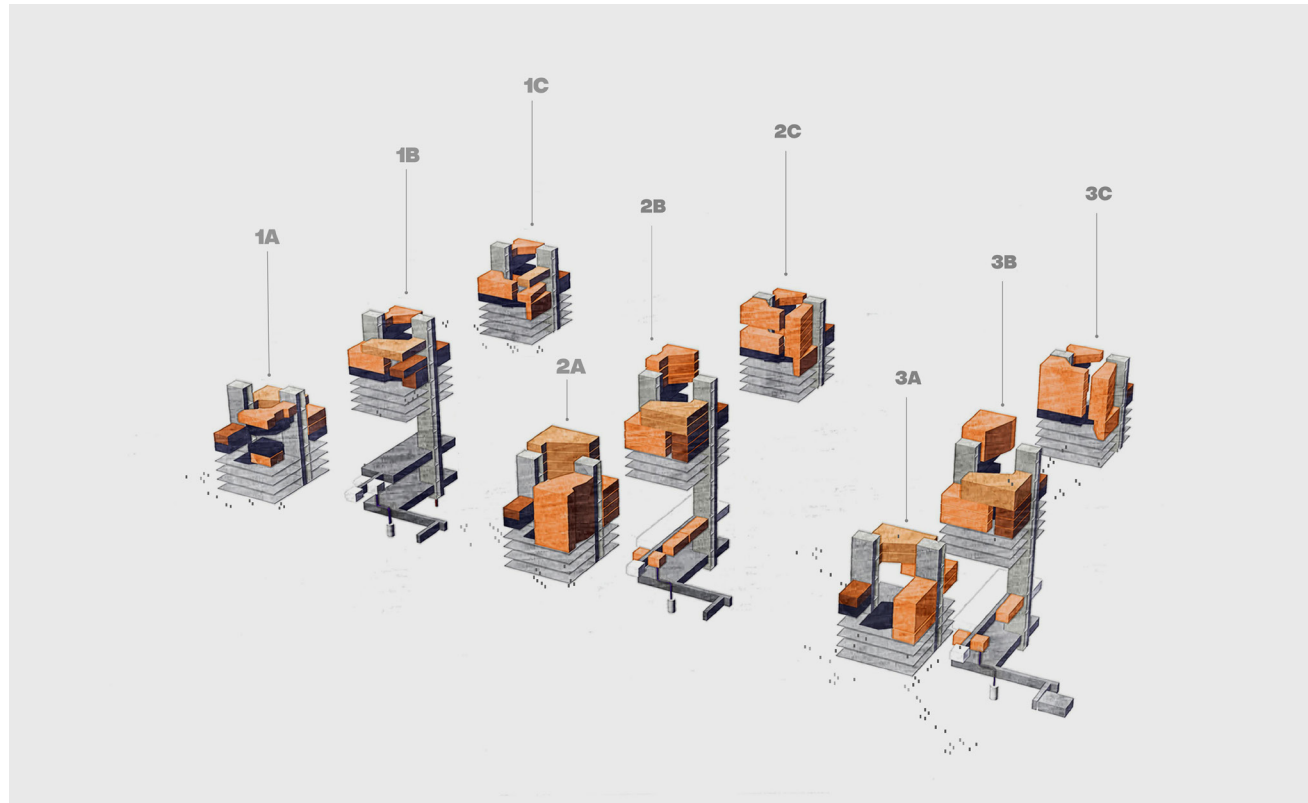


Figure 49 - Combining the Elements

This early iteration was barely tied to space, but did its best to explore how the morphing spaces could possibly come together, past singular time and use.

CHAPTER 12

DESIGN DEVELOPMENT

11A. THE EARLIEST ITERATIONS: A MORPHING ARCHITECTURE

The most seminal beginnings of the design grew from the need to produce an architecture of resilience; one that adapted to changing circumstances to maintain agency past differing use. Arrayed on a changeable 30m x 30m grid, the earliest iteration conceptualized spaces that were interchangeable and part of a larger scheme.

This very first iteration of the design - there would be another 4 up until the compilation of this document - was barely tied to place but explored the ideas expressed above.

5m high ceilings were then incorporated to give the grid a livable volume - the height of which would allow for further spatial flexibilities (Schmidt, R. and Austin, S.A. 2016).

The next step was to abstract and conceptualize these volumes into various shapes, all in a bid to establish commonalities and through lines upon which the “main building” could be established. By lining these commonalities up in a considered and recurring manner, the structural soul of a possible intervention began to develop..

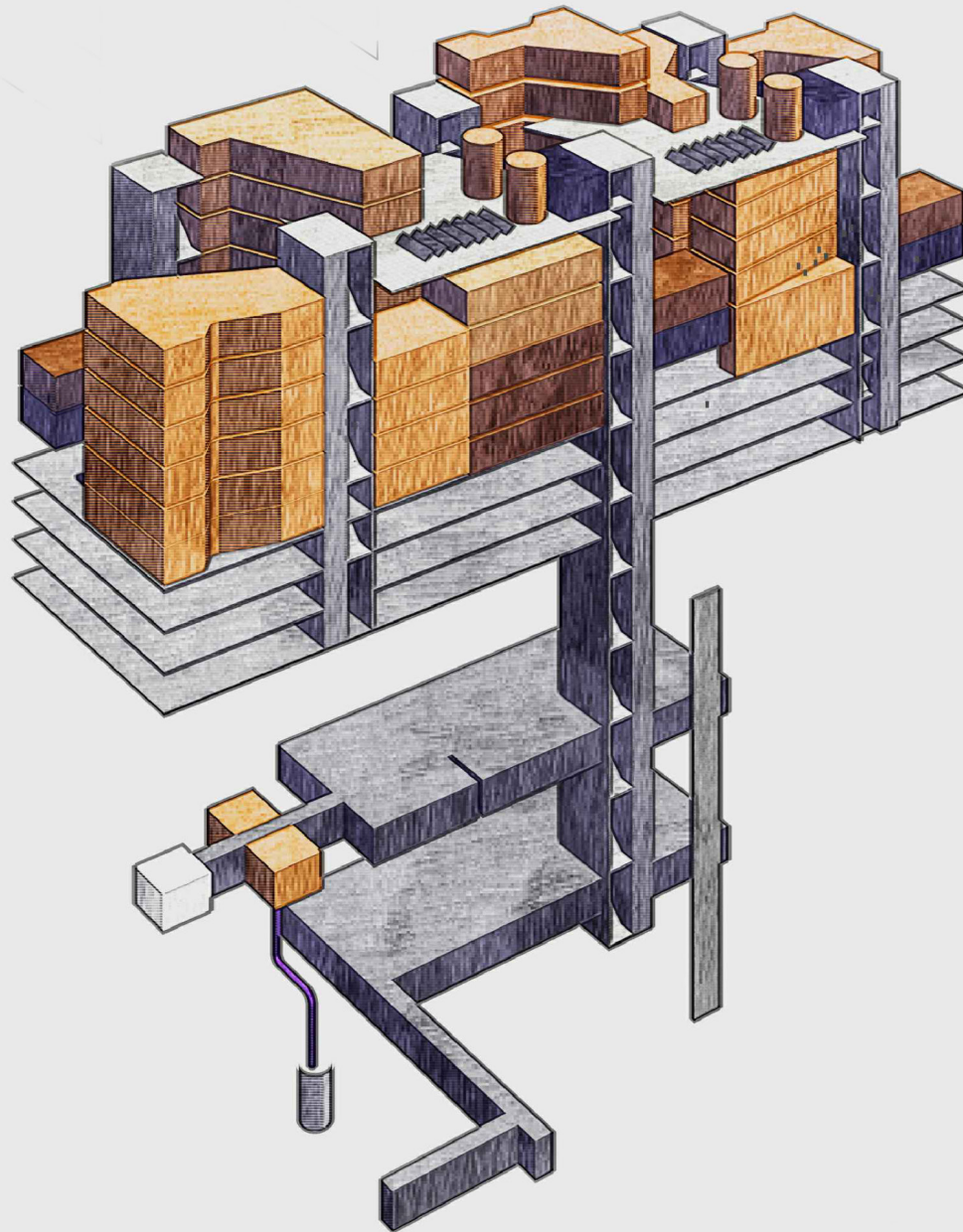
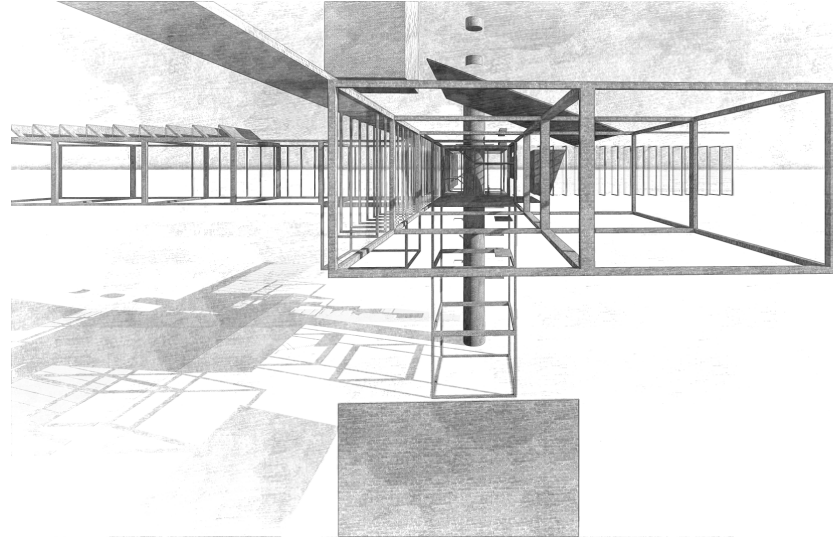


Figure 50 - An array of Options

The early study was akin to a session of Jenga; with apparently randomized model building that strived to establish the main grounds and themes of a possible intervention. This came in response to the sheer expanse of the site, which was both daunting in its scale yet offered the chance for unlimited possibility.

To avoid getting lost in this endless sea of prospect, the first rule was to establish a set of rules to impose useful constraint; in short, a viable and feasible design brief.

This randomized exercise in modular conceptualisation was the first step in this process, and would establish the themes needed to ensure a changeability past initial use.



THE above render stares down into the modulated steel structure, showing the volumetric extent that users would experience while utilizing the space.

11A. THE OPEN BUILDING STRATEGY - EARLY ARTICULATIONS

The search for these modes of commonality upon which a “main building” and a “changeable mass” could be distinguished led me to explore the concept of the Open Building Strategy, as outlined in chapter

The earliest articulations of a possible Open Building Strategy were initially designed in a vacuum - outside the limitations of site and context. The idea, as before in the exercise with the 30m x 30m block was to explore the possibilities when working with this building strategy. It was from this exercise that ideas relating to an architecture of detachment first developed; positing a permanent steel substructure developed in a modulated grid. Cladding, removable floors, and green infrastructure became the theorised infill used to engender the living spaces, while the glazed walkways were designed to have exposed members and a raw finish that evoked the barren nature of the site and exposed - at least at a visual level - the users and tenants to an ugly landscape.

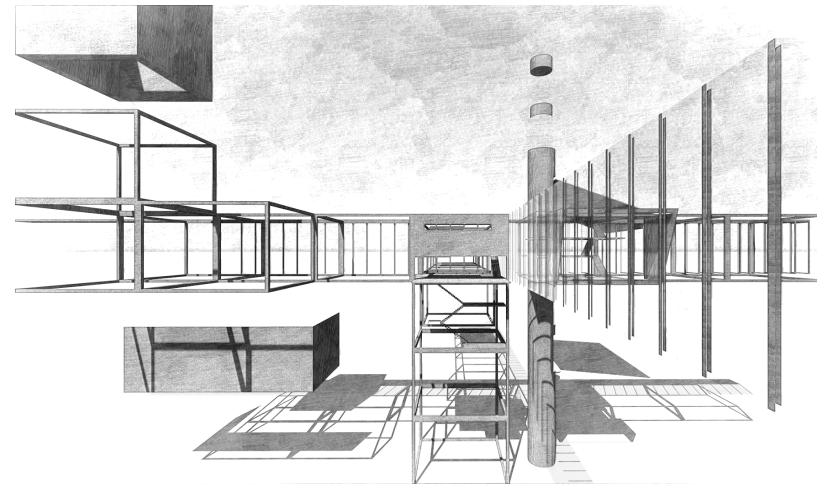


Figure 51 - VIEWS AT THE HUMAN SCALE.

This early iteration was barely tied to space, but did its best to explore how the morphing spaces could possibly come together

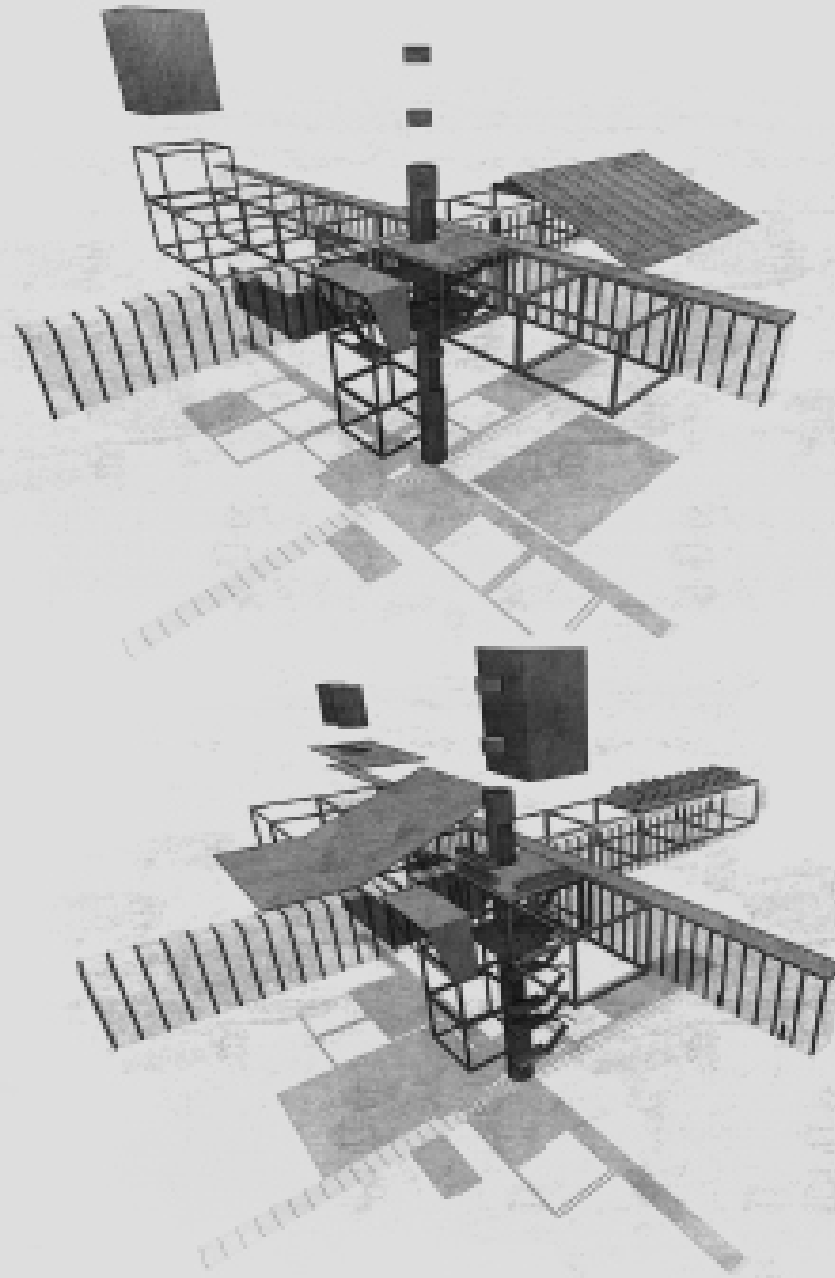
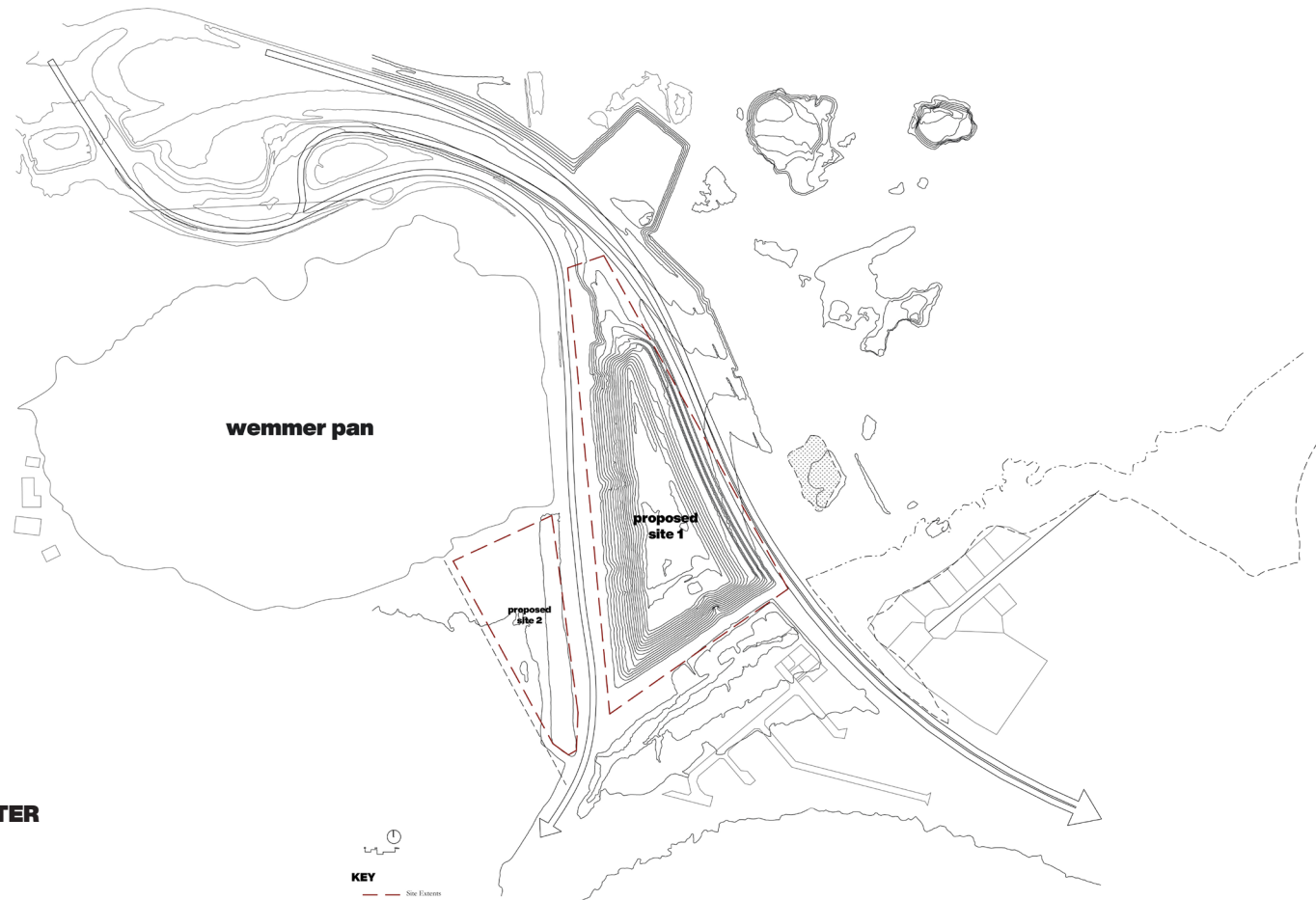


Figure 52- FUTURE CONSIDERATIONS

The two diagrams of this early iteration can be read in either direction (Top to bottom, bottom to top) and were an experiment into how the 30m x 30m steel substructure could be used to house several different cladding and occupational types. Care was also taken to explore the incorporation of net-zero technologies (solar panels, grey water systems,) and green infrastructure in the form of Green walls and gardened roofs



APPROACHING THE SITE: ITERATION 1 - 1ST QUARTER, 1ST SEMESTER

Step 1 - Identifying 2 Sites.

FIGURE 53

The main site was then covered in a square grid of 30m x 30m, within which a changeable matrix of use and habitation could be established. Wemmer Pan road was also identified as the main access route for people seeking to reach the site by road. The relationship between the two sites also became influential in establishing a starting point for where said visitors can arrive and orientate before entering and engaging with the scheme as a whole.



Step 2 - Applying the 30m x 30m Layout.

FIGURE 54

The initial idea revolved around creating a relationship between the tailing and a neighboring brownfield site that could then facilitate the needed change in the waste as it was steadily cleared away. This could then take the form of a fabrication site where prefab elements could be produced for the changing usage and needs of the scheme/structure. It could also serve as a prototyping area where experimentation and test runs for new 3d elements could be implemented.

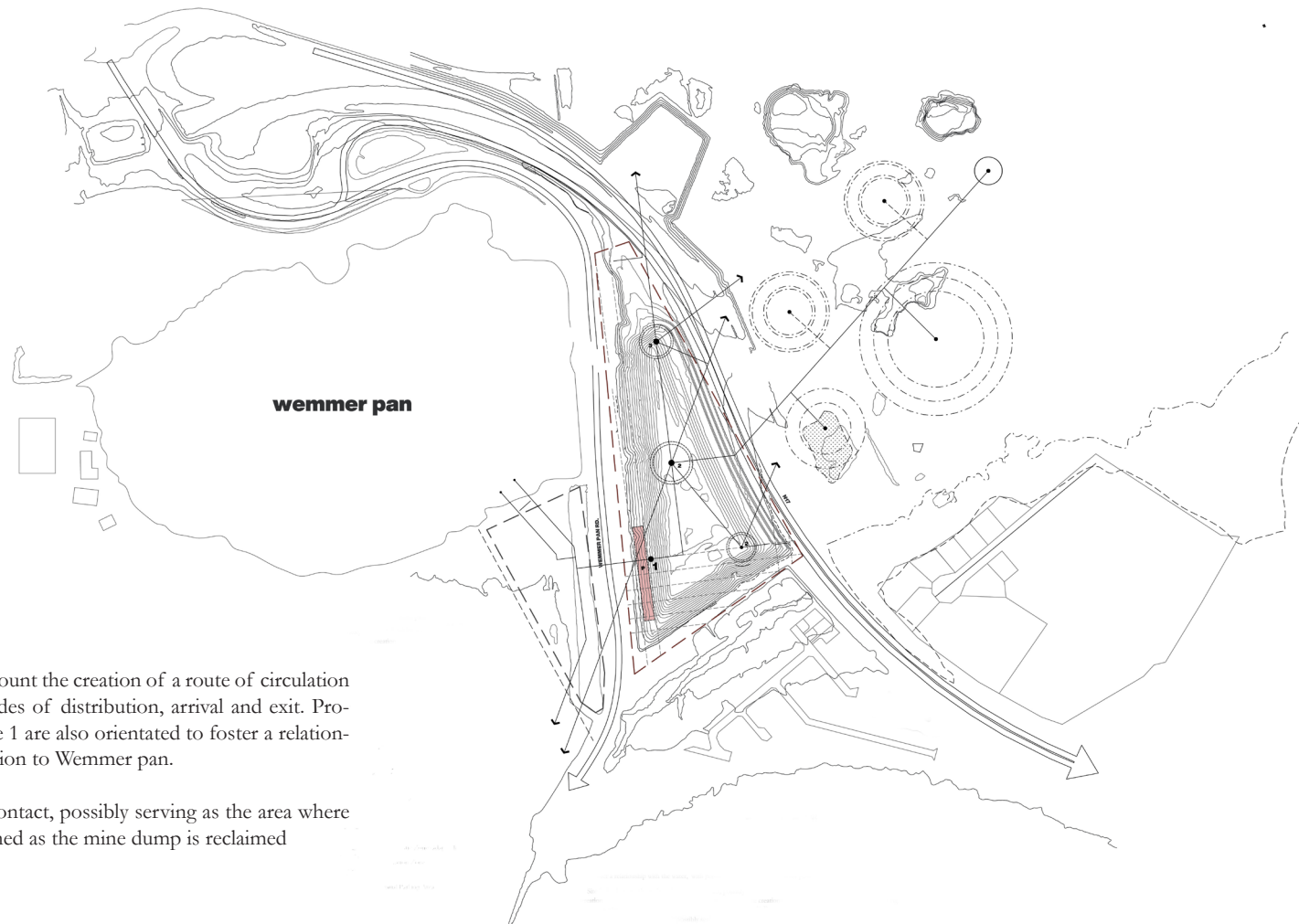
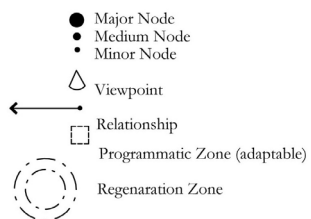
This usage of a secondary site could also be used to maximise the amount of usable land during the initial stages of extraction/removal of the tailings. The space for a proposed prefab workshop would then be better utilized for usage/habitation

Step 3- Wayfinding

FIGURE 55

The initial design development took into account the creation of a route of circulation through the tailing mound, with points/nodes of distribution, arrival and exit. Proposed site 2 and the northern section of site 1 are also orientated to foster a relationship with the water, with perceived connection to Wemmer pan.

Site 2 also became the main point of first contact, possibly serving as the area where waste and service vehicles would be positioned as the mine dump is reclaimed



Step 4- Massing

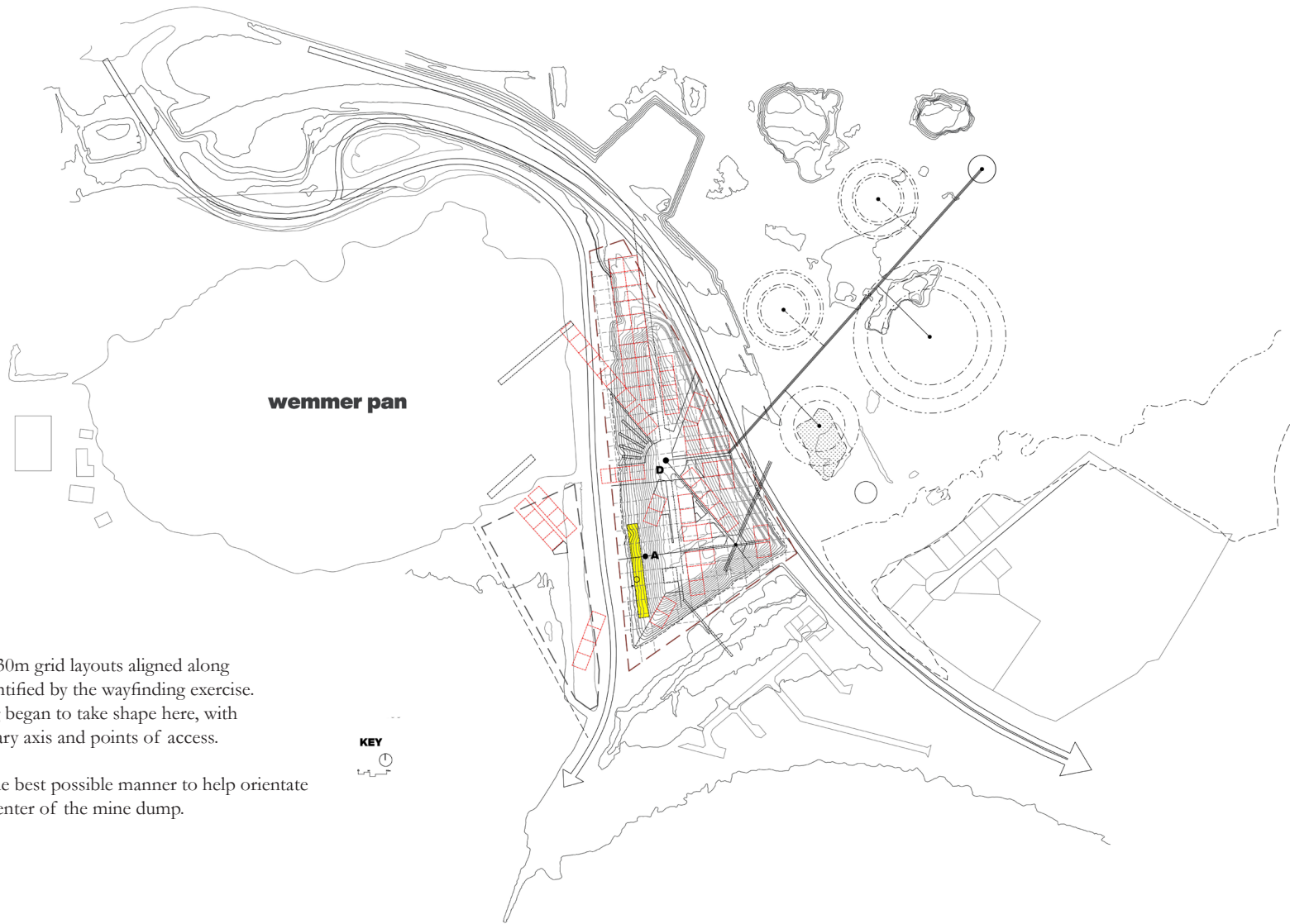
FIGURE 56

The planning of the 30m x 30m grid layouts aligned along the routes and pathways identified by the wayfinding exercise. The massing of the building began to take shape here, with care taken to identify primary axis and points of access.

A central plaza situated in the best possible manner to help orientate visitors was laid out in the center of the mine dump.

KEY

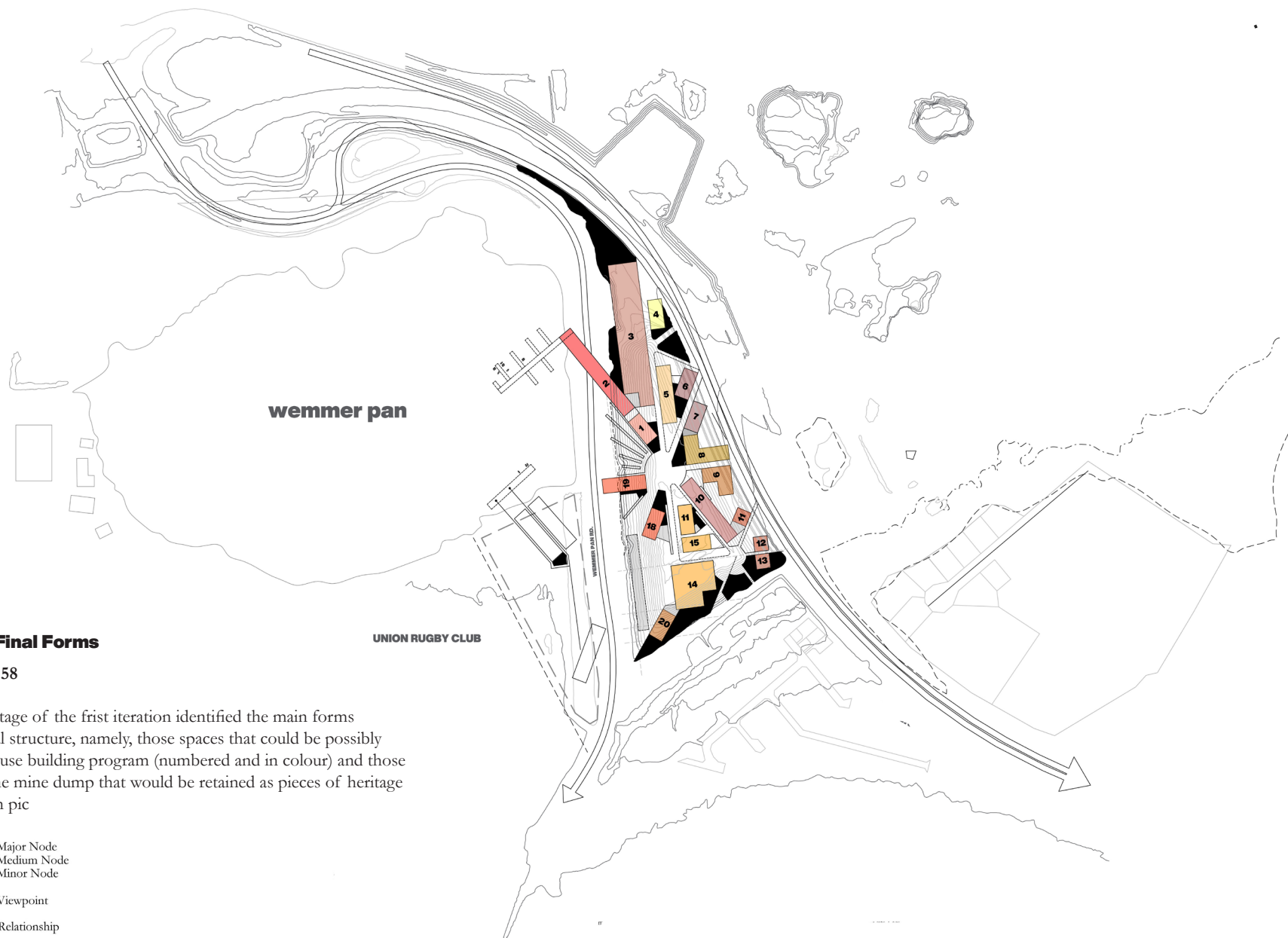
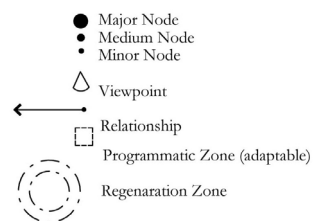
- Major Node
- Medium Node
- Minor Node
- △ Viewpoint
- ← Relationship
- Programmatic Zone (adaptable)
- Regeneration Zone

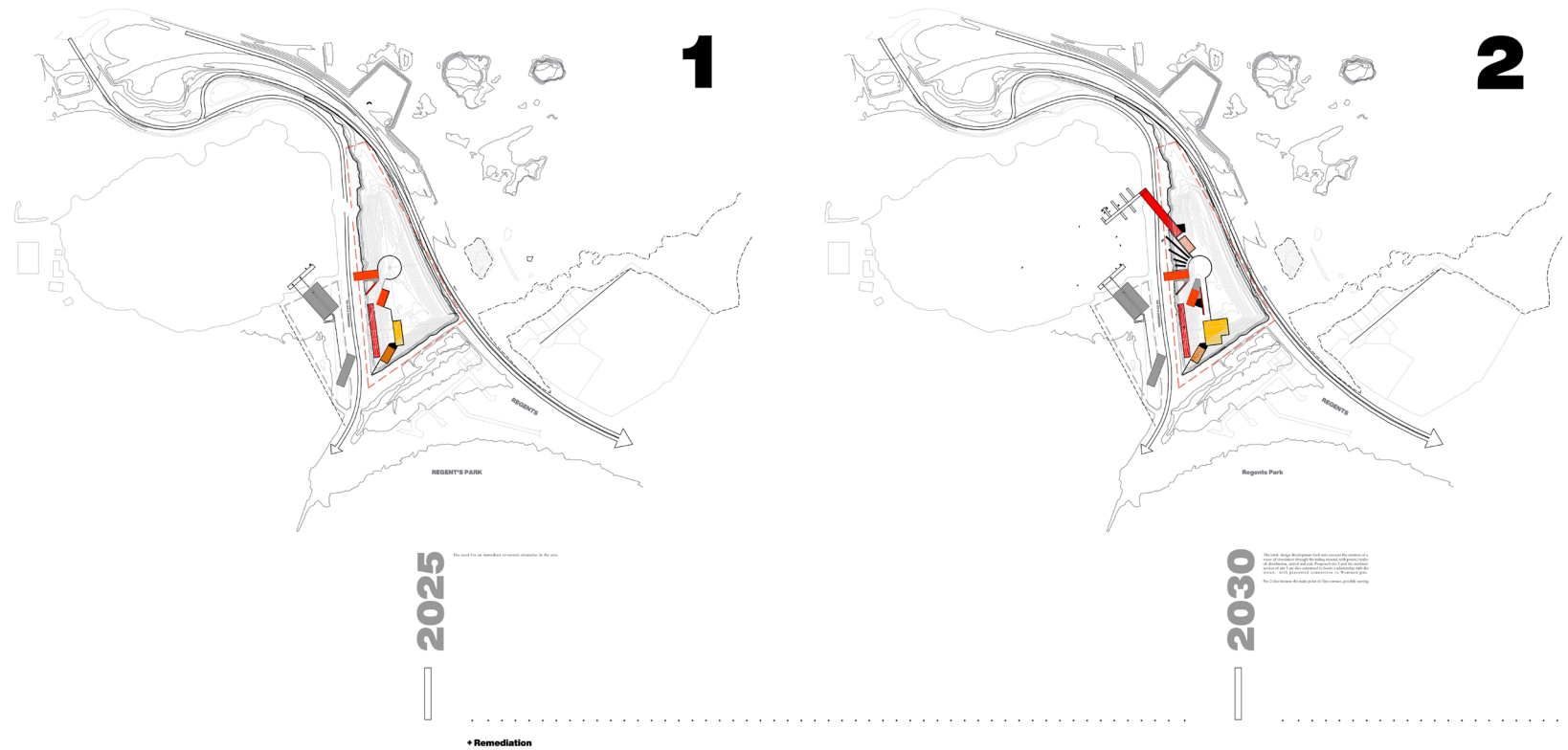


Step 6- Final Forms

FIGURE 58

The 6th Stage of the first iteration identified the main forms of the final structure, namely, those spaces that could be possibly used to house building program (numbered and in colour) and those parts of the mine dump that would be retained as pieces of heritage (hatched in pic)





Step 7-PHASING

FIGURE 59

The last step to be considered was the phasing of the structure, taking into account primary points of access (namely from Wemmer Pan Rd.), I began laying out a sequence by which material from the dump could be reclaimed/remediated before the cleared land was occupied by new infrastructure as laid out in the earlier slides.

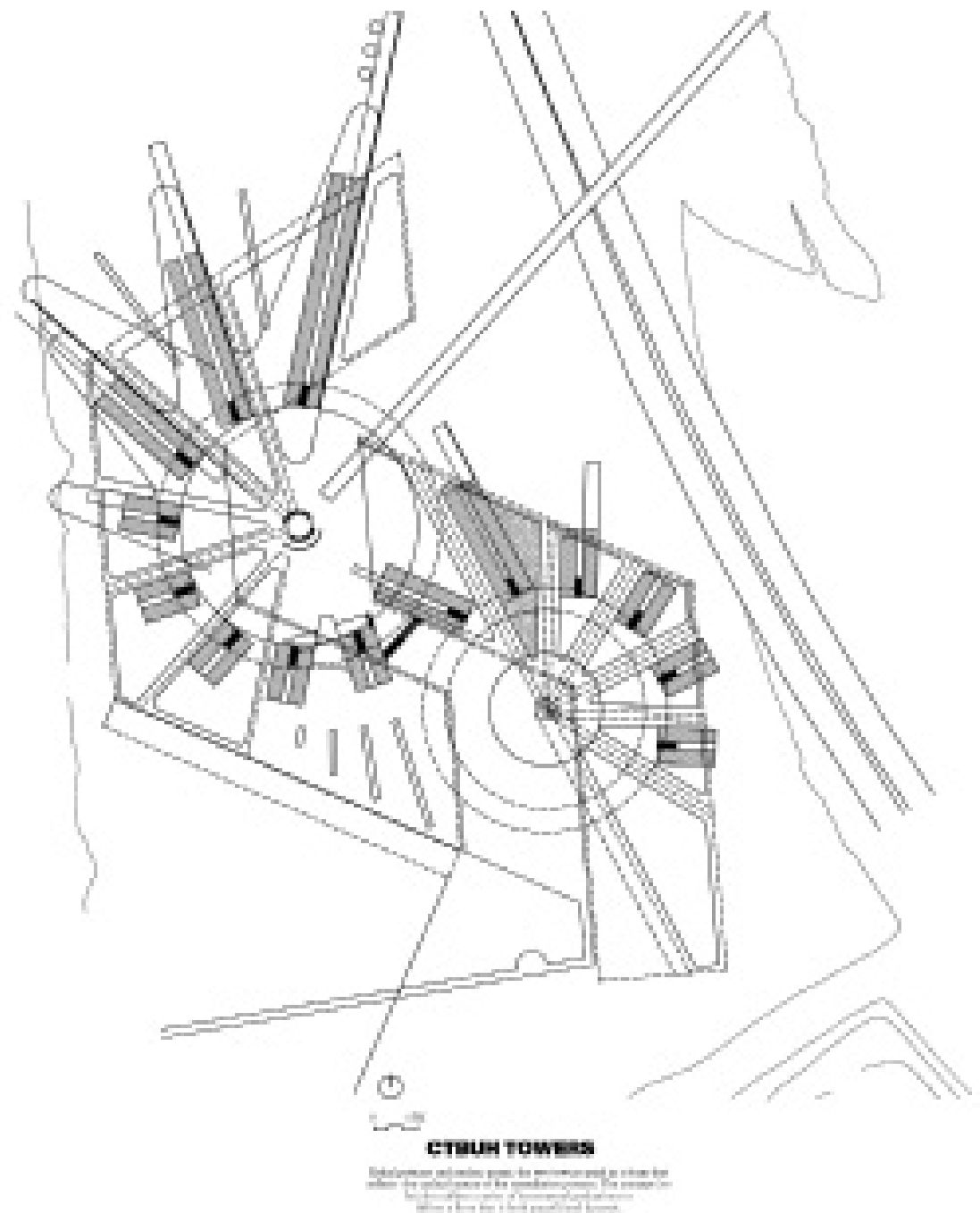
Attention was also paid to the amount of time possibly needed to effect each phase (5 years)

**A NEW APPROACH:
ITERATION 2 - 2ND QUARTER, 1ST SEMESTER**

FIGURE 60

The second iteration of the project was developed as an entry to the CTBUH student competition, but utilised the same site. With the competition's criteria requiring the building of a tall structure, I used this as an opportunity to explore ideas of using sheer height and verticality as wards against the toxicity of the site.

The floor plan of the building was significantly constrained in this iteration after feedback from the last review pointed out that the scale of the project was outlandishly inappropriate. This resulted in the development of a floor plan that revolved around two centralised axis, gradually growing in height and length as it extended over the site.



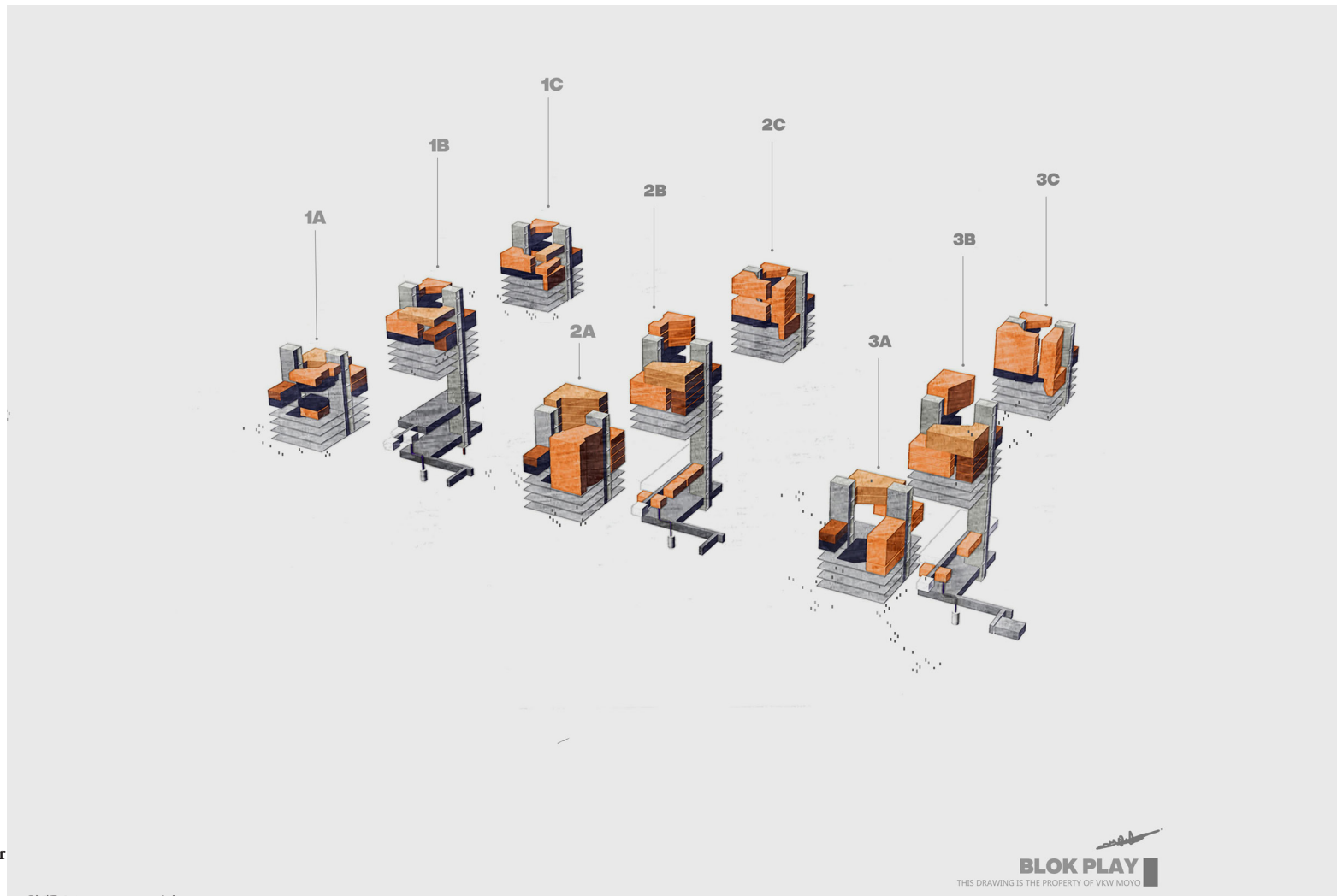


Figure 61 - Main Render

The Main Render for the CTBUH competition. The structure utilised height to distance its inhabitants from the toxic context of Johannesburg's minefields.

CHAPTER 13

THE FINAL ITERATION

13. A FINAL REALISATION

The end iteration of the design coalesced into a multi-faceted building complex combining both the more narrative-driven and analytical themes that this thesis sought to contend with.

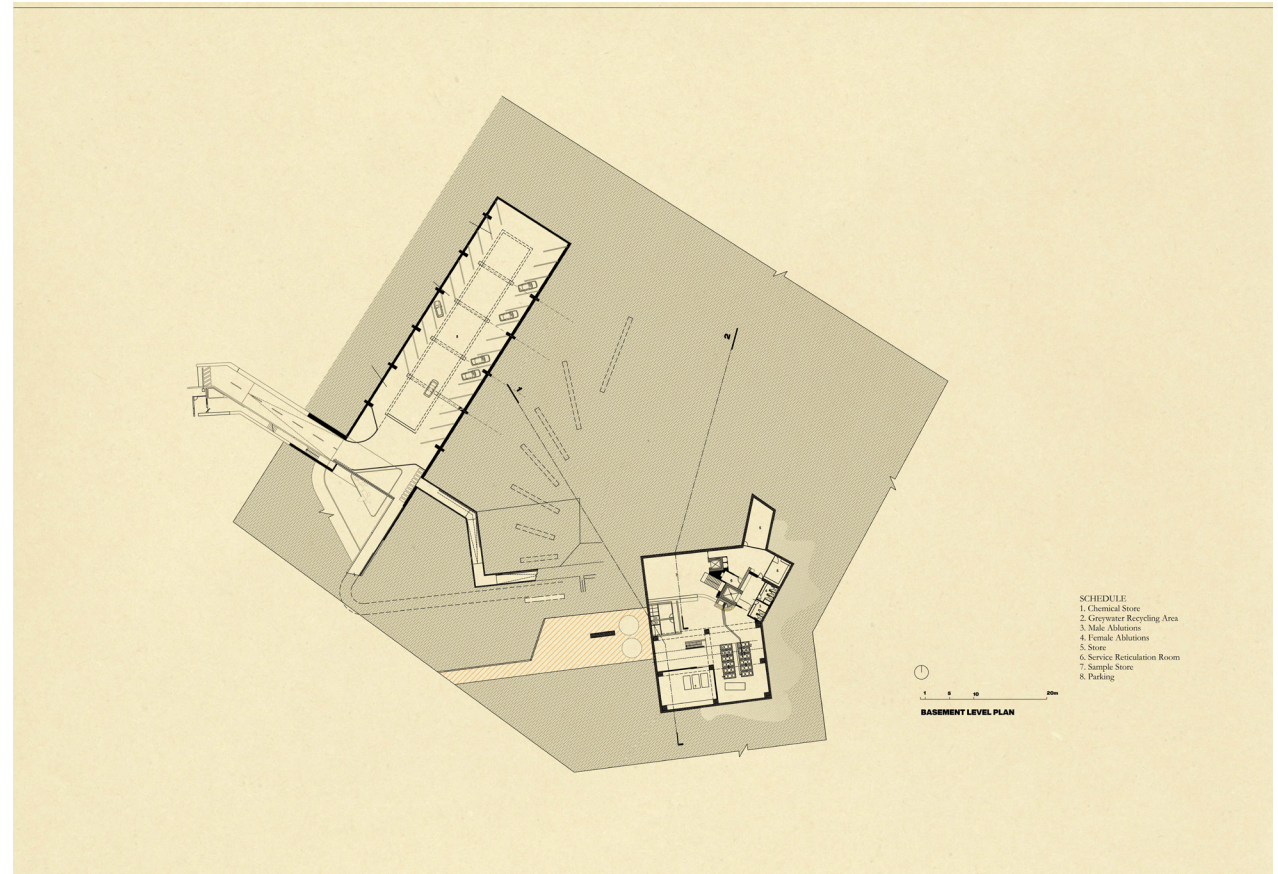
Divided into four distinct zones, it dealt firstly with arrival to the centre, followed by a retelling of the history of mining in Johannesburg in the form of a museum/exhibition space where the general public could interact with a range of ever-changing exhibits that told of the pitfalls, mistakes, hopes, and eventual transformation of its conflicted legacy, a lab and experimentation facility for experts seeking to solve the problem (aligned together with an active remediation centre where the actual process of cleaning and sorting the deposits of the wemmer pan dump was being carried out) and lastly a place of residence where scientists, relevant experts, and the centre's staff could lodge safely for extended periods of time. Achieving a harmony of space between these four main functions was the highlight of this final iteration, and I shall explain each of them in considered detail below.

13.a ARRIVAL

Arrival at the centre was conceptualised into two separate nodes; a necessary device that would function according to the dictates of the weather and overall environmental conditions prevalent at that point of visitation. As always, this was designed to ensure maximum protection from the harsher aspects of the site for the centre's visitors. These two methods are further explained below.

Arrival at times of descent weather

Descent weather conditions would limit the amount of poisonous dust stirred into the air to safe levels, allowing visitors to come to the centre directly via an open walkway (denoted with a 1 on Fig. 63) that fed straight directly from the covered parking area.



Arrival at times of adversity - bad weather

In the windy months of August and September, when high amounts of dust are whipped into the open air by the elements, arrival to the centre is facilitated through a tunnel system to protect incoming visitors from the elements as much as possible. This consideration is detailed in the plan above (Fig. 62)

Figure 62 Defining the Paths of Entry

The basement area of the final iteration was conceptualised as a bunker against the toxic elements of the surrounding terrains vague, with a connecting tunnel between its parking space and the arrival entry point. The area below the main soil recycling facility (the area to the lower right of the image) was also conceptualised as a space of utility where a chemical store and water store could be located.

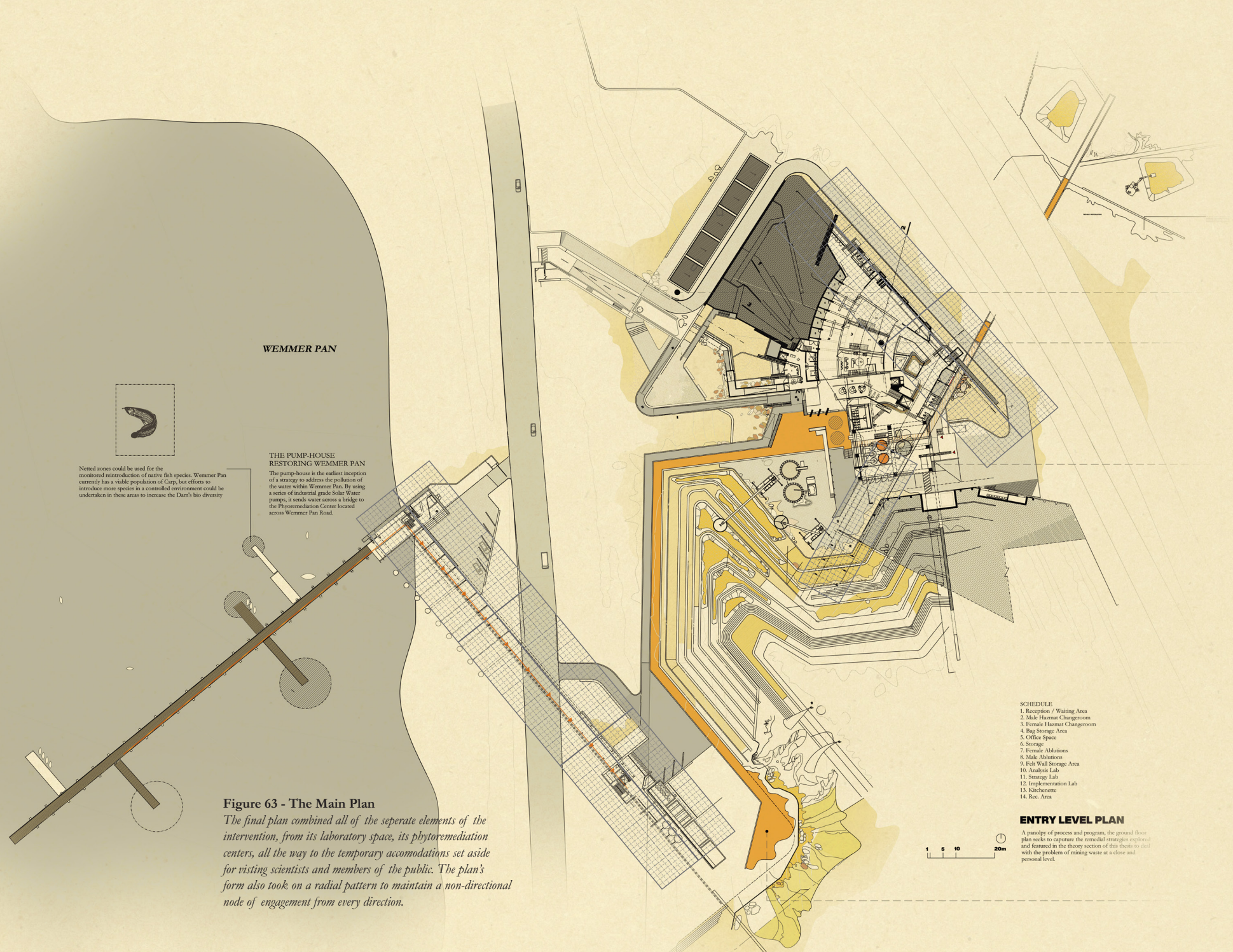


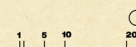


Figure 64 - The 1st Level Plan
The 1st Level Plan shows the integration of the museum area with the wind catching walls of the eastern facade. To the south, cranes replace cleared areas of mining waste with fresh layers of top-soil, while further down a canal system facilitates the flow of slurry from those areas where active removal of minigwaste is happening

- SCHEDULE**
1. Museum Area
 2. Exhibition Storage Space
 3. Analytical Lab
 4. Strategic Lab
 5. Implementation Lab
 6. Kitchen Space
 7. Lab Cleaning Area
 8. Service Room
 9. Soil Cleaning Depot
 10. Meeting Room
 11. Female Ablutions
 12. Male Ablutions

FIRST FLOOR PLAN

The First Floor Plan shows the layout of the Museum and Hospitality area, as well as the Mezzanine working areas in the Laboratory area. The Gradient of Levels also shows how some of the spaces are recessed beneath the remediated mound



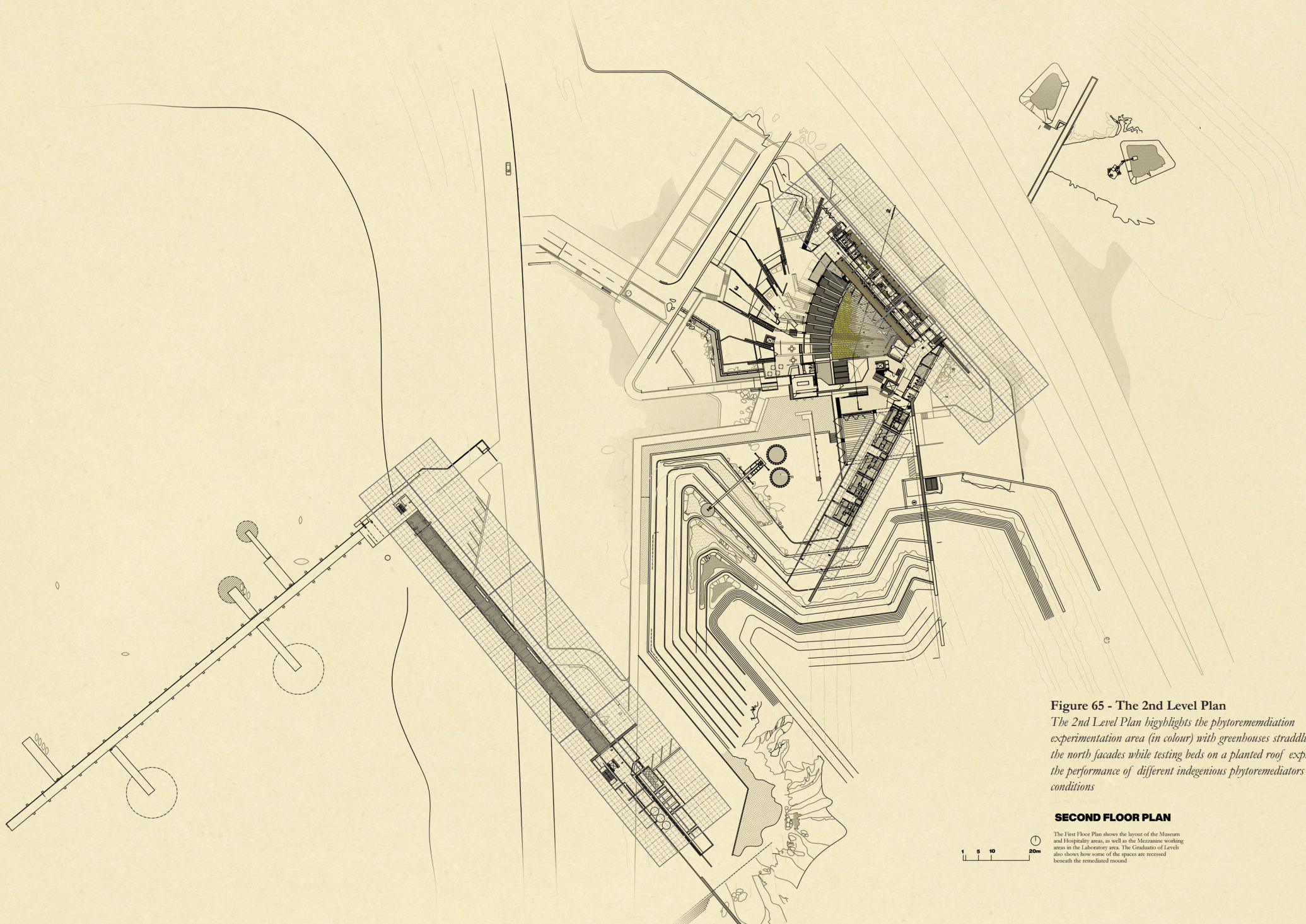
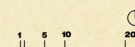


Figure 65 - The 2nd Level Plan

The 2nd Level Plan highlights the phytoremediation experimentation area (in colour) with greenhouses straddling the north facades while testing beds on a planted roof explore the performance of different indigenous phytoremediators in open conditions

SECOND FLOOR PLAN

The First Floor Plan shows the layout of the Museum and Hospitality areas, as well as the Mezzanine working areas in the Laboratory area. The Gradient of Levels also shows how some of the spaces are recessed beneath the remediated mound.



13.b A PLACE OF REMEMBRANCE - RAISING AWARENESS, PRESERVING MEMORY

Beginning with the more negative aspects at the onset of this history, the narrative's tone and message is gradually elevated through a series of ever hopeful exhibits working closely with carefully considered architectural elements and articulations.

A Place in the Dark - Ritual Change

Positioned soon after the main reception area, this part of the centre is a place where awareness and memory with regards to the gravity of the current ecological crisis are pressed upon the minds of the visiting public with an emphasised poignancy. Elevation, light, and spatial ambience are used to heighten the experience, with the narrative journey starting in the cold and dark of a space whose articulation of these qualities closely mimics the atmosphere of a disused mine shaft. A dripping water feature - itself part of the active processes experimentation and remediation in an adjoining zone somewhere above this sombre place, completes the invocation as it harkens the minds of the visitors to the trickling problem of acid mine drainage actively worsening beneath the city of Johannesburg.

Alone as they change into the protective set of gear (hazmat suits etc.) it is a place for personal reflection that sets the first, and earliest tone for the exhibits narrative.

Rising Hope

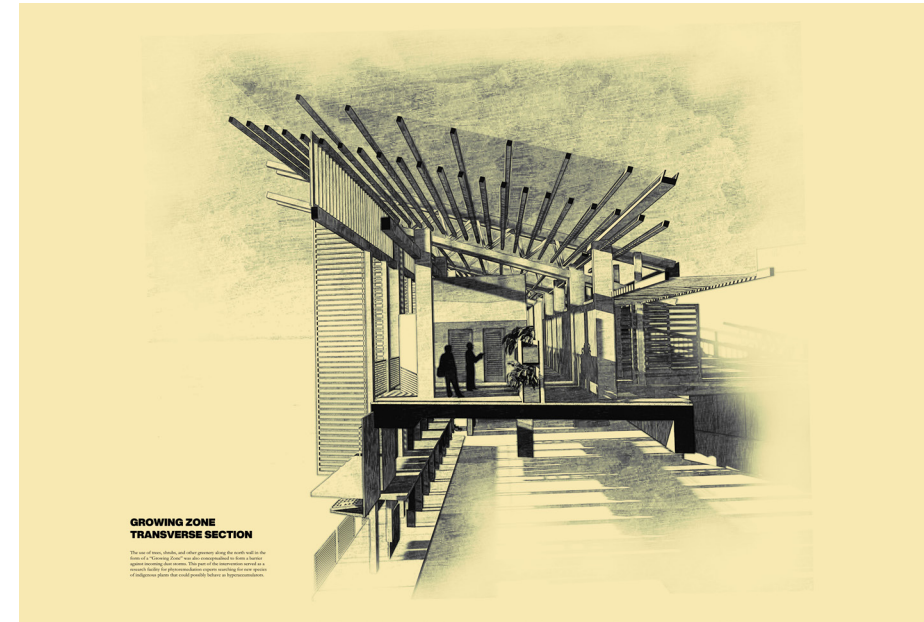
After pressing a theme of sombre poignancy, the exhibit becomes less demur. Visitors emerge into a tiered exhibition area, where generous light and vast volume evoke the feeling of rising from out of the mine shaft with all of its darkness and depression. The effect of emerging from the depths is heightened by the rising elevation of each exhibition space, each of them linked together by a system of ramps and stairs (see Fig.69)

Figure 66 (Upper Right) - Detail Section 1

This detail section, at a slightly larger scale than usual, seeks to show the greenhouse interface with its transparent roof, planted areas and sun screens. The Majority of the elements are adjustable through dual manual and automatized mechanisms to allow for peak control inside the facility's testing areas.

Figure 67 - A Place of Ritual Change

This second detail section shows the first area of contact for visiting members of the public. Though the center is well insulated against the elements, visitors are encouraged to wear protective gear for the duration of their visit as a precautionary measure. This happens in a silent space with an extended light shaft above it, all to mimic the internal atmosphere of a disused mine and bring the visitors to a sombre realisation of the ecological problem of acid mine drainage before commencing their tour of the museum area



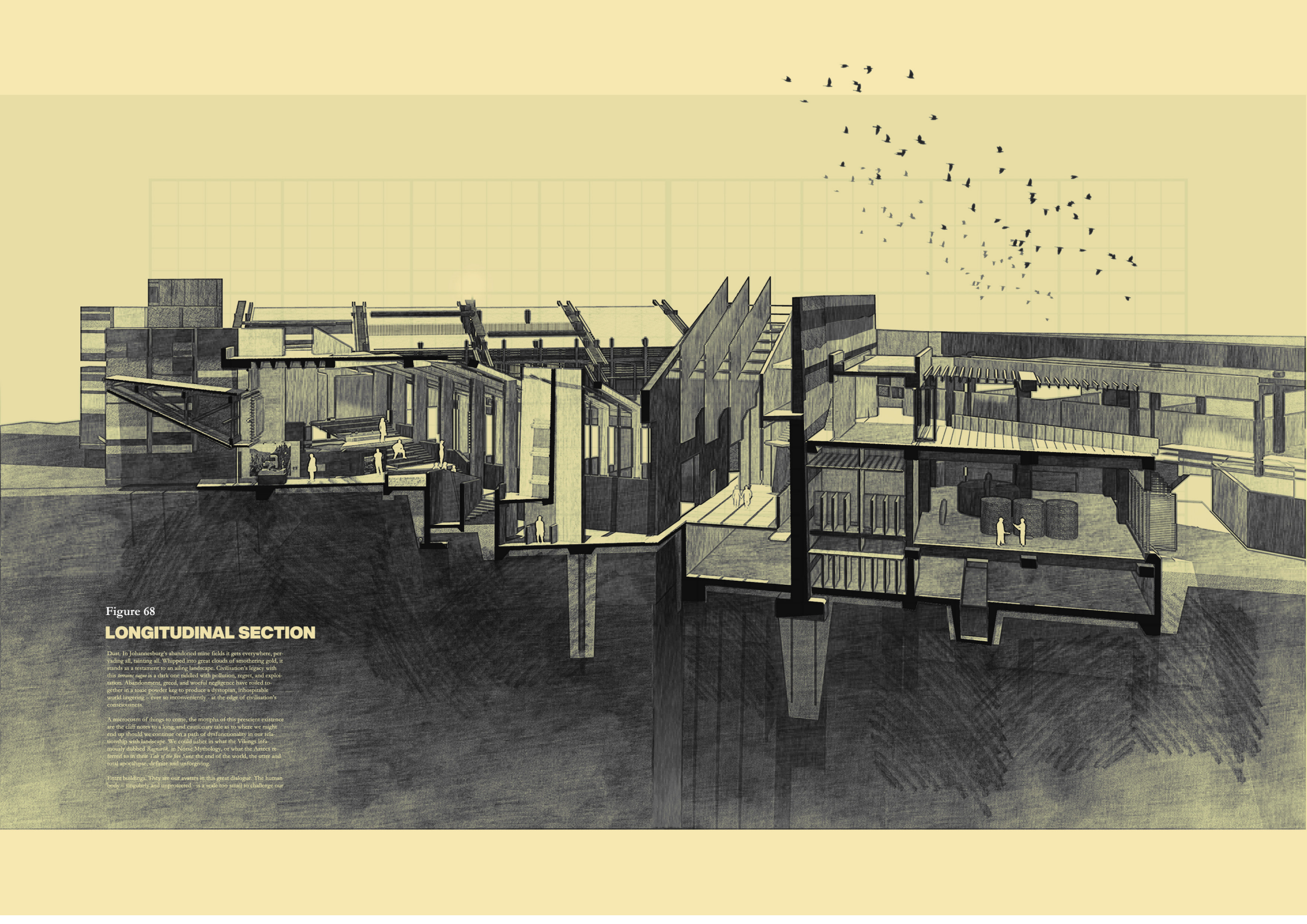


Figure 68

LONGITUDINAL SECTION

Dust, in Johannesburg's abandoned mine fields it gets everywhere, pervading all, tainting all. Whipped into great clouds of smothering gold, it stands as a testament to an ailing landscape. Civilisation's legacy with this *seminar cave* is a dark one riddled with pollution, regret, and exploitation. Abandonment, greed, and wilful negligence have rolled together in a toxic powder keg to produce a dystopian, inhospitable world lingering – ever so inconveniently – at the edge of civilisation's consciousness.

A microcosm of things to come, the morphs of this present existence are the cliff notes to a long, and cautionary tale as to where we might end up should we continue on a path of dysfunctionality in our relationship with landscape. We could label it what the Vikings infamously dubbed *Ragnarok*, in Norse Mythology, or what the Aztecs referred to in their *Tale of the Five Suns* the end of the world, the utter and total apocalypse, definite and unforgiving.

Pitzz buildings. They are our avatars in this great dialogue. The human body – frequently unprotected – is a scale too small to challenge our

13.c A PLACE OF EXPERIMENTATION - IN SEARCH OF ANSWERS

The exhibition ends in a sheltered green-house, where members of the public are shown the efforts and methods taken by scientists and experts to forge a new relationship with Johannesburg's disused mining areas.

Past this point, the center is dedicated to the more practical, hands-on processes and programs it seeks to facilitate in its mission of rehabilitation. Experimentation is foremost in the search for novel and effective means of solving the problems of pollution and waste in Johannesburg's abandoned mine fields, and it was with experimentation in mind that the following spaces were designed and conceptualised.

Experimentation in States of Isolation

In cases where potential phytoremediators needed to be observed under controlled conditions, a green-house was erected on the northern end of the centre. Built with falling eaves and an adjustable roof, the greenhouse is a mechanically flexible space capable of catering to a wide variety of experimental conditions to allow the scientists and experts working at the centre to make the best possible analysis and predictions.

the physical and organisational breakdown of this space are clearly defined on the following page (Fig. 70)

Experimentation in Open Conditions.

Where experimentation and observation needs to be carried out in more open conditions, the area to the south of the green-house was reserved as a plantable green-roof where new phytoremediators could be planted, tested and identified.

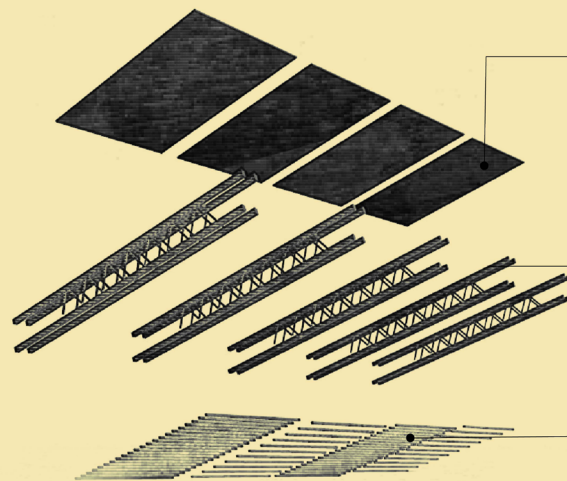
Care was taken to provide sufficient soil depths in these areas, and the subdivisions in the planter beds allowed for a easy delineation of different species for comparison.

A closed loop water system was designed to feed the plants from same tanks utilised by the soil cleaning facilities, ensuring the sustainable reuse of this resource throughout the centre's operation.



Figure 69 - A Tiered Experience

This abstracted call-out shows the tiered museum space, using a gradual progression from low to high to tell an increasingly progressive story about the history of mining in Johannesburg



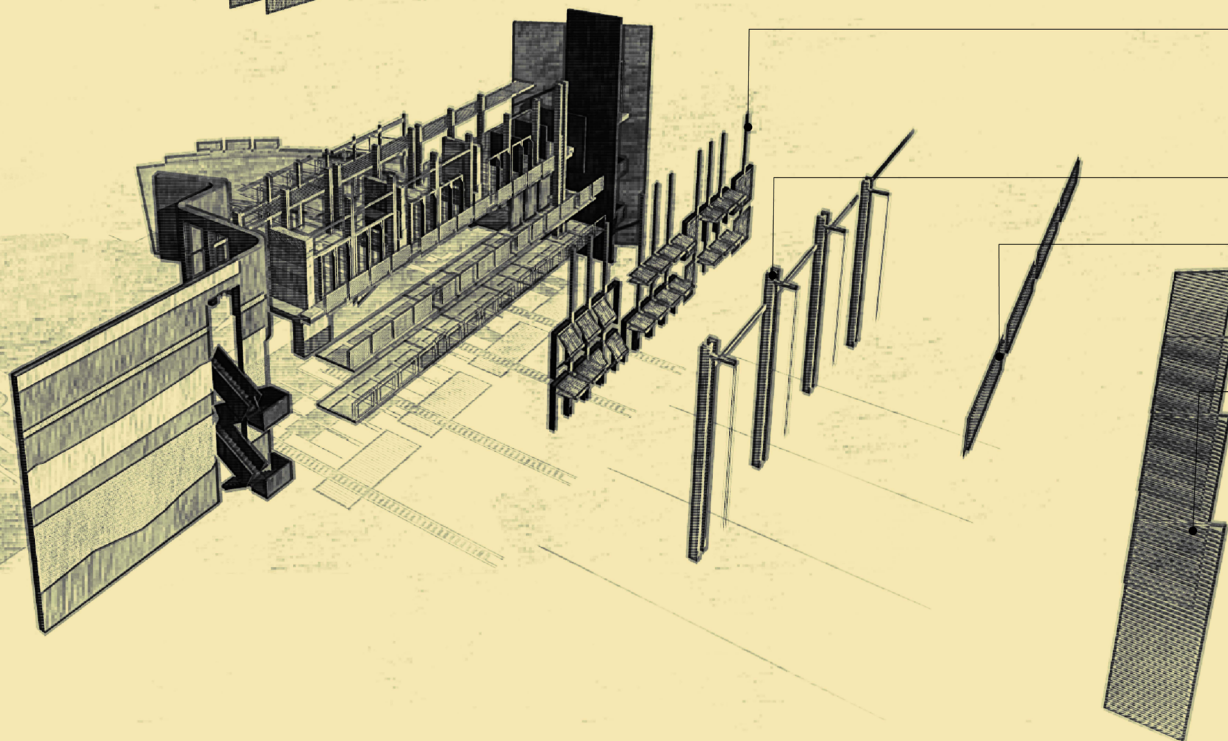
Translucent Roof sheeting allows light into the interior spaces. Glass or Polycarbonate may be the most suited application for this purpose.

Main truss roof structure supports consist of large timber beams braced and held together by triangular truss system between their members.

Variance in the cladding screen below the translucent roof covering and main supports allows for the tailoring of specific climatic conditions within the growing zones. This allows for scientists and researchers to experiment with a wide variety of plants in environments where vital climatic and habitual factors can be control.



Cladding/wall pieces are fashioned from timber slats with sheets of polycarbonate between them



The Felt Wall system cleans incoming wind of toxic dust particle. Once immobilised, these particles can be removed from the felt panels for analysis by scientists and researchers.

Structural upstands that keep the walkways below suspended via a set of steel cables.

Adjustable Shutters that allow for air flow control

Slatted Screens that help to brace the roof's structural members while continuing the aesthetic and Rhythm of the West Facade

Figure 70 EXPLODED VIEW

The Exploded View shows all of the major programmatic and structural components of the Green Zone, including the felt-wall system and the controlled growing area where researchers and scientists can conduct experiments in indigenous phytoremediation

13.d A PLACE OF DEDUCTION

With the results of observation from the two test areas collated and recorded, a place for further analysis and the keeping of records was required. To this purpose, a lab area was designated beneath the green-house and planted roof to facilitate further quantitative measures and provide an archive for the storage of scientific records.

The analysis lab and archive area would likewise fulfil this role for soil engineers and scientists seeking ever more efficient methods to clean material from the mine dumps as well as sift valuable materials from it.

Conceptualised as the “brain” of the facility, it is from this node that a more honed and holistic strategy could be implemented to solve the mine waste remediation, and not just for the Wemmer Pan area but for the mining wider mining belt itself.

In the end, the hope is that this part of the centre would become a unique testing ground for these strategies, situated on the ground within the very problem it is trying to solve. Presently, most remediation “think-tanks” exist off-site and hardly use the physicality of their infrastructure to better understand the environment within which they are working. By providing a place of deduction on site, with a building capable of these measures, the centre could possibly provide precedent as to how the problem of mine waste can be solved not just at a national level, but perhaps even at a regional and possibly international one as well.

13.e A PLACE TO LIVE

For the centre to function as intended in the long-run, regular maintenance and upkeep are necessary. This necessitates the inclusion of a somewhat permanent staff force to oversee and care-take the facility.

It was this need that birthed the centre’s final zone; the residential quarter. Designed to fit into a modular reel of main-building and fit-out sections as outlined in the aforementioned open-building strategy, this area was developed with growth in mind. Long-stay caretakers lived in well-sized pods constructed from modular segments of drywall and hempcrete, with the possibility of future expansion catered into the units as space from the cleared mine dump became more readily available.

Utility, as explored in previous chapters, was also designed with as much autonomy in mind as possible, incorporating water supply tanks, a grey-water recycling system

centre’s main basement area, as well as solar panels to provide for the living areas’ electrical needs.

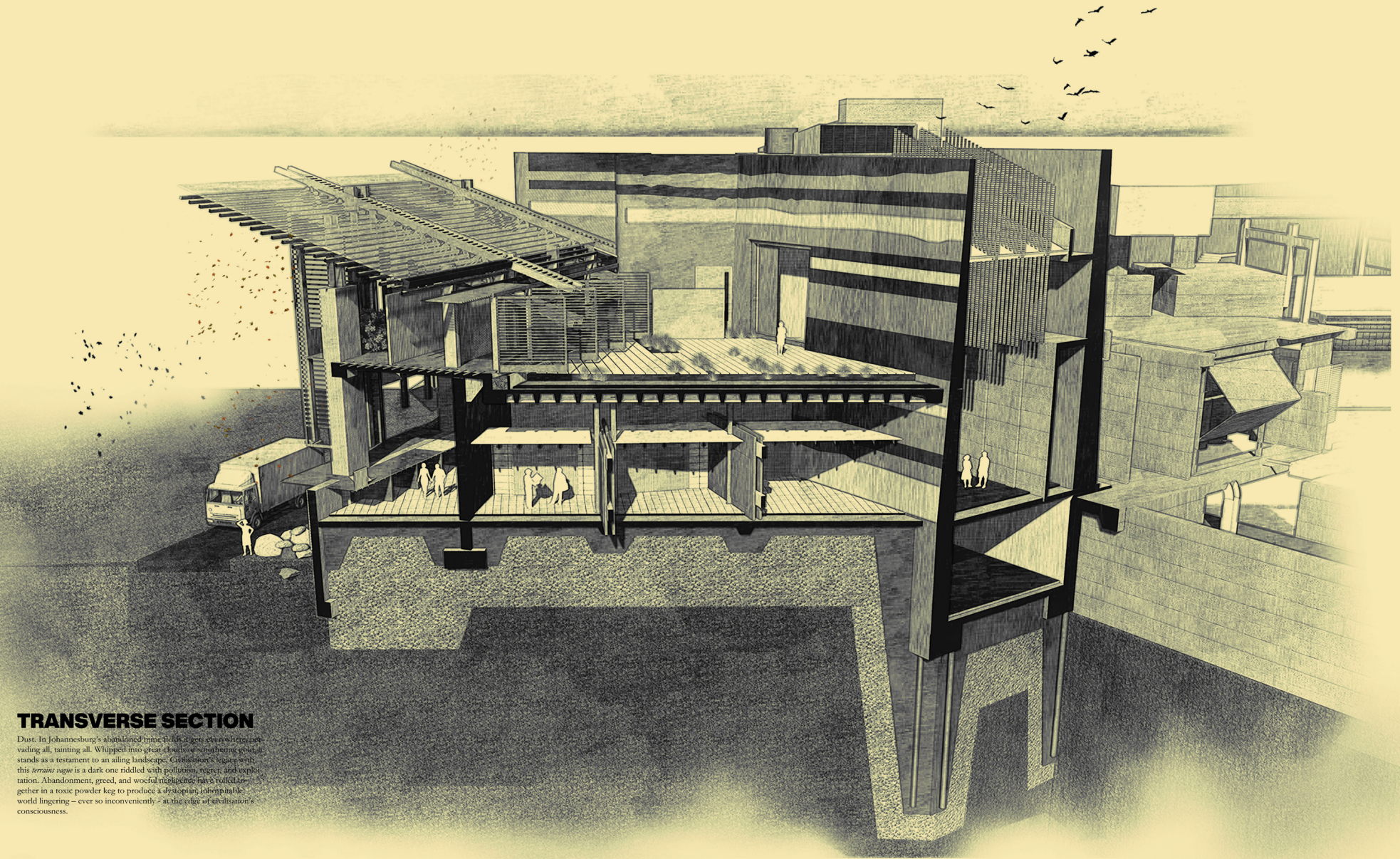
This residential wing also allowed for the housing of experts and scientists staying overnight at the facility for the sake of their work; with the pods having the ability to double as self-catering lodging units to be used at their convenience. The greatest guiding factor in the design of this aspect was the protection of these spaces (as well as the circulation/main building portions) from the harsh elements of high wind and subsequently toxic dust, which prompted the inclusion of shifting walls about the perimeter of the wing to make common areas safe from contamination.

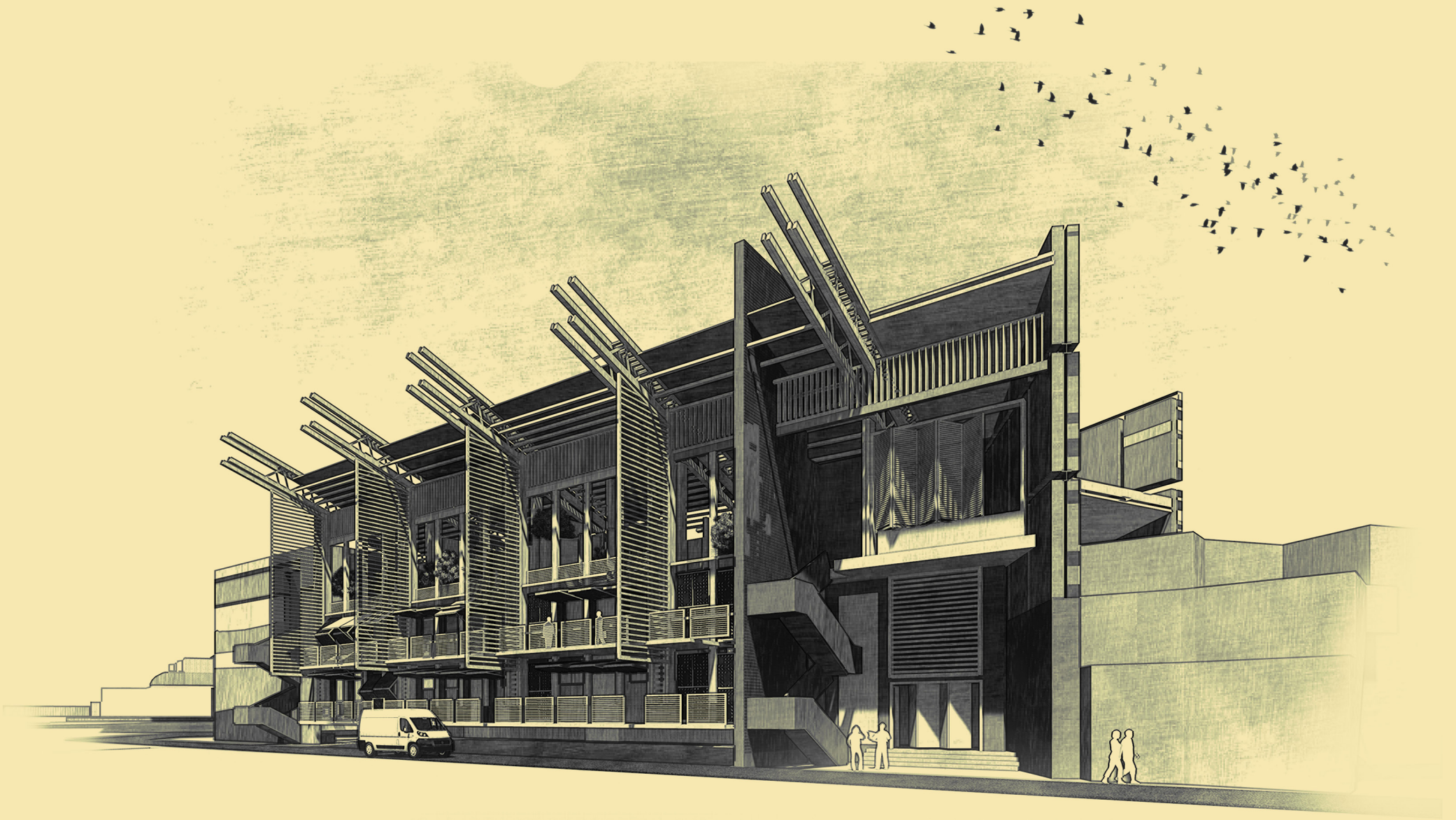
Figure 71 (Right) - Main Transverse Section

The Main Transverse Section shows the relationship between the 3 main levels of the intervention, namely the Ground Floor Area where visitors from the public first come to engage with the centre, the basement area fully fitted out as a utility hub, and the experimental area on the highest level where experimentation into the discovery of new phytoremediators is conducted.

TRANSVERSE SECTION

Dust. In Johannesburg's abandoned mine fields it gets everywhere, not vading all, tainting all. Whipped into great clouds of smothering gold, it stands as a testament to an ailing landscape. Globalisation's legacy writ, this *terrain vague* is a dark one riddled with pollution, regret and exploitation. Abandonment, greed, and wretched resilience play's out all over, together in a toxic powder keg to produce a desolation, a formable world lingering – ever so inconveniently – at the edge of civilisation's consciousness.





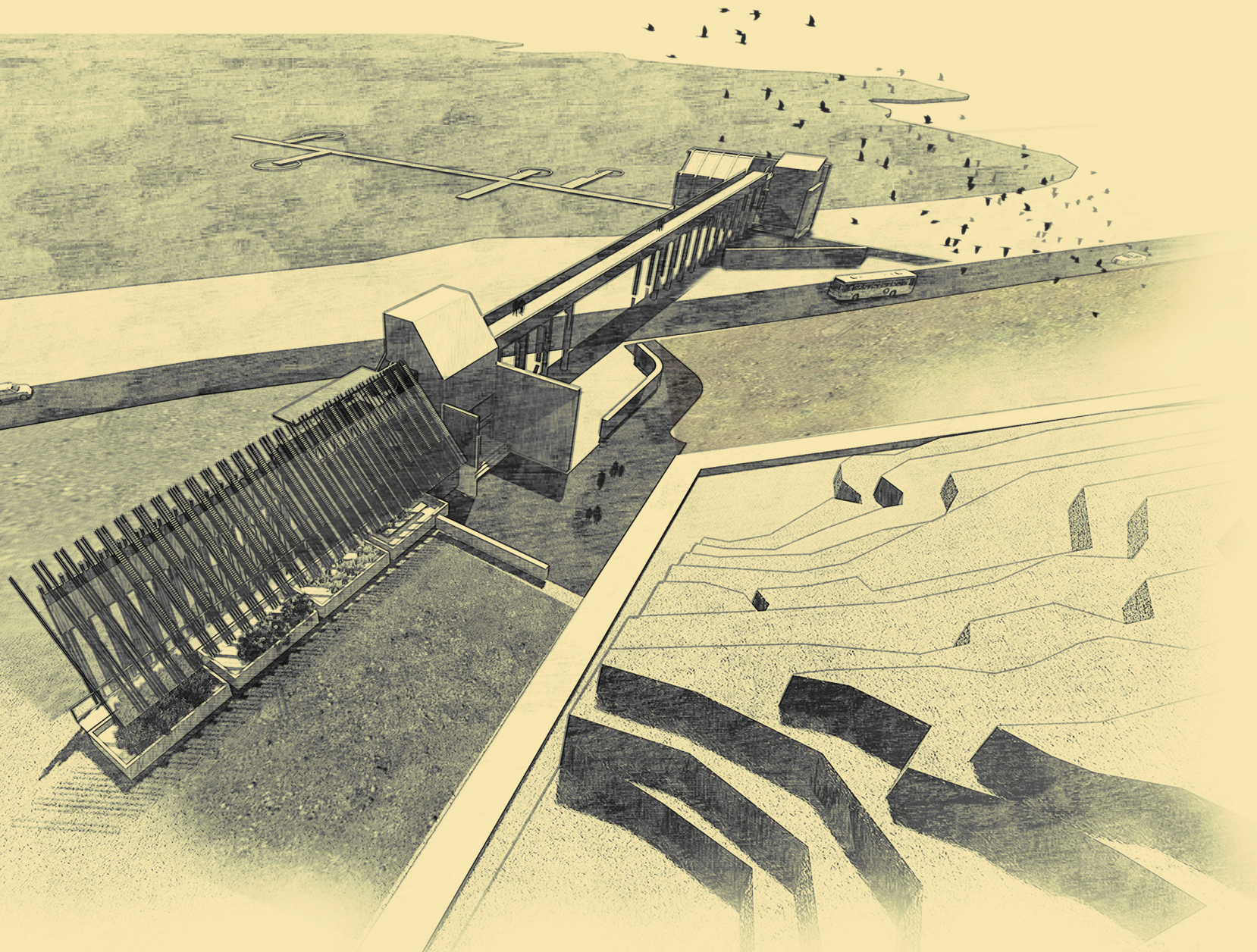
THE NORTH FACADE

Dust. In Johannesburg's abandoned mine fields it gets everywhere, pervading all, tainting all. Whipped into great clouds of smothering gold, it stands as a testament to an ailing landscape. Civilisation's legacy with this *terramis rugae* is a dark one riddled with pollution, regret, and exploitation. Abandonment, greed, and woeful negligence have rolled together in a toxic powder keg to produce a dystopian, inhospitable world lingering – ever so inconveniently – at the edge of civilisation's consciousness.

Figure 72

THE PHYTOREMEDIATION CENTER

Dust. In Johannesburg's abandoned mine fields it gets everywhere, pervading all, tainting all. Whipped into great clouds of smothering gold, it stands as a testament to an ailing landscape. Civilization's legacy with this *terrains vagues* is a dark one riddled with pollution, regret, and exploitation. Abandonment, greed, and woeful negligence have roiled together in a toxic powder keg to produce a dystopian, inhospitable world lingering – ever so inconveniently – at the edge of civilization's consciousness.



13.e AN EYE FOR THE FUTURE

Final considerations centred around the ability of the centre to eventually grow and revitalise the entire area currently occupied by the Wemmer Pan mine dump. This was the initial aim of the final iteration of this thesis, but in the end the rigorous design of a scheme that could accomplish this goal proved too vast a task.

Scale was the biggest limiting factor, as a mere quadrant of the area in question demanded extensive amounts of time and effort to properly design and develop. This issue was mainly exacerbated by the fact that such a wide scale also extrapolated and variegated local conditions, meaning that a single strategy would not work from end of the site to the other.

The exercise in determining said site conditions would have double the time needed to complete this thesis, but it was such an integral part of my initial interest in this subject that I could not wholly let it go.

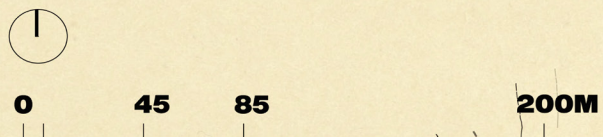
Unfixed in any definite reality; Fig. 74 (right) is an exercise of this intervention's growth over many years. With the final structure of this thesis shown in the upper section of the image, the hope is that the development would grow southwards as the tailing was gradually processed; disappearing as functioning infrastructure grew to fill in the void.

Places of commerce, residence, and even recreation would return to the area, thereby allowing it become a productive piece of the urban fabric once more. With this initial victory, the development would continue to sprawl across the mining belt, transforming this terrain's vague into a bustling metropolis recovered from the clutches of a broken, and degenerative legacy; ultimately fulfilling the lasting hope of this thesis.

Figure 74

THE BIGGER PICTURE

The project's final considerations concerned themselves with the project's future - namely its ability to grow out and occupy the rest of the site, as well as its ability to transform and accommodate new programs once the problems posed by Mine waste had been resolved. Naturally, it is near impossible to accurately predict what such a transformation would entail or resemble, so the project drew inspiration from workshops like archigram for the inspiration of this portion of it's discourse. "The theaters" is a conferencing and event-focused complex that would represent this idealised future; drawing people from all over Johannesburg to attend concerts, festive events, and various ceremonies in a part of the city once left abandoned and derelict. It is this final hope for the future - this reinvigoration of place - that would be the marker of this entire thesis' overall success in mediating a new relationship between landscape and society.



PRECEDENT STUDIES

SYDNEY PARK WATER RE-USE PROJECT

Designers: Turf Design Studio, Environmental Partnership, Alluvium, Turpin+Crawford, Dragonfly and Partridge

Date completed: 2015

Systems: Water Re-Use

Area: 16.000 sqm

Category: Renovation

AN OVERVIEW

Built on a site formerly used as a disposal area for industrial waste, the Sydney Park is a truly exemplary embodiment of what the urban refurbishment movement can achieve. Retargeting 10% of local demand through water capture and re-use in the park, the project alleviates the strain on municipal services while providing Sydney with a new, vital recreational asset for its diverse communities. The repurposing of the site has also resulted in the rejuvenation of native ecologies, with the use of indigenous plant species to jump-start previously extant ecosystems.

The park now goes beyond the picturesque, offering a revitalised & vibrant waterscape that celebrates the connection between people & space. The bio retention wetlands capture and clean the equivalent measure of 340 Olympic-sized swimming pools per annum while incorporating local public artworks & a man-made waterfall.



Figure 75 - Sydney Water Re-Use Project. Main Plan

Image Courtesy of Mena, F. (2020, February 24). Sydney Park Water Re-Use Project / Turf Design Studio, Environmental Partnership, Alluvium, Turpin+Crawford, Dragonfly and Partridge. ArchDaily. <https://www.archdaily.com/793523/sydney-park-water-re-use-project-turf-design-studio-plus-environmental-partnership-alluvium-turpin-plus-crawford-dragonfly-and-partridge> [Accessed 15 Sep. 2020].

DIAGOON HOUSES

Architect: Herman Hertzberg/Delft

Location: Netherlands.

Project Type: Experimental Housing

Year: 1967 - 1970

AN OVERVIEW

The multi-valent nature of the Diagoon housing project was something I sought to emulate in my own work, more in essence as opposed to exact function.

Offering users/tenants the option to customize and even build their own spaces to fit their own changing needs, the units create a sense of ownership through self-design, a concept I wanted my own units to embody.

They can also be used by several different family types, meaning that they would be ideal for the non-nuclear family narrative I sought to accommodate.

These guiding principles allow the Diagoon houses to retain resilience through customizability, as users and tenants are likely to value and thereby preserve something they have had a hand in creating. As opposed to some of the other examples explored in this section, the resilience of the Diagoon houses is based on a set of criteria that is not readily apparent or blatantly obvious.

It is actually a lack of resolution and a higher degree of open-endedness that allows them their capacity as opposed to any stereotypically full-fledged, highly specialized features.



Figure 76

Diagoon Houses: Yard + Back of House
Image by Herman Hertzberger, Netherlands, 1970.

Sources: 1967-1970 (n.d.). *Diagoon experimental housing, Delft*. [online] AHH. Available at: <https://www.abb.nl/index.php/en/projects2/14-woningbouw/79-diagoon-experimental-housing> [Accessed 15 Sep. 2020].



Figure 77

*Diagoon Houses: Frontyard + Driveway Photo
Photo by Herman Hertzberger, Neteberlands, 1970.*

The drawings to the right hand side show how the building's non-finished form allows for a wide range of occupancy types to utilize the space. The structure retains a strong mutivalence, across vertical and horizontal axis. The use of cores is also vital in this regard, as they act as the anchor pieces for the entire building around which change can happen.

They also serve as entry points for the elements, namely, light, and air, allowing the spaces to passively ventilate & thermoregulate. The materiality is also designed to facilitate constant change; making use of neutral colour tones, and hard-wearing components.



Figure 78

*A Panolpy of Changing Occupation. Figure XX
Herman Hertzberger, Neteberlands, 1970.*

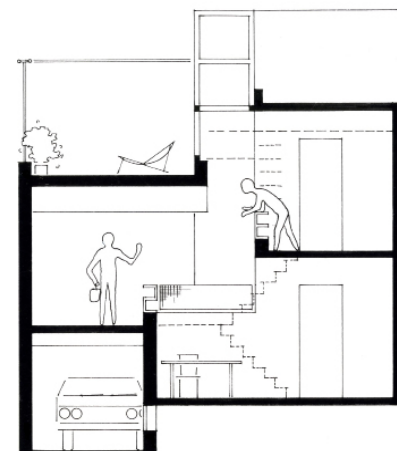


Figure 79

*Occupational Section.
Herman Hertzberger, Neteberlands, 1970.*

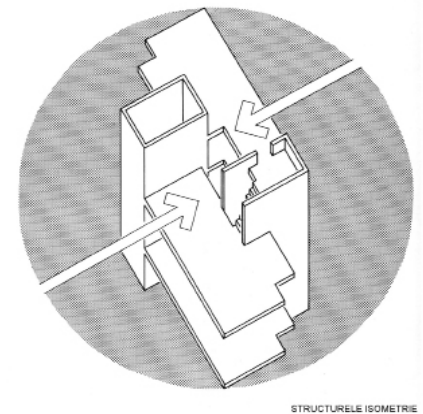


Figure 80

*Relationship between Core & Occupational Space Figure XX
Herman Hertzberger, Neteberlands, 1970.*

SUITCASE HOUSE

Architect: GARY CHANG

AN OVERVIEW

Following a concept of “customizable stratification”, the Suitcase House draws from the architect’s experience from living in the densely populated confines of up town Hong Kong. Closely aligned to the purposes and aims of this thesis, it’s near infinite spatial fluidity and top-down resolution are a master-class in how to achieve the readily re-usable.



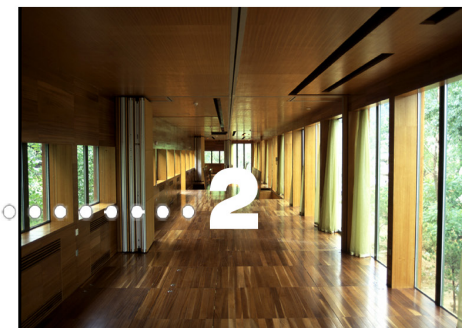
Figure 81

A Deliniation of Space. image courtesy of Gas Co.

An unlikely interface of the building’s spatial layout has been re-imagined for the realisation of Gary Chang’s vision. The floor of Suitcase house is perhaps its most dynamic feature, capable of folding, flipping and falling in on itself to reveal new spaces and allow for customizability.

In a scheme where most anything is subject to flux and change, the architect has reserved some programmatic aspects that are more permanent and provide anchors and keynotes of orientation. These more dedicated spaces include:

- i) Meditation Chamber (with glazed floor looking down the valley below), ii) ii) Music Chamber
- iii) Library
- Lounge
- A fully-equipped Sauna.



Figures 82-84

*Exterior Photo and interior transformations
.image courtesy of Gas Co.*



Figures 85-88
Images courtesy of Gas Co.

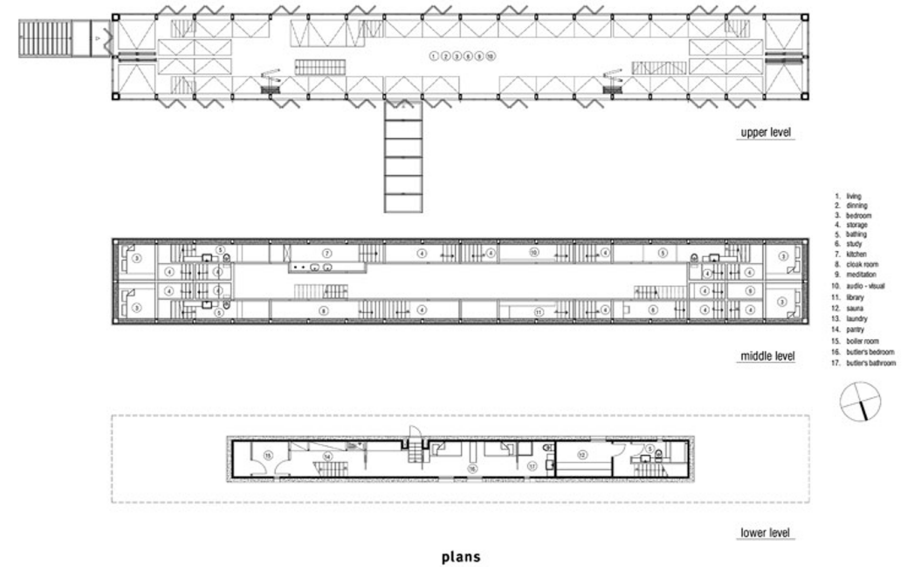


Figure 90 Suitcase House - Main Plans

The Main Plans of the Suitcase House show how the structure's narrow and long form was spatially maximised by rooms hidden beneath collapsable flooring

NEXT 21

Architect: Yositaka UTIDA, Shu-Koh-Sha Architectural and Urban Design Studio

Construction Coordination: Seiichi FUKAO

Design System Planning: Kazuo YATSUMI and Mitsuo TAKADA

Exterior Façade System: Seiichi FUKAO

Modular Coordination System: Seiichi FUKAO

Owner: Osaka Gas Corporation

Dwellings: 18

Support Construction: Reinforced Concrete Skeleton, Newly Developed Façade System

Infill Provision: Experimental System

Next 21 is an experimental, open-building project based in Osaka, Japan.

The premise of the project is to experiment with forward thinking ideas in the residential sphere of architectural design. The project utilises a wide array of systems and utilities to minimize the consumption of resources.



The project utilizes a concept known as the 3-dimensional urban planing analogy to guide its spatial design. This means that the occupational spaces within the building are conceptualised in a similar way to how buildings fit into the urban fabric in a town planning scheme; linked together by roads, alleys and services but essentially independent of each other in function and utility. This analogy in design helps to decrease the number of interdependencies within the spatial layout.

The building's frame, exterior cladding, and interior finishes were designed as an independent subsystem. This subsystem allows for the autonomous adjustment of the building's occupational spaces with minimal disturbance and cost for the users of its 18 different units.



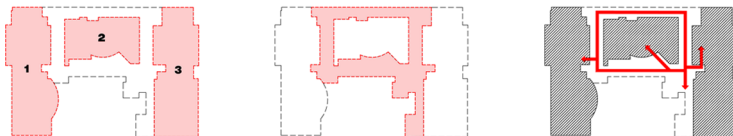
Figure 91 Osaka 21 - Main Street Elevation

Image Courtesy of Osaka Gas Co.



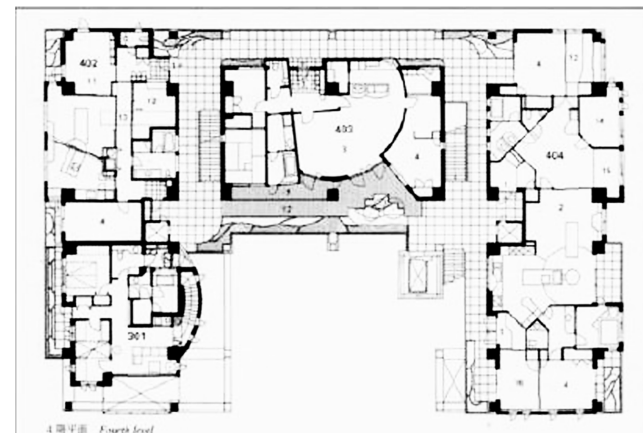
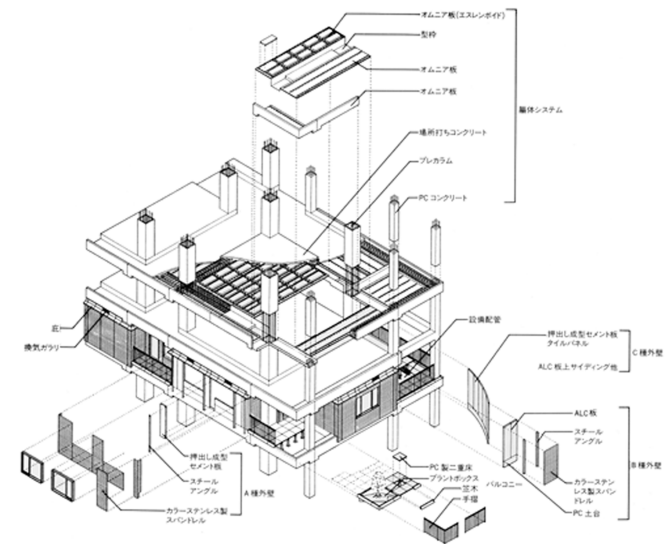
Figures 92 - 96- Next 21 Courtyard and Exterior Views

The images to the right Next 21's internal courtyards, places where inhabitants can experience the outdoors without having to engage the street edge. This concept was pivotal to the early formation of certain design decisions in my own intervention. Images courtesy of Osaka Gas Co.



Figures 97- Making a Deduction

The above image shows my own interrogation of the spaces as marked out in NEXT 21's floor plan area, with Main Building, Changeable space, and directional circulation highlighted (right to left)



Figures 98- Space & Structure

The above images show the delineation of space and structure between the functioning parts of NEXT 21's open building strategy in further detail.

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