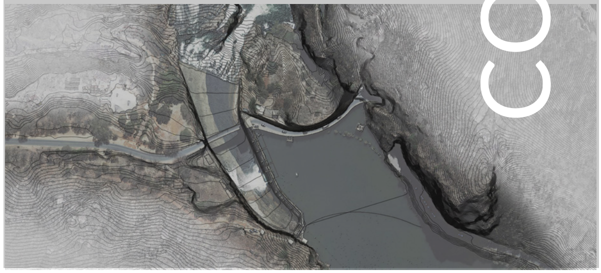
Chapter 2:
A way of seeing

CONTEXT



"The history of water control is extremely varied in its technical complexity, its political and economic intentions, and its ecological and social impacts. Some water projects represent truly dramatic changes in history. When implemented they changed the course of development in the locality and beyond. But mostly water control is an ordinary, everyday matter – as simple as turning on a tap – practices repeated day after day and year after year, and thus re-enacting and confirming existing relationships to water " (Tvedt, 2012).

2.1 A continuum of water history

2.1.1 Giver and taker of life

Before the control over water, humans demand for water meant that we were dependent on the will of the natural water. Settlements would be developed where there were natural springs or rivers. We would have to migrate with the flow of water. Water was viewed as the giver and taker of life. This meant that many religions regarded water as a sacred entity and formed a key part of religious customs and rituals (Tvedt, 2012).

As people evolved, we started to be able to bend water to our will, we were able to create great cities around water points that we had created. The manipulation of these water sources became a celebration of our triumph and became an identity of the city that they surrounded (Tvedt, 2012).

The Greek geographer, Pausanias, who lived more than 2000 years ago, travelled what is now known as Europe. He commented that no city had the right to call itself a city unless it had at its centre, an ornamental fountain. This fountain represented an ideological and cultural notion of the triumph of civilization over nature. these elements showing triumph over water are still found in our cities to this day, maybe no longer fountains, but other water infrastructure such as dams (Tvedt, 2012,Dynesius, 1994: 753-62).

In China the largest dam in the world was created in 2010, the three Gorges dam. This dam was to control the flooding of the Yangtze River, it also created enough energy to power the entire city, more than 14 nuclear power stations can supply (Itaipu Binacional, 2015).

Fig 2.1 Religious customs and rituals (Wikipedia, 2016).

Fig 2.2 three Gorges dam in China (Wikipedia, 2016).

Fig 2.3 in Rome is the Trevi fountain (Author, 2016).

The fountain also symbolizes a more mundane and direct material fact – no city and no country has been able to exist or developed without subjugating water in one form or another to the demands of human society. This universal natural and social fact makes water a key theme in world history (Tvedt, 2012).

A famous example of a water city is Rome, with its water infrastructure still visible to this day. The symbolic fountain in Rome is the Trevi fountain, which was the final destination after the long journey along the aqueducts to its final delivery point of the fountains. Trevi fountain shows its power and the journey that the water made to get to that point. The citizens of that city understood the importance of water and the life that it brought. In modern day cities this is lost as the water infrastructure is mono-functional and hidden, often below the ground. We lose this understanding of the journey and the importance that water brings.

2.1.2 The concealing

The control of water is an endless struggle, even in today's times. Most people do not understand the historical significance of the labyrinth of piping under modern cities. They do not understand every time they turn on the tap where this water comes from and the journey it has to make to that point. They do not understand the urban planning needed from water planners and engineers over generations to make it possible. To bring water to an urban population is a continual effort that has been, and continues to be, fought in cities worldwide (Tvedt, 2012).

All societies have in one way or another been forced to manage their water resources, and have been affected by how the waters run through their landscape and how they have adapted to it and controlled it. From time immemorial, man has tried to master nature by transforming and controlling the water running through the landscape (Tvedt, 2012).

Tvedt (2012) states that man has affected all facets of water from "flood control and disease control, dams and canals for irrigation, rivers for navigation, and the different ways of using water as a source of power. Dams have stored, regulated, and raised water. Watersheds have been reworked and linked. Rivers have been forced between levees and dykes, canalized, straightened and cemented. Water has been diverted from areas of water surplus to areas of water deficit. Lakes have been lowered and wetlands drained and the natural river is now a storm water channel" (Issuu. n.d.).

Fig 2.4 Apies River (Author, 2016).

Fig 2.5 Dam wall (Wikipedia, 2016).

2.2 Riparian Networks

2.2.1 Vision

The class group urban vision focused on the theme of water in Gauteng and neighbouring areas. This was later delimited to Pretoria and the Hartbeespoort Dam. Analysis was done of its water sources, routes, tributaries and spaces along the Apies River in Pretoria, the Walkerspruit, Fountains Valley and the Hartbeespoort Dam was completed. All of these hydraulic elements embody broken ecologies and the infrastructural control of natural systems. Historically, the dam served as natural representations of our identity, where people used to spend Sunday afternoons along their banks and shores, interacting with the animals and plants that water supported (Van Der Waal Collection, 1989).

However today, public spaces around the dam that facilitated holistic engagement with the water are few and far between. The Hartbeespoort dam wall, built to retain more than 195 000 000 m² of water, as a purely engineered element that serves as only the physical function of water retention. Little attention was paid to connect people to the water. There was no celebration of water and the consequences thereof are experienced today. Now there are concerns regarding ecology and natural systems that need to be dealt with in urban design strategies and architectural design (Vuuren, J. 2011).

The urban analysis summarised the mapping of all variables of the river and spaces along the dam wall. These were everyday rituals along the river, ecologies that still exist along the river, spatial interfaces between water's edge and town, and movement patterns along the river. Nodes where the most opportunity for reconnection existed were identified.

The aim of the framework was to:

- Identify and build upon lost space along the water spaces and use them to reconnect the broken hydraulic ecologies.
- Redevelop lost spaces into public interfaces adjacent to the water, to foster a connection between the water and the people and show its importance in the everyday ritual of life.
- Reconnect man to the water to mitigate the limitations of infrastructural fabric and create an identity as a water city through celebration and awareness.
- Reconnect the ecological systems on the site that have been disconnected by the pollution and man and to facilitate exchanges through water and the site.

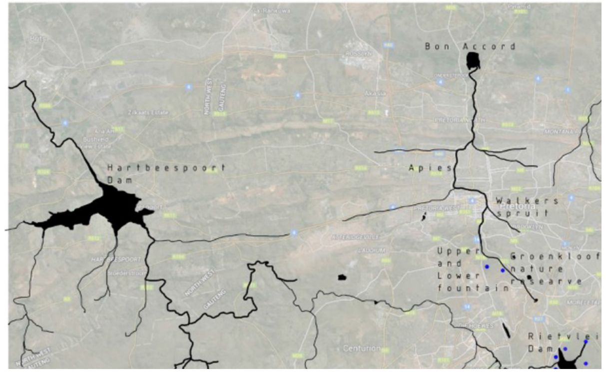


Fig 2.6 Water bodies frame work (Author, 2016).

Fig 2.7 Nodes in urban vision Apies River (Author, 2016).

2.2.2 Mapping

Mapping was done of water bodies in and around Gauteng to gain a greater understanding of current problems. Focus was then placed on the Apies river and the Hartbeespoort Dam. Parallels can be drawn between these water elements and many others in the city.

From the mapping done the following observations about both locations have been made:

-There is a lack of good multifunctional public space along the waters edge for the public to use daily.

-Gated communities and privatisation of land has created a further disconnection between man and nature.

- Water is polluted and disregarded even though it is a vital part of life. People have forgotten our heritage.

-There is a disconnection between ecological systems due to the quality of the water element.

-Through this disconnection we have forgotten our water heritage and this has caused us to lose a part of our identity.

Fig 2.8 Urban problems on Apies River (Author, 2016).

2.3 Site Location

The Hartbeespoort town is located in the North West Province of South Africa. It is situated on the slopes of the Magaliesberg mountain range and is formed around the banks of the dam. The town has become a small resort town consisting mostly of holiday homes situated around the dam as it is near to Gauteng Province. Pretoria is about 35 kilometres to the east.

Some of the main tourist attractions in or around the town are:

The Hartbeespoort Dam wall and tunnel

The Hartbeespoort Dam Snake Park

The Hartbeespoort Dam Aquarium

Hartbeespoort Aerial Cableway

Transvaal Yacht Club

The Elephant Sanctuary Hartbeespoort Dam

(Carruthers, 1990: 333, Wikipedia. 2016).

Hartbeespoort is part of the Municipalities of Bojanala Platinum District, North West, that also includes the nearby town of Brits. Some of the resort areas that have been developed are Kosmos, Melodie, Ifafi, Meerhof, The Coves Estate and Pecanwood Estate which can be found alongside the dam's banks. A number of new leisure developments and resorts are in progress.

Hartbeespoort means "gateway of the Hartbees" (a species of antelope) in Afrikaans. This was because it was a popular spot for hunters. The Hartbees would be chased into the "poort" in the Magaliesberg where they would be shot (de Beer, 1975: 381).

The town was previously known as Schoemansville, named after General Hendrik Schoeman. Schoeman was a Boer General in the Anglo-Boer War and sold his land so the Hartbeespoort Dam could be built (Wikipedia. 2016).

The dam was created here as there is a natural basin and gate way or "poort" through the Magaliesberg mountain range which formed a natural wall. The dam was originally constructed for irrigation purposes, which is still its primary use, but it also now fulfils the domestic and industrial need (Van Vuuren, 2008: 19-21).

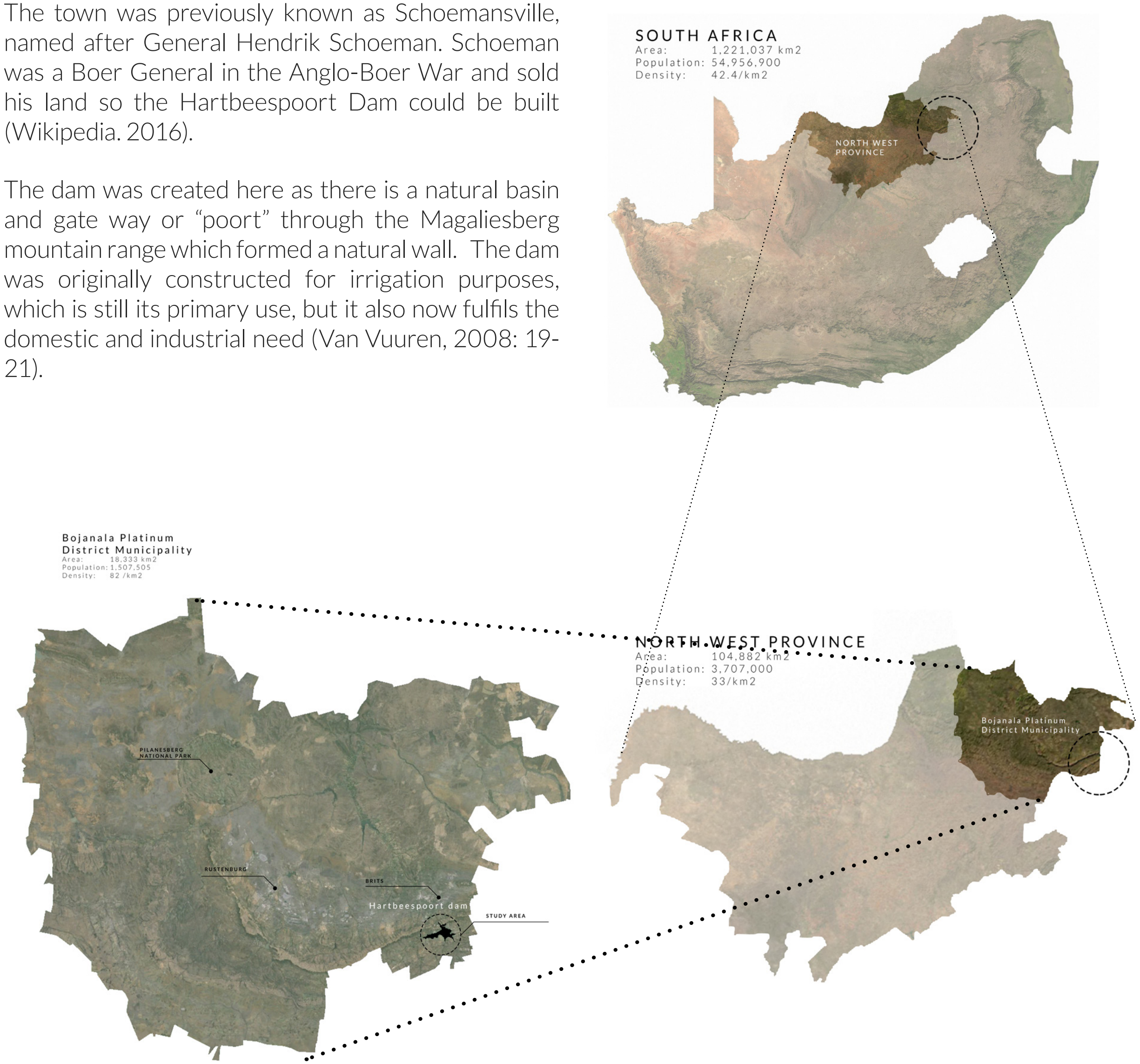


Fig 2.9 Site location. Image by Author (2016) sourced from Google Earth (2016).

Fig 2.10 Site location. Image by Author (2016) sourced from Google Earth (14 may 2016).

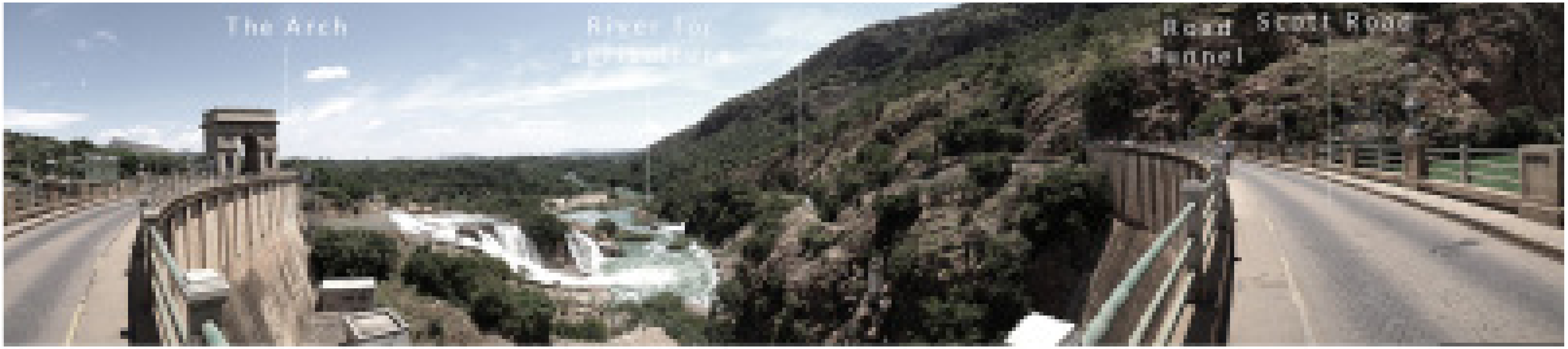


Fig 2.11 Hartbeespoort dam (Author, 2016).

Fig 2.12 Site location. Image by Author (2016) sourced from Google Earth (2000).

Fig 2.13 Hartbeespoort dam (Author, 2016).

Fig 2.14 Site location. Image by Author (2016) sourced from Google Earth (2000).

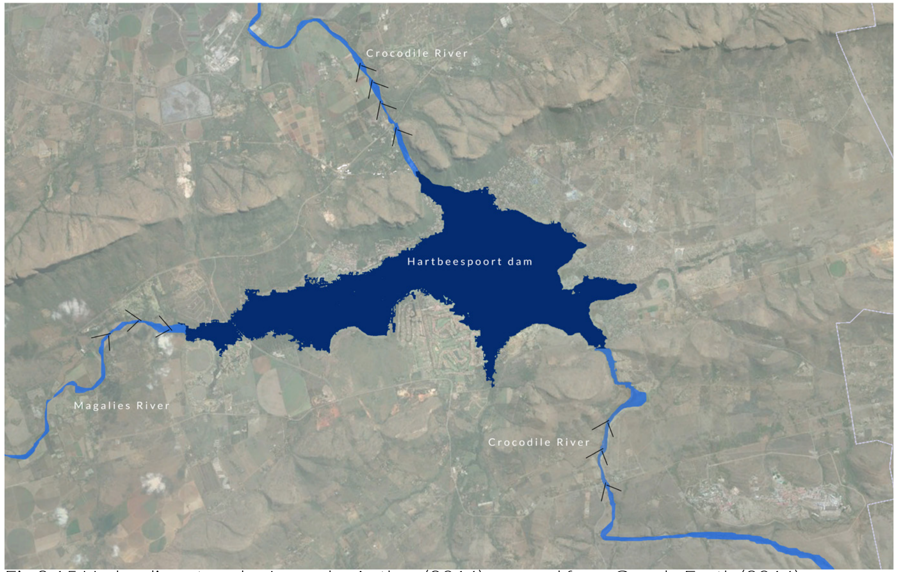


Fig 2.15 Hydraulic networks. Image by Author (2016) sourced from Google Earth (2016).

Hydraulic networks

There are two main rivers that flow into the Hartbeespoort Dam, namely, the Crocodile and the Magalies Rivers. The Crocodile is the larger supplier and flows from the Steenkampsberg mountains. The Crocodile flows through the dam, where it decreases in size as it is mostly used for irrigation purposes

Fig 2.16 Ecological networks. Image by Author (2016) sourced from Google Earth (2016).

Ecological networks

Through the creation of the dam, there has been a disconnection between the ecological networks and an increase in agricultural land. The Magaliesberg mountain range and the ridge to the south are very important ecological networks as they run all the way to Pretoria. There is a growing disconnection at the scarred gateway where the dam wall is built that breaks this network.

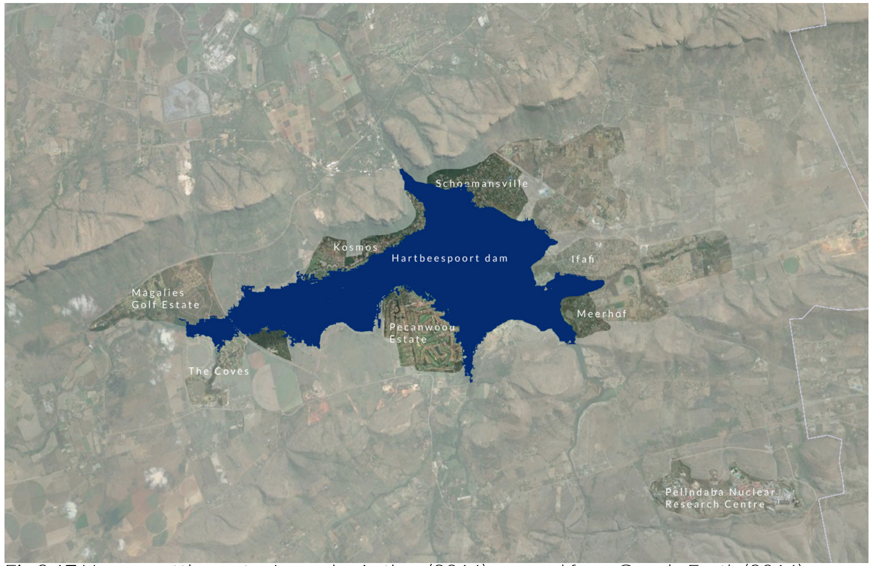


Fig 2.17 Human settlements. Image by Author (2016) sourced from Google Earth (2016).

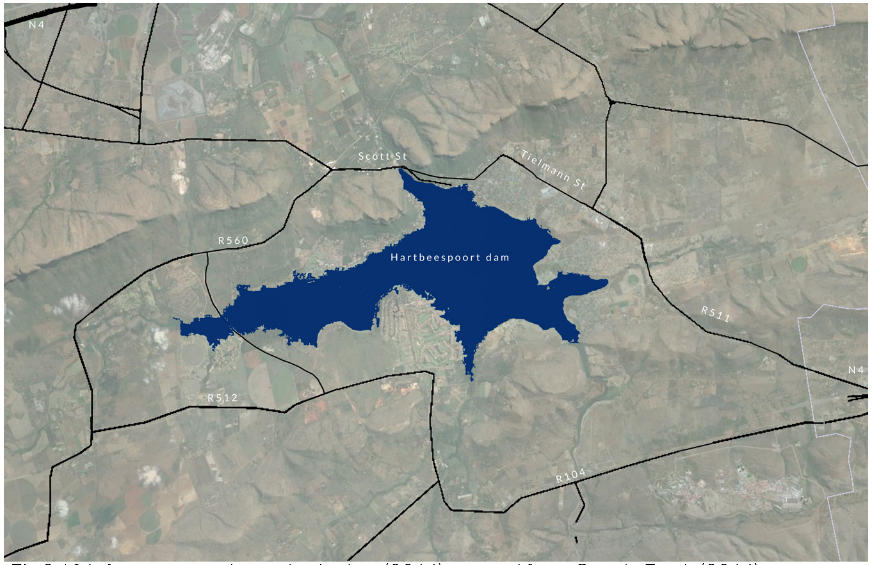


Fig 2.18 Infrastructure. Image by Author (2016) sourced from Google Earth (2016).

Human settlements

These are the surrounding suburbs of Hartbeespoort dam. Schoemansville being the oldest suburb and Magalies golf estate being more recent. The town has a population of 22375 people, with large fluctuations of holiday makers. The town has grown significantly since 1980.

There has been little to no provision for public access to the water's edge as the town has developed. Most of the land around the water edge has been privatised with no street access.

Infrastructure

There is fairly good road infrastructure to the edge of Gauteng province, but from there the N4 ends and two smaller roads divide and loop around the dam. Small roads branch off from this and enter into the smaller suburbs, which often lead to gated communities.

Fig 2.19 Before the dam was build (Ewisa, 2014).

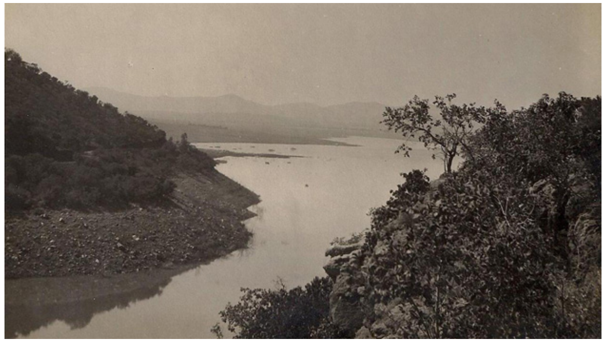


Fig 2.20 While the dam was filling up(Ewisa, 2014).

Fig 2.21 The dam today (Author, 2016).

2.4 Story of a place

2.4.1 History

For 900 years during the Iron Age people used the clay, iron ore and flora in the Hartbeespoort area. The Crocodile River was used as a constant water supply. The first white pioneers rediscovered the potential of this water and used it for agricultural purposes. Furrows were dug for households and farms to access the water. The first dam was constructed in 1896 by *General Hendrick Schoeman*, who owned the farm where the gateway was situated. The dam was named after his wife, Sophia, and was constructed to irrigate his farm as well as his neighbour's farm. It cost him a massive £10,000 to build, which was a fortune during this period. At the time it was the largest dam in the southern hemisphere. The position of this dam was not where today's dam sits, as the river ran a different course then. The dam was nearer to where the railway line runs today in Meerhof. This dam was later washed away in floods in 1891 (Wikipedia, 22 June 2016).

In 1906, the government started to investigate the possibility of building an irrigation dam at Hartbeespoort. An engineer from the Department of Water Affairs carried out a public enquiry into the feasibility of building such a dam, a favourable report was sent to the government. In 1909 a further investigation into the construction of the dam was completed, with the first test holes being drilled at the bottom of the gateway. These tests were to determine the rock formation and whether it was suitable for a dam of this scale. This report was then accepted by Parliament in 1914. Calculations were needed to measure the amount of water that would flow into this dam. Estimates were done to calculate the potential irrigable land that would be created by the building of the dam. It was finally decided to build furrows to divide up the water supply (de Beer, 1975: 387).

The Wall: Physical control


Fig 2.22.1. The dam wall in the past (ewisa, 1918).


Fig 2.22.2. The dam wall in the past (ewisa, 1925).

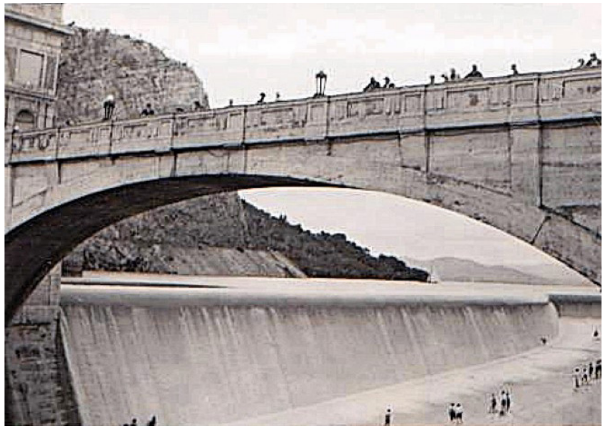


Fig 2.22.3. The dam wall in the past (ewisa, 1925).

The dam wall was constructed in 1925 and is a physical testament to man's control of water

The construction was initially delayed pending the court case between General Hendrik Schoeman and Mr. Marshevin about the expropriation of their properties in order to construct the dam. The case was finally resolved with a heavy hand by the government. The government created many laws to facilitate the creation of the dam.

"The construction of the dam finally started in August 1916 with further delays caused by flooding in 1914 and again in 1918. A large section of the construction was washed away and never recovered. In 1915, the Geldenhuysdam further up the river broke and the flooding of the site also caused a delay" (Wikipedia, 2016).

With the First World War causing further delays, "the first construction company was liquidated due to financial loss resulting from the floods and delays."

During the year of 1921 a second company took over the construction of the dam and an engineer by the name of F. W. Scott brought the project back to life. "Finally in April 1923 after many setbacks and political upheaval the project was eventually completed. Later in that same year the road over the dam wall and the tunnel was opened to traffic. The dam took just over a year to overflow for the first time in March 1925" (de Beer, 1975: 405).

The completion of the dam caused the land to gain in value, especially land close to the canal and the Corocodile river. As a result white farmers came in and replaced the Bakwena people of the Tswana ethnic group who had lived in the area for many generations (Wikipedia, 2016).

The arch was built in 1923 as a replica of the Arc de Triomphe. It was built to commemorate the builders and the men who fought in World War One. As well as the struggle against poverty as this dam made the agriculture land extremely valuable land.

The monument stands as a testament to humans ability to control the water. It speaks of a past paradigm where man sees himself as controlling nature.

The latest addition to the dam was the crest gates on top of this spillway which were added in 1970. This raised the dam by 2.44m and held back an extra 90,000,000 m^3 of water.

The Arch: Symbolic control

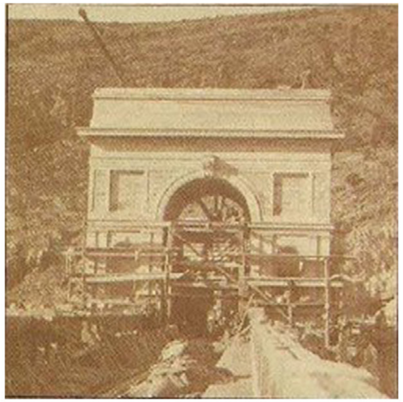
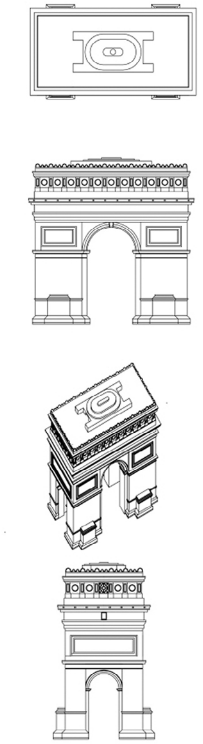


Fig 2.23.1 The Arch over time (Harties, 2016).

Fig 2.23.2 The Arch over time (Ewisa. 2016)

Fig 2.23.3 The Arch over time (Author, 2016).



2.4.2 Heritage memory

Understanding the artefact

"The so-called "Victory Arch" on the western side of the dam is something exceptional and not to be found anywhere else on a dam wall in South Africa. The motivation that it was built for structural purposes is somewhat unbelievable, if we take into account that the dam was already complete and full before the arch was started" (HEHA, 2007: 2-4).

To help construct the arch John Barrow, a specialist in decorative concrete, was called in. This indicates that the visual aspect of the arch was more important than its construction (HEHA, 2007: 2-4).

Hartbeespoort Environment and Heritage Association stated in 2007 that the arch symbolised then "that the struggle for realisation of the dam, and the struggle against poverty was rewarded with victory. The arch is a repetition of the dam's arch shape, which repeats the shape of the Union Building, which was completed just before the dam was built".

There are two quotations written on the western and eastern side of the arch. Both are written in Latin as during this time Afrikaans or English groups could not agree on which language to use

"On the eastern side of the arch an expression out of Varro's "De re Rustica" ("The Rural Case") is written. It reads: *SINE AQUA ARIDA AC MISERA AGRI CULTURA* (Without water, agriculture is withered and wretched)

The expression on the western side was derived from the Latin Bible, Isaiah 44.3. It reads: *DEDI IN DESERTO AQUAS FLUMINA IN INVIO* (For I will pour water on the thirsty land, and streams on the dry ground)" (HEHA, 2007: 2-4).

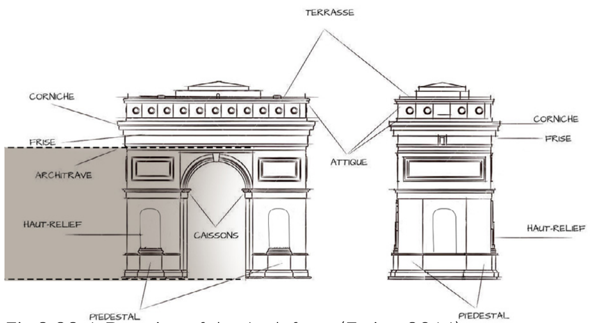


Fig 2.23.4 Drawing of the Arch form (Ewisa. 2016)

The Arch:

The arch was built in 1926 as a replica of the arc de Triomphe. It was built to commemorate the builders and the men who fought in World War One.

Overtime this monument has lost this meaning and now stands as a testament to humans ability to control water. It stands as the symbolic of control over the water as it is placed in-line with the spillway. It speaks of a past paradigm where man sees himself as being above nature.

This element on site still has significant historical value and must be retained on site. It is an important point of reference, a datum, in order for us to gauge how we have moved forward therefore it should be retained. The Burra Charter will be looked at to see how to react to this historical artefact and to develop a specific stance towards it.

The Arch and the Arc de Triomphe

The Arc de Triomphe, August 15 1806, honours those who fought and died for France in the French Revolution and Napoleonic Wars. Similarly the Arch at Hartbeespoort Dam honours those who died in the First World War. In the same way, the Arc de Triomphe became a gateway to the city of Paris and symbolises the triumphs of man.

This monument of war dates back to the ancient times of Rome, an example could be the arch of Titus which was constructed in A.D.82 which created the gateway into the city. This gives the form significance and importance in any city as a gate way (antiquitynow. 2016).

The Arc de Triomphe

The Arc de Triomphe

Fig 2.24 Arc de triomphe (Wikimedia, 2015).

The Arch

The Arch

Fig 2.25 the Arch at Hartbeespoort dam (Author, 2016).

Fig 2.26 building scale possibilities (Author, 2016).

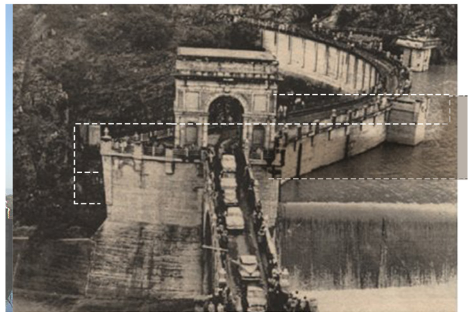


Fig 2.27 the Arch on the dam wall (Ewisa. 2016).

Fig 2.27.1 View of the dam towards the North. Author. 2016.

For nine hundred years the Iron Age people utilized the clay, iron ore and flora for man and animal

Iron Age

1836

The white pioneers "discovered" the potential of the water. Fountains, brooks and rivers were lead to household and agricultural land.

Fords and bridges were constructed and the rivers became the focal point of attention.

Fig 2.28 Painting of The Hartbeespoort (Ewisa. 2016)

General Hendrik Schoeman, owned a farm called Hartbeespoort.He started building the Sophia Dam which was the first dam on the Crocodile river and the largest dam in the Southern Hemisphere.

1896

1902

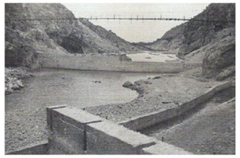
It was decided to relocate the location of the dam wall to between the two mountains. The same position it still remains today.

Fig 2.28.1 Before the dam was build (Ewisa. 2016)

A swedish man by the name of August Karlson was hired to engineer the build.

1905

Fig 2.28.2 Sophia's bridge (Ewisa. 2016)

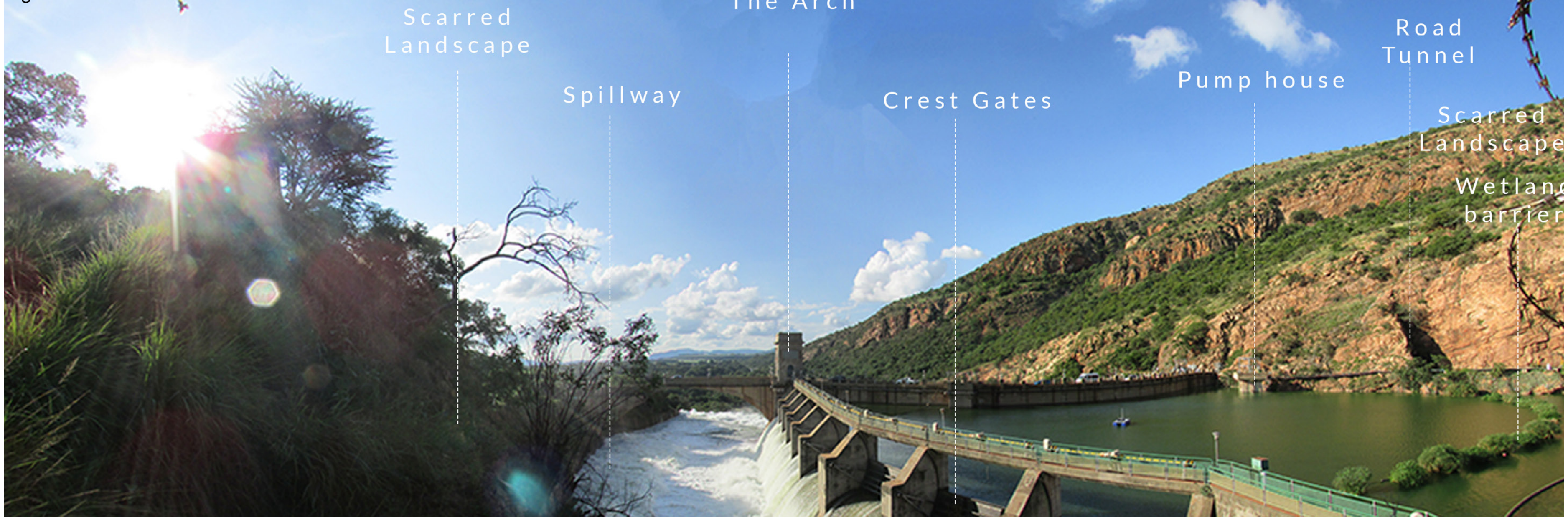


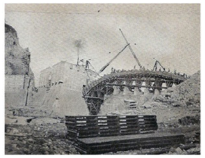
1914

Construction of the dam was however postponed due the outbreak of the First World War (1914 - 1918).

Fig 2.28.3 Suspention construction bridge (Ewisa. 2016)

Fig 2.27.2 water infrastructure. Author. 2016.





1921

Unfortunately, torrential rain washed the temporary dam away. Again construction came to a stand still.

Fig 2.28.4 First bridge attempted (Ewisa. 2016)

The Hartbeespoort Dam first over flowed.

1923

Fig 2.29 Dam washed away (Ewisa. 2016)

1925

The Hartbeespoort Dam wall was completed after many setbacks and political upheaval

The replica of the Arc de Triomphe was built to commemorate the builders and the men who fought in the WW1.

1926

Fig 2.30 The Arch (Ewisa. 2016)

1970

The dam level was raised by 2,44 m, with the installation of ten crest gates on top of the spillway

Fig 2.31Crest gates. (Author, 2016).

The dam in a eutrophic state due to the nutrient build-up, as well as the unbalanced ecology within the HBPD system

1980

Fig 2.32 Hyacinth build up (Harties, 2015).

2007

Hartbeespoort Dam Integrated Biological Remediation Programme (HDRP), started by the Department of Water Affairs (DWA).

Phase 1 is to start the systems and build a business plans.

Fig 2.33 Hyacinth removal (Harties, 2015).

Phase 3 as started with full scale activitys. dredging, vermiculture, removal of fish and creating of wetlands.

2014

Fig 2.34 Remediation program (Harties, 2015).

2.5 Analysis of context

2.5.1 Use

The dam now supplies irrigation water along 550 km networks of canals to 160 km^2 of farmland. This allows crops such as tobacco, wheat, lusern , fruit and flowers to be produced. In the last decade Hartbeespoort dam has become a very popular holiday destination and weekend resort from the neighbouring provinces, with both Pretoria and Johannesburg being less than 50 km away. It is the primary water recreation space for Gauteng and many other neighbouring areas. The Transvaal Yacht Club has been operating at the dam since 1923 (Transvaal Yacht Club: 2008).

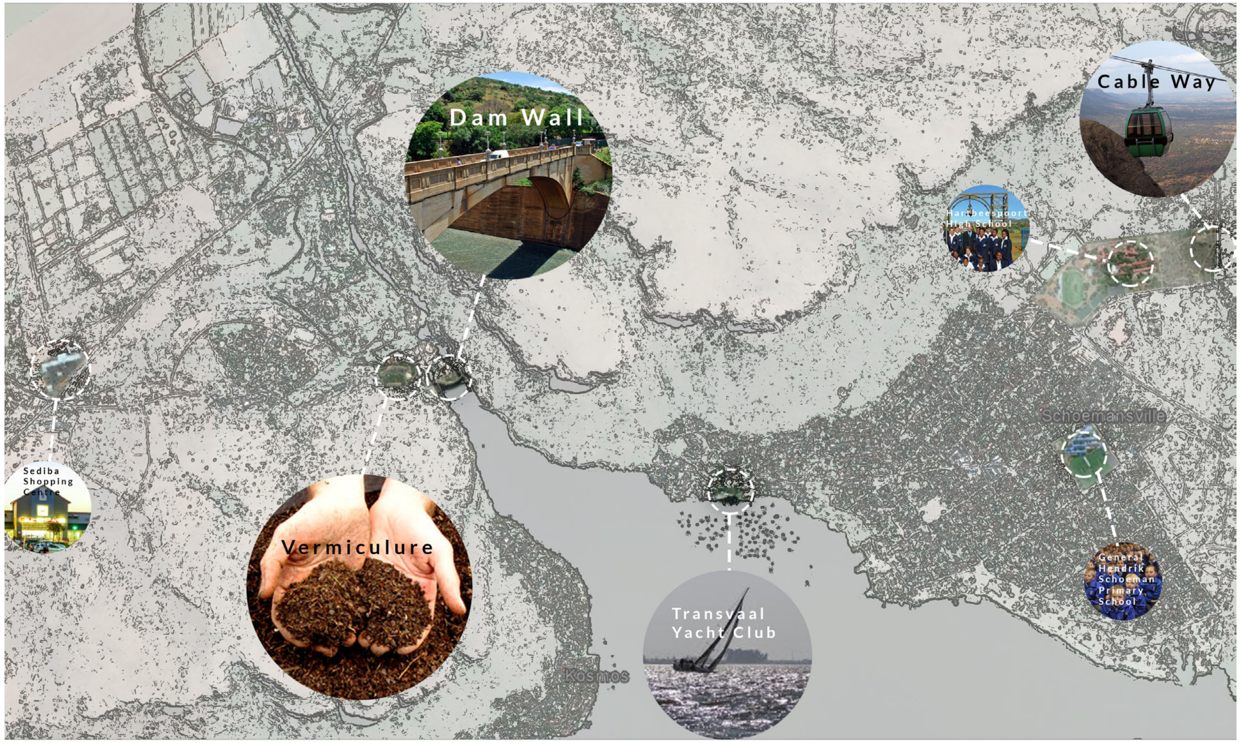


Fig 2.35 The Hartbeespoort location of attractions (Author, 2016).

2.5.2 Water quality

One of the major problems of Hartbeespoort Dam is the water quality. The dam has been in severe eutrophication since the 1970s. This causes two main issues; the nutrient build-up, as well as the unbalanced ecology within the system. This results in high concentrations of sulphates and nitrates in the water. The primary pollution source is from industrial and domestic Gauteng that flows into the Crocodile River and then eventually into the Hartbeespoort Dam (Allanson, 1961: 77–94).

This increase in nutrients causes widespread growth of algae and Hyacinth which covered the dam in 1975. The decision was made to eradicate the Hyacinth using pesticides. This caused the Hyacinth to die and sink. This decayed and released all the nutrients back into the water causing an explosion of Hyacinth (Harding, 2004 and Hart, 2015: 432-440)

Gauteng province is home to 9,6 million people which is 20.2% of the total population of South Africa. This brings a huge water demand to a very small portion of South Africa. This demand is satisfied by the Tugela and Lesotho Highlands water scheme to the Vaal dam.

The northern part of Gauteng is home to 2.5 million people and falls within the Crocodile Marico water management area. This means a huge amount of water flows into the Crocodile and Apies rivers. There are strict sanitation standards applied in this area, although most of the residents are serviced with waterborne sewers. Yet a large amount of grey water and black water still pollutes the water catchment area of Hartbeespoort Dam. " The main cause is from informal settlements, sewer blockages, pump station overflows and storm water pollution"(Harties, 2016).

The statistics from the Department of Water Affairs (DWA) states that "People using water borne sanitation results in the release of more than 700 000 000 litres (700Ml/day) of treated effluent, used and polluted water into the catchment of and directly into the Hartbeespoort Dam per day" (Harties, 2016).

"The internal load of nutrients and sediments trapped within the Hartbeespoort Dam are close to 2 000 tons. This load is constantly mobilised through the continuous movement by sediment feeding fishes, (exotic carp and barbell/catfish) as well as incoming storm water and flooding" (Harties, 2016).

In 2005 the Hartbeespoort Dam Integrated Biological Remediation Programme, Harties Metsi a Me, was put in place by the DWA to combat the eutrophication, in order to improve the water quality.

The aim of the program is to implement various techniques of improving the water quality at the dam for the short term, as well as investigating and stopping the inflow of pollution into the Crocodile River which is the main source of nutrients (Harding, 2004).

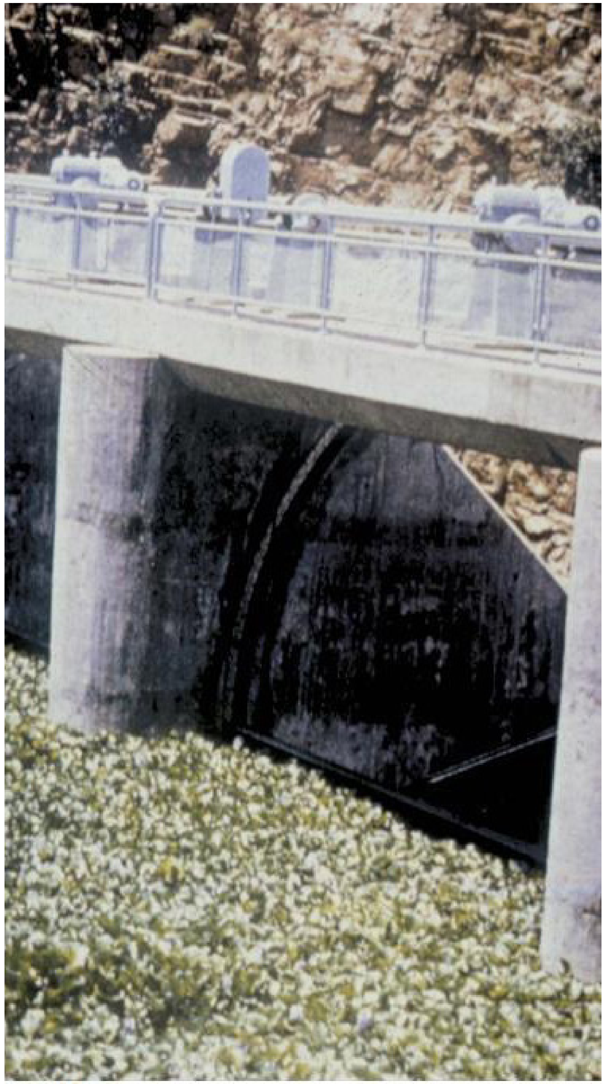


Fig 2.36 The Hartbeespoort water problems (Harties, 2015).

2.5.3 Hartbeespoort Dam Integrated Biological Remediation Programme

A 2-year study was done by the North West local municipality on the biological condition of the Hartbeespoort Dam. From these results the following steps were set as a national priority and in May 2007 the go ahead was given to implement them and fast tracking of the programme (Harties, 2016).

Solution to the problem

The remediation programme focused on projects with short term results and more long term strategies would be introduced as the project progress. A three-pronged approach was adopted to solve this problem and reach the project goal. The points, stated by the DWA (2012), are as follows;

"The application of symptomatic treatment, restorative action and the creation of a biological, self-cleaning, balanced ecosystem in the dam basin.

- This entails removing the bulk of the imbalances that are in exponential growth (excessive external and internal nutrient loads with associated sediments, algae, Hyacinths, dominating undesired fish species, litter and debris).
- Restoring and protecting the natural filters (wetlands and riverbanks) in the immediate catchment of the Hartbeespoort Dam to ensure that incoming polluted water is filtered
- Regulating water use in the greater Hartbeespoort Dam catchment, enforcing regulations regarding unlawful water use, and integrating the interdepartmental efforts across the catchment" (Harties, 2016).

Fig 2.37 The Hartbeespoort water problems (Author, 2016).

2.6 Urban Vision

2.6.1 Macro

The macro urban vision focuses on the ecological problems that were identified at the Hartbeespoort Dam. It also looks at the spatial relationships between a man and nature and tries to shift from a parasitic relationship that currently exists to a symbiotic relationship. Special interchanges were identified to target this approach. These four spatial interchanges became key points to interject with architectural interventions within the water framework.

The diagrams in figure 2.38 show the macro problems between connections to water. Figure 2.38.1 shows that natural connections have been degraded by pollution and eutrophication of the water. This has led to the detriment of natural shorelines at the dam. This is also similar along most water features in the Gauteng province such as the Apies river.

Much of the land around the Hartbeespoort Dam has been privatised and blocked off from public which can be seen in fig. 2.38.2. This means that the water has become a feature for a limited select few, leading to the rest of the public becoming disconnected to water.

Parks are few and far between and have little connection to the water's edge. This has made it an elitist condition as the only way to have a connection to nature is to own land. The town has become filled with gated communities, buying the best land with the best views to the water, leaving little to no space for public activities. This again was something found along the banks of the Apies river.

One of the positions that could create a meaningful connection and understanding of water is the infrastructure of the dam wall. The space also is one of the only public connections to the water, however limited.

2.4.1.1Spatial Interchange

natural connection

degraded river embankment
no physical connection to water

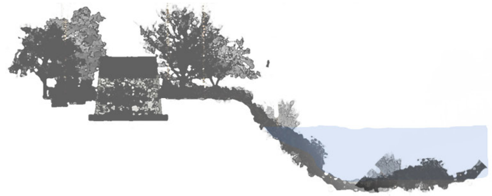


Fig 2.38.1. Existing River Embankment with Historic edge (Coetzee, 2014).

Hartbeespoort Dam Conditions (Author, 2016).

urban connection

seperation of public to waters
edge by gated communities

Fig 2.38.2 Existing Urban Context (Coetzee, 2014).

Hartbeespoort Dam Conditions (www.earth.google.com. 2016).

parks connection

polluted water
no connection to river

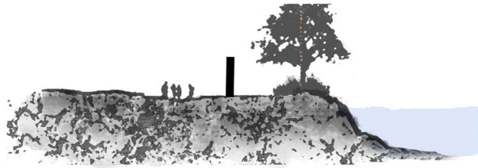


Fig 2.38.3. Existing River Along a Park Space (Coetzee, 2014).

Hartbeespoort dam Conditions (www.earth.google.com. 2016).

bridges and roads

no physical and lack of visual connection

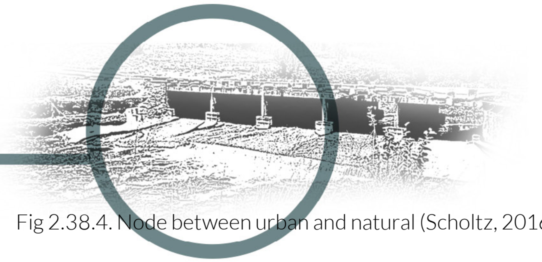


Fig 2.38.4. Node between urban and natural (Scholtz, 2016).

Fig 2.38 Spatial Interchanges (Author, 2016).

2.6.1.2 Problems

The environmental problems of the dam are extensive and mostly due to the eutrophication of the water. This has caused a downward cycle of the ecological system to a point where nature is unable to create equilibrium. The eutrophication of the water has been a result of sewage waste and pollution flowing into the feeding rivers to the dam. Fig. 2.39.1 shows where the problems are located and most severe. The hierarchical list below summarises the most severe problems (top to bottom) .

- Creation of poor water quality for domestic and agricultural use. Increase in algae and Hyacinth
- Damage of shoreline and wetlands
- Decrease in desirable fish species
- Increase in non-desirable fish species
- Increase in litter and pollution
- Increase in sediment (25% of the volume of the dam)

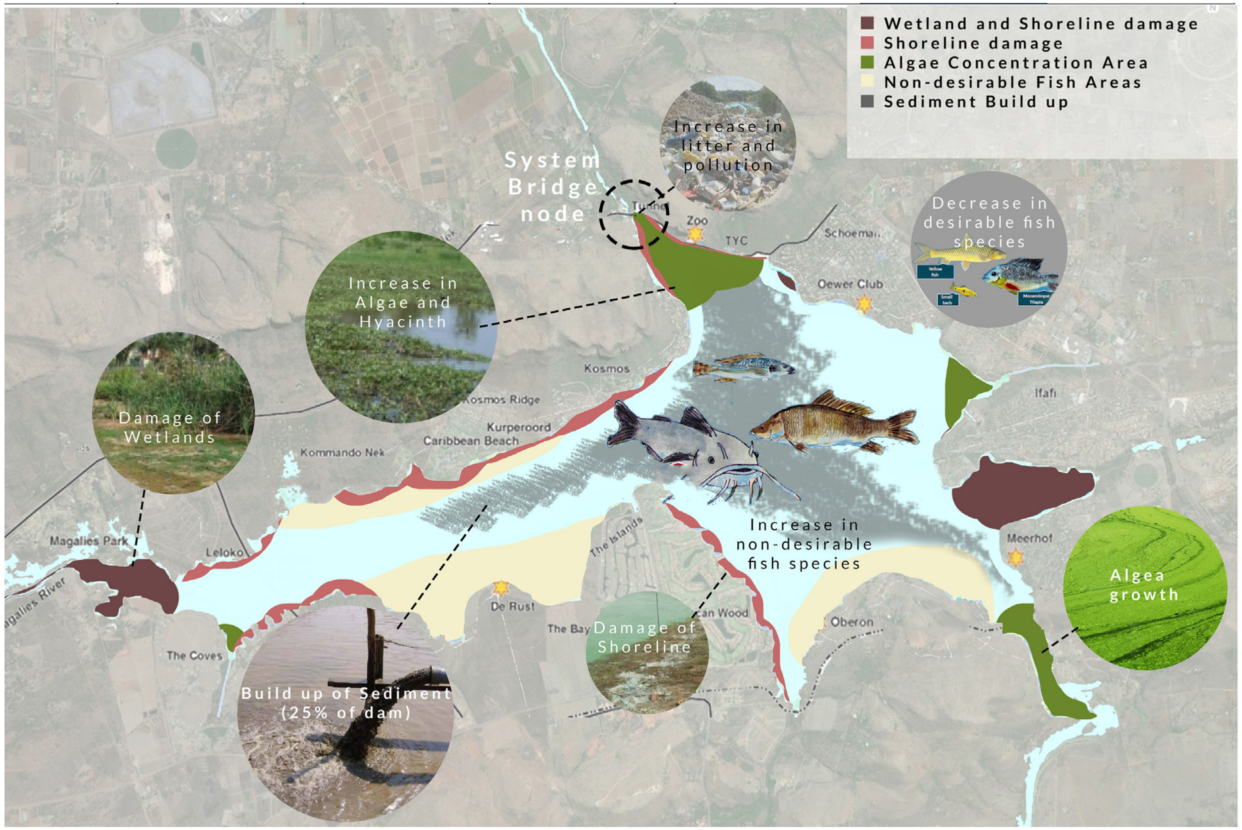


Fig 2.39.1 General location of problems. Image by Author (5 May 2016) sourced from Google Earth (2016).

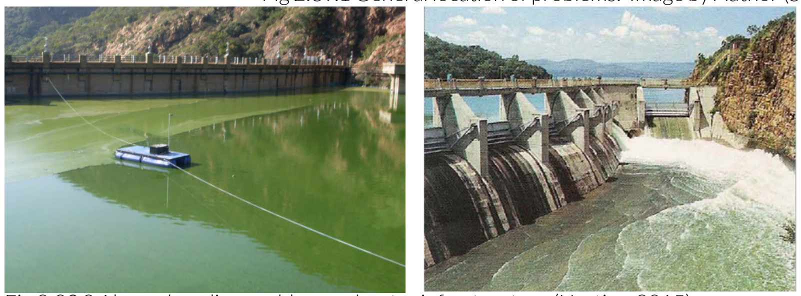


Fig 2.39.2 Algae, shoreline problem and water infrastructure (Harties, 2015).

Fig 2.39.3 General urban issues (Author, 2016).

2.6.1.3 Solutions

As a response to the severe problems that the dam was facing, a remediation program was set in place in 2007 to combat them. Fig. 2.40.1 shows the location and extent of the solutions. These solutions have created many jobs for local people around the dam and have started to have an effect but they are not solving the core problem but rather dealing with the symptoms. The list below summarises the solutions carried out to date.

- Stop inflow of sewerage and fertiliser at source
- Filtering out of algae and Hyacinth
- Rehabilitation of shoreline with compost and creation of floating wetlands
- No fishing zones to stimulate regrowth of desirable fish
- Target fishing of non-desirable fish on shoreline.
- Creation of barriers at river mouths to stop inflow of pollution and nutrients
- Dredging out of the sediment of the dam to increase volume.

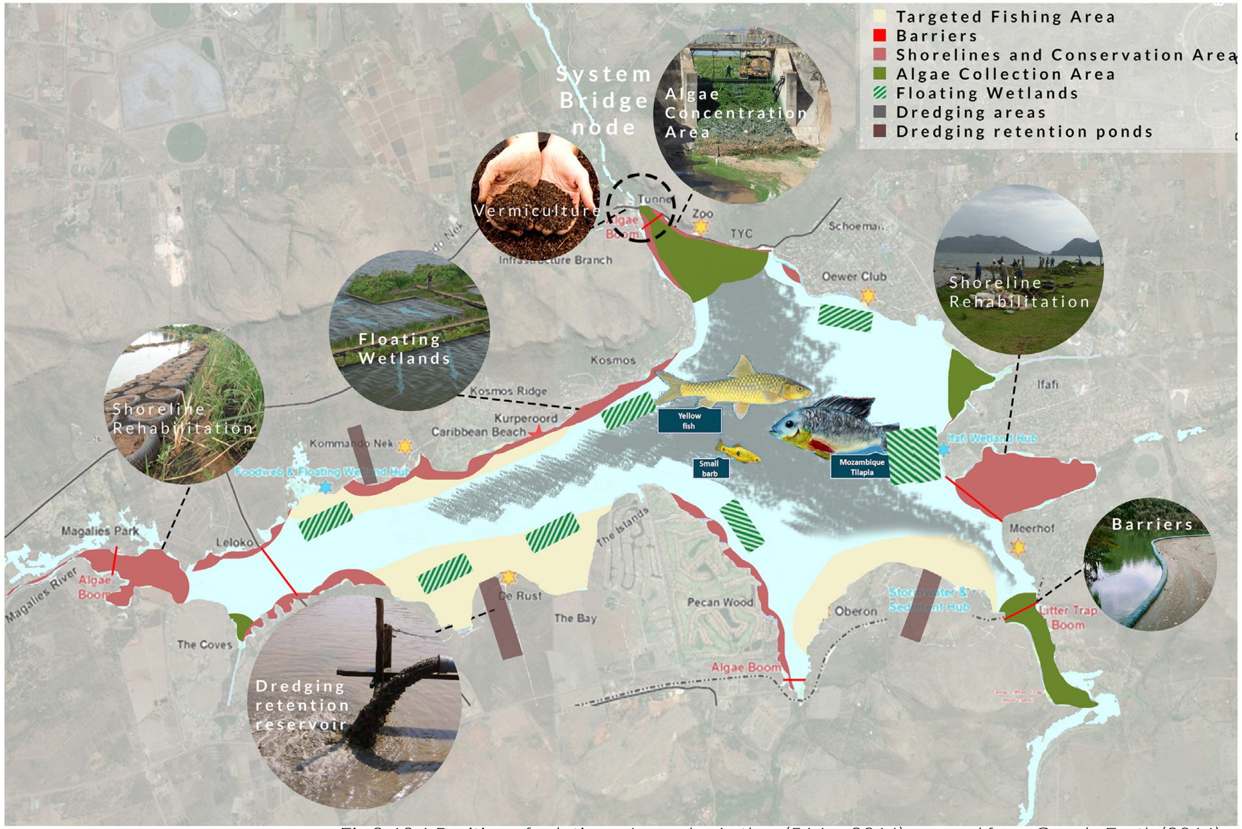


Fig 2.40.1 Position of solutions. Image by Author (5 May 2016) sourced from Google Earth (2016).

Fig 2.40.2 Corniche Nile River Walk (Methoddesign, 2015)

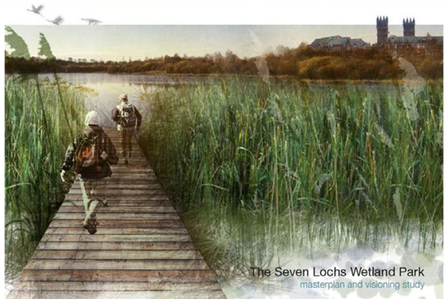


Fig 2.40.3 The Seven Lochs Wetland Park (GCV Green Network Partnership, 2012)

Micro site analysis

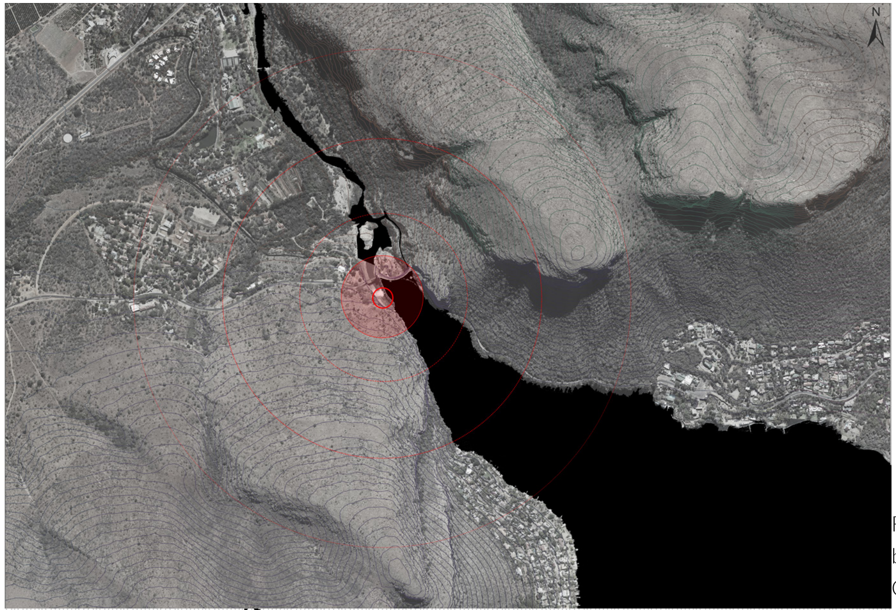


Fig 2.41.1 General location. Image by Author (May 2016) sourced from Google Earth (2016).

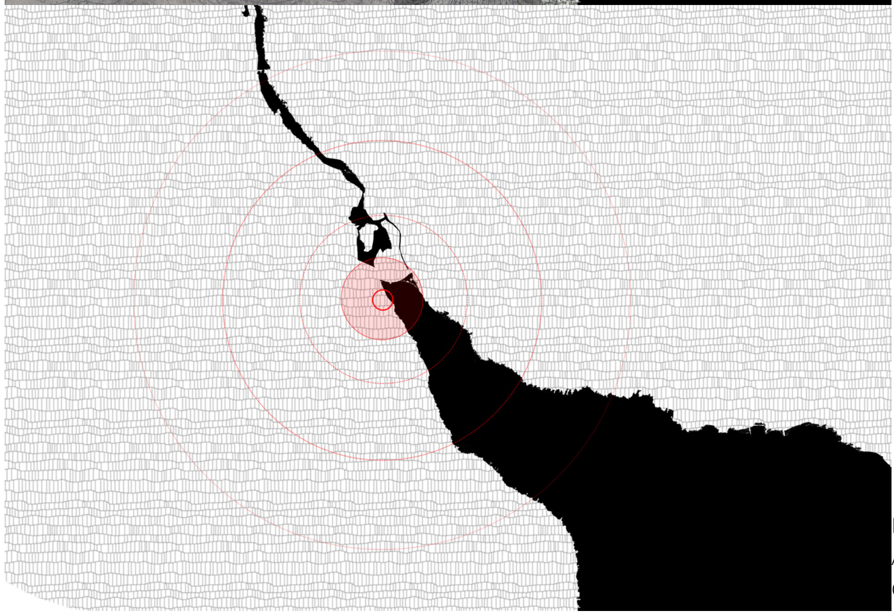


Fig 2.41.2 Water bodies. Image by Author (May 2016) sourced from Google Earth (2016).

The following diagrams analyse the space that the micro vision would deal with. They highlight the ecological systems as well as the urban spaces that happen around the intended sight of this project.

Figure 2.41.1 shows the extent of the micro vision as the area exists now, with which the building will interact. The red dot is the intended site of the project.

Figure 2.41.2 shows the water body on site of the dam as well as the Crocodile river flowing off into the distance. It is also possible to see the secondary outlet that runs on the left hand side to meet up with the river. This insures a constant flow of water in the river to irrigate the agricultural land.

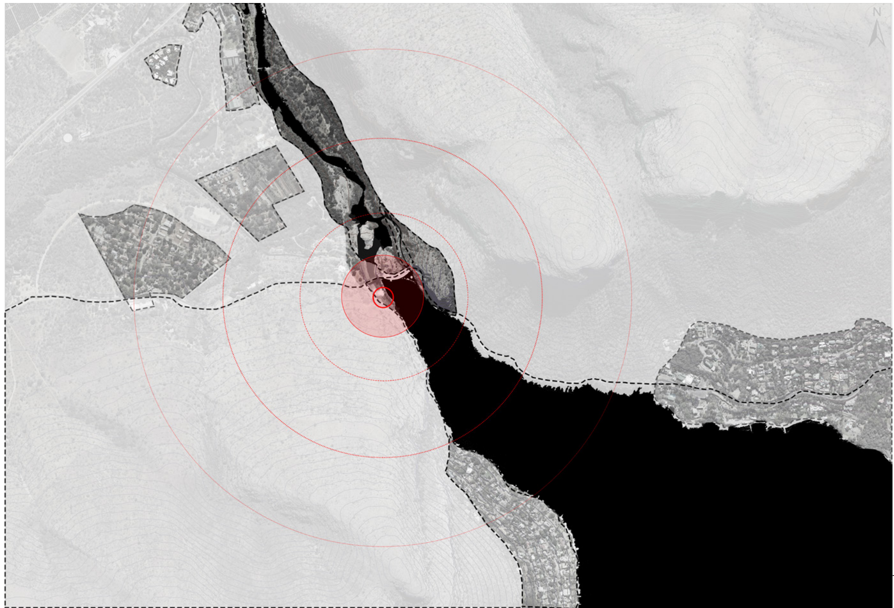


Fig 2.41.3 Human Scarred landscape. Image by Author (May 2016) sourced from Google Earth (2016).

Fig 2.41.3 This figure shows the disturbed sites through human interactions. The closest neighbourhoods are highlighted, the nearest being approximately 500m away. The dam and the river are included in the scarred landscape as humans are to blame for the eutrophication.

Fig 2.41.4 Ecological scarred landscape. Image by Author (May 2016) sourced from Google Earth (2016).

Fig 2.41.4 The area highlighted is where the intervention would most directly interact with the ecology. The water that interacts, in some way or another, with the building would then continue down the river to the agricultural land and therefore interact with a much larger ecology.

2.6.2 Micro

A micro scale analysis of the dam wall revealed three main problems:

- The build-up of Hyacinth and algae
- The lack of meaningful public space that connects to the water's edge
- The mono-functional quality of water infrastructure

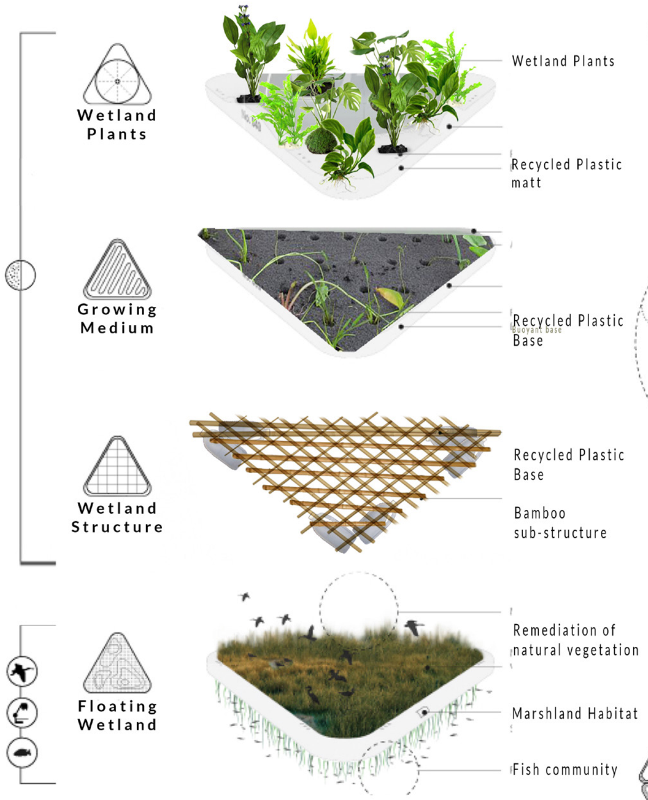
To tackle these problems certain solutions were identified that built upon the remediating program.

Fig 2.44 Micro urban solutions. Image by Author (2016) sourced from Google Earth (2016).

2.6.2.1 Floating Wetlands

Construction of new floating wetlands will allow flora to flouish. This will rehabilitate the desirable fish environments as well as filter out the nutrients that cause eutrophication. The floating wetlands act as barriers to stop and collect the algae.

Where the wetland barriers are connected to the shoreline, vermiculture activities will be located. The algae can easily be collected by walking along the wetland barrier and it can be broken down to compost through the vermiculture.



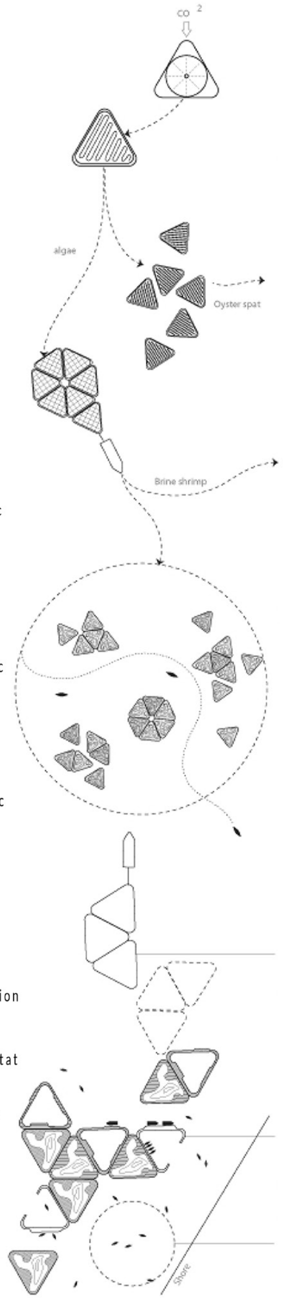
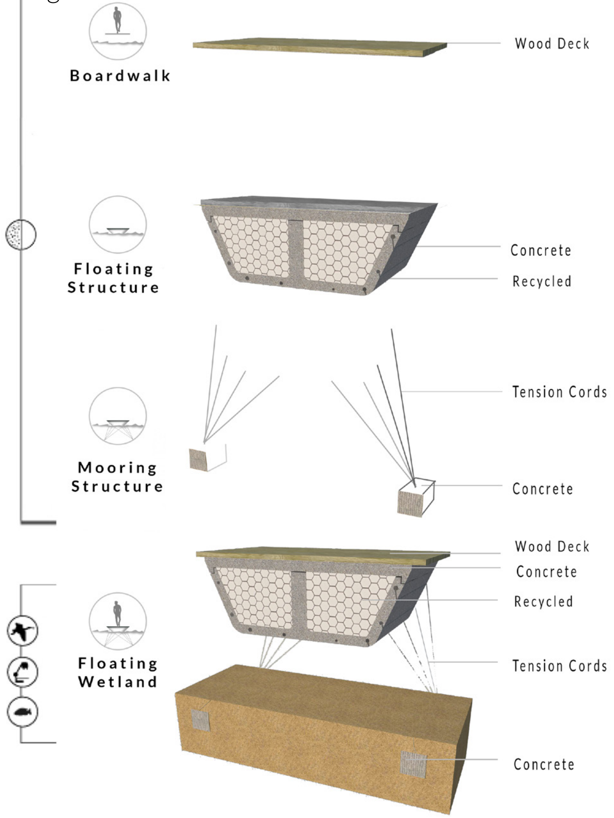


Fig 2.45 Floating wetland and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

2.6.2.2 Floating Boardwalk

The integration of the floating boardwalks will allow access to the floating wetlands. This is necessary to remove algae build up and then to be placed into the vermiculture system. These boardwalks will also act as public spaces that reconnect to nature. These public routes are vital to raising awareness of the water state and creating a better appreciation of water.

This modular construction can be created near to site and allows for many different configurations. A straight route can be created or a larger public space along the boardwalk.



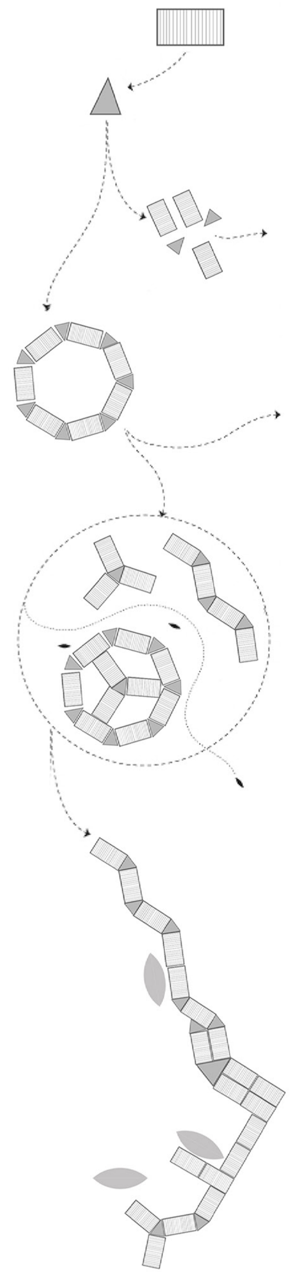


Fig 2.46 Floating boardwalk and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

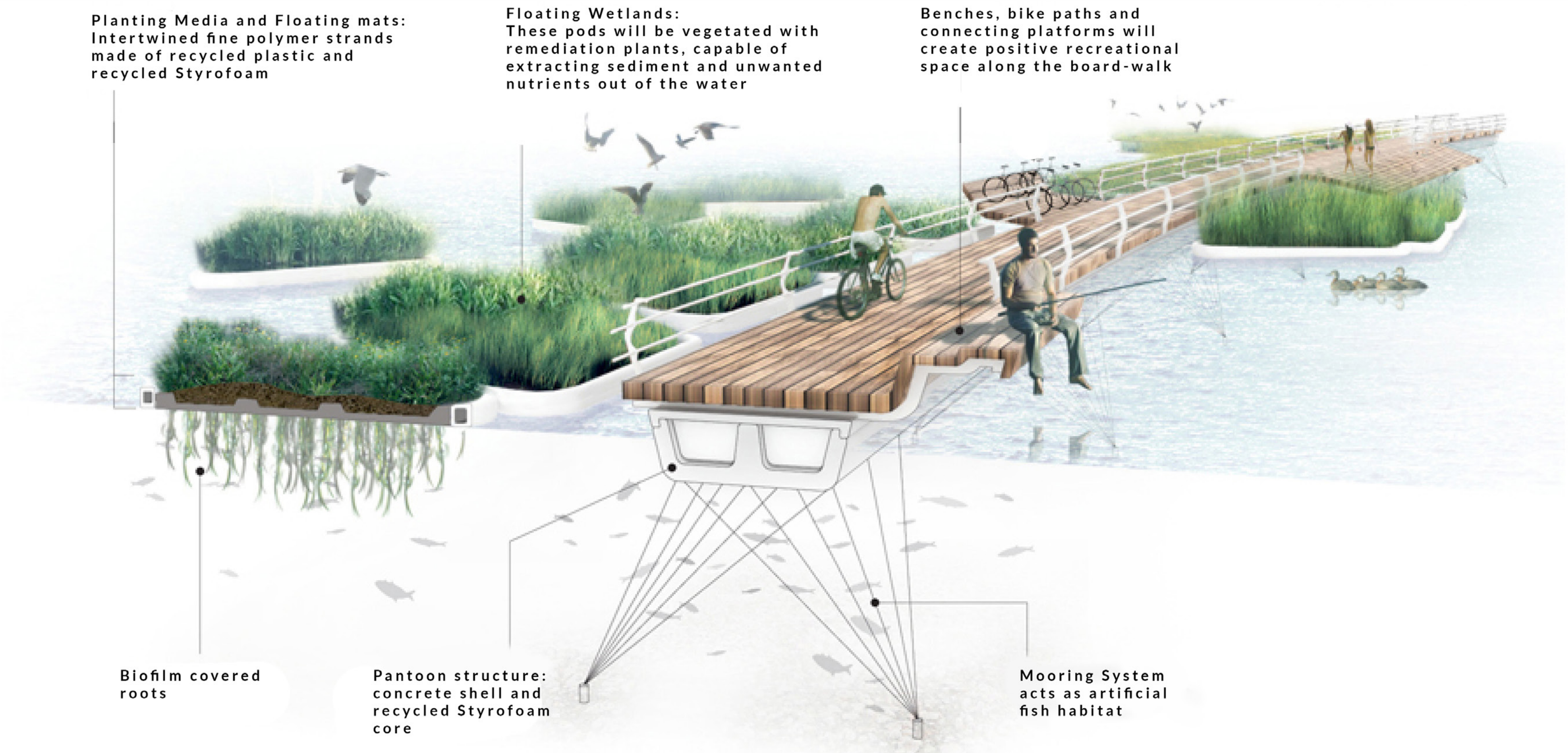



Fig 2.47 Urban vision perspective (Ghazal Jafari & Ali Fard, 2013).

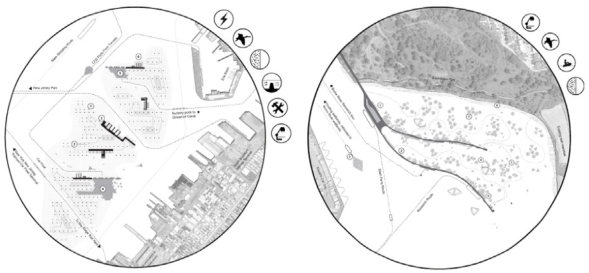


Fig 2.48 Rehabilitation of context (Ghazal Jafari & Ali Fard, 2013).


Fig 2.49 Urban vision perspective (Ghazal Jafari & Ali Fard, 2013).

Fig 2.50 Existing Infrastructure on site (Author, 2016).

2.7 Site Analysis

2.7.1 Site Critique

A site critique was carried out through a SWOT analysis by specifically looking through the following lenses; mono-functional spaces, limited access, memory and history.

The activities on site were split up into the following categories; cultural (split up into historical and social), ecological and economic.

CULTURAL

HISTORICAL

Fig 2.51 Site Critique - Cultural. Image by Author (2016) sourced from Google Earth (2016).

The dam wall was designed in a Neoclassical style and the gateway mimics the Arc de Triomphe and is in the same style. The dam wall itself is part of an architectural memory, as it has multifunctional uses; it dams up the water, it acts as a road to connect either side as well as having historical meaning to it by means of the arched gateway.

This is not the same for the crest gates and spillway which simply control the water and therefore form part of infrastructural memory. As this structure is mono functional and has no access to it, it has less historical meaning then the dam wall itself.

Two contrasting memories allow for a new celebration of site culture and water. An active space that allows for the understanding of the processes needed to rehabilitate the site.

SOCIAL

Fig 2.52 Site Critique -Social. Image by Author (2016) sourced from Google Earth (2016).

Access points are limited around the dam wall and there is little space to linger. Most people drive across the dam and only experience it visually. The idea of public access is crucial to the understanding of the problems on site and therefore a solution. As the public starts to understand the situation better they will take more care of it.

There are three major gateways that express a change in condition across the dam wall.

-From the tunnel side there is a view over a controlled water body.

-As one moves through the arched gateway you experience the power and the release of the water as it flows through the crest gates.

-And then finally the view is angled back towards the serene river that flows off into the distance.

ECOLOGICAL

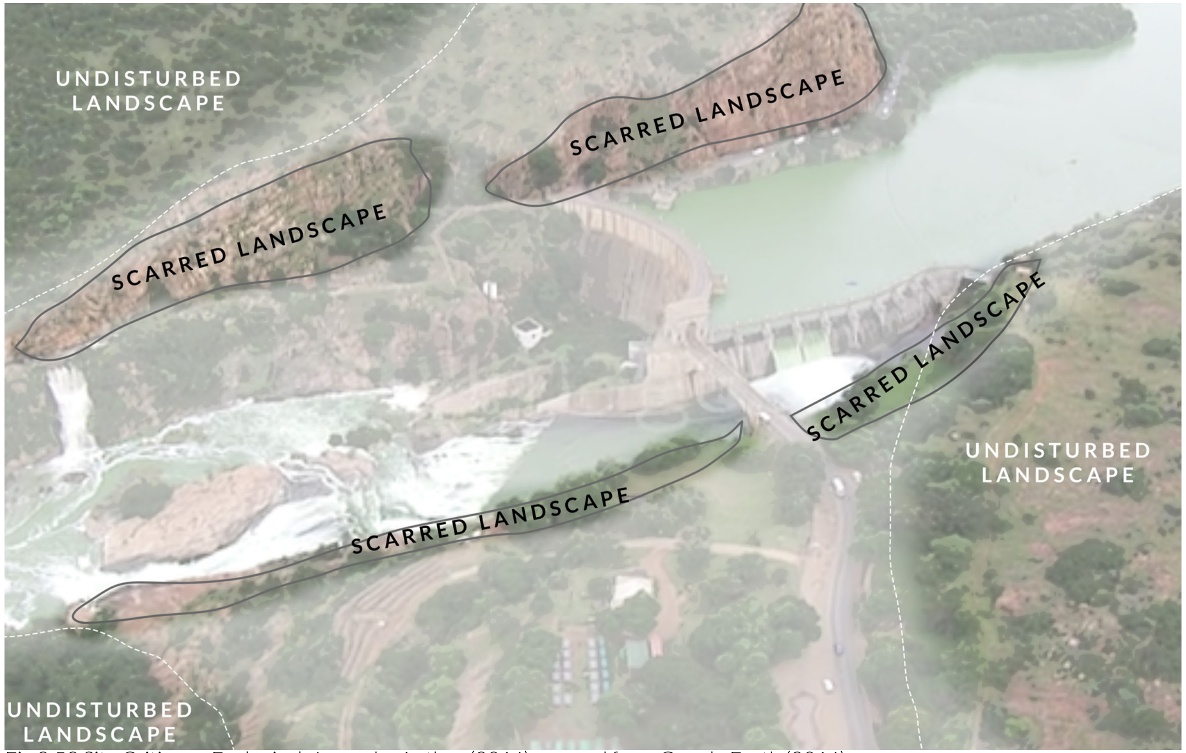


Fig 2.53 Site Critique - Ecological. Image by Author (2016) sourced from Google Earth (2016).

In order to create the dam, part of the poort had to be cut away. This is especially visible on the bank of the spillway. There is a stark contrast between the undisturbed landscape and the cut. This becomes a scar in the landscape and needs to be healed through regenerative architecture.

The ecological networks that used to exist between these two ridges have been disconnected and need to be unified. There is also little access to these ridges as they are often fenced off.

The Vermiculture system is trying to remediate this problem but is unable to do so as there is little to no capital and the system is often crippled by theft of the worms.

ECONOMICAL

Fig 2.54 Site Critique - Economical. Image by Author (2016) sourced from Google Earth (2016).

The Vermiculture system is currently ineffective but has the possibility to be extremely efficient, if security and public awareness is enhanced. There is the possibility of not only rehabilitating the site but also creating an income through selling of products such as compost and vermiliquid.

The idea of public access is crucial to the understanding of the problems on site and therefore a solution. As the public starts to understand the situation better they will take more care of it.

2.7.2 Existing site activities

The site is currently being used for a vermiculture system to deal with the growth of Hyacinth on the dam. Figure 2.49 shows the location of different parts of the vermiculture activities on site as they exist now.

A. shows the 18 vermiculture beds; some of which are partially shaded while the rest are in the sun. They also have a large tented structure that was used for presentations of the system which now is no longer used as the site is closed off to the public.

B. is the prototype testing pool for the floating wetlands, that are also created on site in a separate building. They test different structures of floating Wetlands as well as different plants and how they cope with the structure.

C. shows the litter collected from the crest gates as the litter naturally flows to this point. It was needed to create a recycling collection point to deal with the sorting of the litter. It is currently very badly organised and pick ups of the recycling, to be taken to the recycling plant, are very sporadic.

D. is the point where the Hyacinth is taken once it is removed from the dam. It sits at this point in the sun to start biodegrading, then it is put into the vermiculture beds. There is a smell from this process and it needs quite a large area as the Hyacinth builds up. This is due to the fact that the vermiculture system cannot keep up with the collection rate.

E. is the floating pump station which is tied to the crest gates; this is used to collect the Hyacinth. It is also used to pump algae buildup down to the bottom drying station before being placed in the vermiculture beds.

F. is a view from the old pump house, looking across the crest gates towards the arch and dam wall. This is quite a unique view as the public is not allowed to this point currently.

When the dam was originally constructed there was a space just below this image designed for public engagement. In 1980 it was closed for safety reasons and the fence is still there to this day.

Fig 2.55 Vermiculture activities on site (Author, 2016).

Fig 2.56 Wetland activities on site (Author, 2016).

Fig 2.57 Recycling activities on site (Author, 2016).

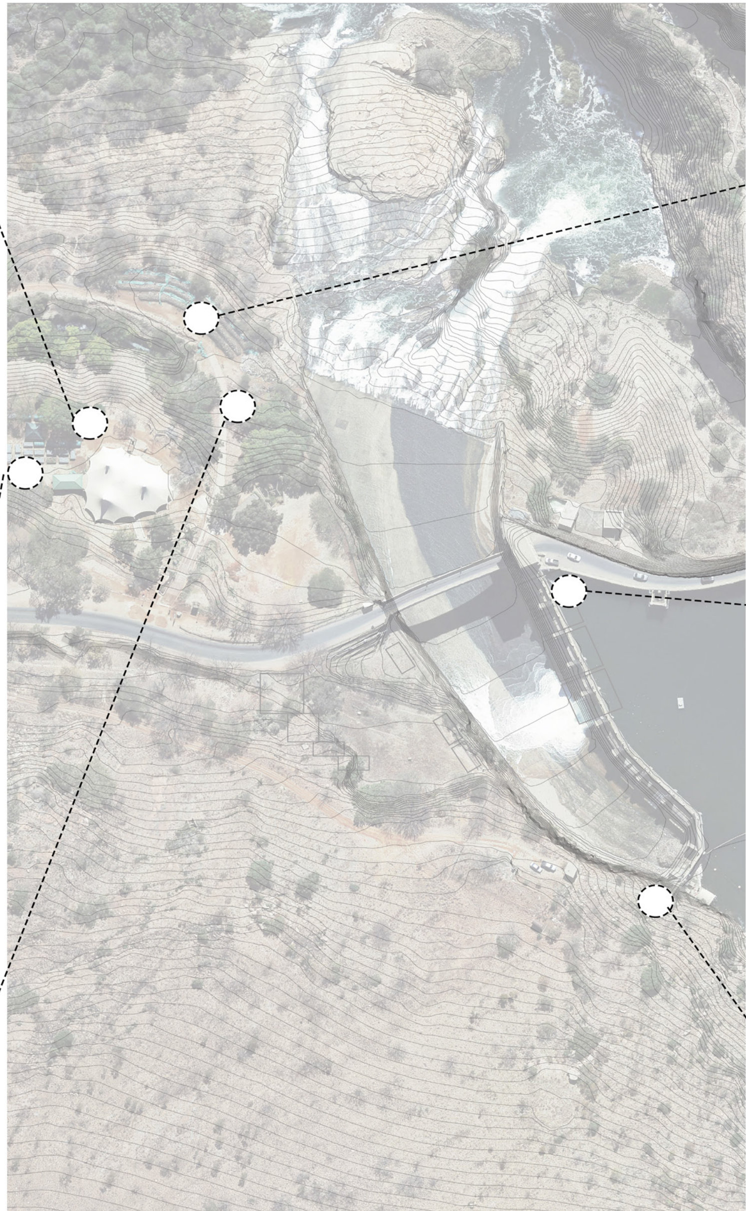


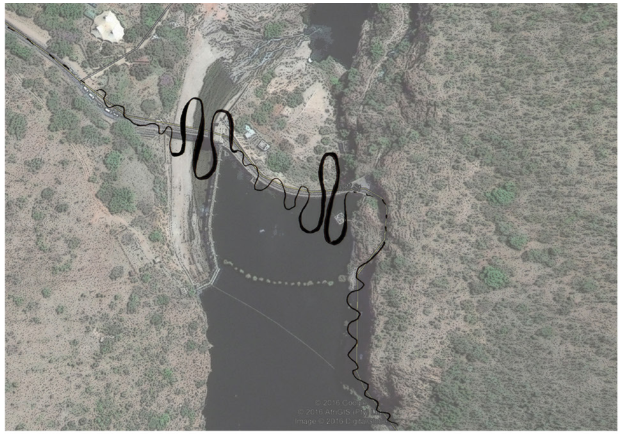
Fig 2.58 Existing site. Adapted image by Author (2016) sourced from Google Earth (2016).

Fig 2.59 Hyacinth on site (Author, 2016).

Fig 2.60 Pump raft (Author, 2016).

Fig 2.61 existing activities on site (Author, 2016).

2.7.2 Haptic Observation



When visiting the dam you experience it in different ways, depending on your movement across the bridge. Either way there is a concealment of the dam to a point where there is a sudden release, were you experience the dam in its entirety.

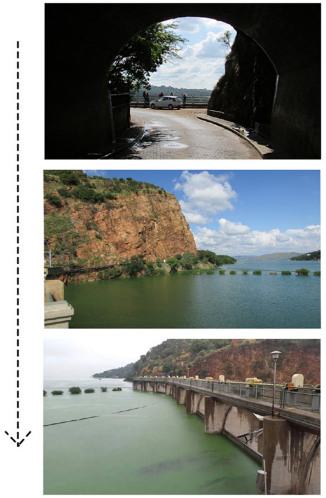


Fig 2.562 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.63 Hartbeespoort dam gate way (Author, 2016).

There are two conditions divided by the dam wall; on one side there is controlled water which is contained and captured and on the other side there is this serene natural river that flows off into the distance which gives life to the land.

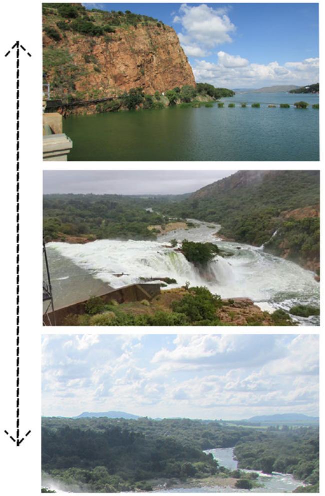


Fig 2.64 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.65 Hartbeespoort dam gate way (Author, 2016).

There is quite a stark contrast between the two conditions of the water; from being a large passive body of water to a raging gushing torrent that is released down the spillway.

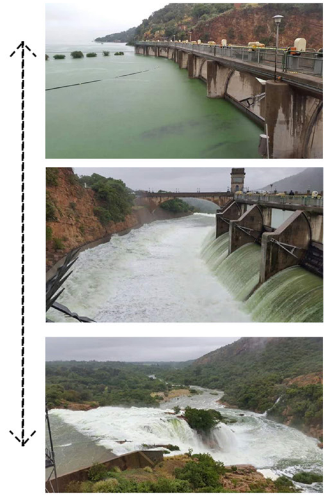


Fig 2.66 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.67 Hartbeespoort dam gate way (Author, 2016).

2.7.2 Water and landscape

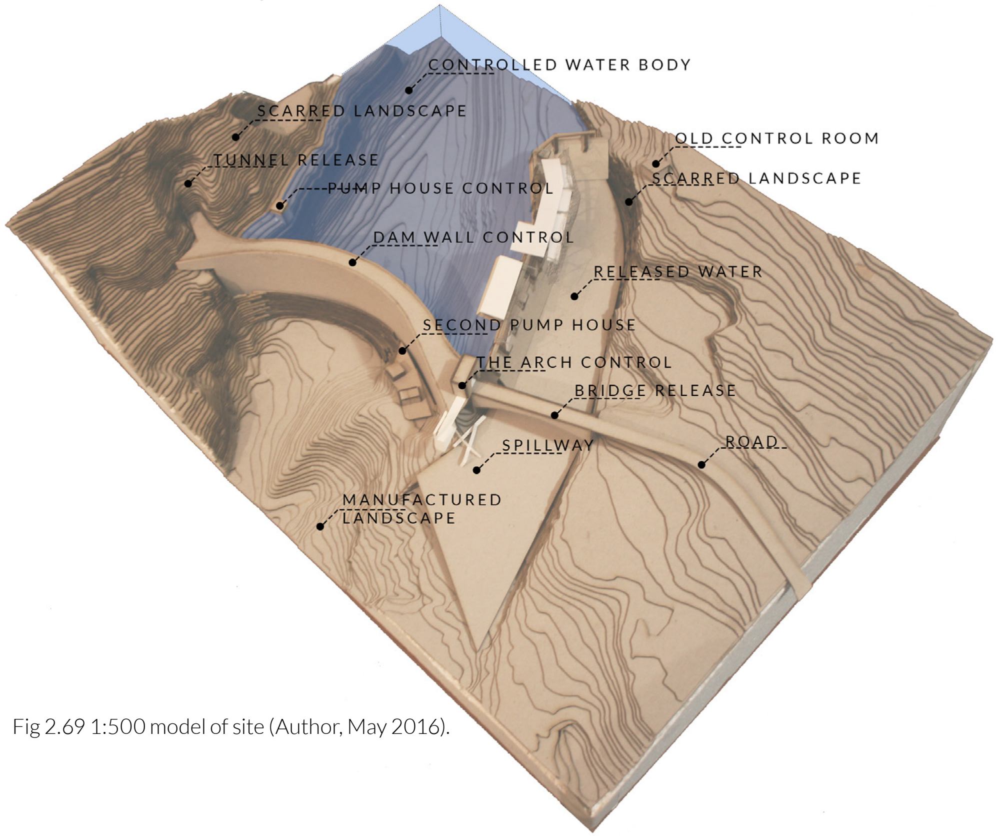
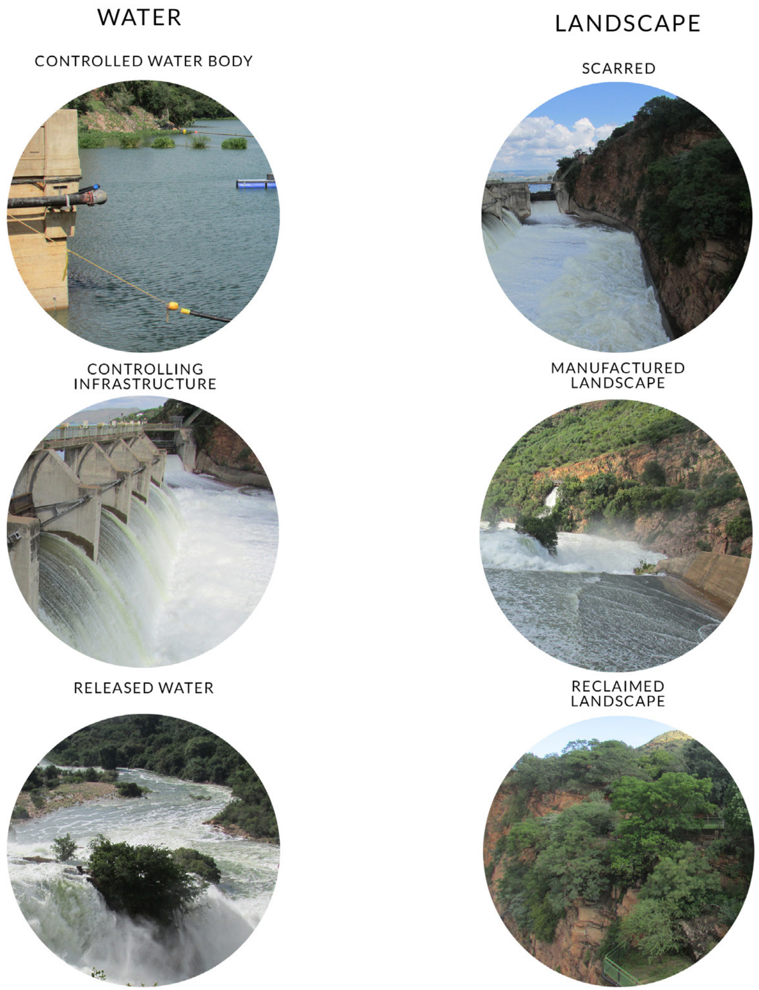


Fig 2.69 1:500 model of site (Author, May 2016).



The creation of the dam has changed certain characteristics of elements on site. This diagram shows that there are some elements that embody control and certain that embody release, such as the water infrastructure of the crest gate has both controlling and releasing elements. Even though it is controlled off site, there is still the old pump control centre, which is a palimpsest of control.

To create the dam, the landscape had to be adapted. The scar is still visible today but it is interesting to note in some places the natural vegetation is reclaiming the scar. There is also a duality between the natural bedrock and the concrete spillway which causes the water to change dramatically at this point.

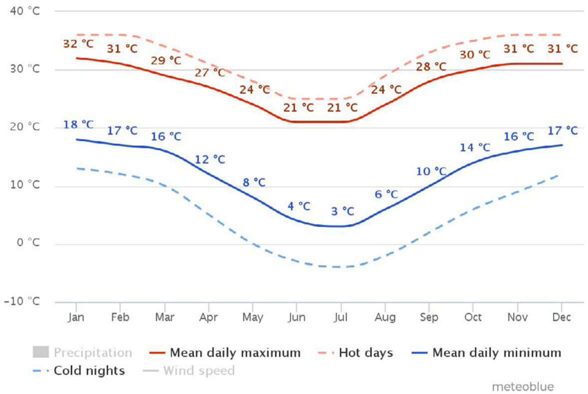
Fig 2.68 observations of water and land scape (Author, June 2016).

Climate Analysis

Hartbeespoort has almost year-round sunshine. Summer temperatures range, on average, between 18° C and 32° C, with afternoon thunderstorms from August to March. During the winter the nights are cold although the temperature may drop to below freezing. The average daytime temperature from May to July is 19° C. (show me Hartbeespoort, 2009)

The climate of the area is generally moderate, with hot summers and mild winters typical of the Highveld weather conditions. Summer rain varies between 600mm and 650rnm per year, whilst average temperatures vary between 3°C and 34°C. Frost occurs during winter in the period between 15 May and 15 August, and on average hail occurs on about 1 day a year (Seaton et al. 2003:18).

The prevailing wind direction in the months between September and March is North (NNW) to East (ENE), while in the winter months it blows much slower from an east-south-easterly direction predominantly. The average wind speed is 8 km/h with a very rear maximum of 28 km/h just +-70 hours of the year.

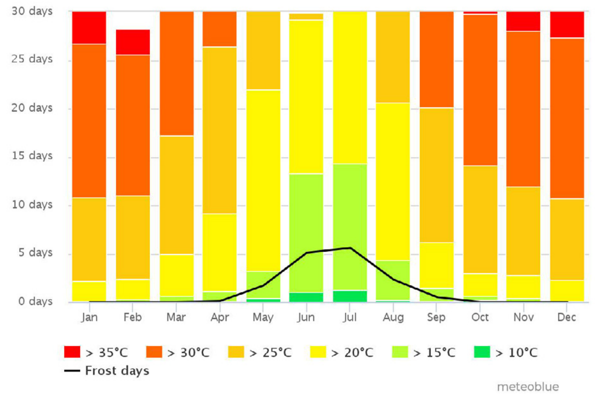


"The mean daily maximum (solid red line) shows the maximum temperature of an average day for every month for Hartbeespoort Dam. Likewise, mean daily minimum (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average of the hottest day and coldest night of each month of the last 30 years" (meteoblue, 2016).

Average temperature in summer is from 18 °C to 32 °C with minimum and maximum of 13 °C and 36 °C

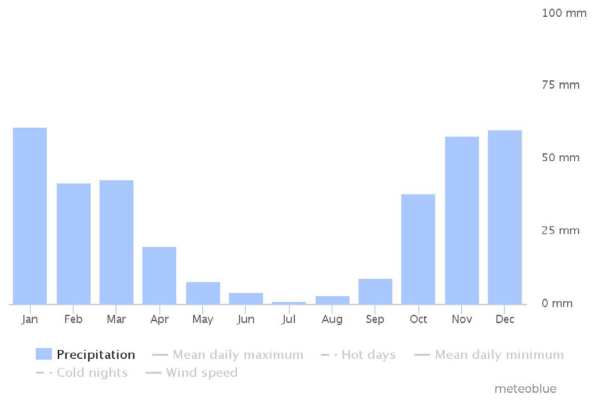
Average temperature in winter is from 3 °C to 21 °C with minimum and maximum of -4 °C and 25 °C

Fig 2.70 Average temp graph for Hartbeespoort dam (Meteoblue, 2016).



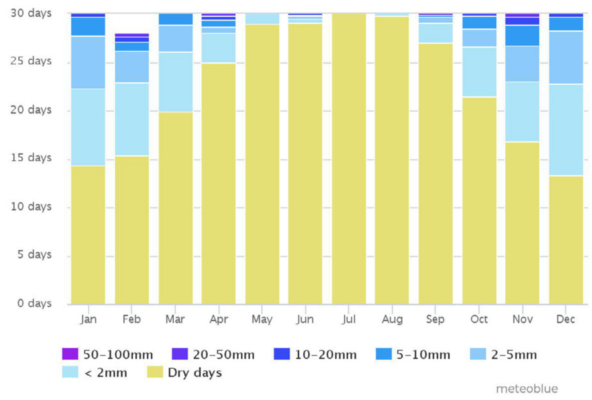
The maximum temperature diagram for Hartbeespoort dam displays how many days per month reach certain temperatures (meteoblue, 2016).

Fig 2.71 range of temp graph for Hartbeespoort dam (Meteoblue, 2016).



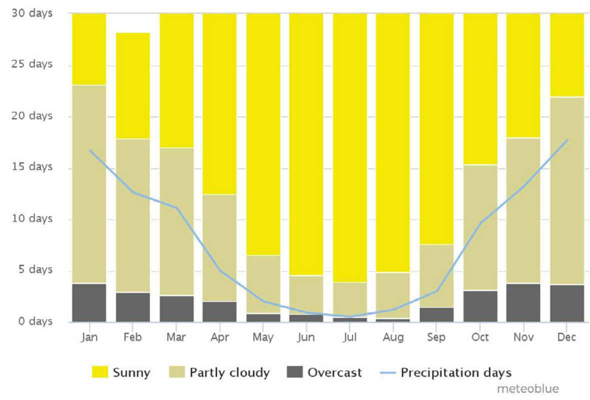
This graph shows the annual precipitation across each month. Hartbeespoort Dam has summer rainfall averaging 60mm in November, December and January. In winter months it drops to less than 10mm. (meteoblue, 2016)

Fig 2.72 Precipition graph for Hartbeespoort dam (Meteoblue, 2016).



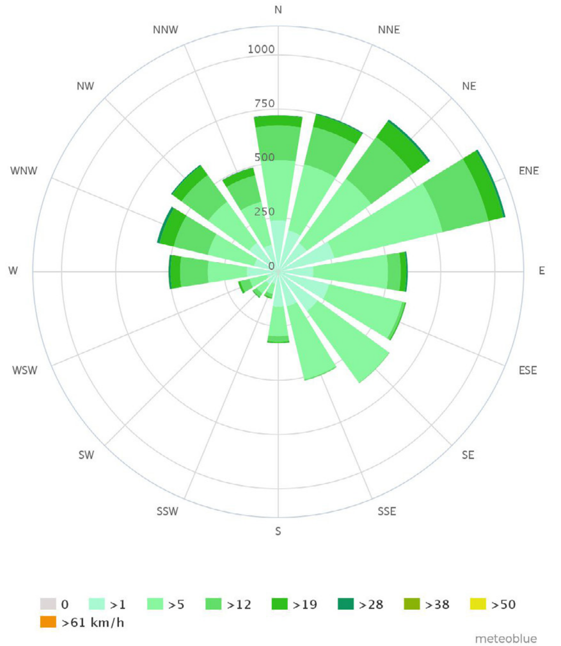
The precipitation diagram for Hartbeespoort dam shows on how many days per month it receives precipitation. Hartbeespoort Dam gets quick thunderstorms that last one or two hours and then it clears up. (meteoblue, 2016)

Fig 2.73 range of amounts of precipition graph for Hartbeespoort dam (Meteoblue, 2016).

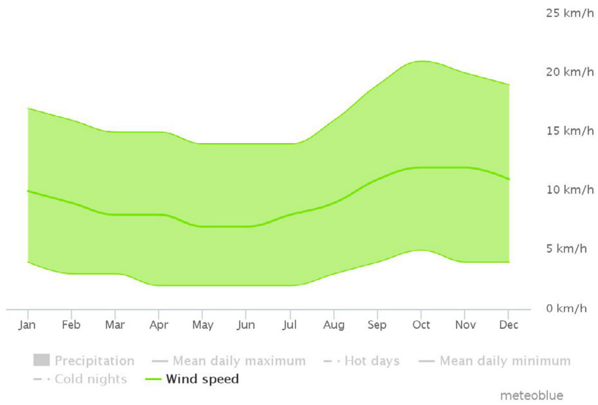


The graph shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast. As can be seen from the graph, there is a large amount of solar hours in the year, with short periods of overcast times in the evening. (meteoblue, 2016)

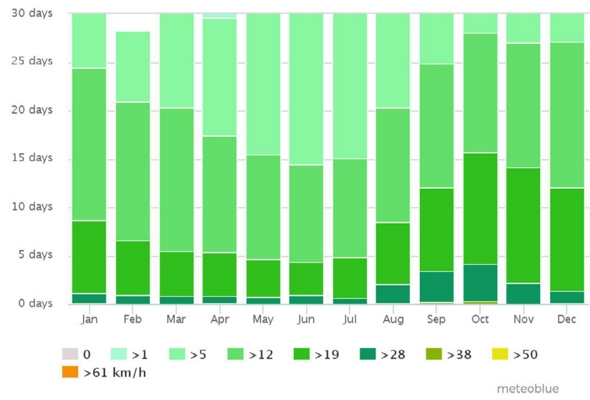
Fig 2.74 graph show cloud coverage for Hartbeespoort dam (Meteoblue, 2016).



The wind rose for Hartbeespoort dam shows how many hours per year the wind blows from the indicated direction. As seen the predominant wind is from the North (NNW) to East (ENE).



This graph show the average wind speeds as the solid green line, averaging around 8 km/h, with the light green strip as the range of wind speed.



The diagram for Hartbeespoort dam shows how many days within one month can be expected to reach certain wind speeds. Stronger winds in the summer months and weaker in the winter months with an average wind speed is 8 km/h with a very rare maximum of 28 km/h. (meteoblue, 2016)

Fig 2.75 Wind rose for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.76 average wind speed for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.77 graph show range of wind speeds for Hartbeespoort dam (Meteoblue, 2016).

Climate Understanding

Through this climatic analysis it is clear that the building will have to be protected during the overheated period. The winter months fall within the comfortable zone of the building and it does not need much additional heating. That being said, overhangs will need to be designed correctly to allow sunlight in the winter for the space to heat up sufficiently but stop direct sunlight in the summer to keep the space cool. To deal with the overheated period the best option is to give the building thermal mass and to have night ventilation. This may not be possible due to the difficulties of construction on the crest gate walls and so other methods may need to be investigated. Due to the linear nature of the building the façades of this building becomes extremely important in blocking out sun due to overheating. Using lighter colours on the façade and shading it with shading devices also need to be investigated.

Rain water collection would clearly be an issue in the winter months as there is very little rain. But the building is located directly on top of the dam and this water will have to be utilised during these winter months and maybe in the summer months too. this water would need to be sent through a filtration system as potable water is required. The water level in the dam only reduces by 0.8 m in winter and therefore is a reliable source (Hartie, 2016).

On dry land in Gauteng, humidity levels become very low during the winter months. This would not be a large problem as the site is directly over the water. Humidity levels staying reasonably constant all year round.

The dam experiences very little wind and therefore the outdoor space will not need to be protected.

The micro climate at Hartbeespoort Dam wall is mainly influenced by the water in the dam. This is due to the fact that water has a higher heat capacity (thermal conductivity) than land. This means that it fluctuates less and slower than land. For example at night the water body will remain warmer than the air temperature. This water body would give off heat to the air and then would heat up the space directly above it which is where the building is situated.

Likewise during the winter months the large body of water would retain the heat from the summer months and would take longer to become colder in the winter months. The sunlight is also able to penetrate deep into the water, therefore heating up more water.

There are prevailing winds from the NNW to ENE direction during the summer months. This air will be channelled through the port of the mountains and as this draws air over the water body, it will create evaporative cooling. This will greatly reduce the local temperature during the summer months. This means air needs to be drawn into the space from the North to East direction to make the most of this cool breeze during the overheated period.

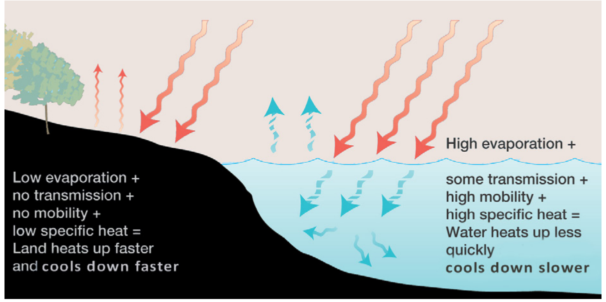
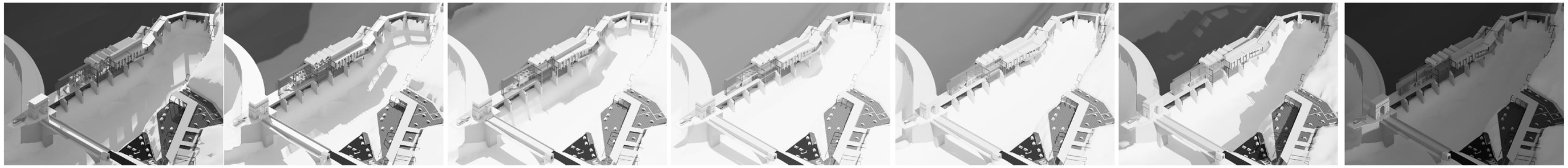


Fig 2.78 Water vs land heating (Wikipedia, 2016)

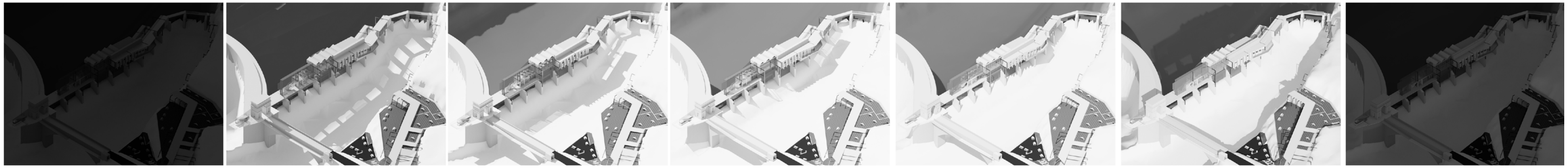
SOLAR STUDY

Summer Solstice
21 Dec



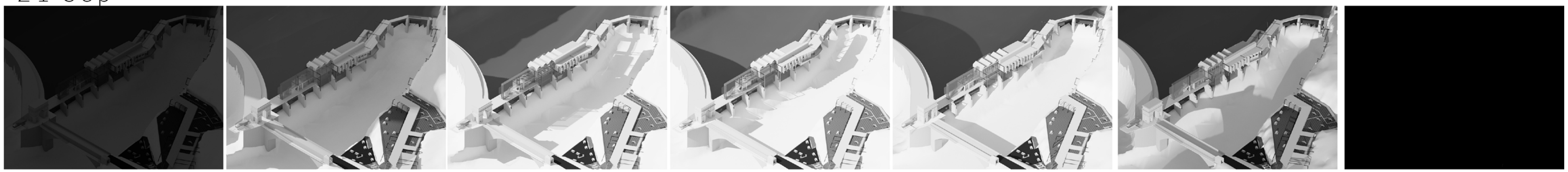
6:30 8:30 10:30 12:30 14:30 16:30 18:3(

Winter Solstice
21 Jun



6:30 8:30 10:30 12:30 14:30 16:30 18:3(

Equinox
21 Sep



6:30 8:30 10:30 12:30 14:30 16:30 18:3(

The site's micro climate has some noticeable characteristics. With regards to direct sun light, the site is located directly in the middle of the "poort" of the Magaliesburg mountain range that runs in west east direction. This will change the time of sun rise and sunset, decreasing the amount of solar hours on the west and east façade. This will be mostly felt in winter due to the position of sun rise and the sun's height above the horizon. The implications of this for the project are that any habitable development will need to fully utilise and maximise exposure to available sunlight during the winter period. Public spaces will need to allow for large amounts of direct sunlight to heat habitable areas. This means solar screens need to be designed with care.

Fig 2.79 solar study for Hartbeespoort dam (Author, 2016).

2.8 Site Precedent

Project title: Borderline mediated landscape

Designer: Jurie Swart (University of the Free State)

Location: Fika Patso Dam, Eastern Free State, South Africa

Year: 2011

Swart (2016) stated in his portfolio that "this dissertation explores whether nature and architecture can amalgamate to become a hybrid solution in a vast landscape which has lost its reference to time and space. The transformation of space and time through architecture results in a progressive fusion giving meaning to a certain non-place lacking character and special qualities and resulting in an awakened space.

Architecture should become a space within which nature can grow and become part of the symbiosis called life. When the colliding systems are fused, a coherent typology emerges; juxtaposing the forgotten space and creating a tabula rasa where the non-place can be reactivated resulting in a spatial awakening".

The program of this dissertation is a water research centre for the University of the Free State. It uses biomimicry as a theoretical point and how the skin of a building can be related to the skin of plant or animal. They are able to regulate temperature, generate energy and adapt to change. He states that there are ways of applying these clues from nature to architecture that would ultimately result in the creation of a hybrid building; a building that is resilient and can adapt to its surroundings (Swart, J. 2016).

Swart's project works within a very similar kind of landscape as this dissertation and was therefore looked at as a precedent. This dissertation will look at how to align human activities with natural processes in order to continue the function and evolution of ecosystems.

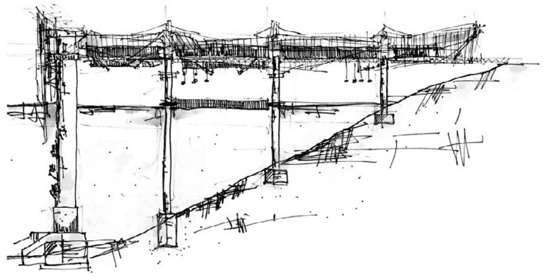


Fig 2.80 Resilient diagram (Metropolismag, 2016).

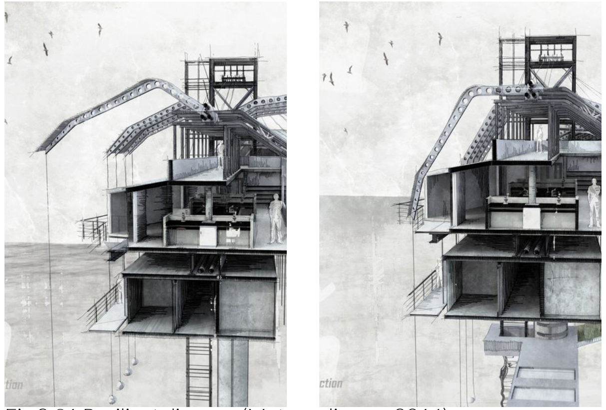


Fig 2.81 Resilient diagram (Metropolismag, 2016).

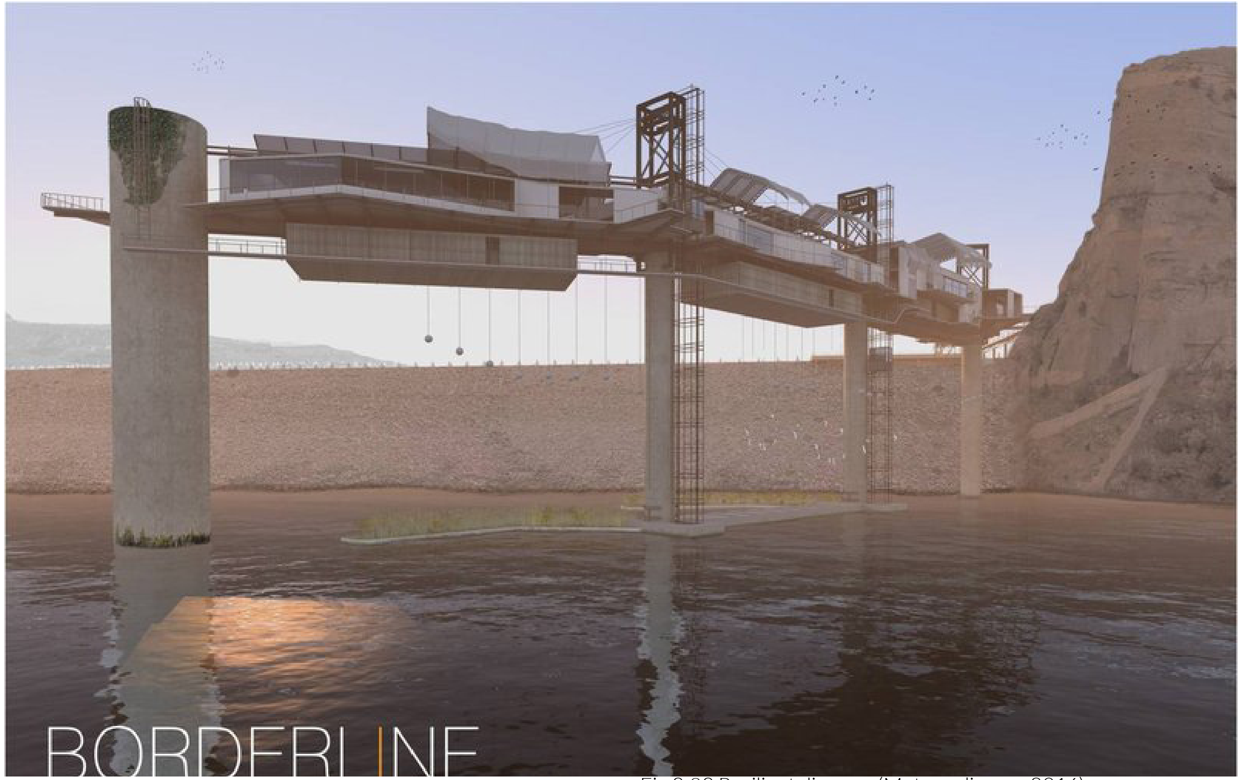


Fig 2.82 Resilient diagram (Metropolismag, 2016).