

REGENERATIVE BIOHISTORIC WATERSCAPES

ANDREAS G. MAVRAKIS 2016

Λήθη Lethe

(n.) a river in the Greek underworld that, when drunk from, made souls forget the sufferings of life; oblivion or something to make you enter oblivion and forget.

Στην οικογένεια και τους φίλους μου, εκφράσω τη βαθύτατη ευγνωμοσύνη μου και σας ευχαριστώ για την υπομονή σας, τη σοφία και την καλοσύνη. Σας ευχαριστώ για όλες τις συνομιλίες του καφέ.

Stin oikogeneia kai tous filous mou, écho ekfrásei ti vathýtati evgnomosýni mou kai sas efcharistó gia tin ypomoní sas, ti sofía kai tin kalosýni. Sas efcharistó gia óles tis synomilíes tou kafé.

To my family and friends, I express my utmost gratitude and thank you for your patience, wisdom and kindness. Thank you for all the coffee conversations.



REGENERATIVE BIOHISTORIC WATERSCAPES

by

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Submitted in partial fulfilment of the requirements for the degree

Magister in Architecture (Professional)

in the

Department of Architecture

at the

University of Pretoria

**Faculty of Engineering, Built Environment, and Information
Technology**

Course Co-ordinator: Dr Arthur Barker

Study Leader: Dr Edna Peres

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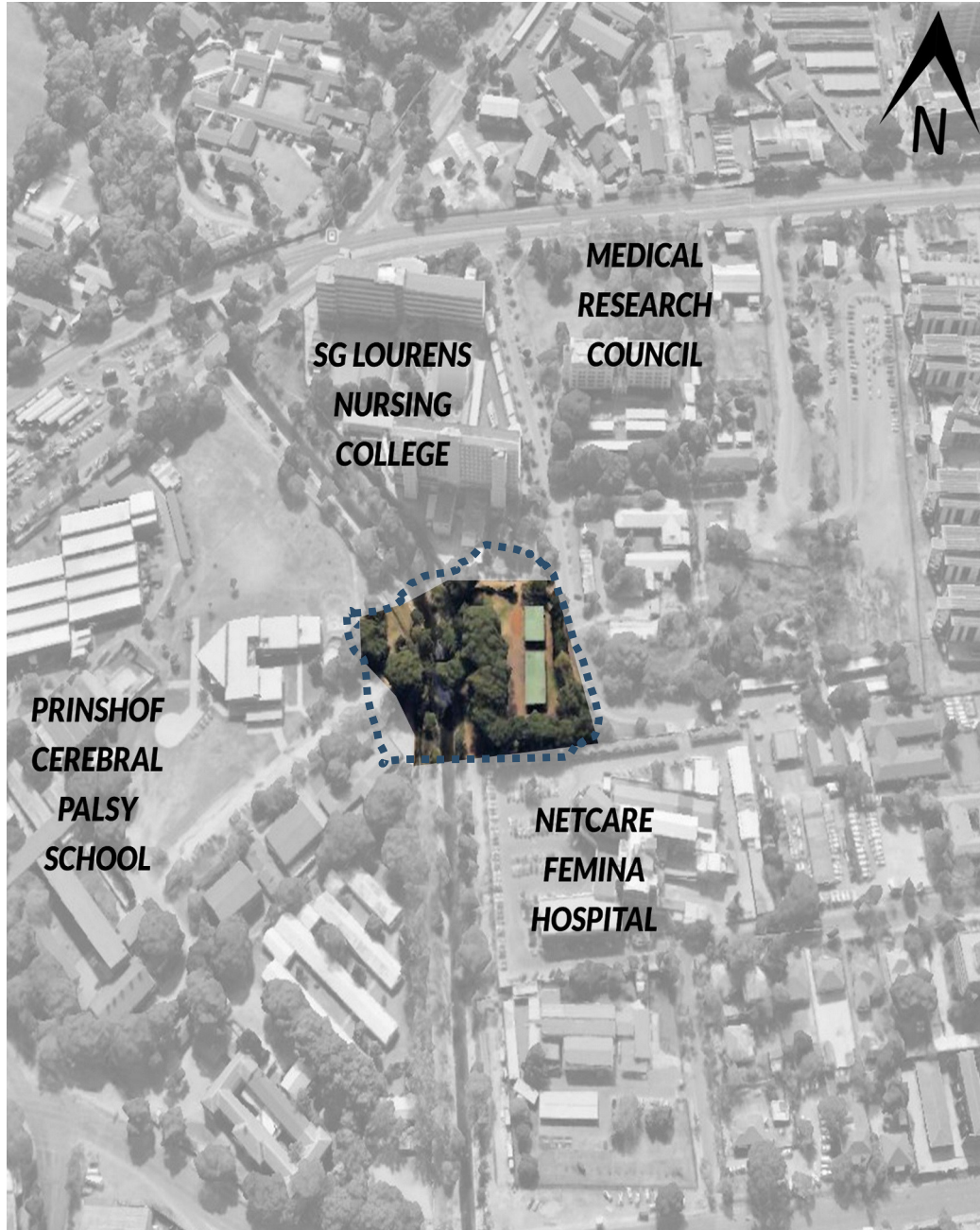
DECLARATION

In accordance with Regulation 4[e] of the General Regulations [G.57] for dissertations and theses, I declare that this thesis, which is hereby submitted for the degree Master of Architecture [Professional] at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution. I further state that no part of my thesis has already been, or is currently being, submitted for any such degree, diploma or any other qualification. I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

DISSERTATION TITLE:

REGENERATIVE BIOHISTORIC WATERSCAPES

PROJECT INFORMATION



Project Information: Site Location. Adapted image from googleearth.com, 2016.

Programme: Hydrotherapy Centre

Site Description: Prinshof, Pretoria, located between the SG Lourens Nursing College and Apies River.

Site Location: Prinshof 349-JR, Part of lot R14 and R22.

Address: Corner of Theodore Hove Street and Oumashoop Street, Prinshof, Pretoria

Co-ordinates: 25° 44' 20.371" S ; 28° 11' 57.047" E ;

Elevation: 1307m

Research Field: Environmental Potential

Client: Prinshof Medical District

Theoretical Premise: Regenerative water practice as an approach to making urban river space.

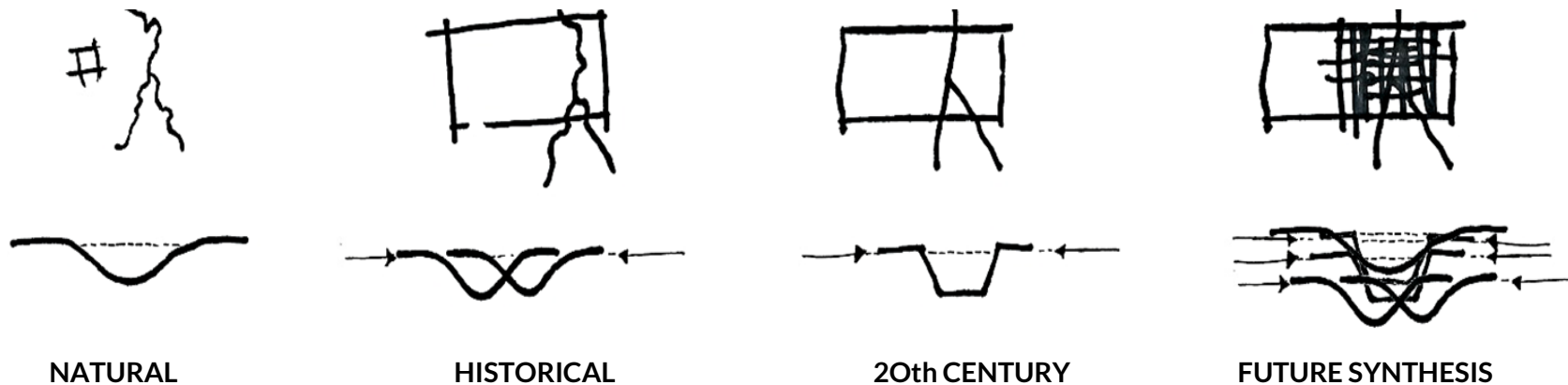
Architectural Approach: The exploration of a regenerative architectural intervention which promotes Pretoria's hydrological heritage and future potential of the Apies River.

ABSTRACT

The dissertation focuses on regenerating and adapting a part of the Prinshof Medical District. The site is identified as an abandoned, left-over space which is located adjacent to the Apies River in Pretoria's urban context. The site's forgotten natural and historical layers, formerly part of the historical Hove's Drift, and the chronological narrative of the Apies River, are investigated in this study. A regenerative water design method is used to catalyse these lost layers in the aim of cultivating a functional and poetic water-conscious design intervention.

The programme proposes the creation of a hydrotherapy centre for use by the surrounding institutions in the Prinshof Medical District as part of the continuing narrative for the site and that of the Apies River respectively. Regenerative Biohistoric Waterscapes is able to synthesise the river's natural, historical, and Modern infrastructure narratives and contribute an alternative meaning towards the eco-systemic understanding of the river's potential for Pretoria's future generations.

Keywords: Apies River, eco-systemic, functional, hydrotherapy centre, Pretoria, regenerative, urban, water infrastructure.



OPSOMMING

Hierdie verhandeling konsentreer op die hernuwing en aanpassing van 'n gedeelte van die Prinshof Mediese Distrik. Hierdie terrain is geïdentifiseer as verlate, 'n oorblewende spasie wat geleë is langs die Apies Rivier in Pretoria se stedelike konteks. Hierdie terrain se vergeete natuurlike en historiese agtergrond, voorheen gedeelte van die geskiedkundige Hove's Drif, en die kronologiese relaas van die Apies Rivier, word in die verhandeling ondersoek. n' Hernieuwe water ontwerpte metode gebruik om hierdie verlore agtergrond gedeeltes in te sluit met die doelwit om 'n funksionele en kunstige water bewuste ontwerp te winkel.

Hierdie program stel die skepping voor van 'n hidroterapeutiese sentrum vir die gebruik deur die omliggende inrigtings in die Prinshof Mediese Distrik as deel van die deurlopende relaas vir die terrain en die Apies Rivier onderskeidelik. Die Hiernieuwe Biohistoriese Waterterrein sal die rivier se natuurlike, historiese en moderne infrastruktuur saamvoeg en sal tot 'n alternatiewe betekenis bydra met betrekking tot n' eko-sistemiese begrip van die rivier se potensiaal vir Pretoria se toekomstige nageslagte.

SLEUTELWOORDE: Apies Rivier, eko-sistemiese, funksionele, hidroterapeutiese sentrum, Pretoria, hernieuwe, stedelike, water infrastruktuur.

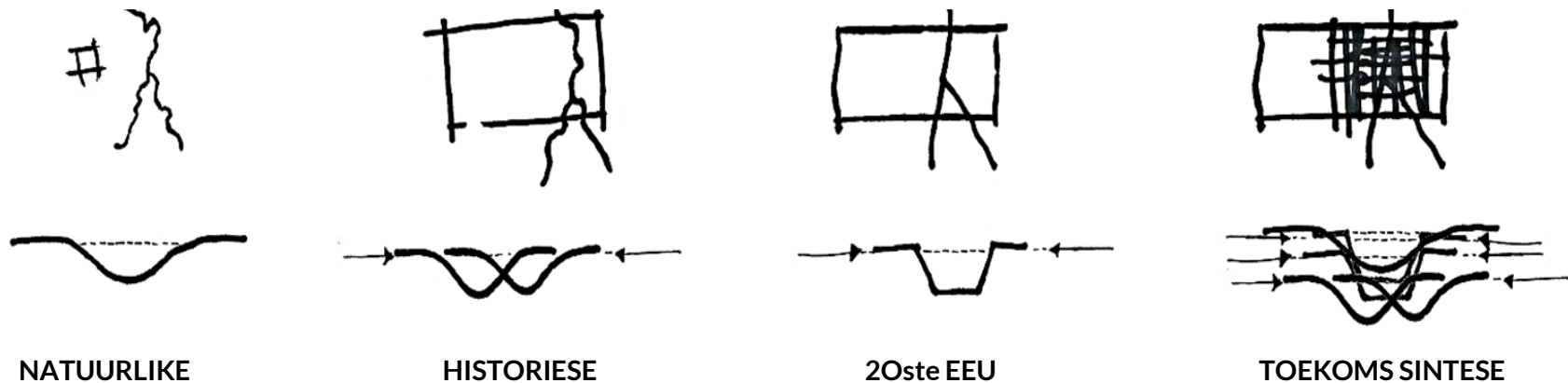


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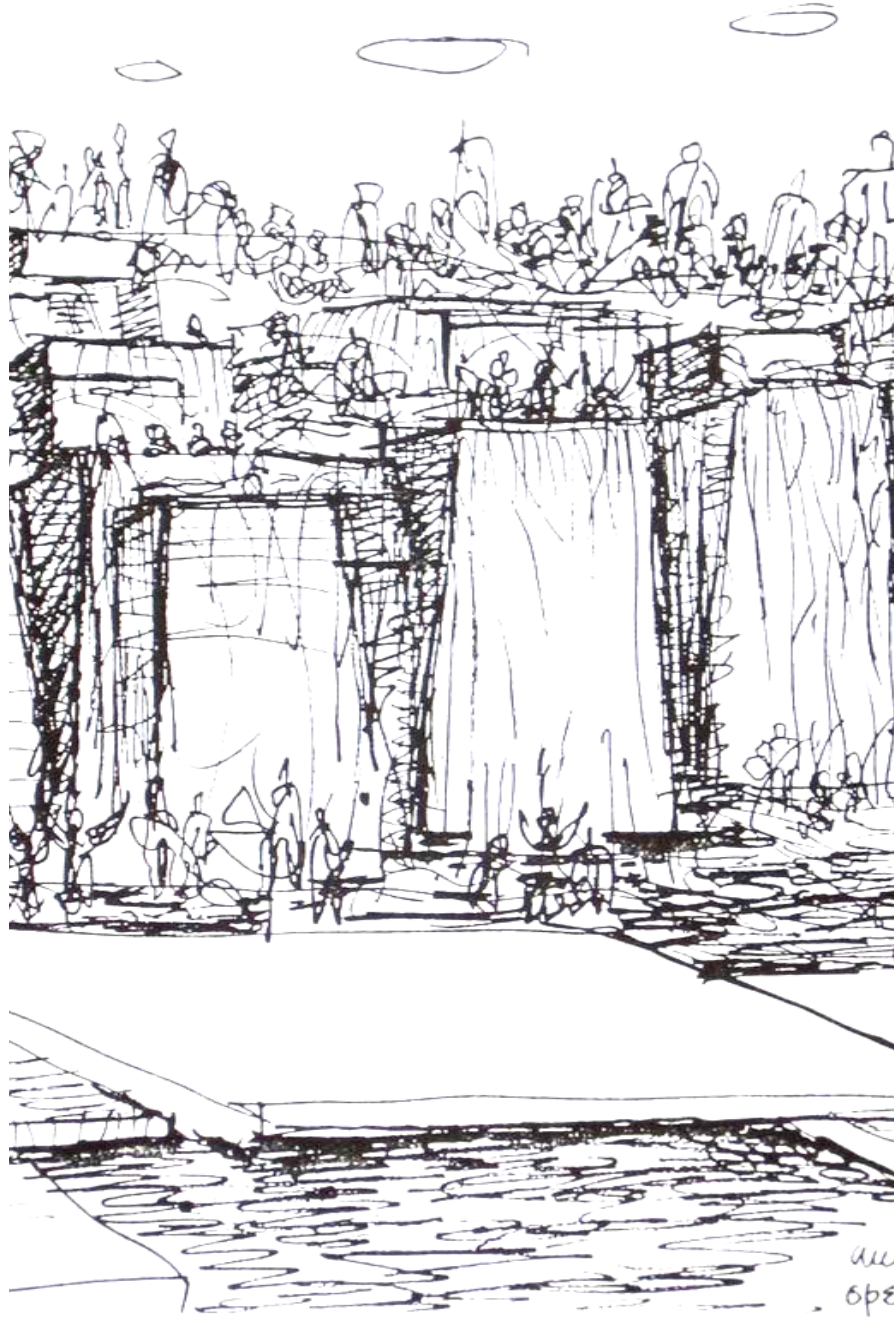


Figure 1.1. Keller Fountain Park in Portland by Charles Halprin. www.huffingtonpost.com. 2013.

AUTHOR'S MANIFESTO

Our awareness of the corporeal world is therapeutically reinforced and poeticised.

- Adapted from Juhani Pallasmaa's (Castle and Pallasmaa, 2016: 57) essay on Water, Time and Architecture.

Water as a visibly flowing and placidly revealing natural resource, tactfully narrates an individual's chronological progression in contrast to the backdrop of urban and rural landscapes. The ebb and flow of water encapsulates both the static and dynamic flow of time. The pensive skin of innocuous water conceals its bathos of an obscured cosmos. The dualistic nature of water flows in our contemplations through past, present and future. Its inherently natural and regenerative approach possesses the earthly icons of torrential activity, overwhelming submergence and scarcity. As humans, we are caught in the middle ground between the sky above us and the earth below us. We are entrapped between life and death, compassion and calamity. The traces of water semantically ignite design and create a vessel that retains spirituality, time and even sorrow. This is reflected in the water sentient spaces of Lawrence Halprin, Sigurd Lewerentz and Carlo Scarpa. Lewerentz's St Peter's Church in Sweden keeps the soaked lacerations in the brick floor fed with an agonising trickle of water derived from a suspended seashell above. Similarly, it is discovered in the silently submerged spaces of Scarpa's Brion-Vega Cemetery in Italy. Luis Barragan's hydrophilic buildings in Mexico are flowing, gushing and meditatively build up a heightened momentary experience. Frank Lloyd Wright's Fallingwater House in Pennsylvania interlaces a dense tactile and acoustic embeddedness in providing a naturally poetic experience.

Despite water being affected by pollution and scarcity, the objective of this dissertation is to balance the 21st century eco-systemic and functional needs of water with its poetic qualities in a contextually appropriate architectural expression adjacent to the Apies River.



Figure 1.2. Brion-Vega Cemetery in Italy by Carlos Scarpa. www.dome.mit.edu. 2008.

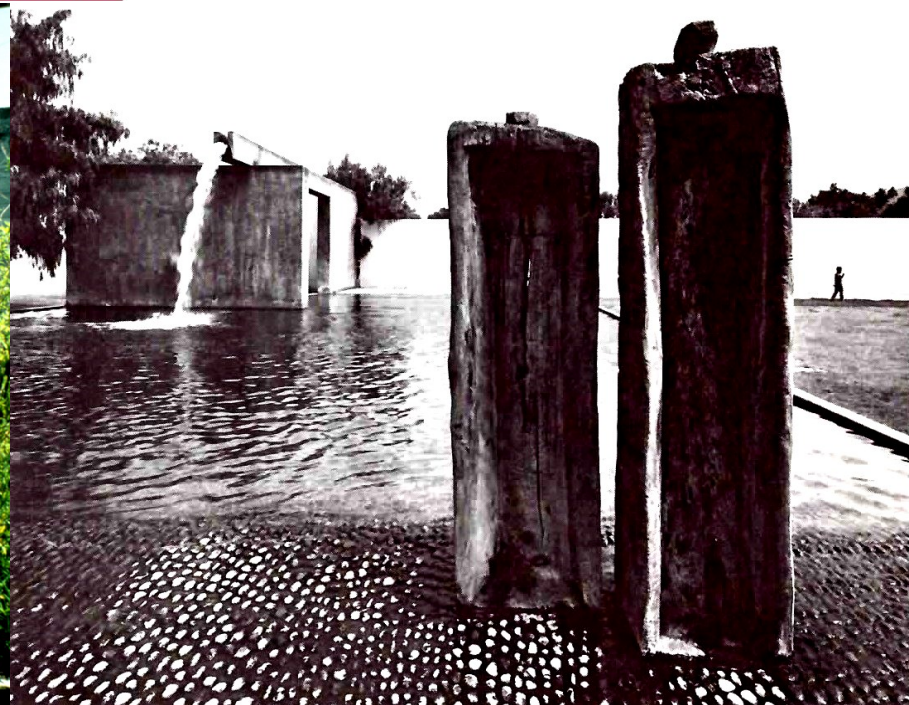


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Figure 1.5. Fallingwater House by Frank Lloyd Wright in Pennsylvania. www.amnesta.net. 1964.

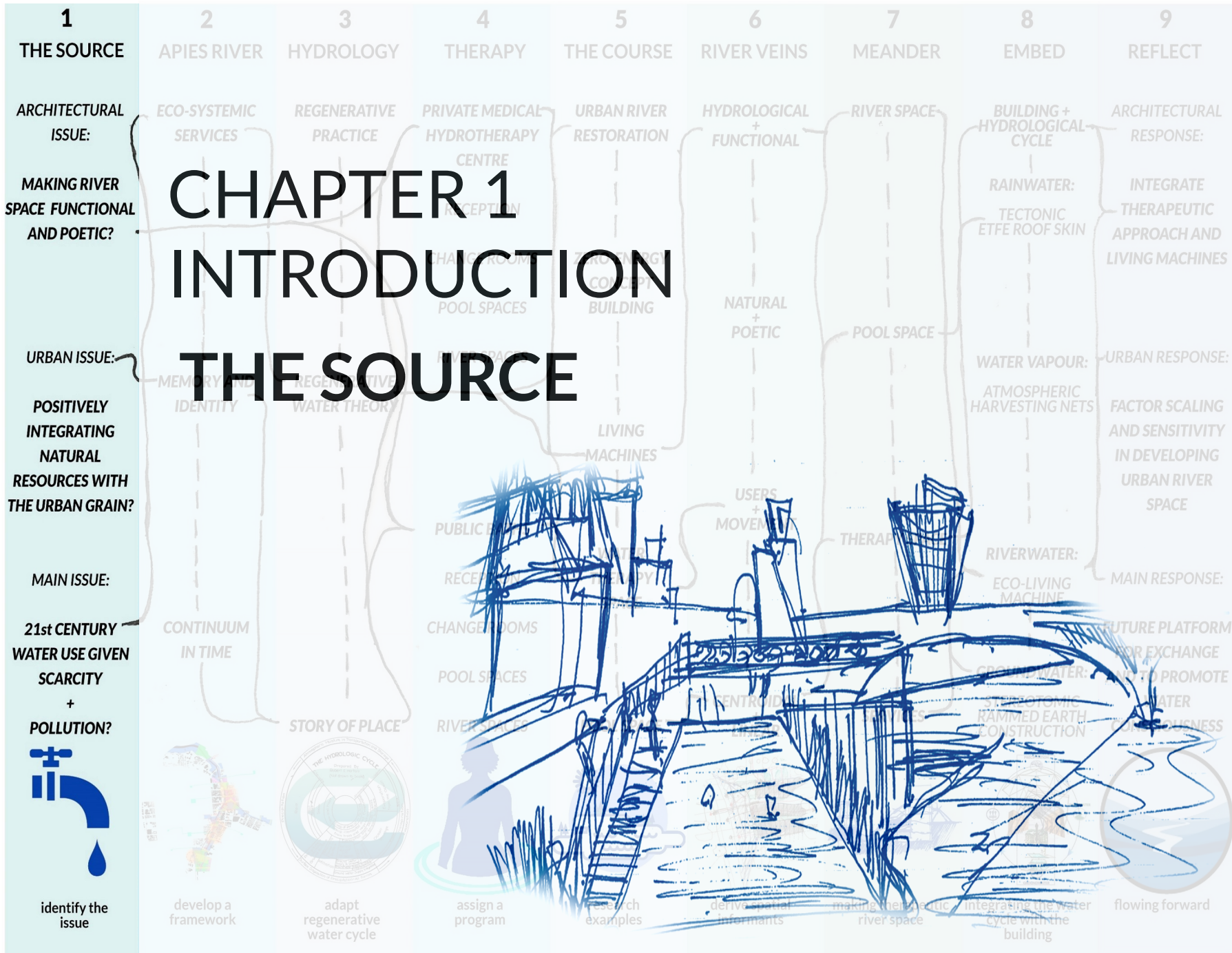


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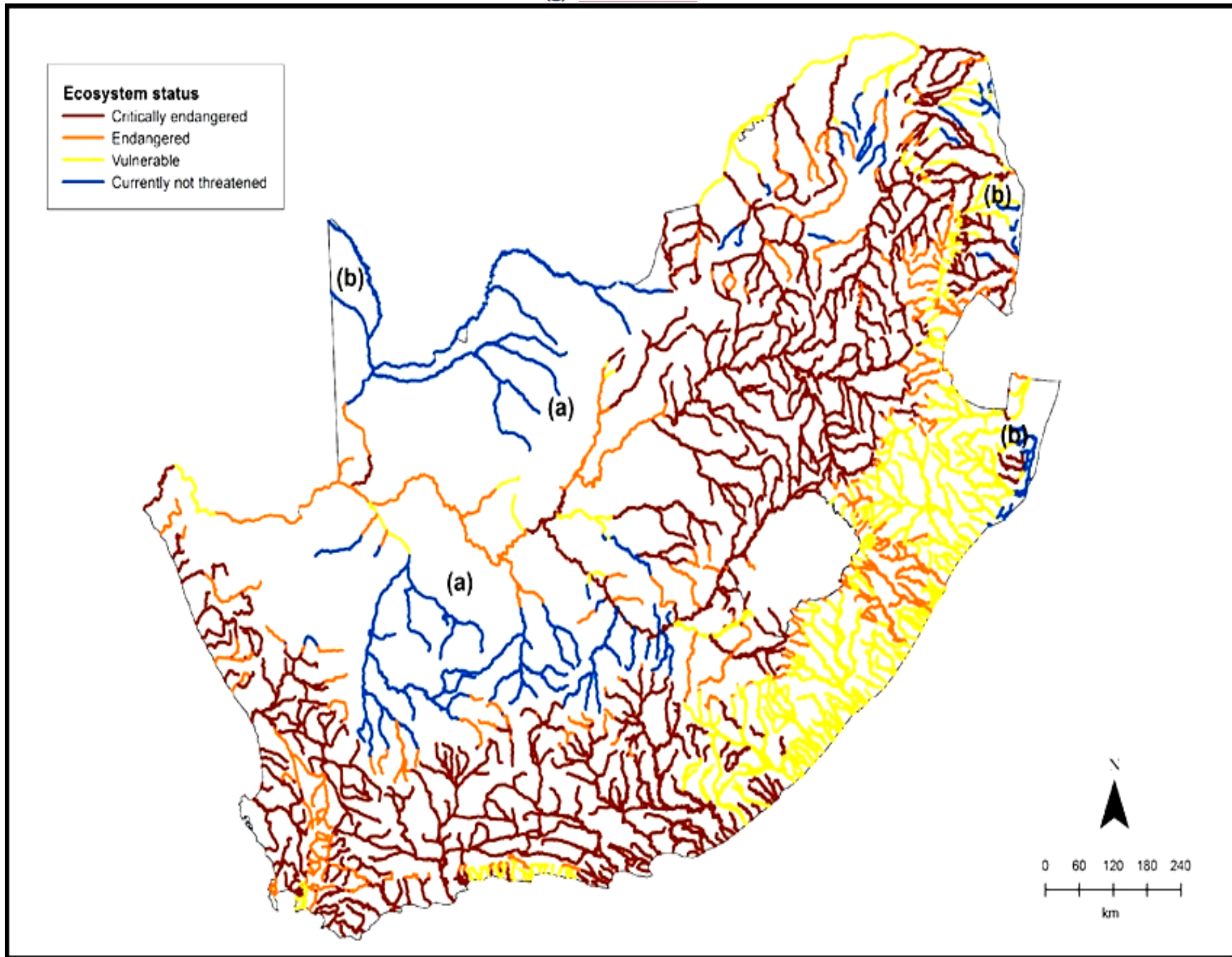


Figure 1.7. Ecosystem status of main rivers in South Africa, based on the extent of ecosystem still intact. p. 348, Nel and Roux et al., 2007.

1.1 PROBLEM STATEMENT

Urban rivers are civic, political, and dynamic natural resources which have been poorly integrated with public space, and they have thus been made disparately mono-functional. As natural entities, they are central in maintaining healthy ecosystems. In South Africa, most of the natural river ecosystems are threatened by urban pollution, as stated in the Annual National State of Water Resources report by the Department of Water Affairs (2012:43). The state of South Africa's rivers has destabilised eco-systemic services that are freely provided to our natural and human systems (see Figure 1.7).

The Council for Scientific and Industrial Research report titled *A CSIR Perspective on Water in South Africa* (CSIR, 2010: 62) argues that the implementation of advanced technologies to confront the water crisis is often unsuccessful, given the infrastructural challenges confronting South Africa require adequately integrated urban water management. Economically feasible solutions and adequate management or operations of any future or proposed infrastructures are significant additional factors to consider (CSIR, 2010: 62).

If South Africa's water demands increase based on current trajectories, technological infrastructures may become too costly to implement (CSIR 2010: 62) and will potentially

require alternative bio-technological innovations i.e. eco-living machines, phytoremediation or reverse-osmosis technologies as suggested by Ray Chittaranjan and Ravi Jain, (2014: 19).

A design solution is thus needed in order to balance a technological approach with the personal rituals and behavioural patterns involving water use in South Africa (CSIR 2010: 62). The importance of water relative to Pretoria's inhabitants is best shown in the Water Research Commission's (2015) video, "*Hydrological Heritage Overview: Pretoria's Fountains - Arteries of Life*".

This study architecturally explores the exchanges between natural and human systems, and provides ideas regarding functional water use. It attempts to promote a civic awareness of Pretoria's hydrological heritage with regard to its water infrastructure.

The architectural intervention attempts to unify human and natural systems in order to create a coherent and urban response to the problem. The intervention attempts to balance an architectural response with a regenerative water method that balances infrastructural, contextual, and user requirements involving water use.



Water in South Africa: Where does it leak?

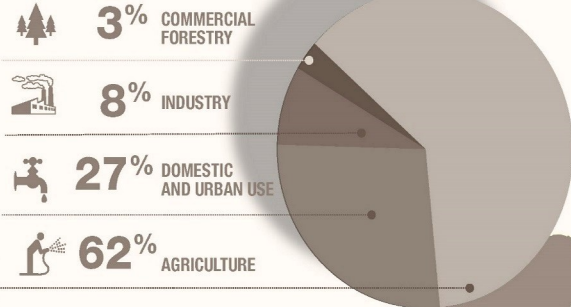
SOUTH AFRICA IS THE
30TH DRIEST
COUNTRY IN THE
WORLD

BUT IT
USES MORE

ON AVERAGE
235^L
WATER/DAY

COMPARE TO THE
REST OF THE
WORLD

173^L
WATER/DAY



4.3M
Swimming Pools

36.8%
OF WATER IS
WASTED

= 7.2M
Rands / Year

Unbilled Use

5%

IS TAKEN BY REGISTERED USERS

Direct Stealing

6.4%

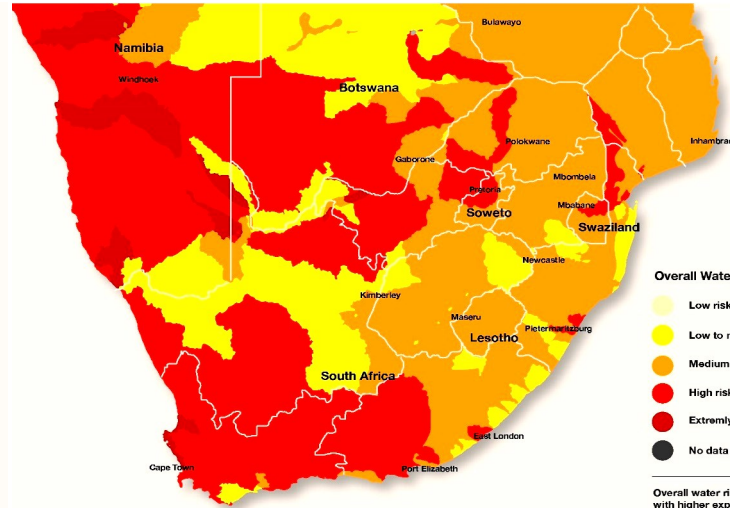
STOLEN BY UNAUTHORISED USERS

Indirect Stealing

25.4%

REAL LOSSES DUE TO INEFFICIENCIES

ADOPT WATER EFFICIENCY MEASURES NOW!



Overall water risk identifies areas with higher exposure to water-related risks and is an aggregated measure of all selected indicators from the Physical Quantity, Quality and Regulatory & Reputational Risk categories.

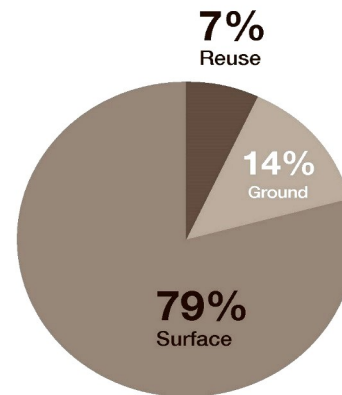


Figure 2: Current water supply: 14.6km³

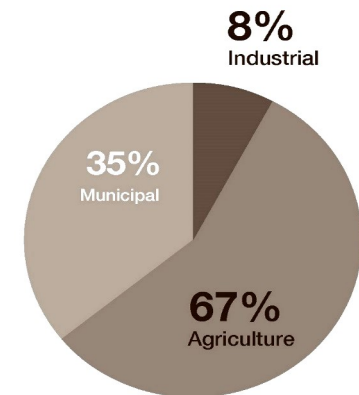


Figure 3: Current water demand: 15.6km³

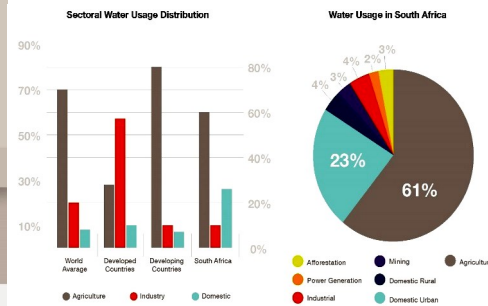


Figure 5: Sectoral use of water in South Africa, 2013

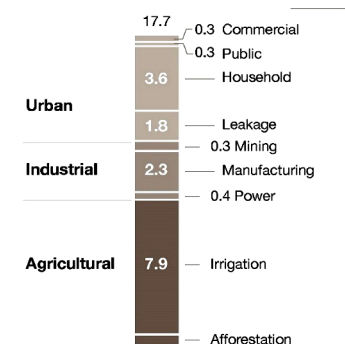


Figure 1.8. Issues regarding the Water Crisis in South Africa: Running on Empty Water Efficiency Report. p. 16-17, ActionAid South Africa. 2016.

1.2 BACKGROUND

According to the United Nations World Water Assessment Programme (WWAP) (2015:25), South Africa is considered an arid country and the 30th driest country in the globe (see Figure 1.8). Its water demand already exceeds natural water availability in many of South Africa's river catchment zones. Water pollution is a concern as urban pollution is considered in instances such as: industrial waste runoff, acid rock outflow from mining operations and chemical runoff from agricultural practices (WWAP) (2015:25).

According to a report by the United Nations Environment Programme Finance Initiative (UNEP FI, 2009:43) "South Africa's water governance is constitutionally enforced by the National Water Act of 1998" which emphasises social equity and environmental sustainability. The Department of Water Affairs recently classified the Apies River as a natural disaster zone due to an unresolved raw sewage spill at the Rooiwal water treatment plant in 2011 (Grobler, 2015). This incident has affected many farmers, including farmers in the area beyond the Bon Accord Dam, as well as the potable water quality of the water supplied to the inhabitants of Hammanskraal (Grobler, 2015).

In addition to the above mentioned issues regarding water pollution, Grant(2016:10) discusses modern urban water management responses (see Figure 1.10), particularly in the

1.3 CONTEXT

use of profiled concrete channels used for urban river management. This approach considers rivers to be natural, linear systems that swiftly conveys water out of cities. This global background provides a platform for an urban or architectural response regarding the behavioural use of water in the 21st century.

1.3.1 URBAN DESCRIPTION

As abovementioned, the Apies River was declared an urban pollution disaster zone by the National Department of Water Affairs in 2011. In addition, urban river channels could be considered as mono-functional, non-spaces acting as dividers in the urban grain, particularly between humans and the natural world. The urban vision proposes strategic intervention points which can regenerate the urban grain in certain areas adjacent to the Apies River (see Figure 1.8).

1.3.2 SITE DESCRIPTION

The former Hove's Drift (now Prinshof) is surrounded by separate and privately accessed medical, social, and administrative functions. The surrounding site shows remains of single-storey buildings. The site is overgrown with unmaintained vegetation. The channelised Apies River is potentially considered as a mono-functional non-space and its adjacent river space is publicly inaccessible.

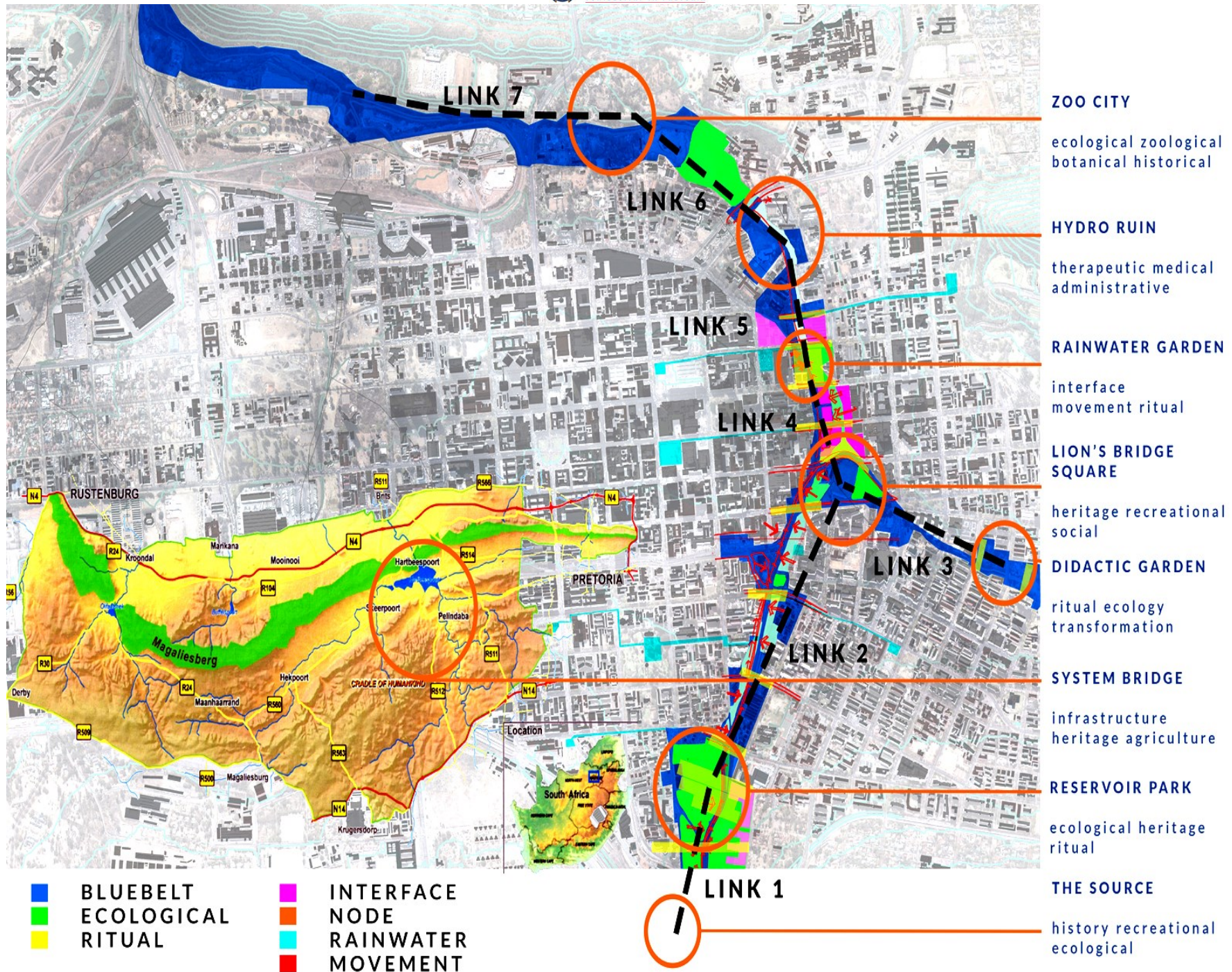


Figure 1.9. Water Framework Nodes. Erasmus, Kelly, Mavrakis, Nicolaides, Scholtz, and Taylor, 2016.

1.4 THEORETICAL APPROACH

The dissertation attempts to use regenerative design theory, which is considered a research and design method.

According to Mang and Reed (2012: 27), the theoretical stance used in design practice should integrate natural systems (i.e. the hydrological cycle) with place, along with its historical narratives. They are seen as working in a symbiotic manner. In order to create a site strategy for positive long-term regeneration, the project attempts to intertwine regenerative practice with place. The method is applied as a hydrotherapy centre. It intends to create an approach of connect the natural and man-made systems as mapped on site and respond to the needs of the surrounding institutions.

1.5 SPATIAL INFORMANTS

1.5.1 URBAN INFORMANTS

The site along the Apies River was identified as a strategic point for regenerating the city, with potential exploration towards the medical, administrative, and therapeutic functional uses (see Figure 1.9). This site could be considered a significant water distribution point and place for ritual exchange that can be potentially integrated with or alongside the river. It holds significant potential as a major densifying anchor point on the edge of the Pretoria Central Business District (CBD).

1.5.2 CONTEXTUAL INFORMANTS

The intervention could potentially appeal to the general public and to the surrounding Prinshof Medical District. It can become a main driving force involved in informing space-making and places of exchange (see Figure 1.10), which relates to civic water use.

1.5.3 CONCEPTUAL INFORMANTS

Places of exchange are viewed in terms of the hydrological cycle and human systems (see Figure 1.10). These places of exchange tangibly interact with each other. The proposal can be spatially interpreted as consisting of centroidal and linear spaces which facilitate users' activity and movement respectively. Places of exchange and the hydrological cycle as mapped in Chapter 2, provide an understanding of the unseen relationships between the existing built urban environment and water, and may identify potential development for an architectural intervention. This concept is further considered in Chapter 6 of the dissertation.

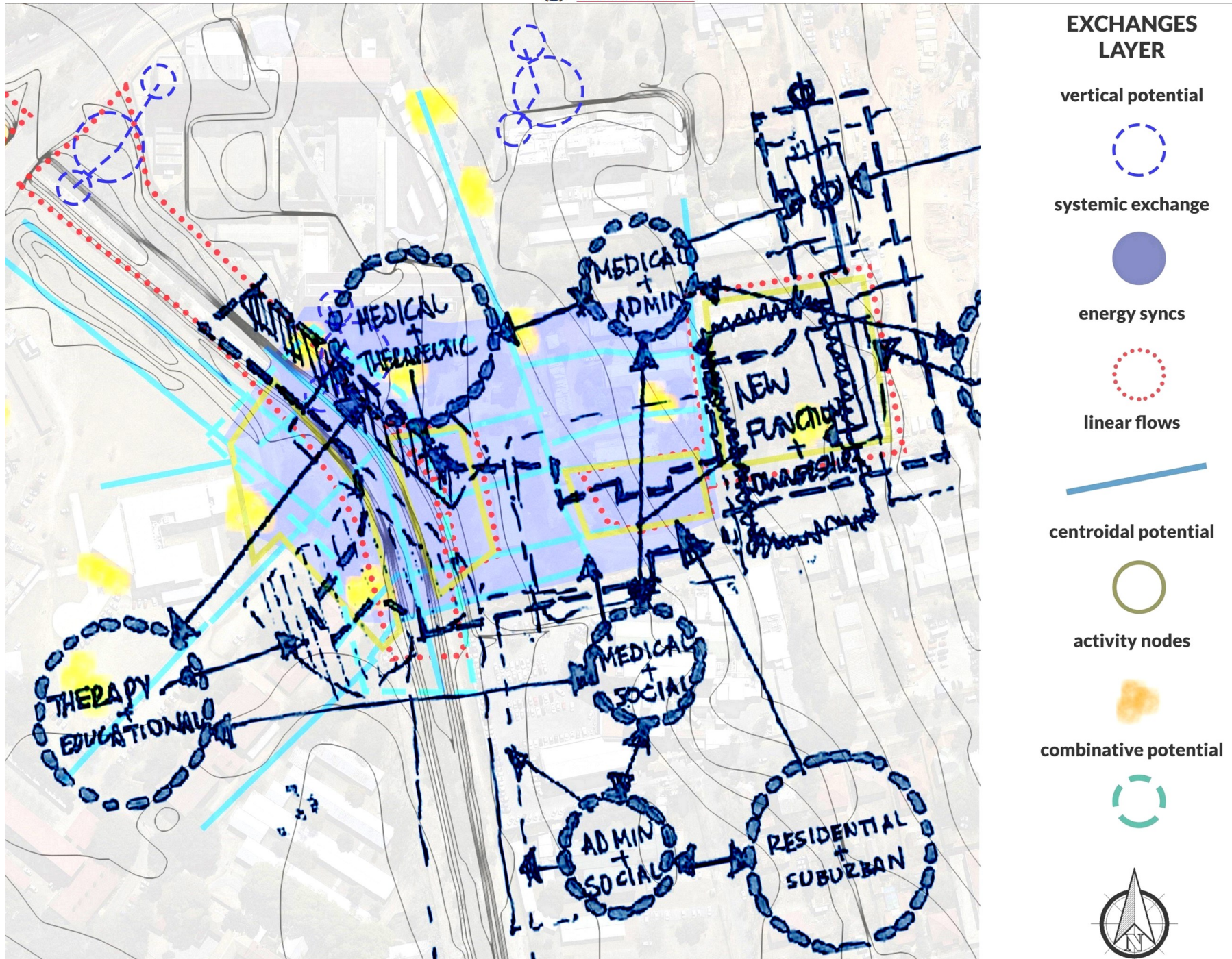


Figure 1.10. Overlaying the surrounding site programmes with potentials for exchange between natural and artificial elements as mapped on site. Author, 2016.

1.6 ISSUES

“We live in a world defined by 19th century water law, 20th century infrastructure, and 21st century water needs.” - Jennifer Pitt, (medium.com, 2015).

The issues discussed below are pertinent with regard to this statement. By making an architectural intervention that is eco-systemic, functional and poetic with regards to the use of water as a significant natural resource:

1.6.1 GENERAL ISSUE

How do designers facilitate 21st century water needs and how do we remain cognitive about its importance or relevance in a world where natural resources are becoming increasingly polluted and scarce?

1.6.2 URBAN ISSUE

How do we positively integrate a segregated and forgotten bio-historical resource in an urban environment?

1.7 ARCHITECTURAL QUESTION

1.6.3 ARCHITECTURAL ISSUE

The relationship between architecture and water has been severed, as argued by Moore and Keim (2004:20). This disconnect has absented architecture from actively participating in issues regarding current urban water management and daily social use (see Figure 1.11). Due to historical responses pertaining to water management (concrete lining and concealment) and its present divisive spatial nature, we have become uninformed about its spatial characteristics (see Figure 1.12), its daily impact on our lives, and its crucial importance, particularly in times of drought.

Contemporary global eco-systemic issues have provided architects the opportunity to define the future of our urban rivers, as argued by Grant (2016:87). Ultimately, such issues may re-define our urban grain's spatial composition and orientate it towards a socially embedded water infrastructure. A key concern arises – how should designers manage and develop sustainable future urban water projects that are both functional and experiential?

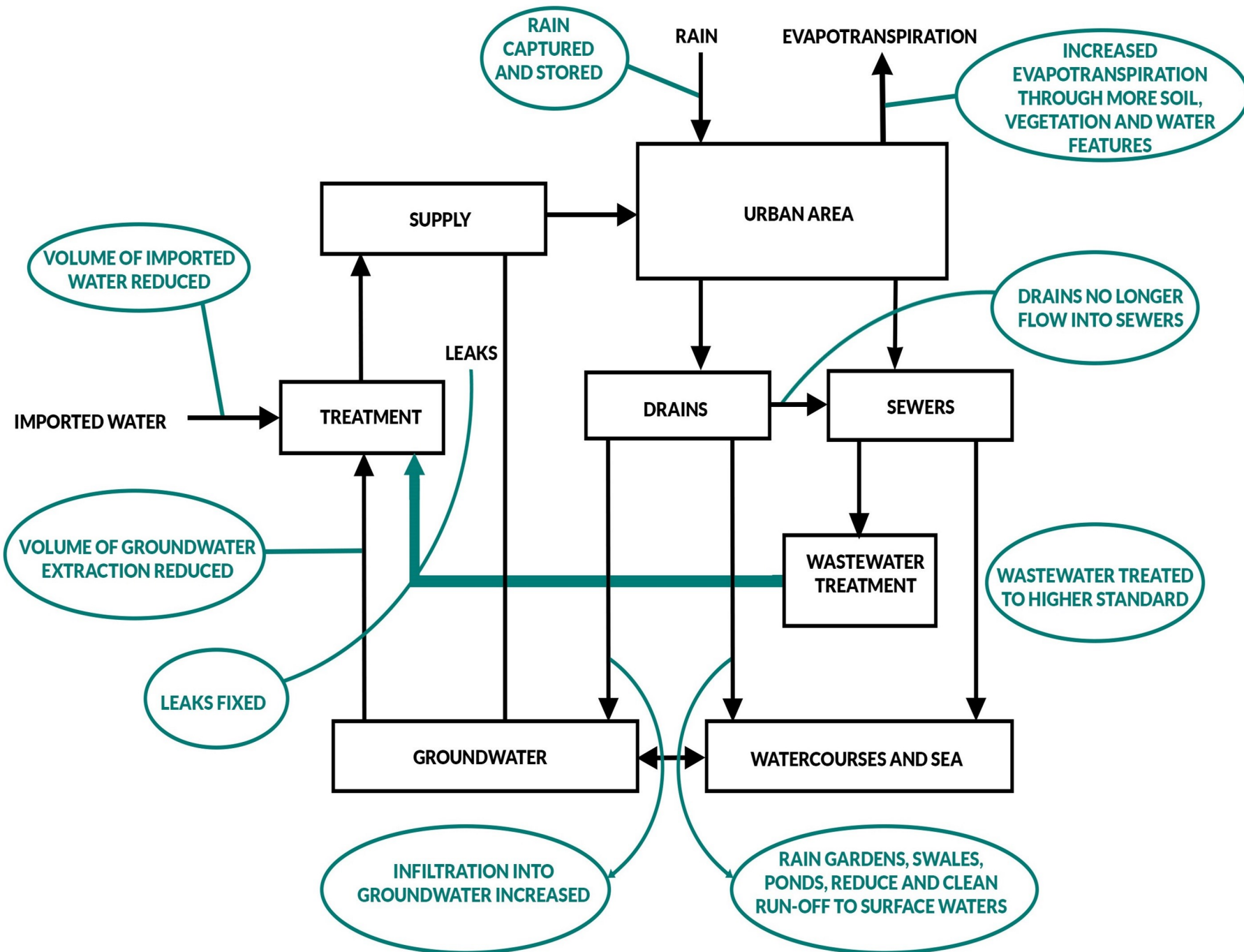


Figure 1.11. The sustainable urban water cycle, Grant (2016: 26).

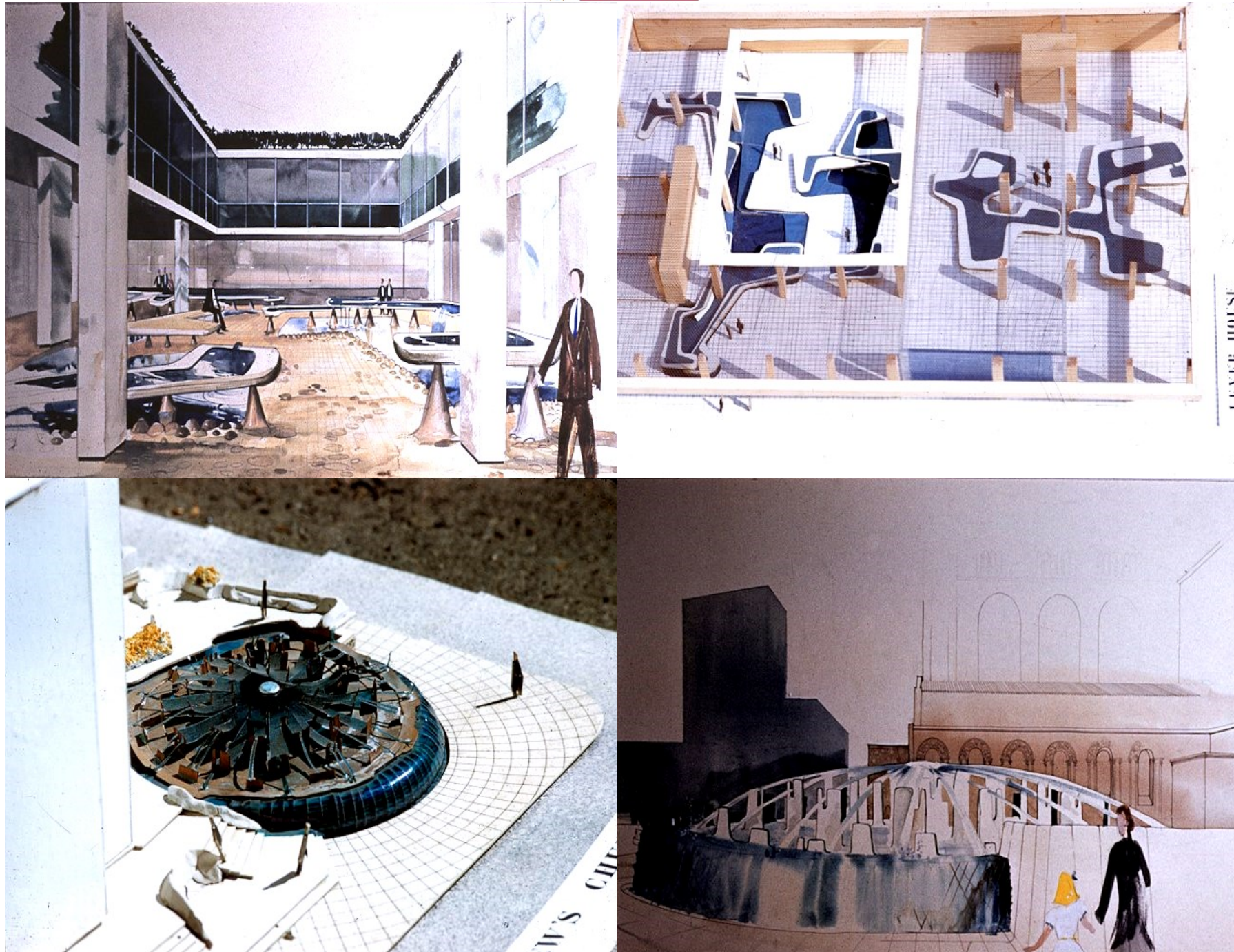
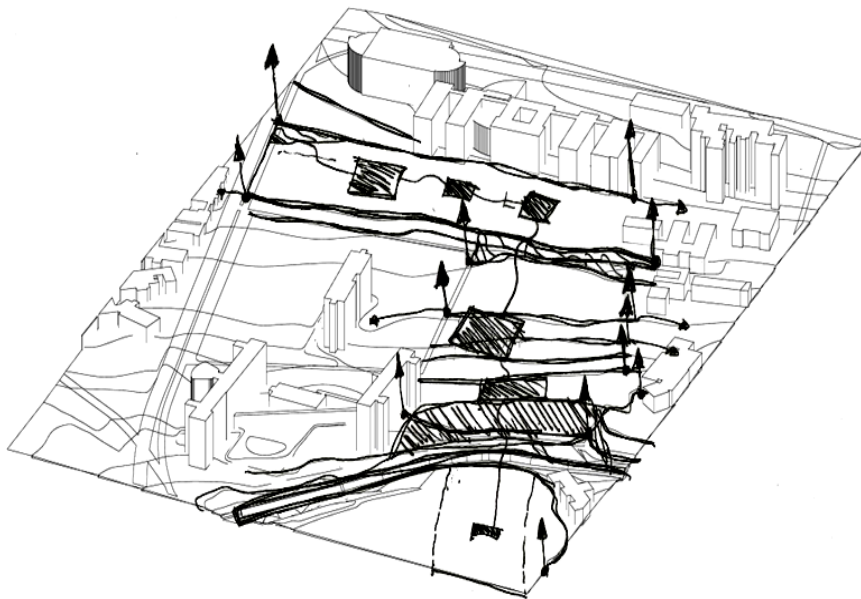
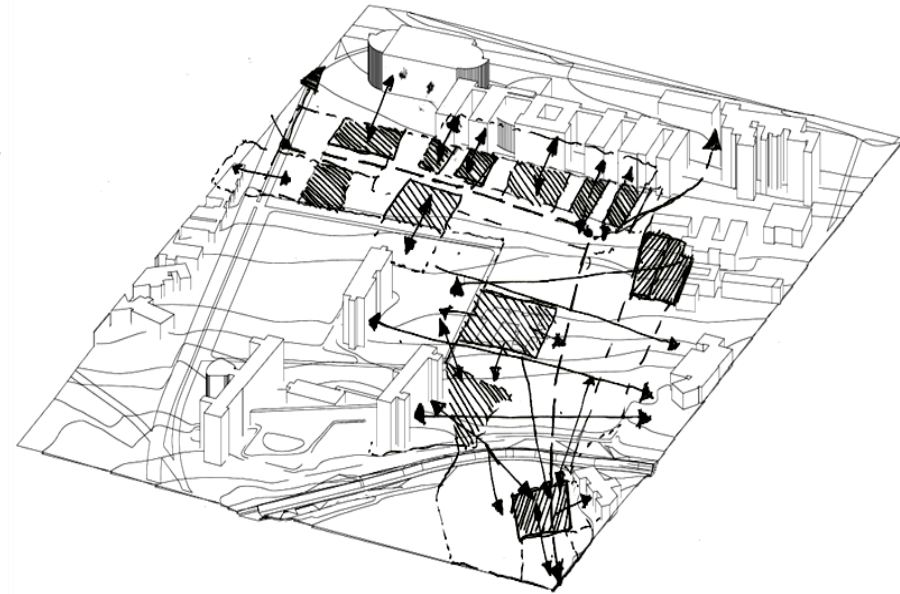


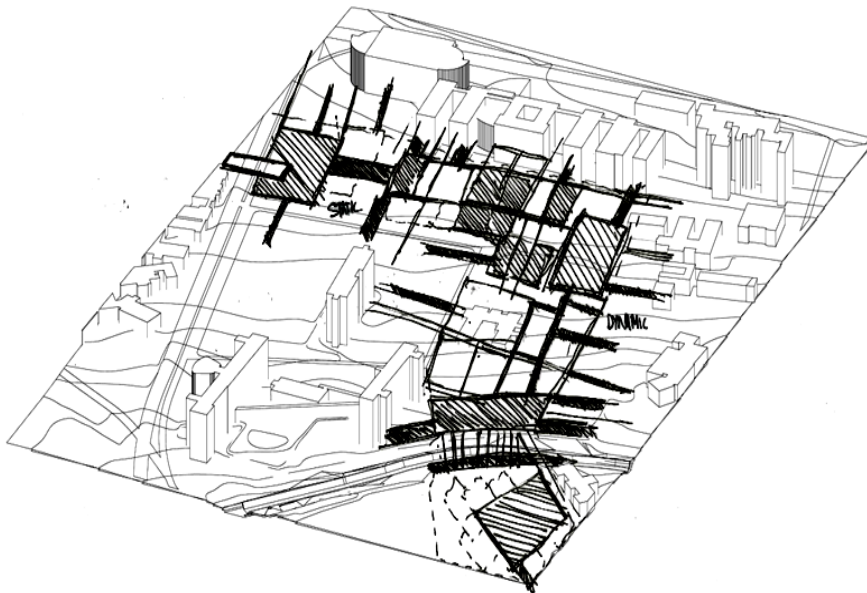
Figure 1.12. Conceptual maquettes from Charles Moore's Doctoral Dissertation on "Water and Architecture" in 1957. charlesmoore.org, 2016.



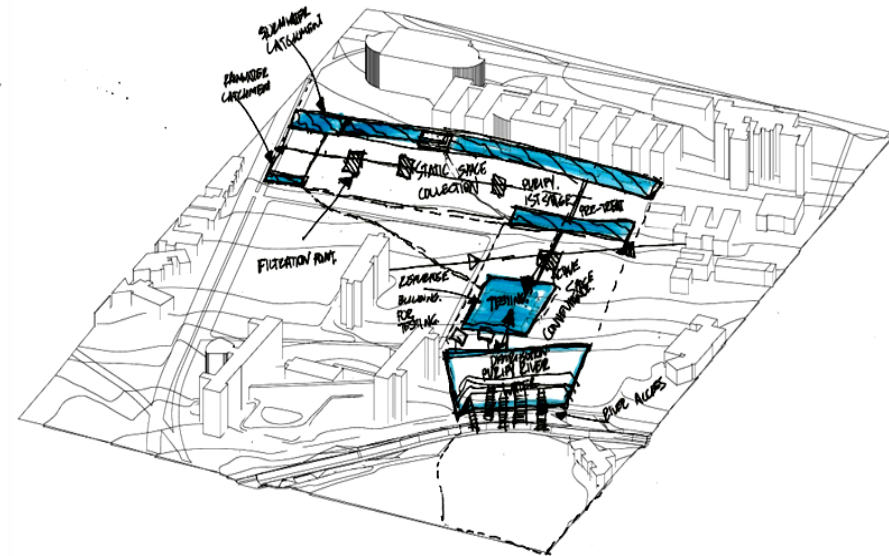
NATURAL+POETIC



USERS+MOVEMENT



CENTROIDAL+LINEAR



HYDROLOGICAL + FUNCTIONAL

Figure 1.13. Conceptual sketches showing programmes of the natural + poetic, user + movement, hydrological + functional, centroidal + linear. Author, 2016.

1.8 DESIGN INFORMANTS

Spatial design informants can be developed as a potential strategy for identifying the appropriate position for the intervention with regard to the specified site (see Figure 1.14). This particular aspect of the intervention is considered in relation to potential vertical and horizontal collection and use zones of the hydrological cycle, as well as in relation to the adjacent river interface. The design informants are expressed by using four distinct concepts as represented in Figure 1.13 and described below:

1.8.1 NATURAL + POETIC

By re-organising the topographical ground figure of the landscape and infrastructure, permeable spaces could be used as infill and could be integrated into lost historical and natural layers. The formal and spatial structure of the proposed waterscape can be informed by contouring the intervention and by using the slope of the site to an advantage.

1.8.2 USERS + MOVEMENT

Movement and experiences of an individual as approaching the site and river space can be integrated through places of exchange and civic water use (in parallel) to demonstrate water utilities.

1.8.3 HYDROLOGICAL + FUNCTIONAL

Natural cleansing systems could be utilised to treat polluted waste water produced by the river, the building, or the surrounding institutions. Natural drainage can be used, in addition to impervious surface areas, to form a rainwater harvesting system. Water from potential roof surfaces can be collected within a local or centralised cistern courtyard space to supplement the potable water supply for public use.

1.8.4 CENTROIDAL + LINEAR

Linear and centroidal spaces act as sinks and flows, creating a space for natural elements and man-made infrastructure to intersect with each other. The centroidal spaces should facilitate functions for activities involving water use. Linear spaces provide passage for a flow of people's movement to exist alongside the water.

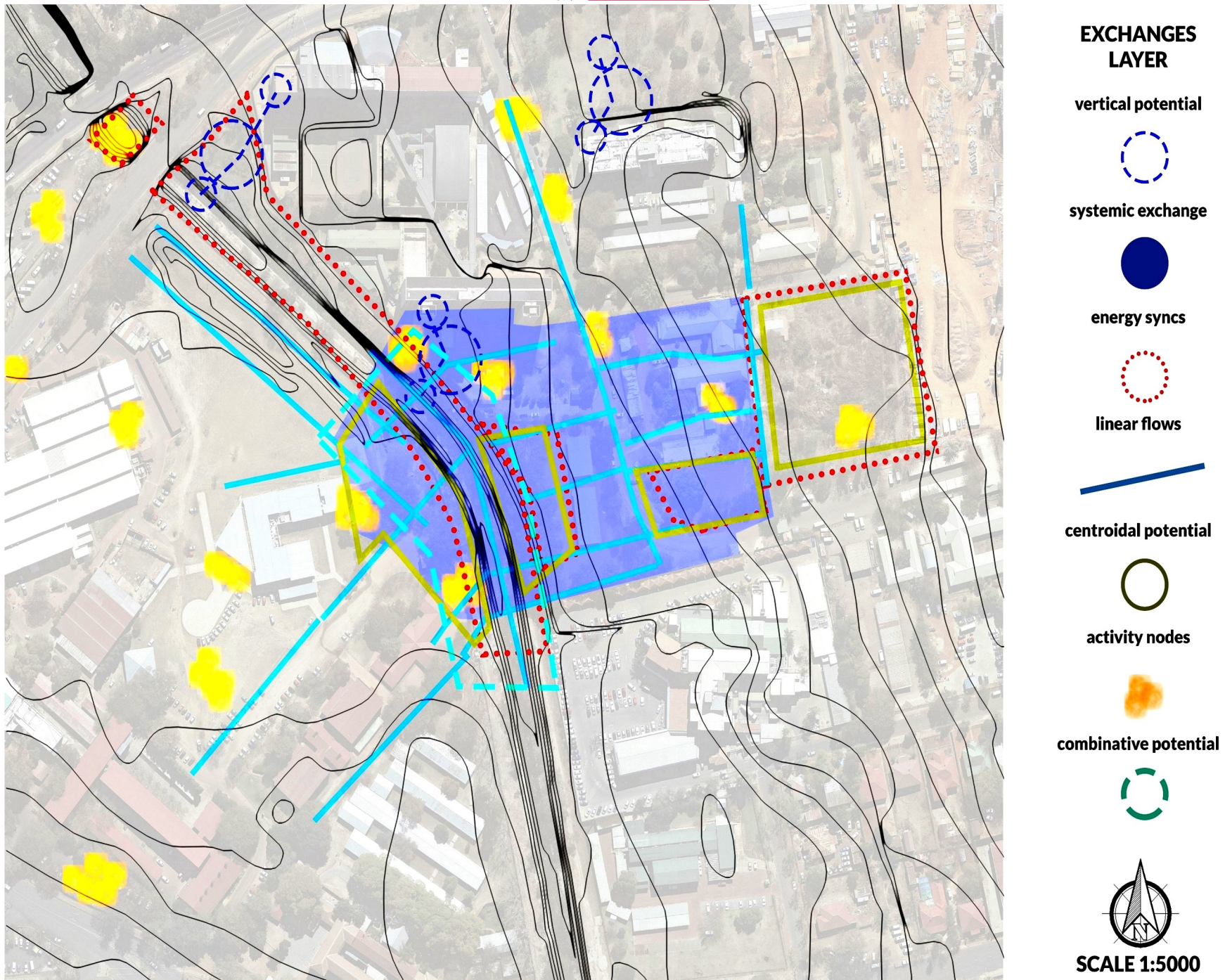


Figure 1.14. Synthesising man-made ecologies and natural ecologies. Author, 2016.

1.9 DISSERTATION OVERVIEW

1.9.1 GENERAL INTENTION

The core aim of this study is to explore speculative architectural translations of urban river architecture. Furthermore, the study intends to reconnect urban dwellers with the Apies River (see Figure 1.15). The use of a public architectural intervention would allow urbanites to appreciate the Apies River and its natural setting.

1.9.2 URBAN INTENTION

The intervention employs a combination of lost natural, historical, and present programmatic conditions surrounding the specified part of the Apies River to achieve a synthesised approach in integrating isolated river space within urban areas. The approach used coincides with the hydrological cycle of collecting and cleansing water in order to create spatial experiences and to expose the importance of water as a life-giving resource in a passive yet intentional manner.

1.9.3 ARCHITECTURAL INTENTION

The intention of this study is to use regenerative methods to incorporate the site's natural and built environment. The proposal intends to provide functional water spaces by using spatial poetics as a driver in making and using water-conscious architecture. This intention would be achieved by using the following research techniques:

- regenerative practice which aims to regenerate the urban condition and the site's natural environment,
- site analysis which takes into account the surrounding urban parameters,
- relative precedent studies which address urban river architecture or architecture involving major water use, and
- architectural explorations which make use of physical scale models, explorative drawing exercises, and various three-dimensional computer-generated models.

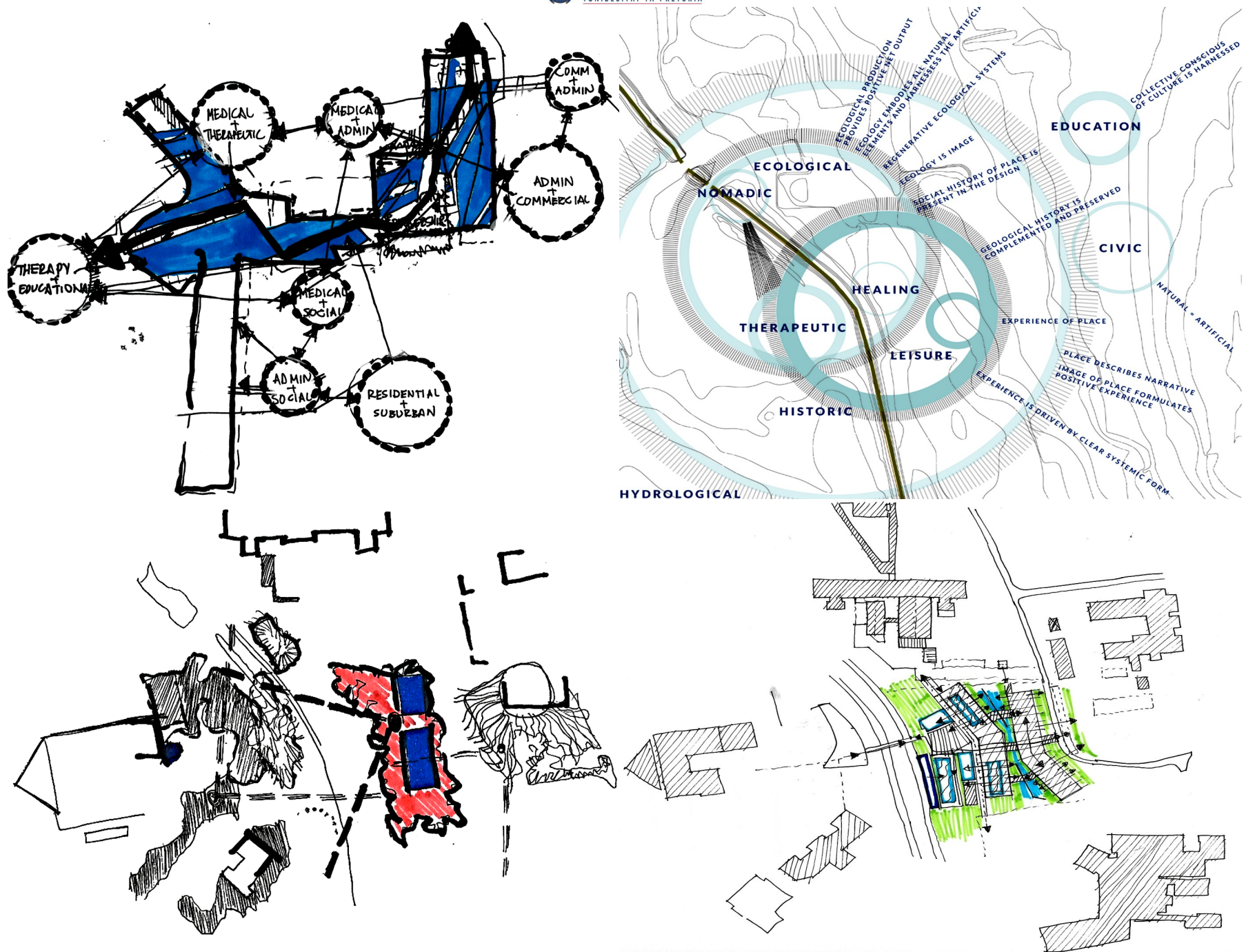


Figure 1.15. Development of diagrams over the year identifying the users, the physical site and experience of river space as contributing elements to the architectural parti . Author, 2016.

1.10 DESIGN BASIS

1.10.1 LIMITATIONS

Limitations in this project are discussed below:

- **Physical limitation:** The intervention will be limited to site plan with the technical resolution of the specified site along the Apies River channel.
- **Urban limitation:** Restrictions imposed by architectural or urban proposals, modifications, or developments made to the existing site for the duration of investigation.
- **Hydrological limitation:** There is a need for updated hydrological and flood line data. There are various general hydrological factors with regard to the site in question which may limit the proposed intervention.
- **Site visit limitation:** Access to surrounding medical educational institutions is limited.

1.10.2 DELIMITATIONS

Delimitations in this project are discussed below:

- **Physical delimitation:** Physical limit regarding the Apies River, and thus a part of the river will be investigated.
- **Technical delimitation:** Beyond technical expertise to resolve detailed urban water infrastructure design and engineering. In addition, the bio-technical design regarding water purification systems.
- **Historical delimitation:** There is a broad amount of

historical data ranging from the establishment of Pretoria and the importance of the Apies River.

- **Literature delimitation:** Water, hydrotherapy and disability are extensive research topics. As a result, selected aspects pertaining to the architectural application regarding the dissertation were applied.

1.10.3 ASSUMPTIONS

The site has adequate groundwater levels which are deemed suitable for potable water use. The flow rates of the Apies River are sufficient to support a water purification intervention. Furthermore, the geological condition within the proposed site boundaries and adjacent to the Apies River is assumed as being adequate for a super and sub-structural building/intervention.

1.10.4 DISSERTATION CONCEPT

The dissertation attempts to create a holistic approach (see Figure 1.16) that aims to deliver a positive impact on this part of Pretoria's urban grain. It aims to apply the aforementioned layers to facilitate contextual flows on site and to create experiential river space (see Figure 1.15). The proposal intends to combine water conscious architecture with an eco-systemic mind-set in order to raise awareness about the importance of water in South Africa.

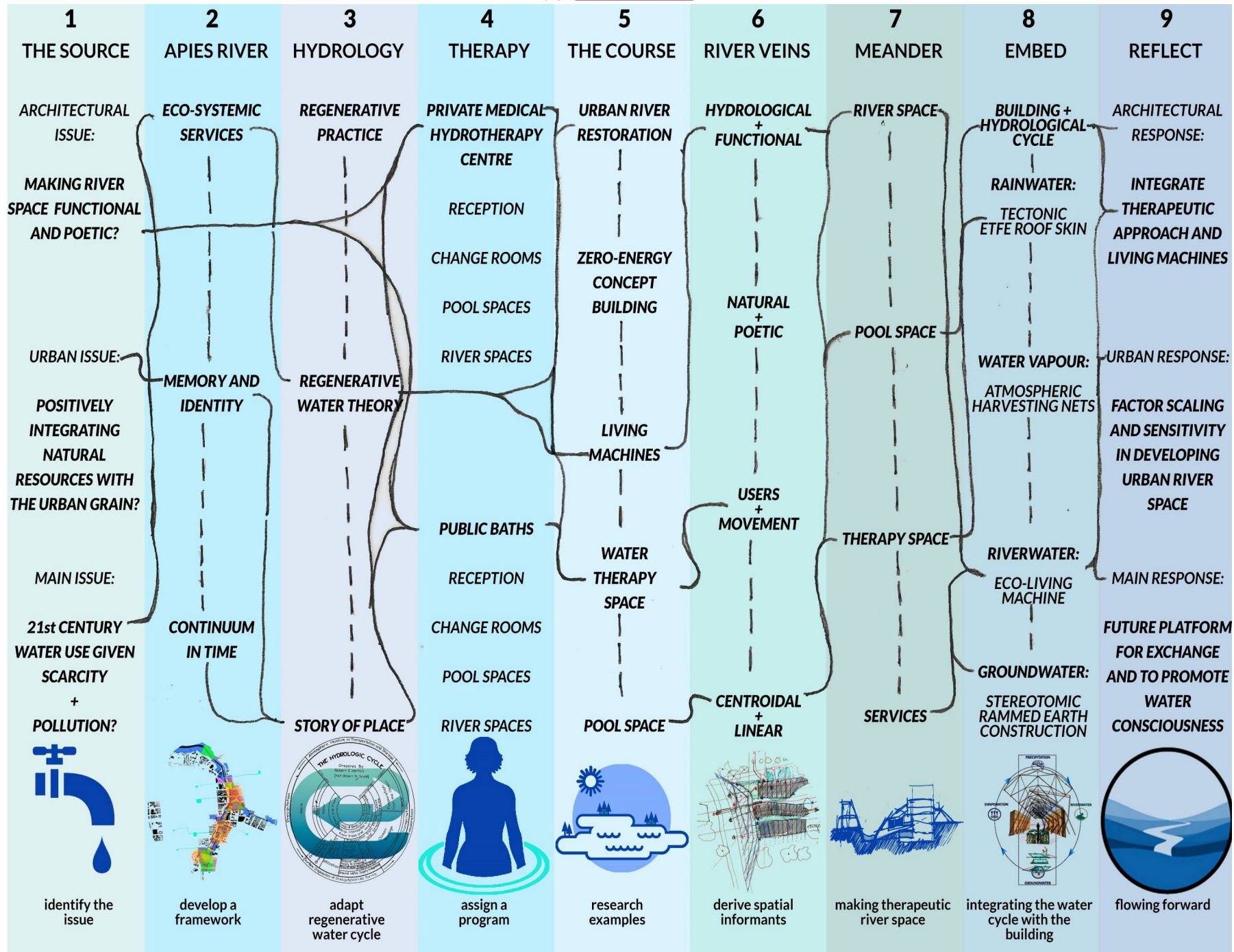


Figure 1.16. Dissertation methodology, Author, 2016.