

University of Cape Town



*INFLOW:*

Spatially Integrating Local Water Capture into Gugulethu and Surrounds, Cape Town

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*INFLOW*: Spatially Integrating Local Water Capture into Gugulethu and Surrounds, Cape Town

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MCLJUL004

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60 Credits

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## EXECUTIVE SUMMARY

The city of Cape Town requires a secure water supply to function. A severe drought in recent years has placed pressure on the water supply infrastructure, with dams at times, precariously low. To address this, stormwater harvesting is being considered as part of diversification strategies aimed at augmenting the current water resources. This local water capture strategy however, needs to be spatially integrated into settlement, as argued by Dewar (2017).

Stormwater infrastructure systems have however, generally been considered as purely utilitarian public works services, designed to drain water as rapidly as possible from impermeable surfaces of built up areas. They are not spatially integrated into urban settlements and ultimately create barriers that divide space and segregate communities. Buildings have in response, turned their backs on these channels and they have become dumping grounds, unsafe and neglected. It is therefore necessary to design sustainable stormwater infrastructure systems that not only capture and store water, but also serve as multi-functional public open space systems that are integrated with the fabric of the urban settlement.

The research explores the notion that lines of movement are flows of energy. A continuous uninterrupted line however, acts as a barrier as it limits crossings, interaction or access. Conventional stormwater and vehicular networks are continuous lines of flow, focussed on uninterrupted movement, whether of vehicles (in mobility routes) or surface water run-off (in canals). They act as barriers, limiting crossings and impeding spatial integration. They create along their edges, what Jane Jacobs refers to as 'border vacuums' (Mehaffy, et al, 2015:206). To remove these barriers of flow, the research design proposal applies the 'accessibility surface' (Dewar and Louw, 2016:25) to movement and surface water systems (including stormwater) as a means of removing barriers and generating access, opportunity and spatial integration. In this water sensitive urban design approach, stormwater infrastructure functions as a hybrid system, serving 'cultural, social and ecological functions' (Morrish and Brown, 2008:141) within settlements, providing varied opportunities as part of a multi-purpose public open space. The term 'Inflow', is applied to define and encapsulate the approach: the movement of both water and people into space in the pursuit of place-making opportunities.

To test the hypothesis, the design research applies the 'accessibility surface' of movement and surface water systems to the Zeekoe Catchment of Cape Town. The study area is focused on the Big Lotus 'River', a canal constructed to drain water from Cape Town International Airport as well as the areas of Gugulethu, Nyanga and surrounds. It devises a spatial development framework that guides and informs the three-dimensional spatial aspects of an urban design framework. It further tests this notion of 'inflow' at a precinct scale exploring various details.

The design research concludes that an 'Inflow' approach that stitches the surface water systems (including stormwater) into the settlement as part of an 'accessibility surface' provides a suitable basis for structurally and spatially integrating local water capture into settlement. Furthermore it addresses the problem of barriers of flow that spatially segregate and reduce accessibility by providing greater permeability and accessibility according to a hierarchical system. 'Inflow' therefore creates the opportunities for stopping or pause moments that allow for permeability and improved access to opportunity.

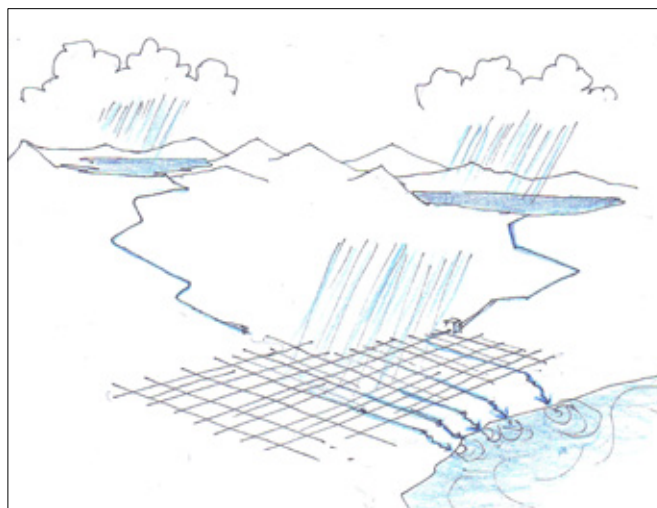
## 1.0 INTRODUCTION

Like any settlement, large or small, the city of Cape Town requires a secure water supply to function. Recently, the worst drought in a hundred years placed excessive pressure on urban water supply systems with dam levels, at times, precariously low (de Klerk, 2017). Studies indicate the potential of locally harvested stormwater to improve water security (Fisher-Jeffes, et al, 2016). In this approach, stormwater run-off is considered an asset to be valued and not a problem to be disposed of. The city itself functions as a water catchment using a Water Sensitive Urban Design (WSUD) approach. This local water capture strategy however, needs to be spatially integrated into settlements, as argued by Dewar (2017).

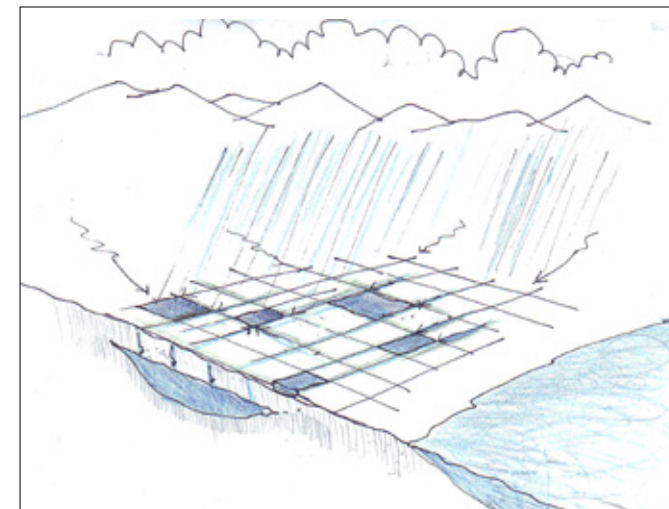
Stormwater infrastructure systems have however been considered as purely utilitarian public works services: a network of invisible drains channelled into wide engineered canals. These engineered canals, designed to remove water as rapidly as possible from impermeable surfaces of built up areas, are not spatially integrated into urban settlements and instead create barriers that divide space and segregate communities. Buildings have in response, turned their backs on these channels and they have become dumping grounds, unsafe and neglected. 'Inflow' refers to the flow of materials into a place, in this case, the flow of water and people. This research proposal seeks to design sustainable stormwater infrastructure systems to not only capture and store water, but serve as multi-functional public open space systems within urban settlement.

It does this by exploring in section 2 of the document, the relationship between water and urban form and its implications for structural-spatial systems. Section 3 considers sustainable stormwater systems and the multi-functionality of the Water Sensitive Urban Design approach. In section 4, the barriers formed by the flow of water as well as that of vehicles (in mobility routes) that impede spatial integration are explored. Section 5 considers the 'accessibility surface' (Dewar and Louw, 2016:25) and considers its application in relation to surface water systems as a means of removing barriers and generating access, opportunity and spatial integration. It concludes with the proposal as part of an 'inflow' accessibility surface using surface water systems, in part, to remove these barriers, structuring and reintegrating the spaces back into settlement by seeking place-making opportunities where cultural and socio-economic activities can occur.

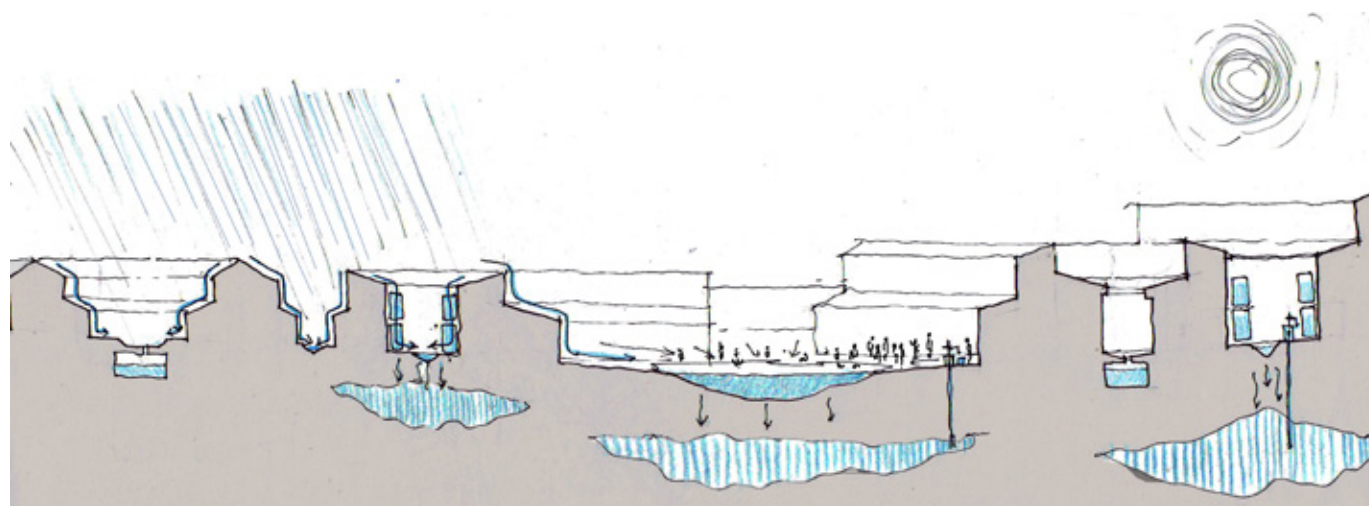
*InFlow: Spatially Integrating Local Water Capture into Gugulethu and surrounds, Cape Town*



*Current approach: Water is piped in from distant dams, whilst rain falling on the city is not valued and is rapidly removed.*



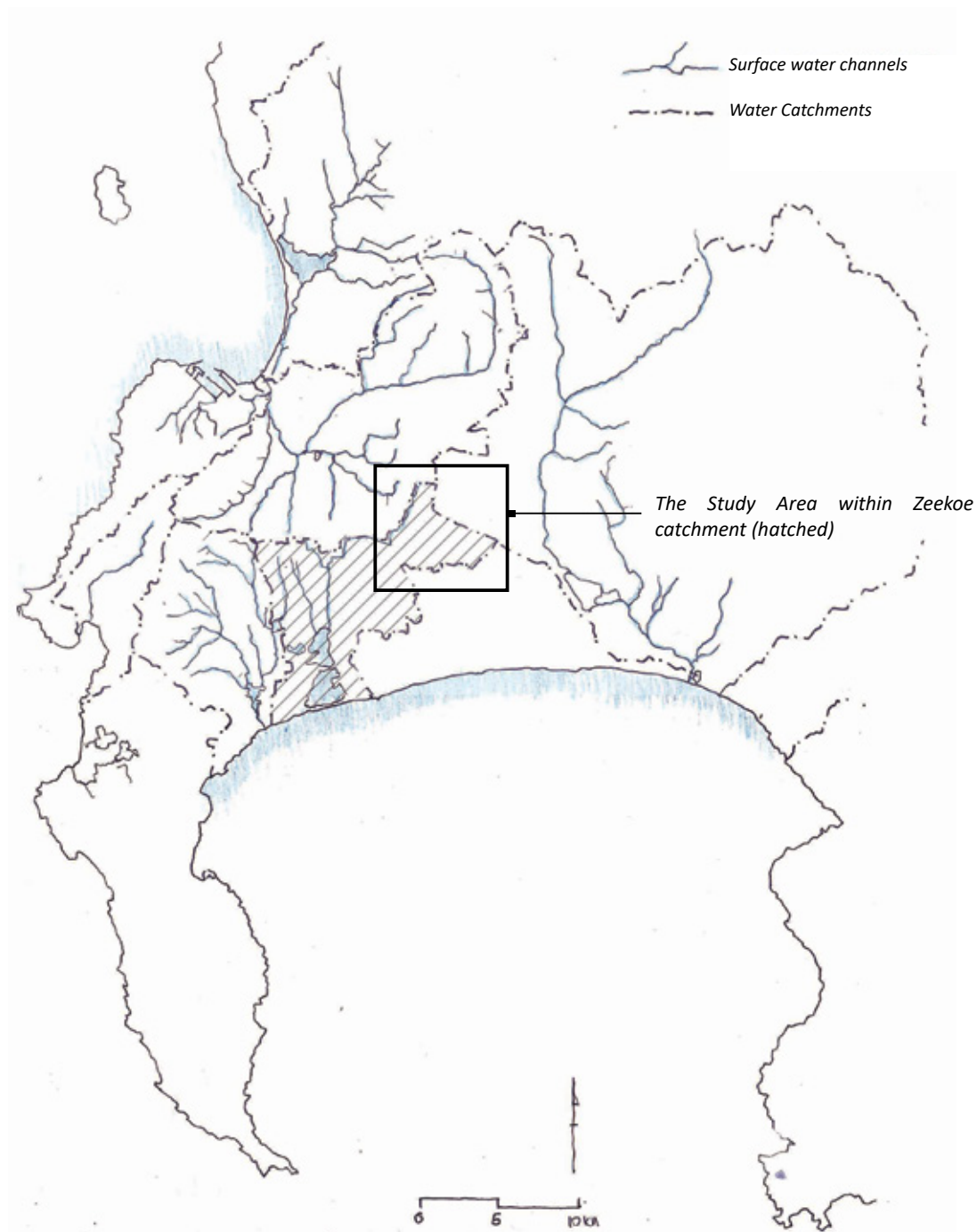
*Proposed Approach: The City as Water catchment - Surface water run-off as an asset to be valued, captured and integrated into the spatial planning of the settlement*



*INFLOW: An approach that spatially integrates water into settlement, using it to facilitate the movement of water (perennial and seasonal) and people, into a place*

It tests this in the Zeekoe Catchment of Cape Town. The study area focusses on the Big Lotus 'River', a canal constructed to drain water from the airport as well as the areas of Gugulethu, Nyanga and environs within a partially engineered upper catchment. Reports submitted to the Water Research Commission by UCT's Prof Neil Armitage and PhD Candidate John Okedi (2018) indicate the potential of this Big Lotus 'River' within the Seekoe catchment to recharge the Cape Flats aquifer in order to ultimately diversify water sources for the city of Cape Town. It tests this within a 'Beyond Day Zero in Post Peak Oil' scenario.

#### CAPE TOWN METRO SURFACE WATER SYSTEMS



## 2.0 THE ROLE OF WATER SYSTEMS IN URBAN FORM & STRUCTURE

Though water is an essential resource for the establishment of any permanent settlement, it is also a significant shaping and structuring element of urban form.

### 2.1 Water systems and movement

Water systems (rivers, lakes and so on) often determine the most strategic location for convenient crossings and thus play a significant role in setting up movement routes. Copenhagen's distinctive 5 fingers of growth emerged from the strategic crossings located across a water body that served a defensive role in its earlier development. The original settlement of Mexico City was located in the middle of a lake and connected via stone causeways to the mainland. Where these movement routes intersected in the centre of the settlement, was the location for important public buildings flanked by open space.

### 2.2 Water infrastructure as Public open space

Water supply infrastructure systems in the past, provided devices for ordering spaces within the settlement (Smets and Shannon, 1996) spatially integrating them to create attractive and meaningful public open spaces. Water collection points, for instance served not only functional needs but provided a social gathering space at a strategically accessible location for communities, such as the well point in a public square in Piazza della Cisterna of San Gimignano, Italy (Hough, 1995: 45) or the stepped wells of India, such as that at Chand Bawri, Rajasthan.

### 2.3 Water and building typologies

Water shapes building typologies, with the need to either escape it (floating houses or stilts houses) or capture it such as in the courtyard houses of Benin City with their impluvium designed to channel rainwater to a well in the centre of the courtyard. Underground storage was also integrated into building complexes as cisterns.

### 2.4 Water as basis for activity socio-economic activity

Water supply systems shaped agricultural activities. Up to the 19th Century, a system of rice fields formed part of the urban tissue of Tokyo. The water systems provided irrigation for food as well as providing flood control (Stokman, 2008).

Cities have been able to design with the water systems, shaping them and integrating them into urban settlements to address their various needs.



*Mexico City connected via stone causeways to mainland. Where movement routes intersected in the centre of the settlement important public buildings flanked by open space were located (adapted from Correa, F. and C. Garcıavelez Alfaro.2014. Mexico City: Between Geometry and Geography, p43)*



*Water collection points as social gathering space at a strategically accessible location for communities, such as stepped well at Chand Bawri, Rajasthan (adapted from Google Earth)*

### 3.0 WSUD & LOCAL WATER CAPTURE AS MULTI-FUNCTIONAL PUBLIC OPEN SPACE

#### 3.1 Water Sensitive Urban Design (WSUD)

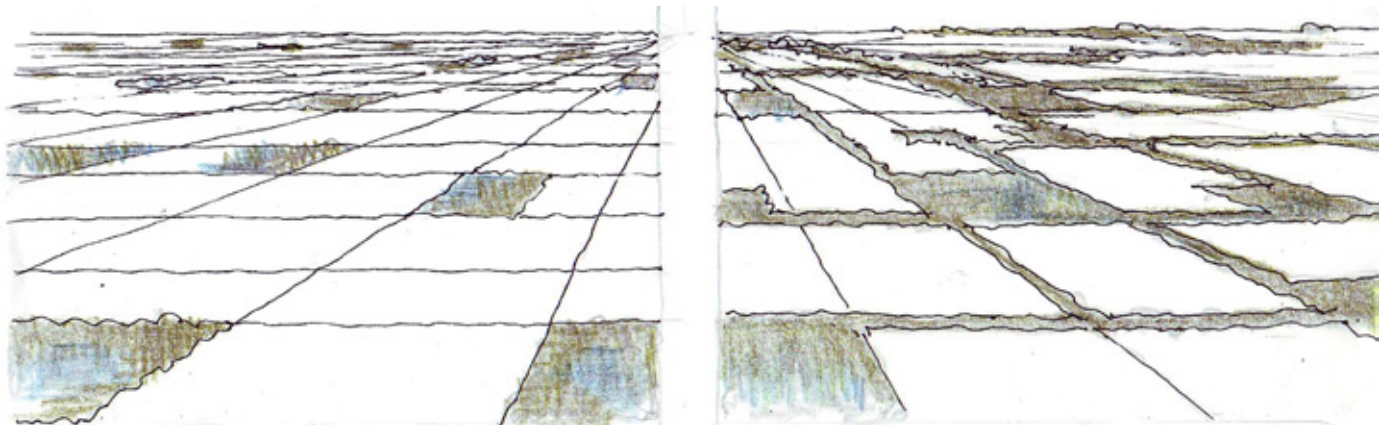
The Water Sensitive Urban Design (WSUD) approach views the city as one in which a more sustainable water management approach provides 'adaptive, multifunctional infrastructure' (Brown, Keath and Wong, 2008:5). The planning of cities is integrated with the management of the urban water cycle and the networked infrastructure of potable water, sewage and stormwater. WSUD includes the use of tools such as sustainable stormwater infrastructure. In this approach, constructed ecologies (plants, soil mediums, etc.) slow, clean and filter surface water run-off as part of natural processes (Madsen et al, 2016).

#### 3.2 Local water capture as Multi-Functional Open Space

Whilst stormwater infrastructure is used to prevent flooding, recent local studies suggest the potential of locally harvested stormwater to improve water security (Fisher-Jeffes, et al, 2016) using it to recharge aquifers at strategic locations. The harvesting of stormwater provides other benefits that include water quality improvement as well as providing productive and recreational landscape opportunities, amongst others (ibid). In this approach, stormwater, (essentially surface water run-off that includes streams and rivers) is an asset and not something to be disposed of.

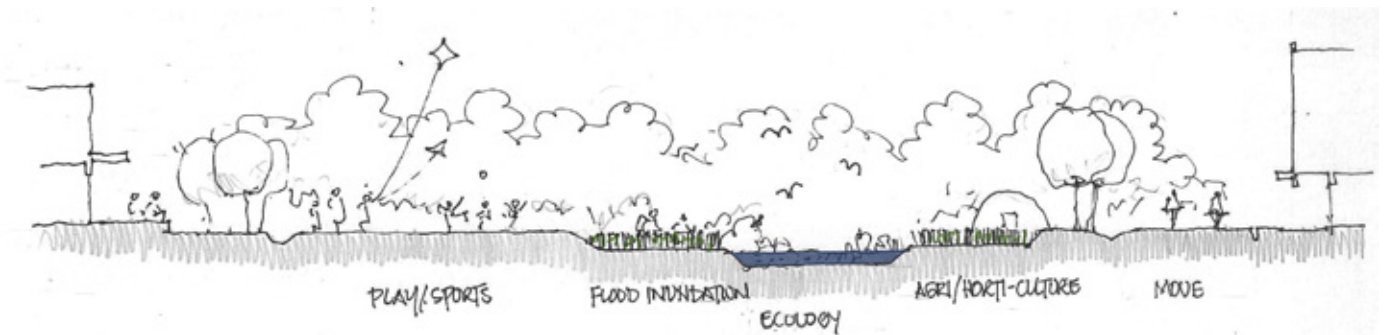
Unlike the conventionally engineered piped stormwater drainage approach, this stormwater infrastructure is a hybrid, serving 'cultural, social and ecological functions' (Morrish and Brown, 2008:141). To function effectively, this multi-functional stormwater infrastructure needs to consider the following though:

- Ecological aspects: Fragmented patches of planting in open space are ecologically ineffective (Dramstad, Olson and Forman:1996). For ecological processes to function effectively, a continuity of the system is required.
- Social and cultural aspects: Whilst providing recreational and amenity value, hybrid infrastructure facilities can be designed to be part of multi-purpose urban open space system of waterways, planted pedestrian paths, etc. (Morrish and Brown, 2008) that also offer socio-economic opportunities such as urban agriculture.



*Fragmented patches of planting in open space are ecologically ineffective (Dramstad, Olson and Forman:1996).*

*A continuity of natural systems is required for ecological processes to slow, treat and filter surface water run-off before it enters aquifer.*



*Hybrid stormwater infrastructure designed to be part of multi-purpose urban open space system that also offers socio-economic opportunities*

This hybrid-infrastructure as multi-functional open space system is not a recent innovation. In Boston's Emerald Necklace in the U.S., infrastructure systems that included transportation as well as flood and drainage engineering were integrated with a scenic landscape of recreational and amenity value. A similar approach was adopted almost a century later to address the stormwater challenges in Brazil's city of Curitiba, integrating sustainable stormwater infrastructure into a recreational park along the Iguaçú River.

It is vital that we move away from the utilitarian infrastructural and engineered approach to water and adopt one that once again delivers 'the creation of infrastructure back to the field of urbanism' (Smets and Shannon, 2010:55) spatially integrating it into settlements to create multi-functional public open space opportunities.



Curitiba, Brazil integrating sustainable stormwater infrastructure into recreational park along the Iguaçú River (adapted from Tucci, C.M. 2004. Integrated Flood Management Case Study - Brazil: Flood Management In Curitiba Metropolitan Area)

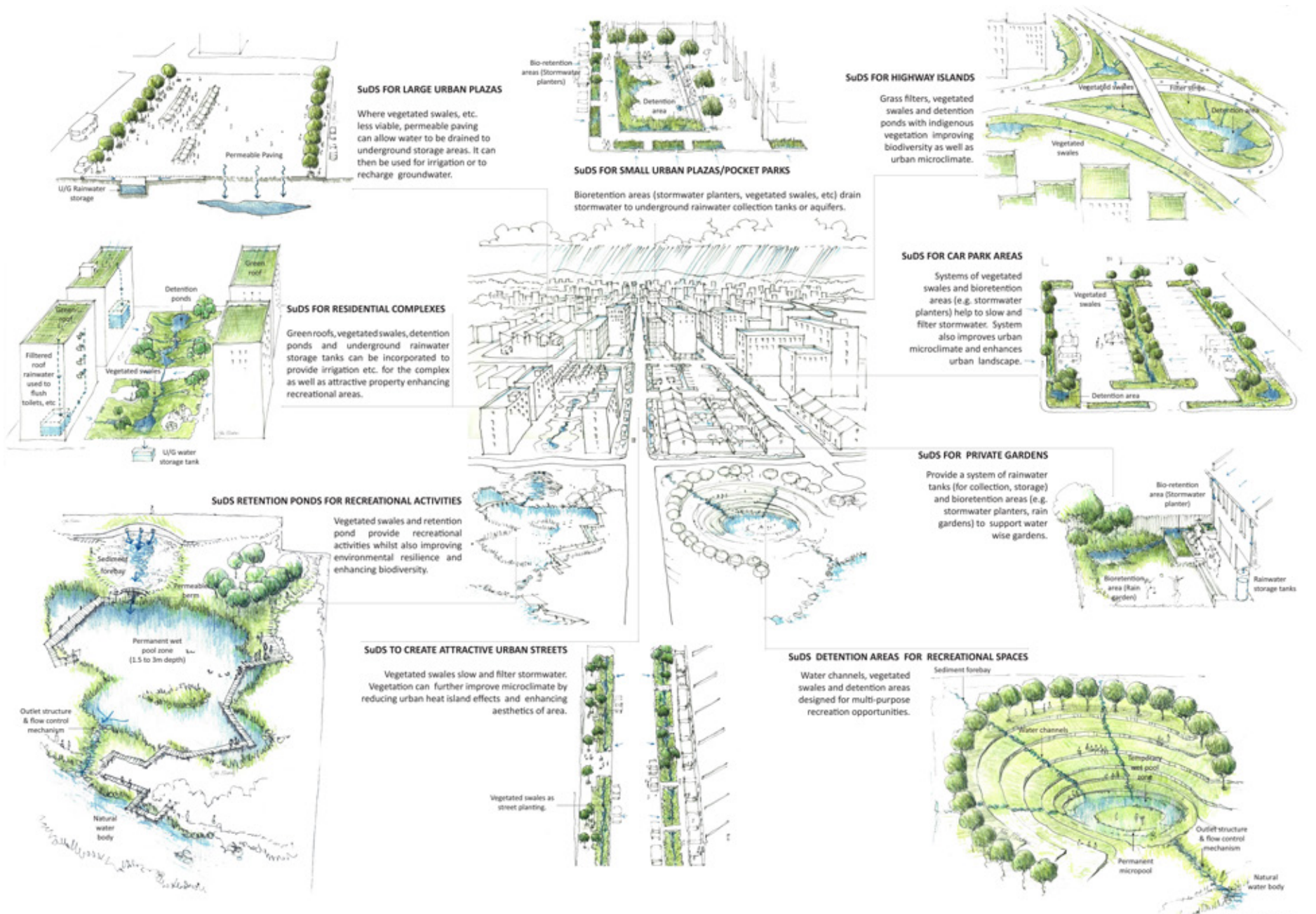


Boston's Emerald Necklace hybrid landscape integrates transportation, flood and drainage engineering into landscapes with recreational and amenity value (adapted from Jellicoe, G. and S. Jellicoe. 1987. The Landscape of Man. , p281)



Sydney, Australia: Stormwater re-use park (Turf Landscape Architects) integrates engineering and water sensitive urban design to capture and filter stormwater from the surrounding area (Image Source: <http://turfdesign.com/sydney-park-water-re-use-project/>)

# WSUD AND LOCAL WATER CAPTURE AS MULTI-FUNCTIONAL PUBLIC OPEN SPACE



ARTWORK BY JULIA MCLACHLAN  
Artwork by Author for UCT Urban Water Management Group, for The South African Guidelines for Sustainable Drainage Systems

## 4.0 FLOW AS A BARRIER

Lines are flows of energy. A continuous uninterrupted line is a barrier: it limits crossings, interaction or access. Stormwater and vehicular networks (engineer-driven) have focussed on flow and mobility. The result has been a coarse-grained plan of barriers. These networks of continuous flow create along their edges, what Jane Jacobs refers to as 'border vacuums' (Mehaffy, et al, 2015:206).

### *Water flow as barrier*

In the early 20th century water systems became segregated from the spatial planning component of urban settlement. Stormwater infrastructure systems evolved into purely utilitarian public works services: an invisible network of drains and canals designed to remove run-off as rapidly as possible from the city. In essence, this 'engineered-to-single-purpose' approach has also caused significant problems for settlement design. It has resulted in the 'separation of two worlds: the utilitarian and the natural' (Morrish and Brown, 2008:139). Hydrological systems, such as wetlands and rivers, have been drained or built over, their critical ecological processes compromised. 'Corridors' have been created where buildings have turned their backs on surface water channels that have now become unsafe as well as impromptu rubbish dumping grounds. In many instances, strategies adopted by city councils to manage stormwater have occurred in isolation from the spatial planning for open space, often allocating it any residual space (Dewar, Louw and McLachlan, 2017:50).

### *Mobility routes as barriers*

The stormwater network generally follows the road network and as stated by one of the fathers of the modernist movement, Le Corbusier, the 'modern street should be a masterpiece of civil engineering' (2013: 95). Modernist ideology sought to separate pedestrian and vehicular movement routes to enhance flow in limited access or mobility routes (as well as directing that activities, such as live, work and play should be separated and allocated their own zones).

This emphasis on the unhindered flow of vehicles in mobility routes created barriers separating communities. In South African cities, separation was further designed into settlements with the application of Clarence Perry's 1929 'neighbourhood unit' concept. In this approach a large settlement was considered to be comprised of smaller cells or 'neighbourhood units' or free-standing cells linked to each

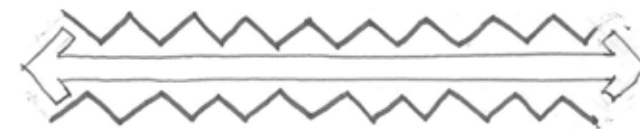
other and the larger settlement by rapid transport routes such as collector roads (Dewar, 2015).

### *Barriers to opportunity*

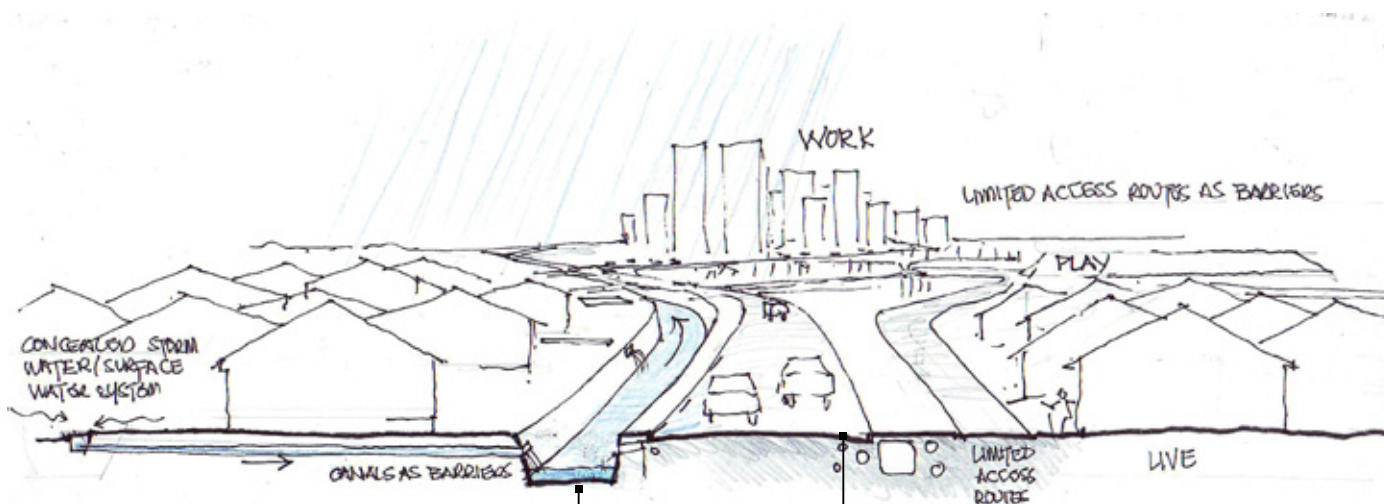
Access to opportunity has been compromised by these barriers and despite the downfall of apartheid, the spatial patterns of fragmentation and separation persist today and are compounding significant developmental problems, particularly in settlements like Cape Town, where high levels of poverty, unemployment, issues of food security and water scarcity, amongst others, affect the poor the hardest (Dewar, 2017). They have little, if any, access to opportunity, with residential areas separated by great distances from centres of work, requiring movement over significant distances to access potential economic opportunities.



*Lines of movement possess an energy*



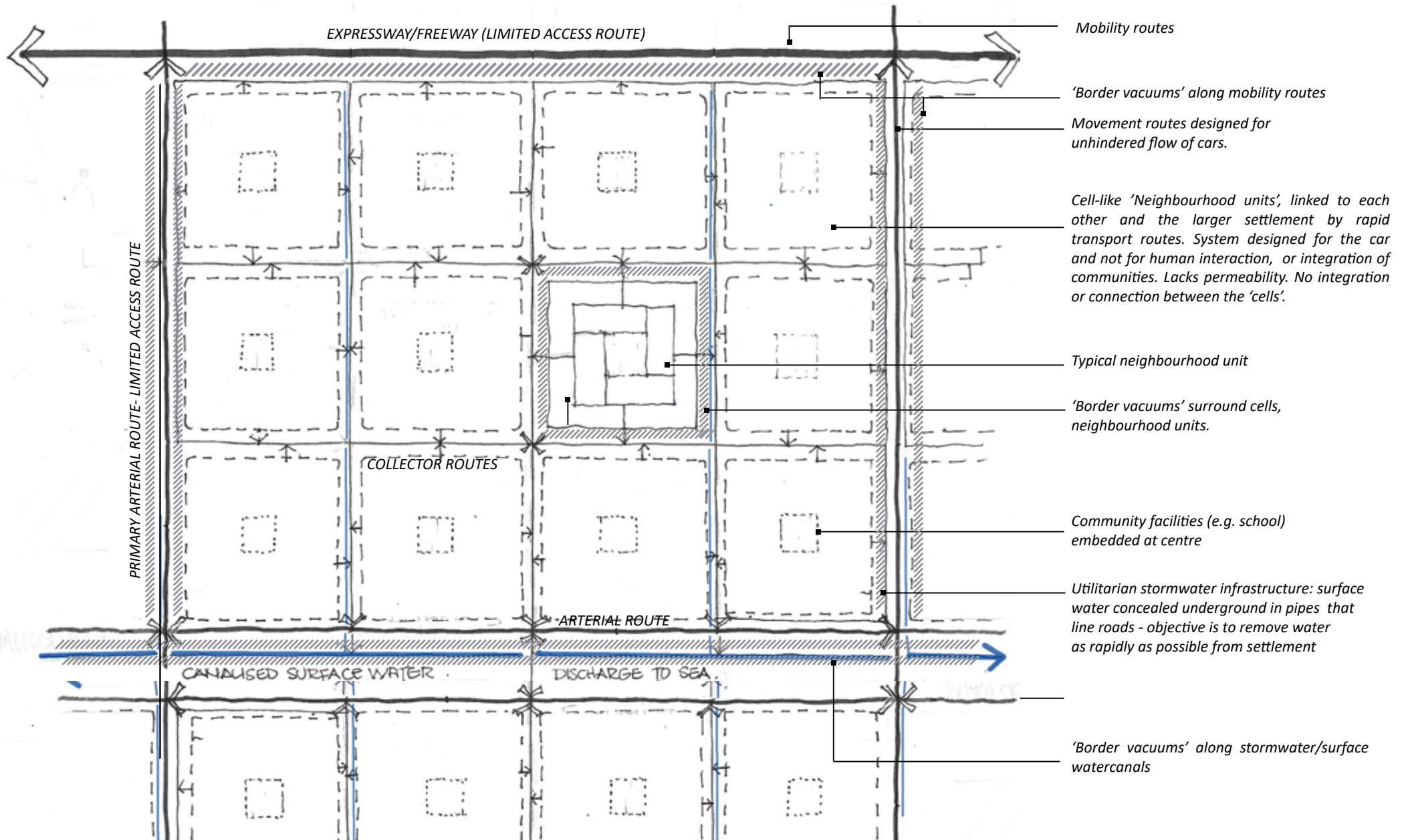
*Uninterrupted lines are barriers to cross movement. They create 'border vacuums' according to Jane Jacobs (Mehaffy et al)*



*Stormwater canals as barriers with unhindered flow. Surface water run-off is diverted and concealed underground into pipes.*

*Limited access routes provide mobility and the unimpeded flow of cars. There is little if any access for pedestrians*

FLOW & MOBILITY FOCUSED SYSTEMS AS BORDER VACUUMS: SPATIAL BARRIERS, NOT INTEGRATORS



Mobility routes

'Border vacuums' along mobility routes

Movement routes designed for unhindered flow of cars.

Cell-like 'Neighbourhood units', linked to each other and the larger settlement by rapid transport routes. System designed for the car and not for human interaction, or integration of communities. Lacks permeability. No integration or connection between the 'cells'.

Typical neighbourhood unit

'Border vacuums' surround cells, neighbourhood units.

Community facilities (e.g. school) embedded at centre

Utilitarian stormwater infrastructure: surface water concealed underground in pipes that line roads - objective is to remove water as rapidly as possible from settlement

'Border vacuums' along stormwater/surface watercanals

## 5.0 THE 'ACCESSIBILITY SURFACE' AND SURFACE WATER SYSTEMS

There is a need to design for the pedestrian, providing within walkable distances, access to economic opportunities, public transport, food, water, amongst others. Hillier suggests that the relationship between movement and the urban grid structure is critical to how socio-economic forces shape the city with 'well-functioning cities' considered as 'movement economies' (Hillier, 1996:113) with a strong correlation between the effects of movement and space.

Lines of movement possess an energy that can only be freed if stopping or pause moments are included that provide opportunities for the integration of spaces (Dewar and Uytendogaardt, 1996:27). If we acknowledge this, then to address the problem in our cities of 'flow' as barrier (whether of water or vehicles) and the border vacuums that have developed, we therefore need to create what Jacobs refers to a 'seams': we need to stitch these seamed edges together with lines of cross-movement (Mehaffy, et al, 2015:206) to create accessibility and a more permeable pedestrian network. These lines of cross-movement cannot be arbitrary though. Critical to the notion of accessibility is the spatial logic of structure: how are the spaces organized and structured and what role do these spaces fulfil in the overall structure of a settlement? When elements of public structure are organised and co-ordinated in a geometry of point, lines and grid, an 'accessibility surface' is created (Dewar, 2015:240). This geometry of points and lines forms part of a hierarchical system in which 'different levels of access' create 'different types of opportunities' (ibid) allowing within it, a gradation from very public to private spaces. The 'accessibility surface' is fundamental to understanding the logic behind how settlements work (Dewar and Louw, 2016:25).

### The Need for Structure

Structure is a device that is inherent in all systems: it organises them and enables them to function, contributing to how they grow over time and whether they adequately accommodate human life and everyday activity (ibid). Structure provides order and a logical framework within which considerations such as 'sense of place, integration, functional efficiency, environmental harmony and commercial viability' can be addressed and integrated as part of the urban design response (Llewelyn-Davies, 1996:33). Water systems, for instance, whether natural (such as flood prone areas, rivers,

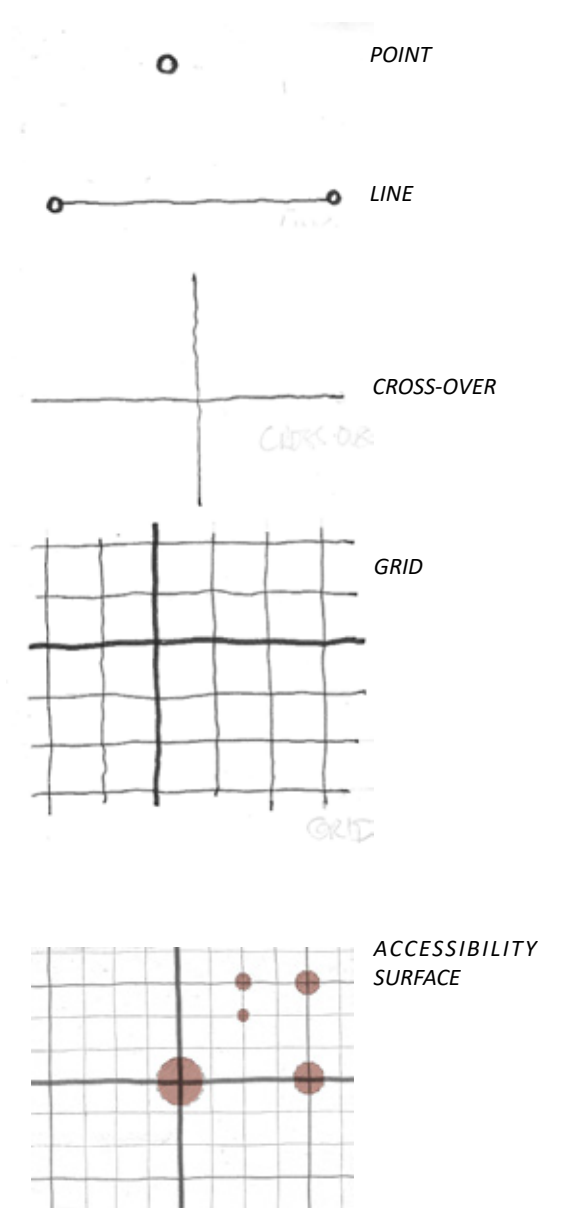
drainage channels, wetlands etc.) or man-made (sustainable stormwater infrastructure) can play a role as urban structuring devices.

### Open Space systems as element of Urban Structure

Public open space is a fundamental element of urban settlement structure and is generally categorised into 'hard' or 'soft' open space. Soft, green open space is generally dominated by the natural environment and permeable surfaces that allow water to infiltrate the ground. Parks and linear greenways or green corridors are examples of this type of public open space, often associated with recreational amenity. Hard urban open spaces can refer to movement routes such as streets, and social gathering spaces such as squares. Trancik characterises hard spaces as those that are spatially contained by buildings that serve as the 'architectural walls' (1986:63). Catering mostly to intense movement (pedestrian and vehicular traffic) the surfaces of these spaces are mostly hard, impermeable surfaces that contribute to levels of high water run-off that needs to be channelled to permeable soft open spaces. Water systems have the potential to serve as the base of these public open space systems: they provide much-needed permeable surfaces to reduce flooding; they sustain valuable ecological functions; have the potential to provide alternative water sources and provide various activity spaces with amenity value.



*The energy in lines of movement can only be freed if stopping or pause moments are included. These pause moments provide opportunities for the integration of spaces. (Dewar and Uytendogaardt, 1996:27)*



*Geometry of points and lines forms part of a hierarchical system: 'different levels of access create different types of opportunities' allowing within it, a gradation from very public to private spaces (Dewar, 2015).*

### *Open space as Line and Points*

Conceptually, it could be considered that hard and soft open spaces channel the flow and 'capture' of people as well as water. Movement or channelling (whether of water or people) suggests a line or linear form, whilst the notion of gathering (of people) or capturing (of water) is suggestive of a point or node in space.

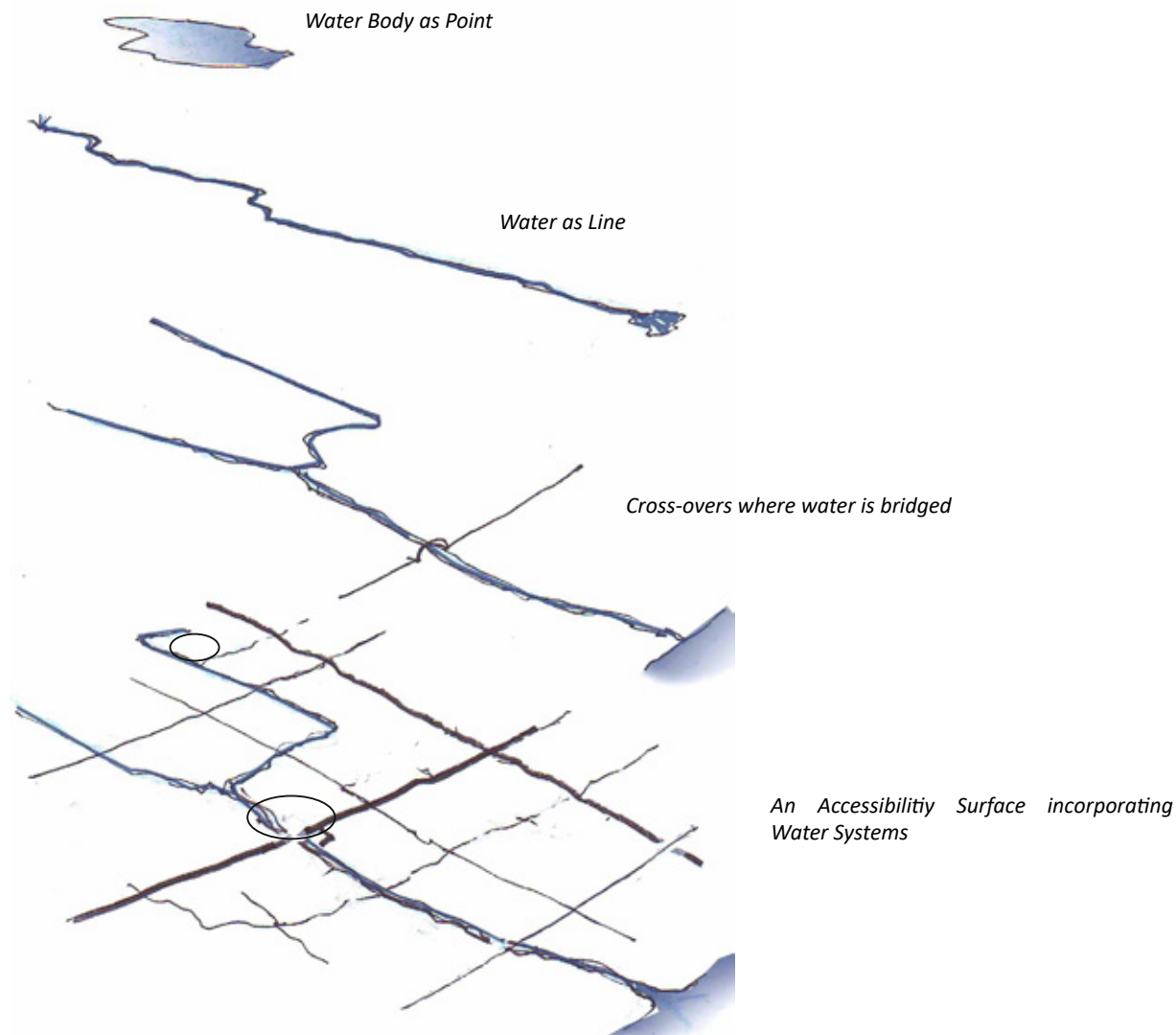
*Lines:* Lines or linear elements possess an energy that can only be freed if stopping or pause moments are provided on the line. In contrast, lines of mobility offer few, if any stopping points or pause moments. Conventional engineered stormwater systems similarly focus on rapid flow and removal of stormwater into surrounding waterways (Brown, et al, 2008:6). As such, accessibility and with it, access to opportunity and interaction and are compromised. Instead, monofunctional stormwater infrastructure creates linear barriers in settlements. Not being part of a public open space system, this 'no-mans-land' often becomes a channel for rubbish disposal, with houses turning their backs on it. If we consider water in a landscape, storage areas, such as wetlands and lakes act as stopping areas for water as well as people: they provide a place where a pause in movement is permitted. Flowing water features such as rivers, act as linear open space systems and green corridors that need stopping points to bridge or connect to places and districts (Trancik, 1985:105).

*Points:* In the urban context, a point or node represents a particular location or a special place within the structural framework of a settlement. Space for public gatherings, such as squares or parks, can act as reference points within a settlement, providing a significant element in terms of place-making (Dewar and Uytenbogaardt,1996:23). To function effectively though, the points need to be accessible: where lines (such as lines of movement) intersect, a node is generated. Several nodes can set up a spatial system across a larger area, becoming a 'family of events' that have similar positions in the framework and play a similar role, though at different hierarchical levels (Dewar and Uytenbogaardt,1996:23).

A settlement's water catchment area (of both sustainable stormwater and natural water systems) is made up of a family of events of water systems that can contribute to a clear, intelligible structural framework by providing public open blue-green spaces within which urban life is conducted.

The challenge however is to spatially integrate local water capture into Southern African cities, like Cape Town, where the structural and spatial system has been shaped by barriers of flow and mobility and not by integration and accessibility.

### THE GEOMETRY OF WATER SYSTEMS

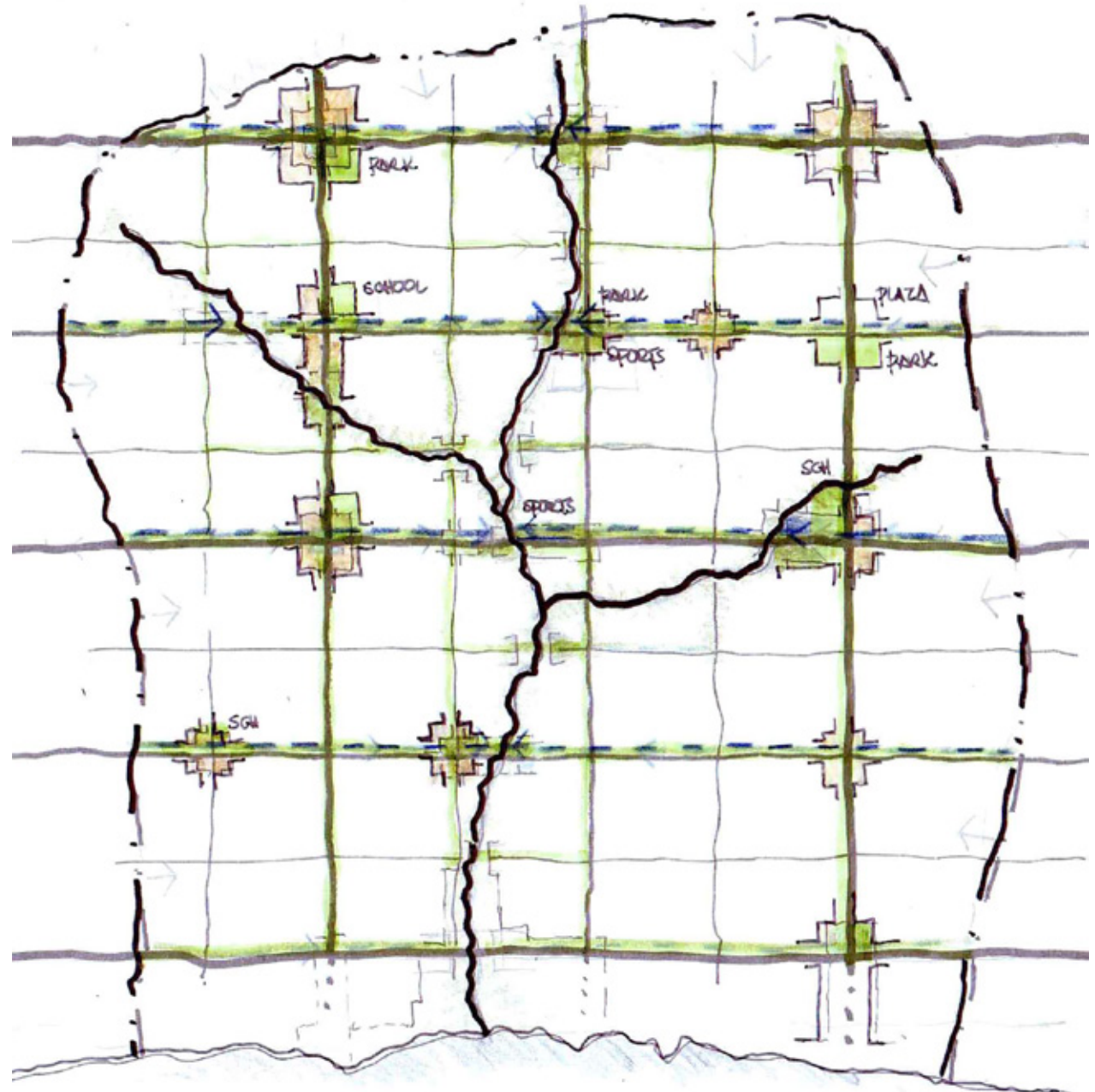


## 6.0 INFLOW: SPATIALLY INTEGRATING LOCAL WATER CAPTURE INTO SETTLEMENTS

'Inflow' refers to the flow of materials into a place, in this case, the flow of water and people. This research proposal seeks to spatially integrate local water capture into Southern African cities, like Cape Town, as a part of an 'accessibility surface' of water systems, spatially integrating sustainable stormwater infrastructure systems (designed to capture and store water), to serve as multi-functional public open space systems within urban settlement. It aims to integrate multi-functionality, accommodating both ecologically functional hydrological systems as well as vital urban structuring elements that provide access to social, economic and cultural opportunities, to those who move on foot, bike or via public transport, in particular.

Given the current water crisis and the growing unpredictable climate globally, drastic changes are required in how we design our cities. The conservation of natural systems should serve as the basis for stormwater infrastructure systems, offering a valuable opportunity to not only capture and store water within the city, but also to spatially and functionally reintegrate and celebrate these natural systems, with multiple benefits for the inhabitants.

DIAGRAM ILLUSTRATING THE ACCESSIBILITY SURFACE APPLIED WITHIN A WATER CATCHMENT



## 7.0 INFLOW: SPATIALLY INTEGRATING LOCAL WATER CAPTURE INTO GUGULETHU, CAPE TOWN

### 7.1 SCENARIO: BEYOND DAY ZERO, POST PEAK OIL

This research proposal tests the concept of 'Inflow': Spatially integrating local water capture into settlements in Cape Town in the Zeekoe Catchment area, adopting a 'Beyond Day Zero in a Post Peak Oil' scenario.

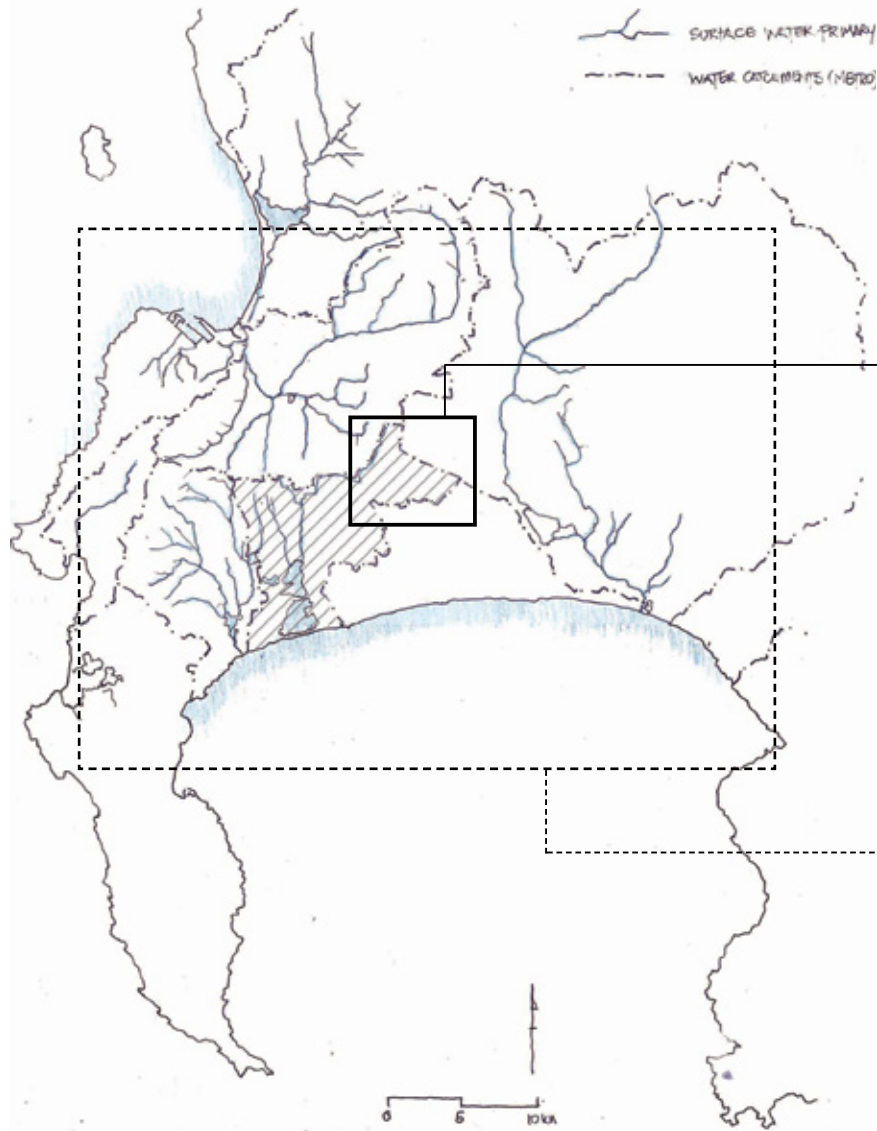
Beyond Day Zero envisages the city in which we can no longer depend on distant dams for water supply and have to diversify water resources, to include stormwater and ultimately designing the city as a water catchment.

Post Peak Oil refers to a period when we will no longer be able to rely on fossil fuels as a cheap energy source. As in Cuba, following the fall of the Soviet Union in 1991, a significant shift occurred, from being fossil-fuel dependent to one that without cheap fuel, had to focus on local and community access for water, urban agriculture and other basic services, constrained by the distance limitations of pedestrian or bike accessibility.

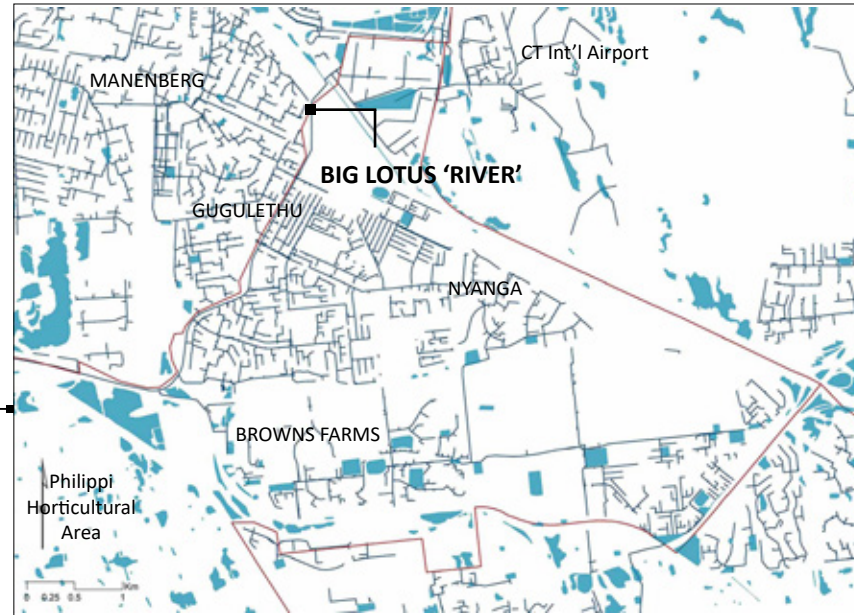


7.2 BIG LOTUS 'RIVER' CANAL (ZEKOE CATCHMENT) AS WATER CAPTURE AND STORAGE SYSTEM

SURFACE WATER SYSTEMS AT A METRO SCALE



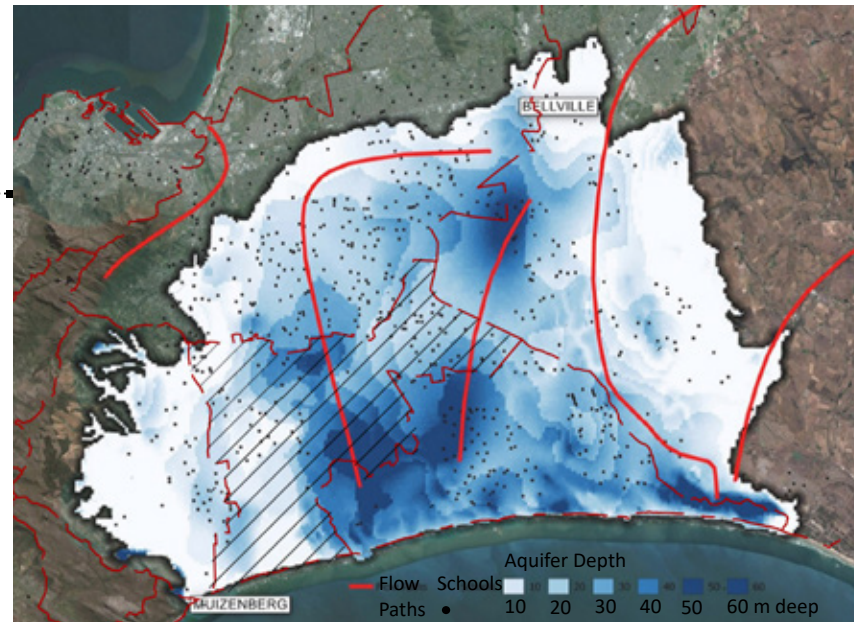
BIG LOTUS 'RIVER' CANAL AS SURFACE WATER CAPTURE



Big Lotus "River" is a canal constructed to receive stormwater runoff from the airport, as well as the built up areas of Nyanga and Gugulethu.

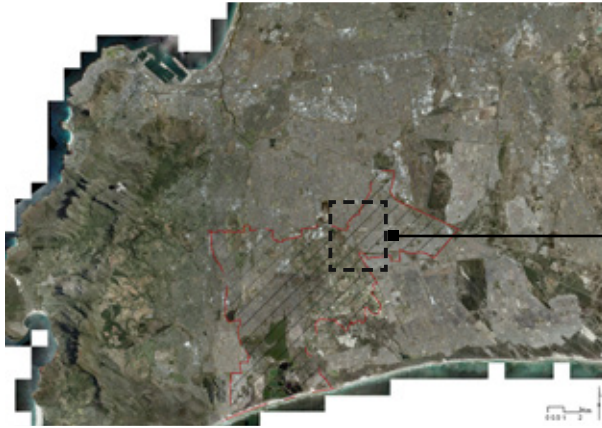
Much of what is named the Big Lotus 'River' was a string of seasonal wetlands (Brown and Magoba, 2009:182) (Map Source: Cape Town GIS)

CAPE FLATS AQUIFER AS WATER STORAGE SYSTEMS



Zeekoe Catchment area (hatched) feeds into 55-60m deep aquifer partially sited below Philippi Horticultural Area most suitable for storage (Map Source Hay, R., et al: 2015). Storage below ground preferable due to dry summers with high evaporation.

7.3 HISTORICAL IMAGERY AND THE DEVELOPMENT OF BARRIERS

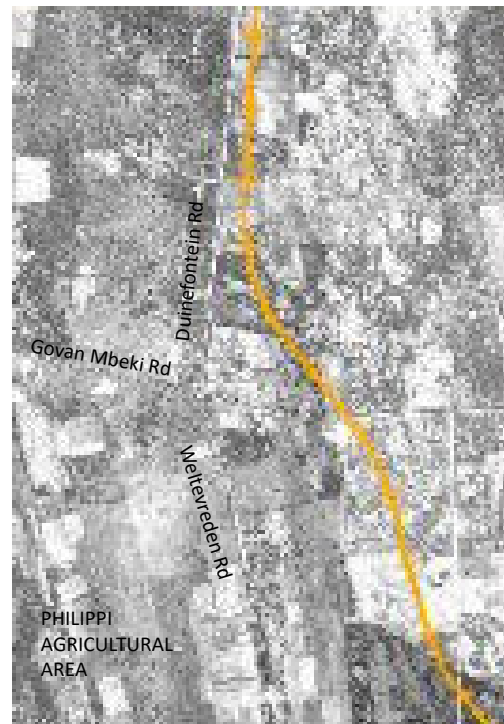


Area shown below of portion of study area showing barriers resulting from Flow: mobility routes and Big Lotus River canal.

1945



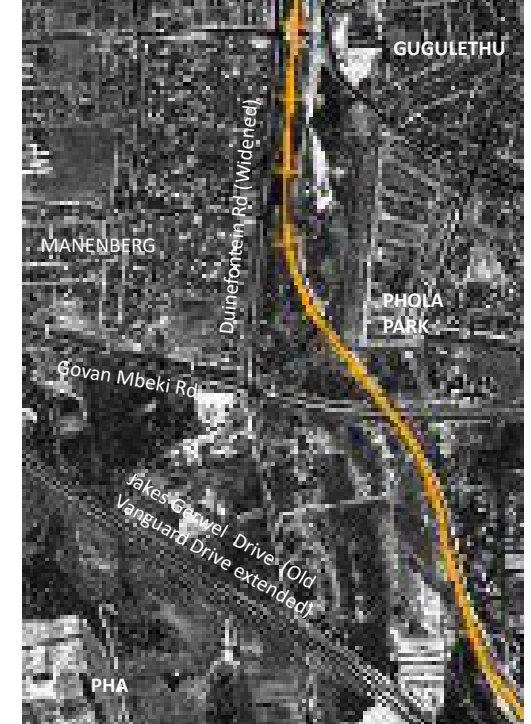
1953



1980

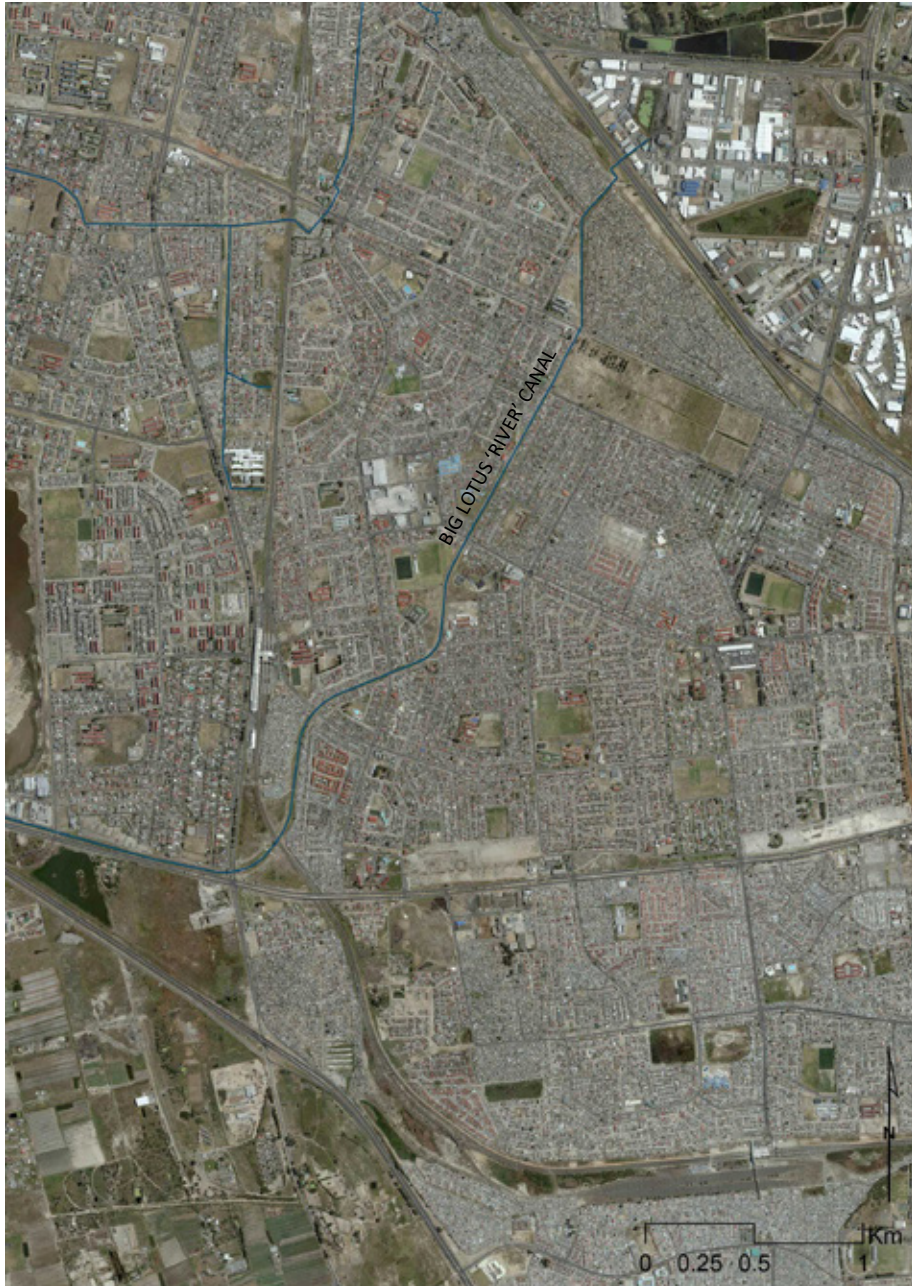


1988



Area transforms as existing movement routes (Wetton Rd, Duinefontein and Weltevereden) are upgraded to mobility routes that form barriers of flow and separate areas (Note: Yellow line refers to rail line built in 1980's. Line used to only as reference). (Images source: City of Cape Town)

7.4 BIG LOTUS 'RIVER' CANAL: AS BARRIER AND BORDER VACUUMS RESULTING IN DEAD, NEGLECTED EDGES



Map Source: City of Cape Town GIS

Pollution from industry



Pollution from roads



Leaching in from car wash and land-fill



Dump site



Grey-water discharged



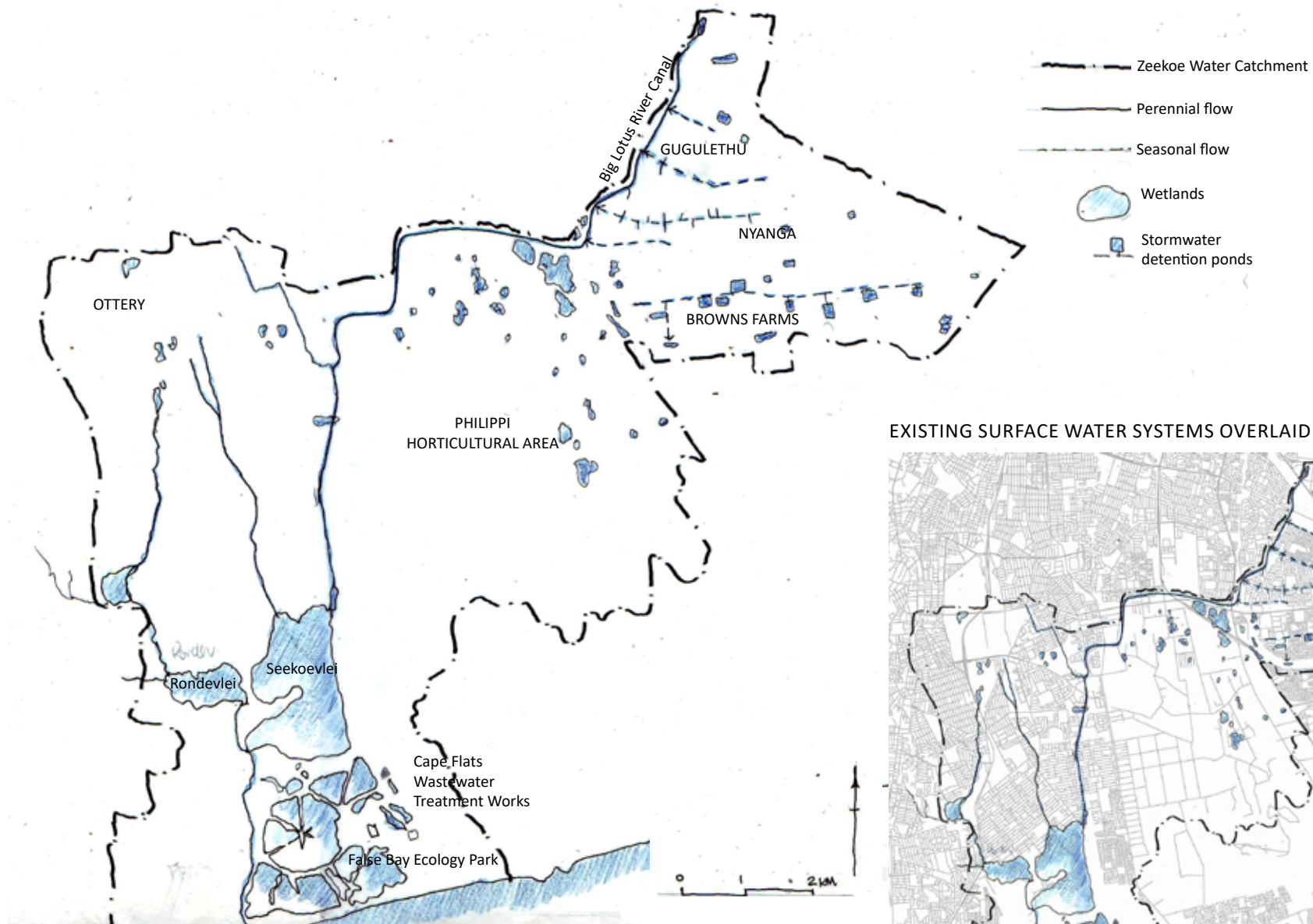
Improvised urinal



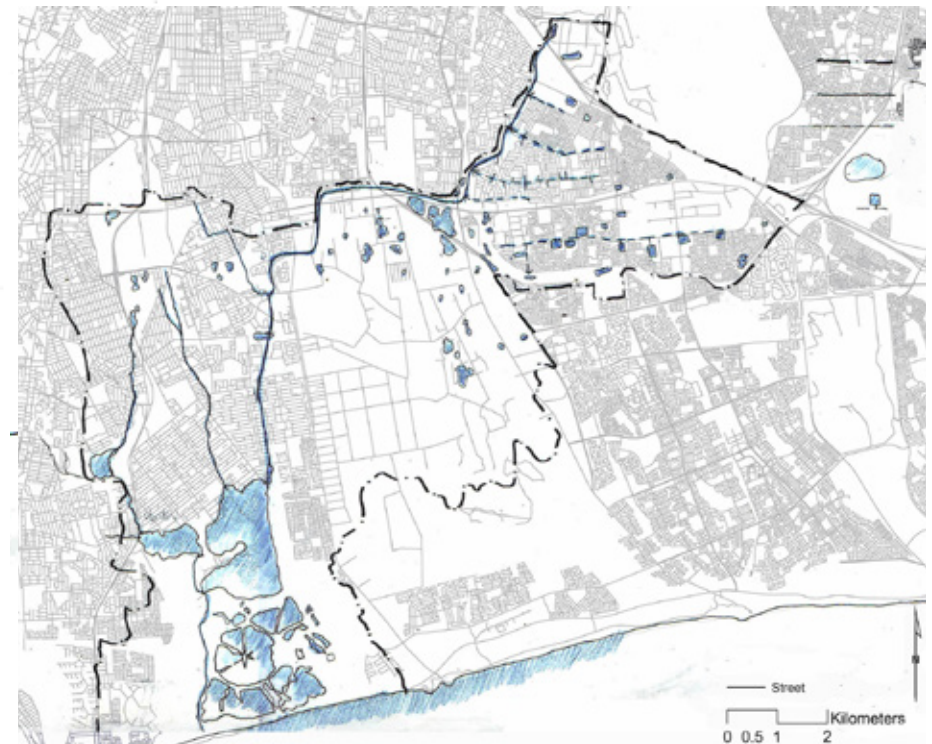
Image Sourced from Okedi, J, April 11, 2017 Presentation, Stormwater ponds as resources for water supply –case of Zeekoe Catchment in Cape Town, South Africa

7.5 WATER SYSTEMS: FROM REMOVAL TO CAPTURE

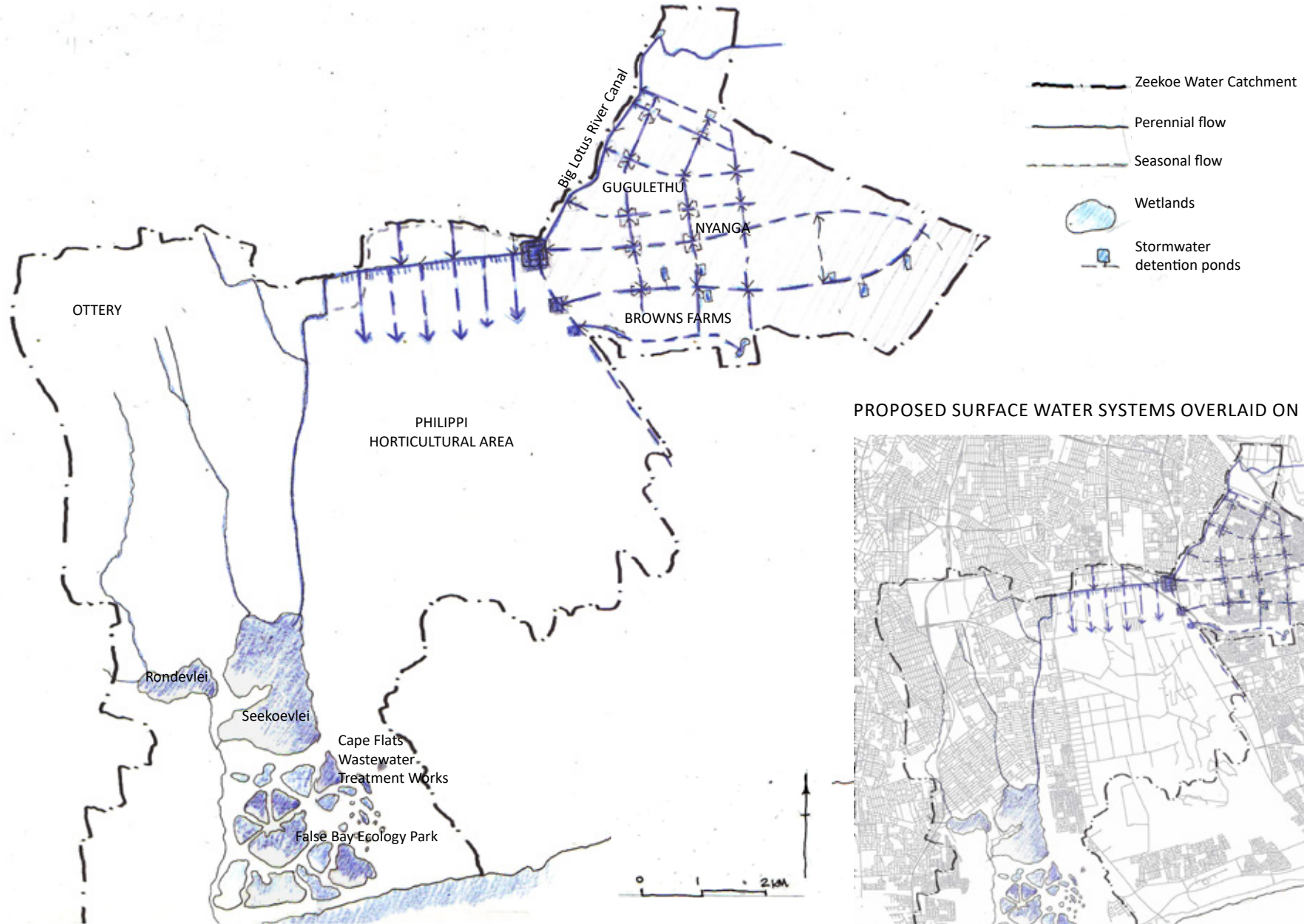
ZEEKOE WATER CATCHMENT: EXISTING SURFACE WATER SYSTEMS WITHIN THE CATCHMENT



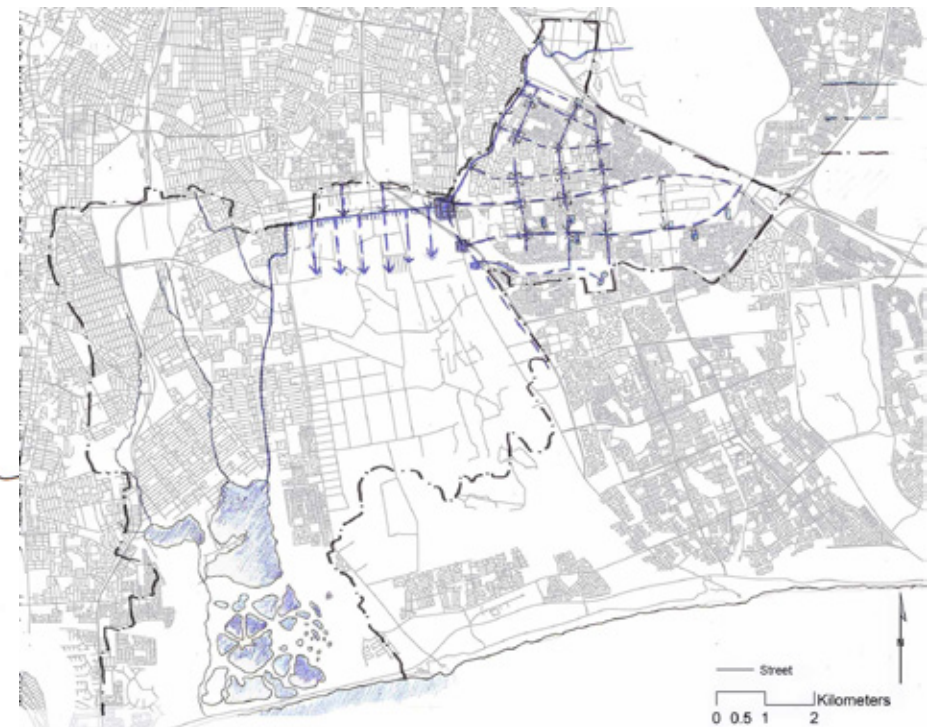
EXISTING SURFACE WATER SYSTEMS OVERLAID ON STREET MAP



SURFACE WATER SYSTEMS ALTERED TO CAPTURE AND CHANNEL WATER TO RECHARGE AQUIFER



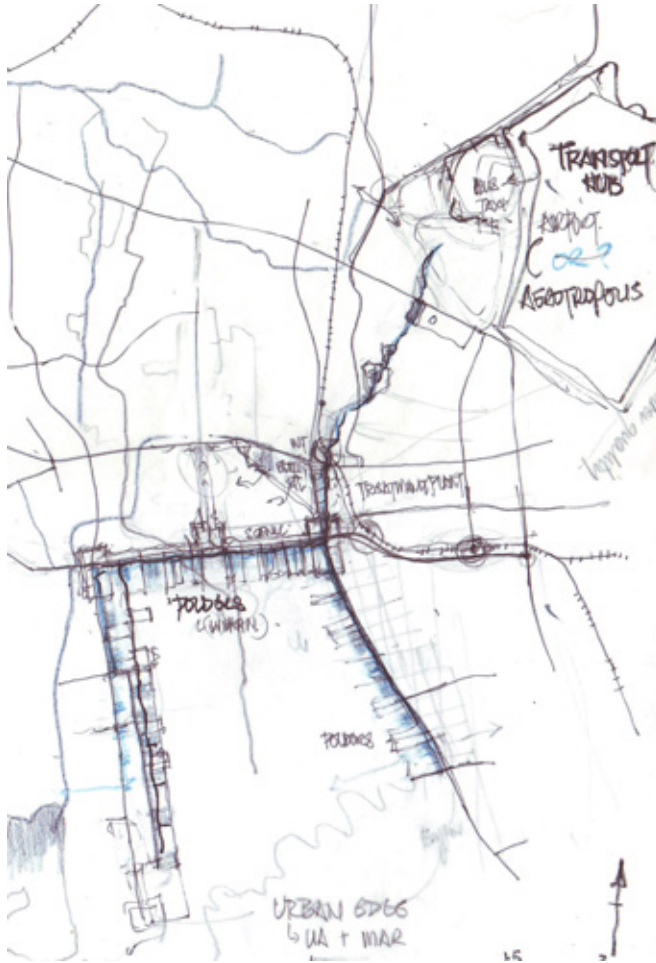
PROPOSED SURFACE WATER SYSTEMS OVERLAID ON STREET MAP



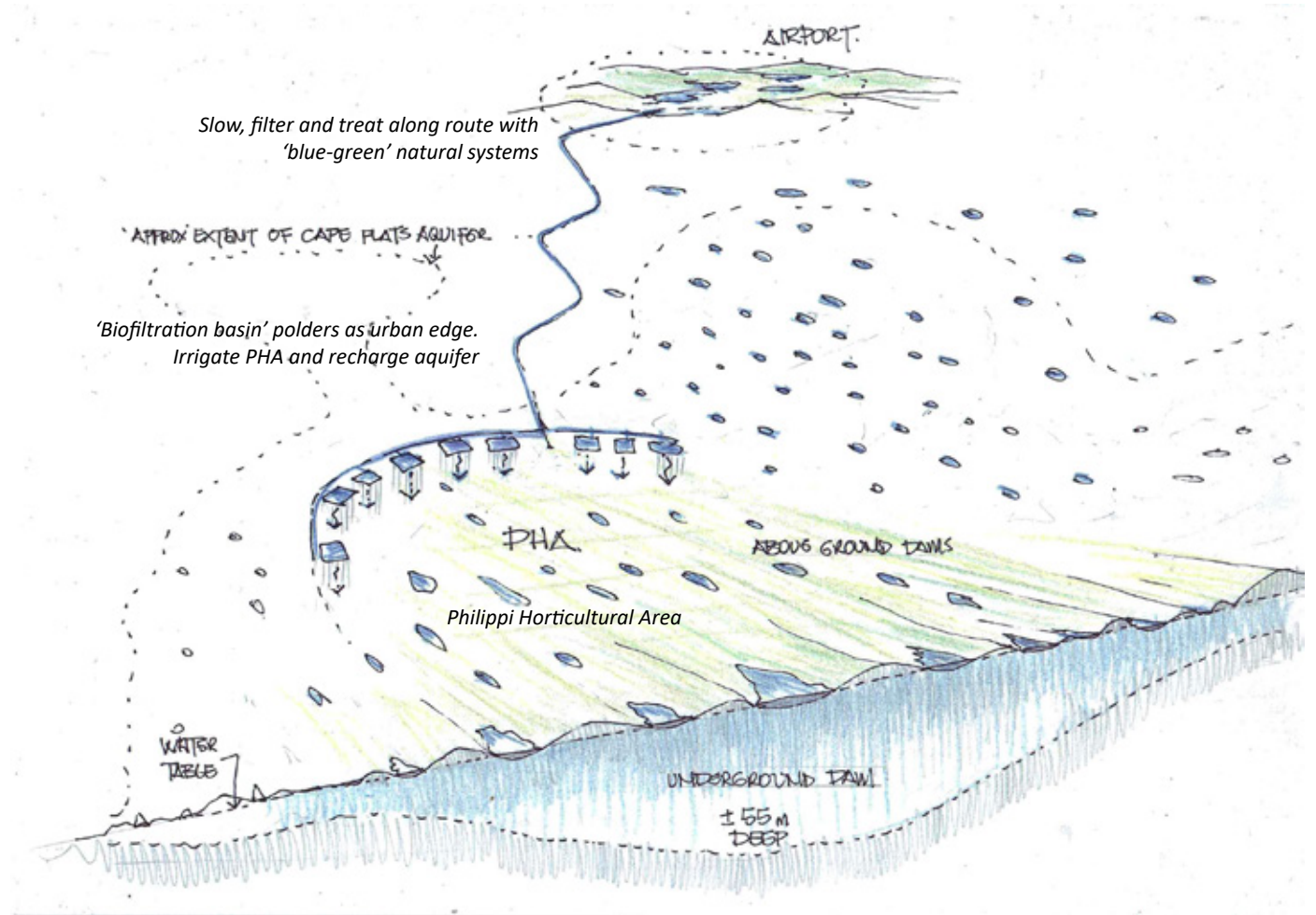
## 7.6 SPATIALLY INTEGRATING LOCAL WATER CAPTURE INTO GUGULETHU AND SURROUNDS

### INITIAL CONCEPT SKETCH

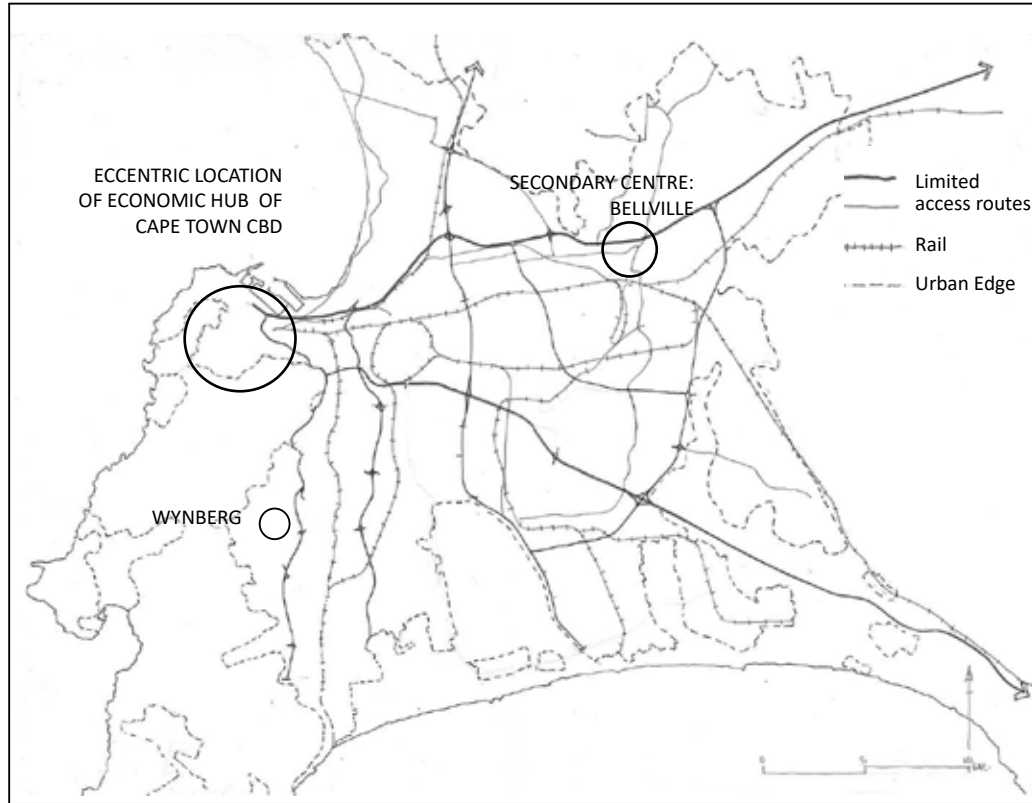
Water as place-making element, creating accessibility at strategic locations



### CONCEPT DEVELOPMENT



EXISTING: LIMITED ACCESS MOBILITY ROUTES & LIMITED ECONOMIC OPPORTUNITIES



- Existing settlement: Eccentric layout of economic centres.
- Mobility focus: parallel limited access routes at around 2km apart

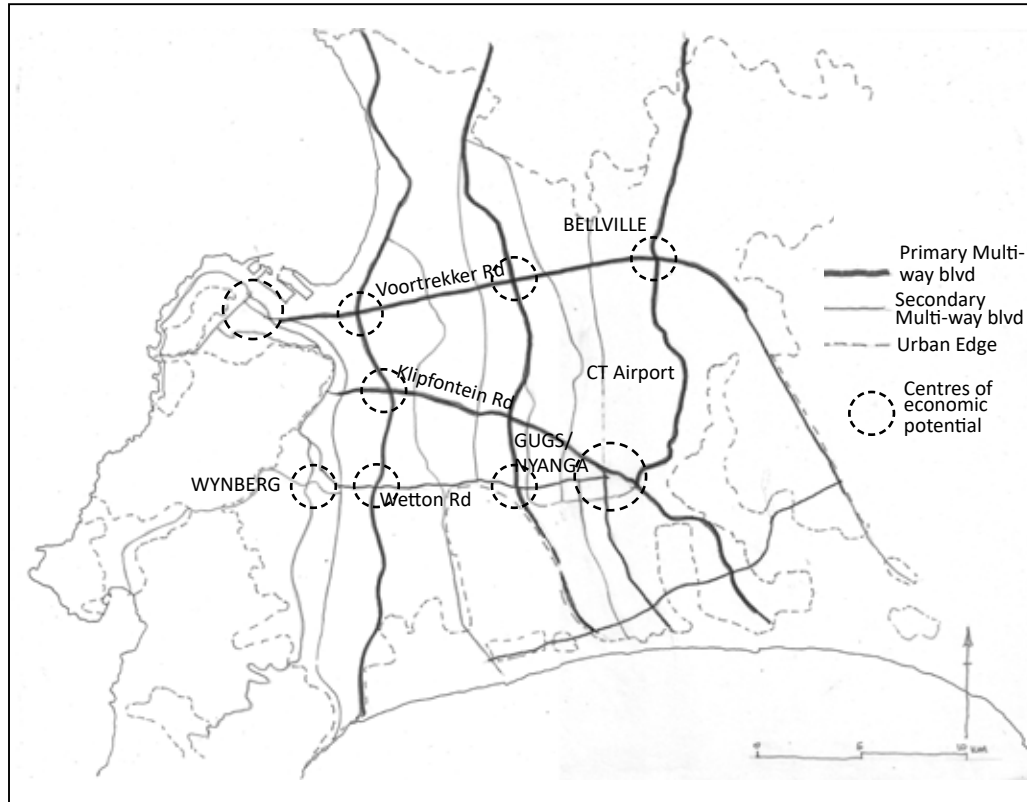
FRAGMENTED URBAN FORM RESULTING FROM MOBILITY ROUTES



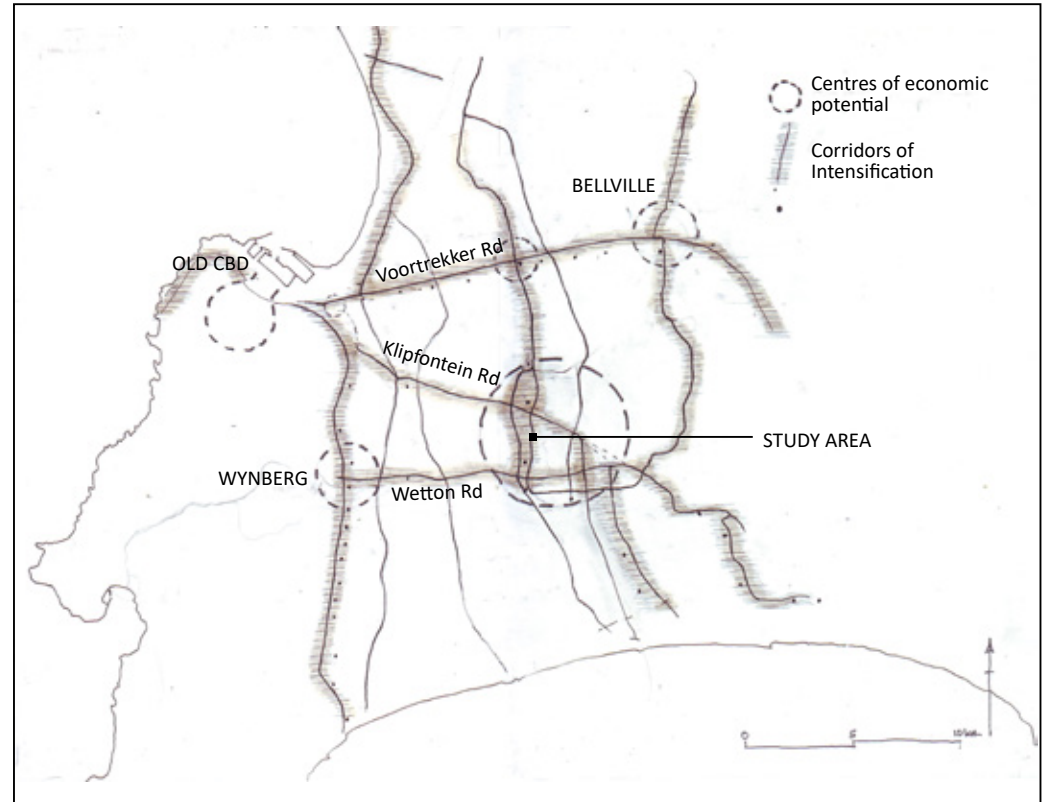
- Flow creates barriers and 'border vacuums'
- Rail and limited access routes limit integration, reinforce separation, create islands dividing communities, inhibit economic opportunities.

## 7.8 INFLOW: FROM MOBILITY TO ACCESSIBILITY

### CREATE ECONOMIC OPPORTUNITIES ACROSS THE METRO



### APPLYING AN ACCESSIBILITY SURFACE ACROSS THE METRO



- Post peal oil scenario: Focus on *Accessibility* in lieu of mobility (especially of the private car)
- Walkable distances to access economic opprtunities, public transport.
- Downgrade and hybridise existing limited access routes to connect and integrate communities (excludes N1, N2 highways)
- Limited access routes become integrators, accommodating local traffic as well as central lanes for public transport moving across metro.
- Multi-way Boulevards that includes 'local' roads link communities, remove islands. Movement routes serve as integrators, at local scale. Others serve to integrate at a metropolitan to regional scale.
- Focus on corridors of Structutral intensification, that form part of the accessibility surface.

## 8.0 DEVISING A SPATIAL FRAMEWORK FOR 'INFLOW'

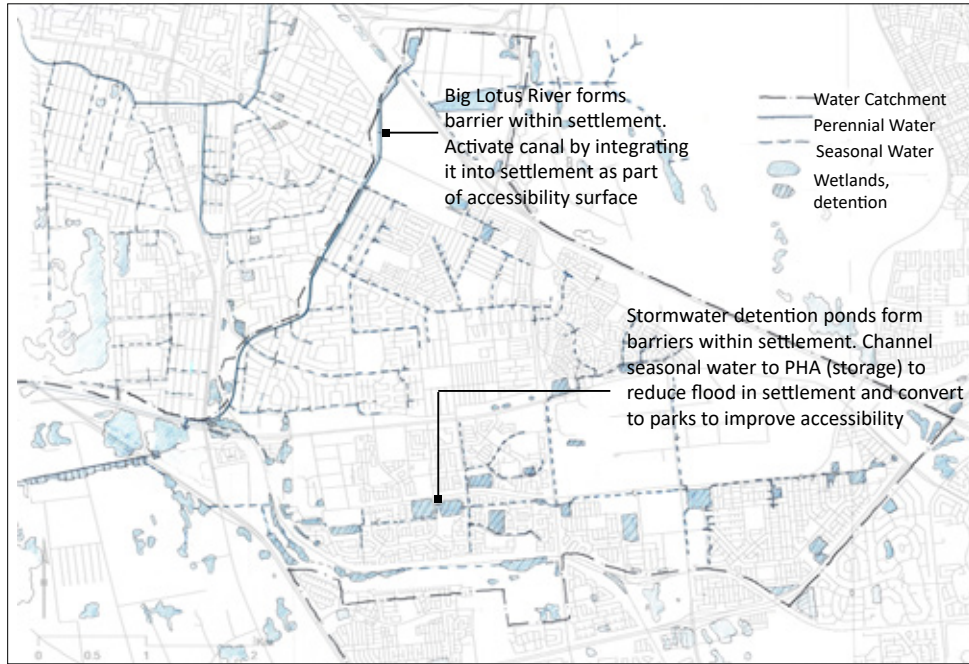
### 8.1 SUB METROPOLITAN AERIAL VIEW OF AREA OF STUDY



*InFlow: Spatially Integrating Local Water Capture into Gugulethu and surrounds, Cape Town*

8.2 INFORMANTS AND CONSTRAINTS

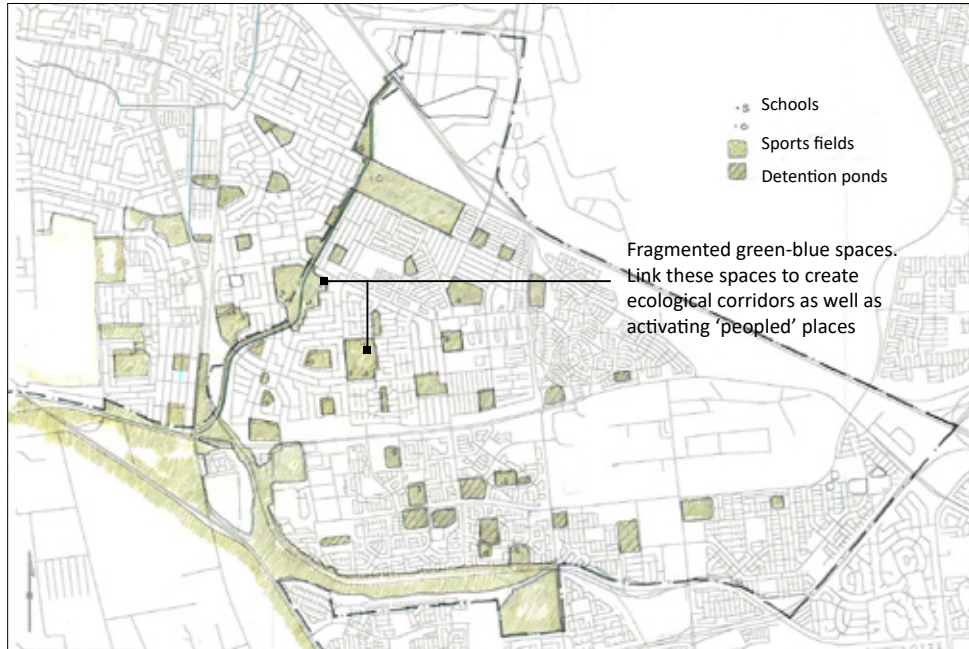
SURFACE WATER SYSTEMS



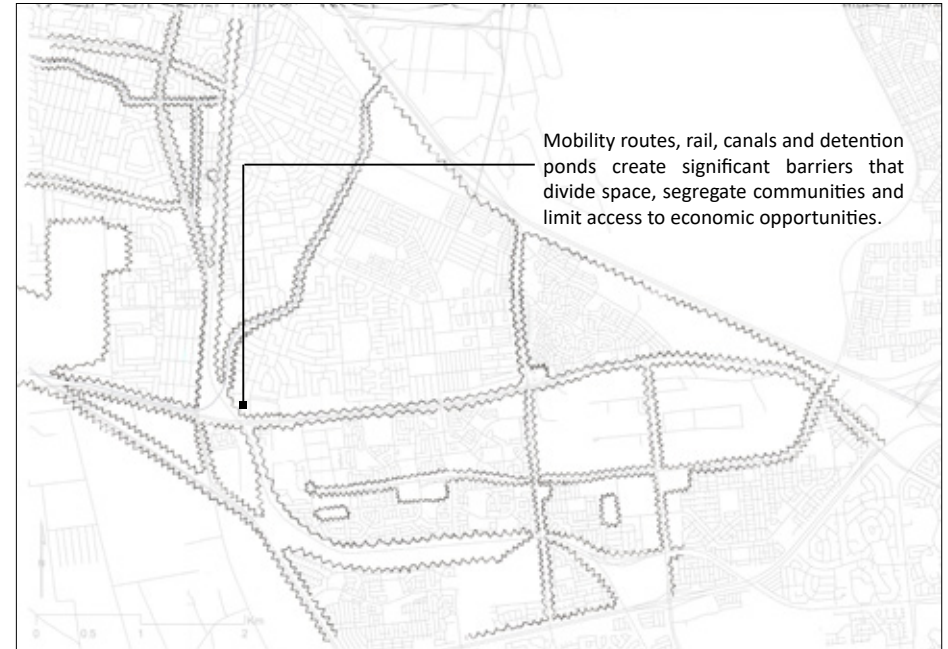
MOVEMENT SYSTEMS - RAIL, VEHICULAR



GREEN SYSTEMS

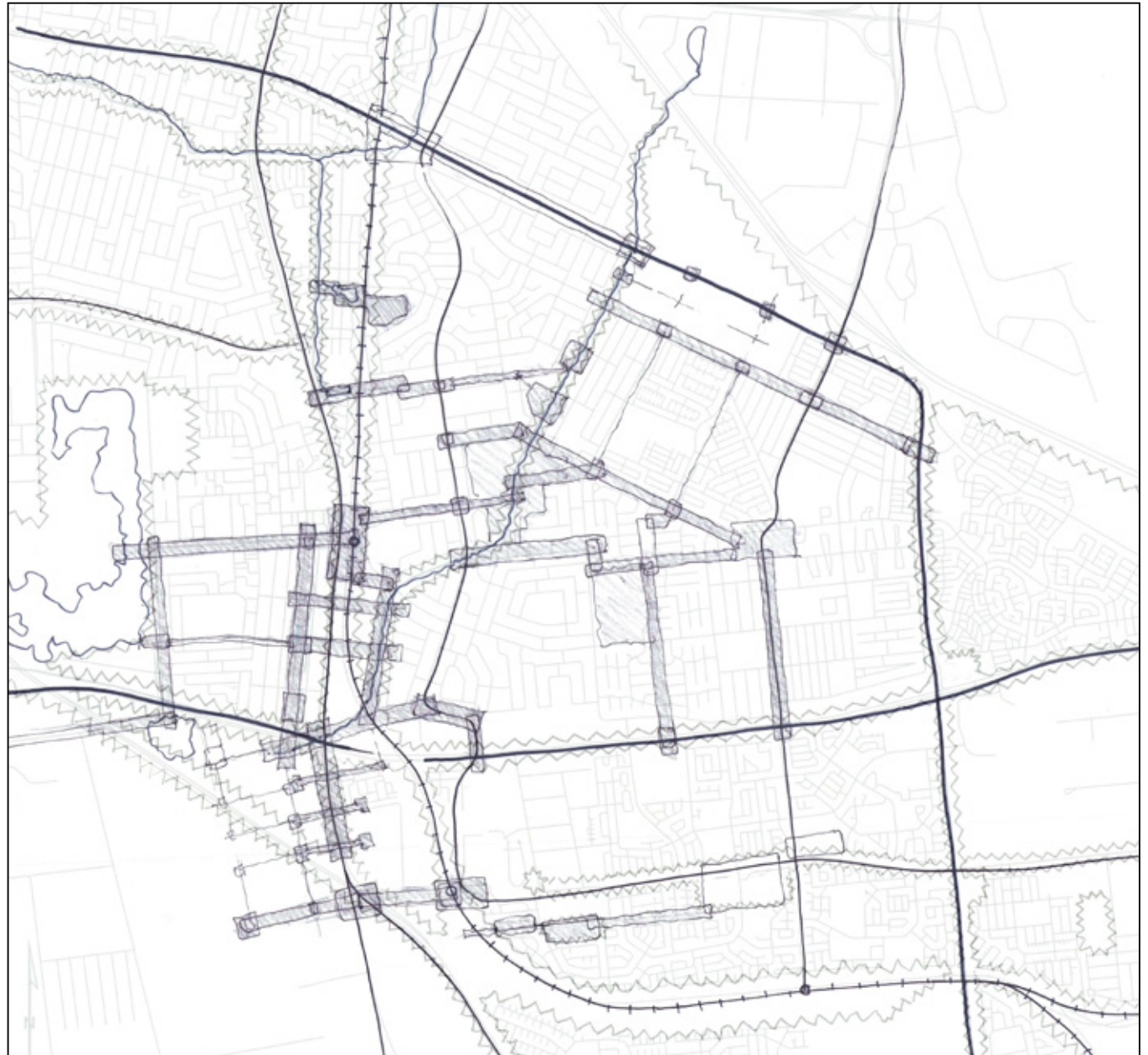


MAPPING THE BARRIERS OF FLOW



### 8.3 SEAMS TO STITCH ACROSS BARRIERS

To address the problem in our cities of 'flow' as barrier (whether of water or vehicles) and the border vacuums that have developed, Jane Jacobs suggests the need to 'seam': we need to stitch these seamed edges together with lines of cross-movement (Mehaffy, et al, 2015:206) to create accessibility and a more permeable pedestrian network.



*Diagram showing Stitches, strategically located to cross barriers and border vacuums and create permeability and access to opportunities*

8.4 INTEGRATING & STITCHING LOCAL WATER CAPTURE INTO GUGULETHU & SURROUNDS: A SPATIAL FRAMEWORK



## 9.0 INFLOW AS URBAN DESIGN FRAMEWORK

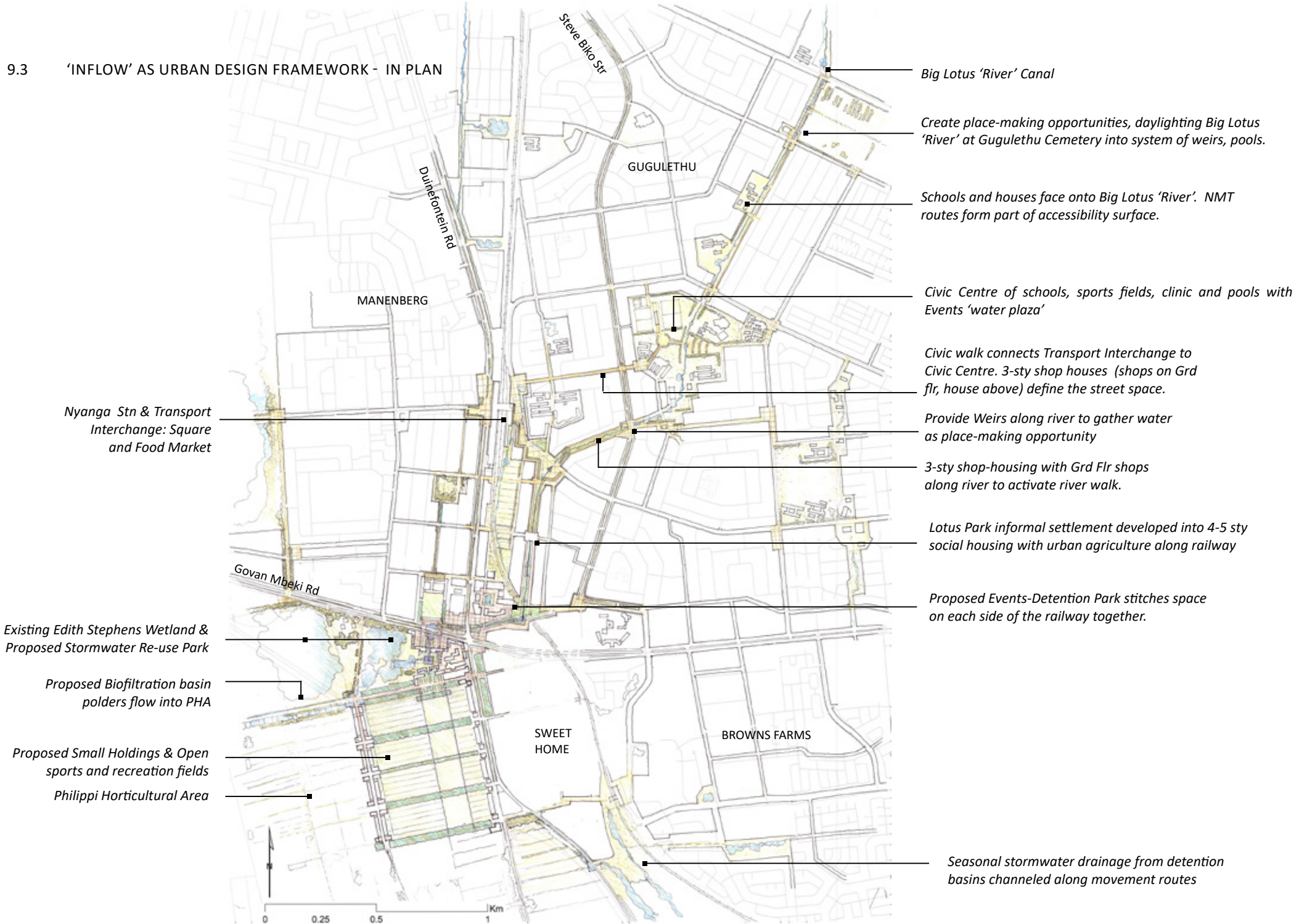
### 9.1 AERIAL VIEW OF EXISTING STUDY AREA



### 9.2 'INFLOW' AS URBAN DESIGN FRAMEWORK - OVERLAID ON STUDY AREA



9.3 'INFLOW' AS URBAN DESIGN FRAMEWORK - IN PLAN



Big Lotus 'River' Canal

Create place-making opportunities, daylighting Big Lotus 'River' at Gugulethu Cemetery into system of weirs, pools.

Schools and houses face onto Big Lotus 'River'. NMT routes form part of accessibility surface.

Civic Centre of schools, sports fields, clinic and pools with Events 'water plaza'

Civic walk connects Transport Interchange to Civic Centre. 3-sty shop houses (shops on Grd flr, house above) define the street space.

Provide Weirs along river to gather water as place-making opportunity

3-sty shop-housing with Grd Flr shops along river to activate river walk.

Lotus Park informal settlement developed into 4-5 sty social housing with urban agriculture along railway

Proposed Events-Detention Park stitches space on each side of the railway together.

Nyanga Stn & Transport Interchange: Square and Food Market

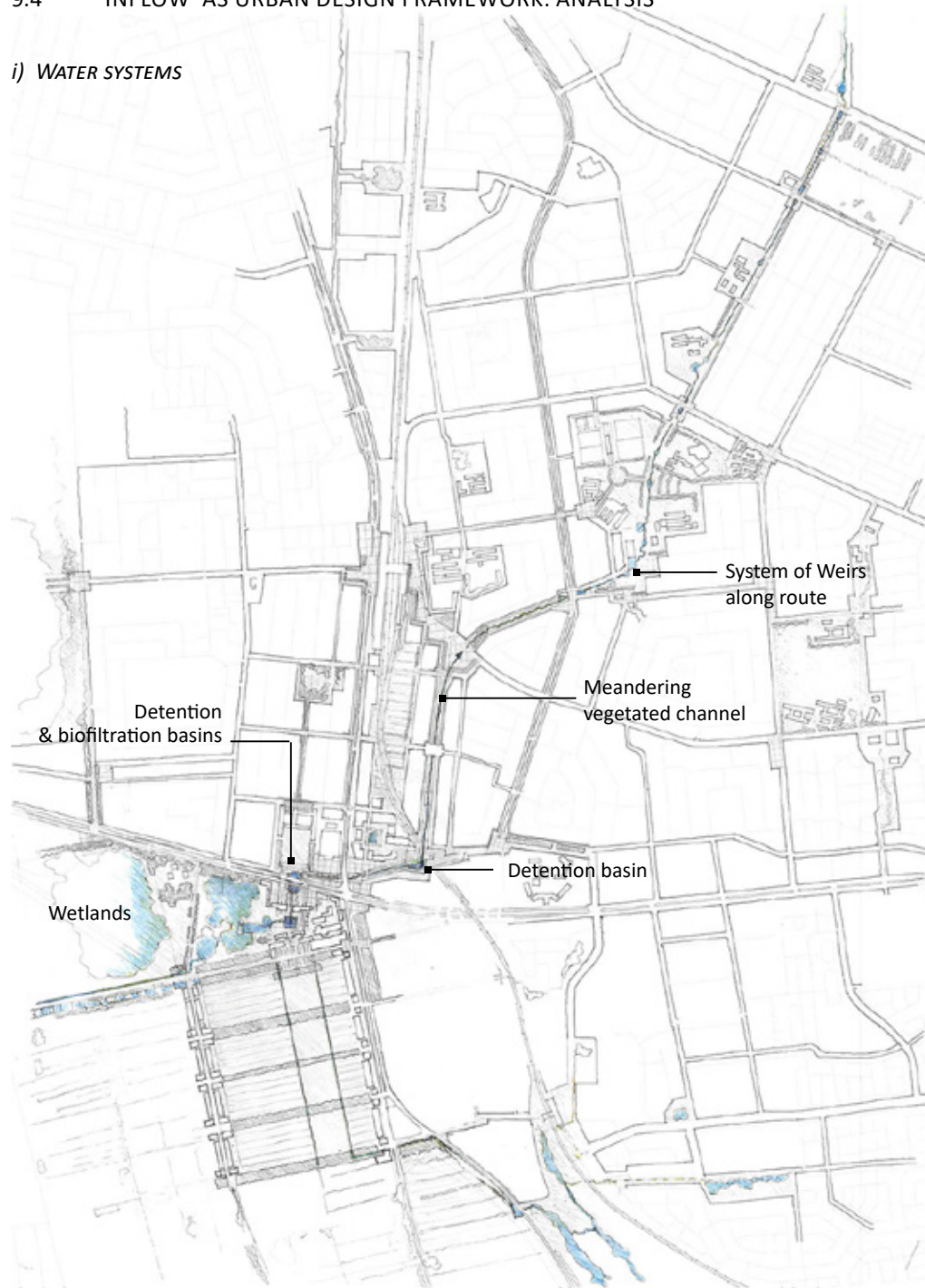
Existing Edith Stephens Wetland & Proposed Stormwater Re-use Park

Proposed Biofiltration basin polders flow into PHA

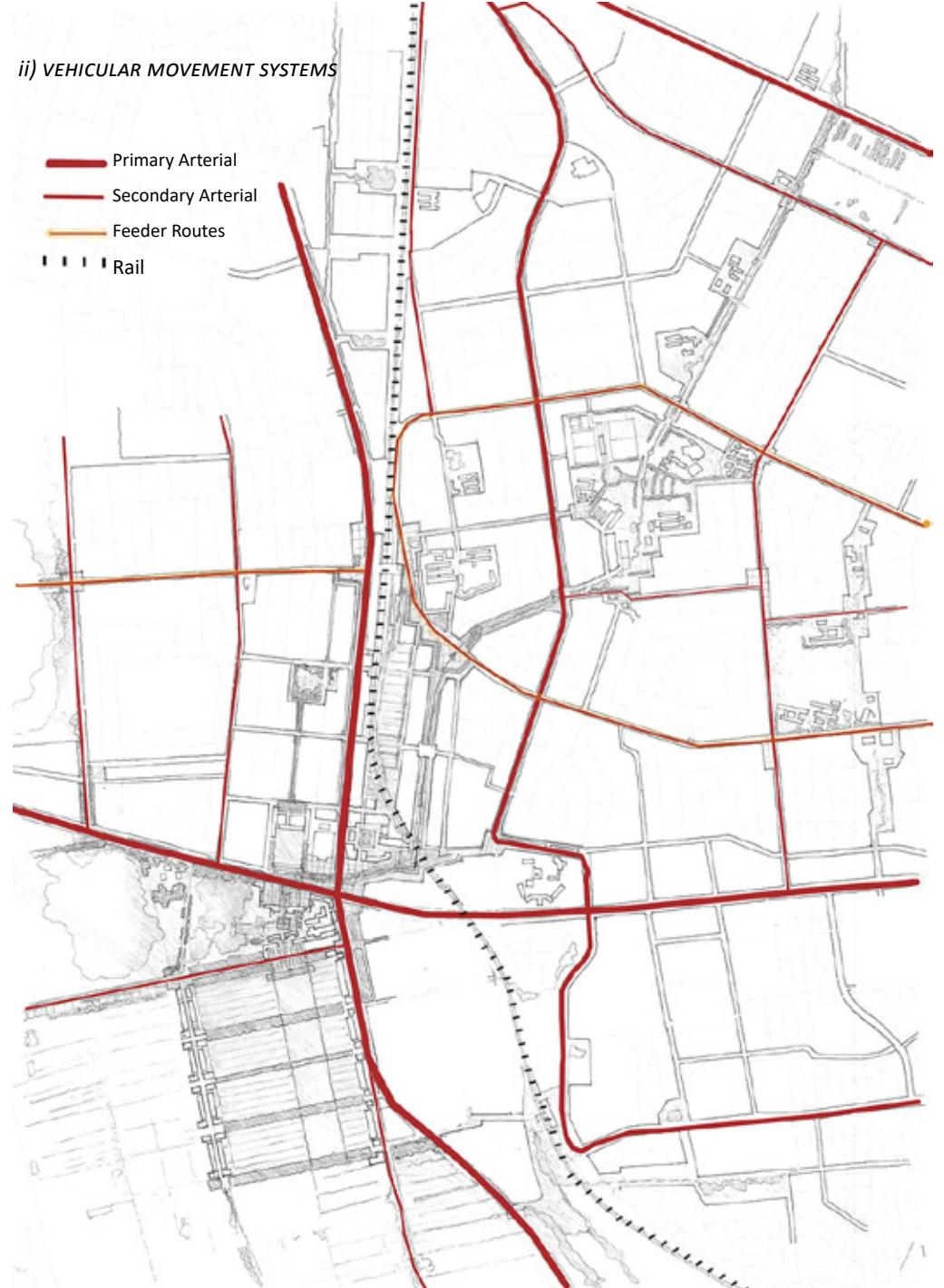
Proposed Small Holdings & Open sports and recreation fields  
Philippi Horticultural Area

Seasonal stormwater drainage from detention basins channeled along movement routes

i) WATER SYSTEMS

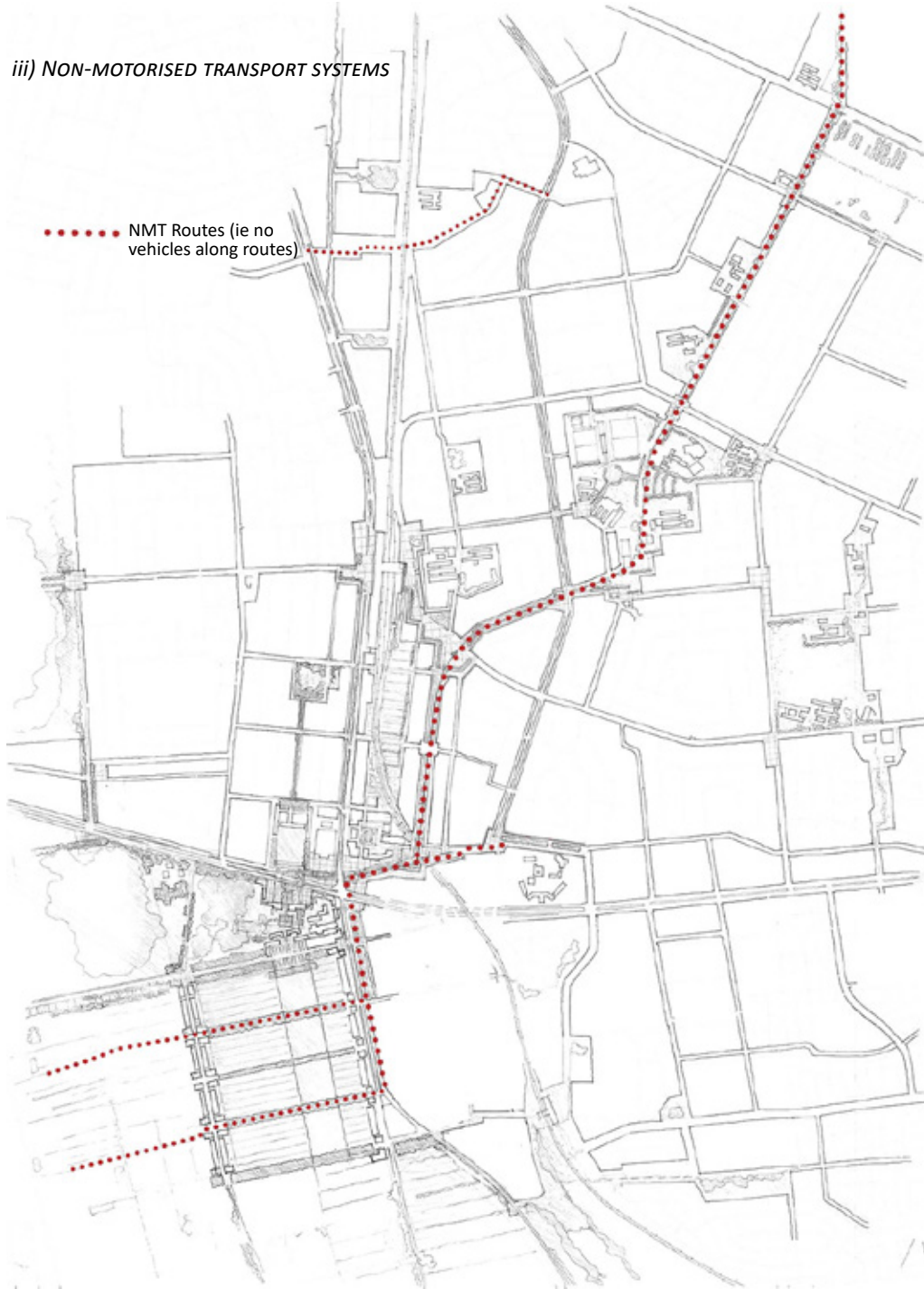


ii) VEHICULAR MOVEMENT SYSTEMS



iii) NON-MOTORISED TRANSPORT SYSTEMS

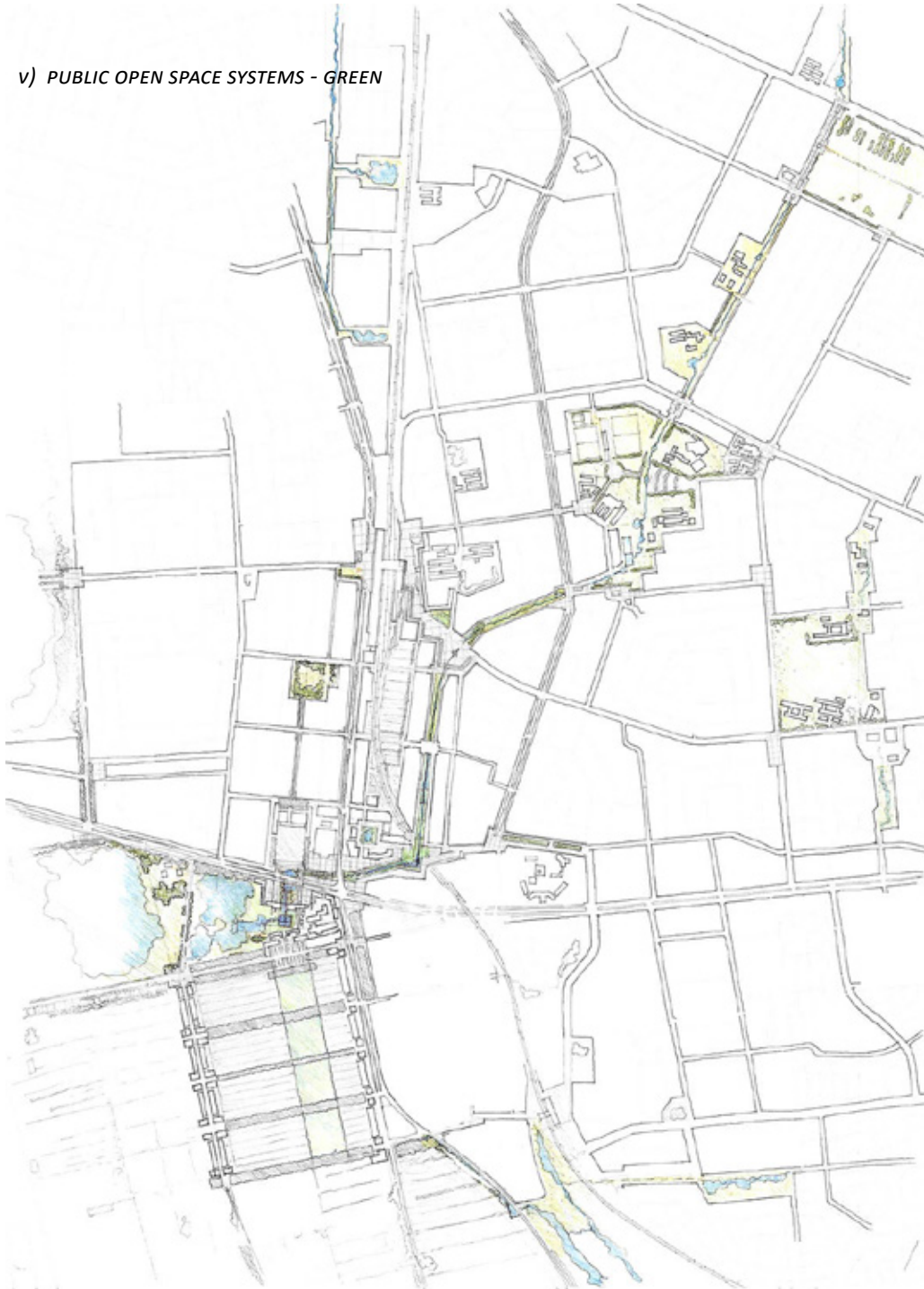
..... NMT Routes (ie no vehicles along routes)



iv) PUBLIC OPEN SPACE SYSTEMS - PLAZAS



v) PUBLIC OPEN SPACE SYSTEMS - GREEN

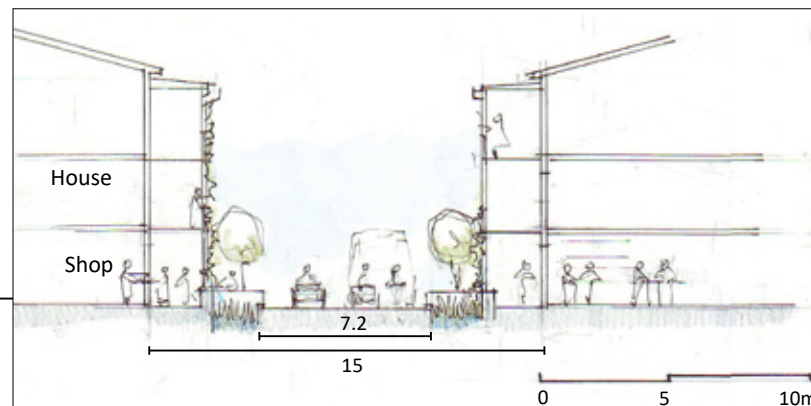


vi) URBAN AGRICULTURE



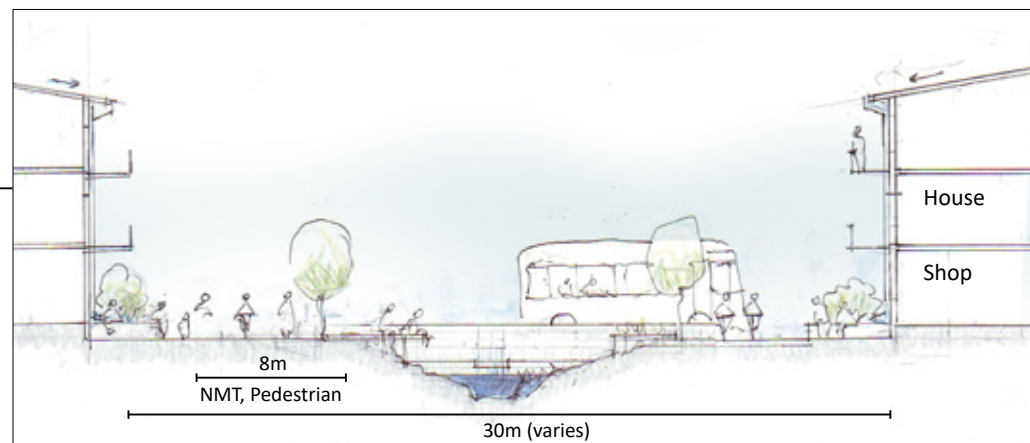
vii) TREED AVENUES & WINDBREAKS



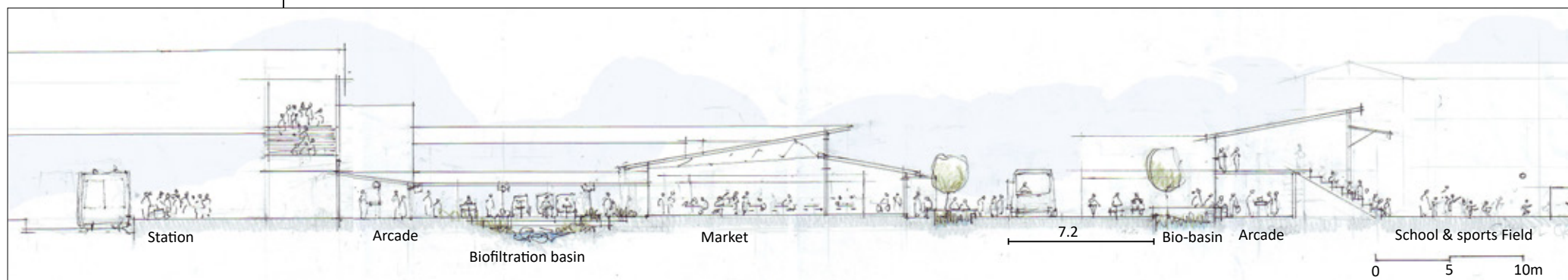


Section through street showing water collection infrastructure: Water collected from roofs, into biofiltration planters that form seat-walls. Swales carry all run-off to detention areas

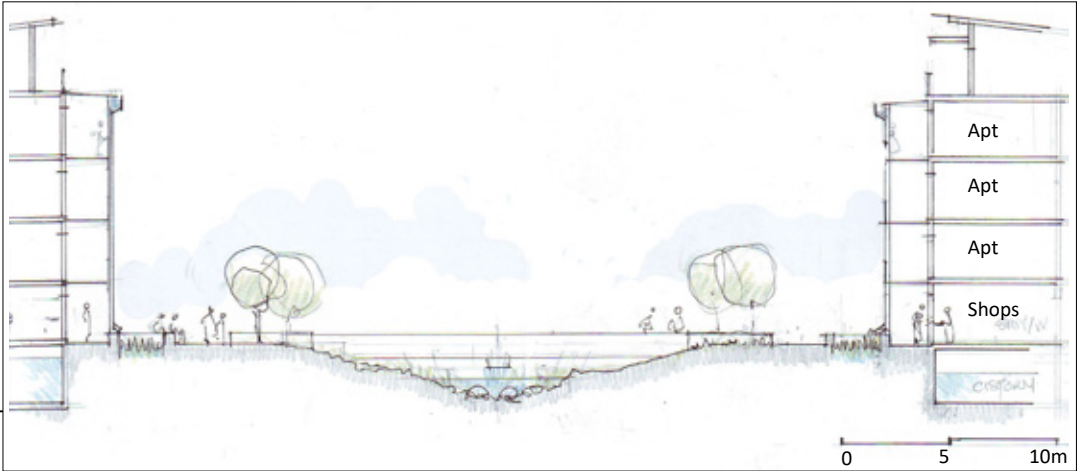
SECTION THROUGH TYPICAL STREET



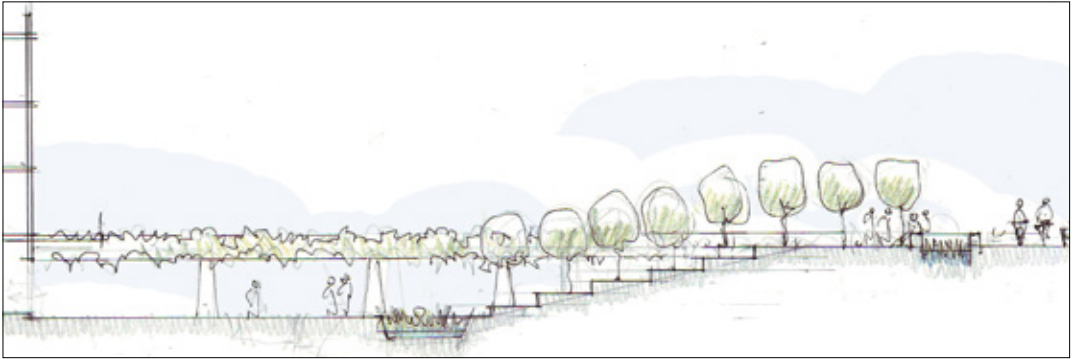
SECTION THROUGH 'WATER WALK'



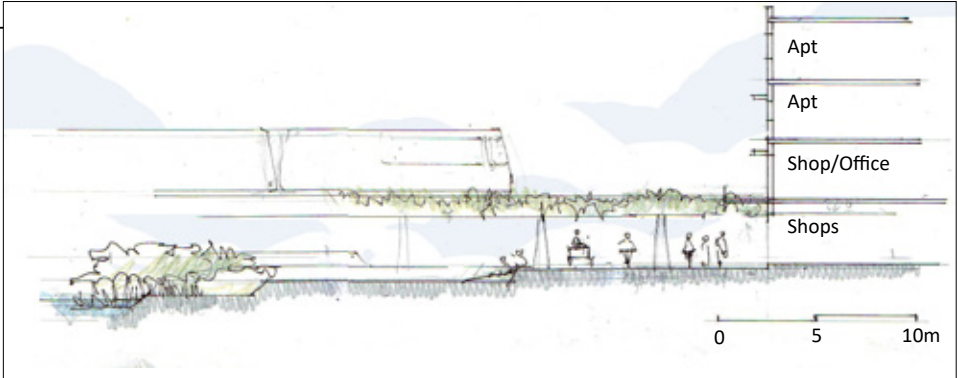
SECTION THROUGH TRANSPORT INTERCHANGE



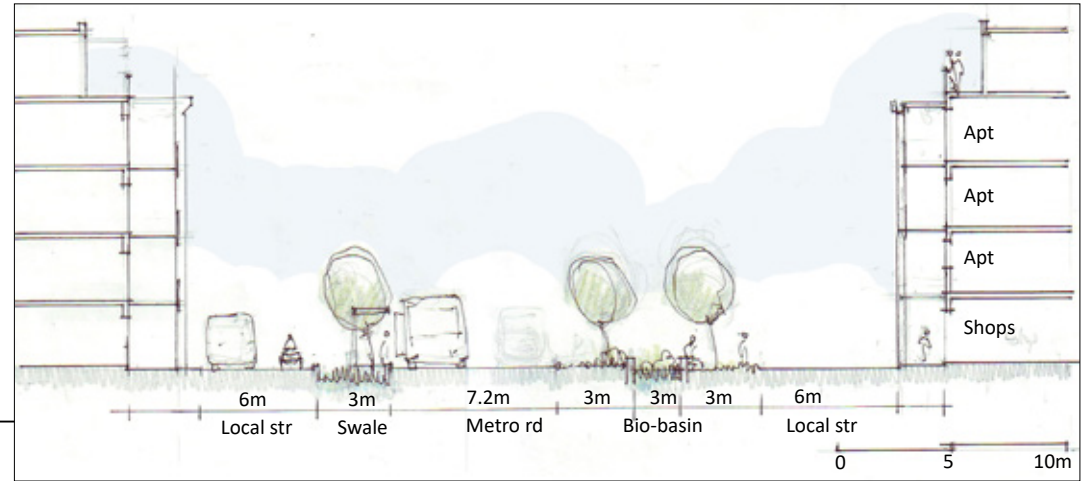
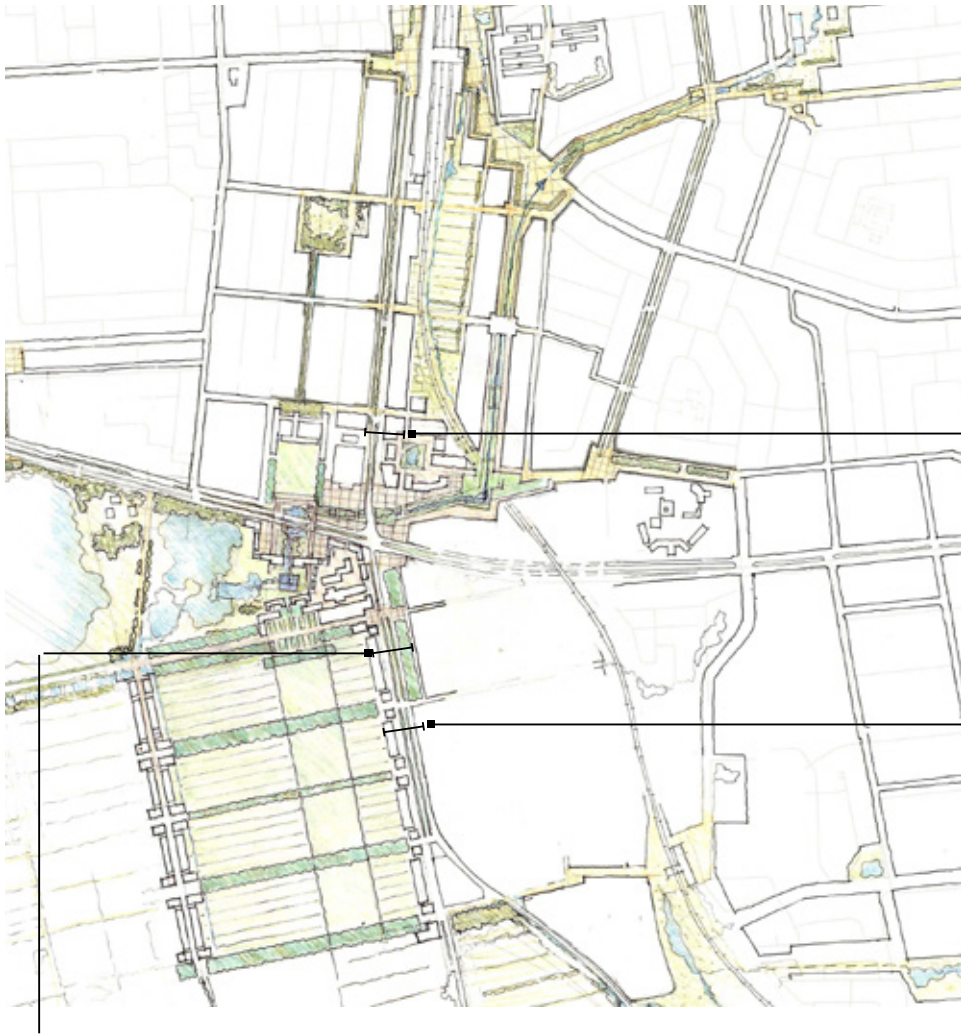
SECTION THROUGH LOTUS PARK RIVER WALK: 4-5 STY SHOPS & SOCIAL HOUSING



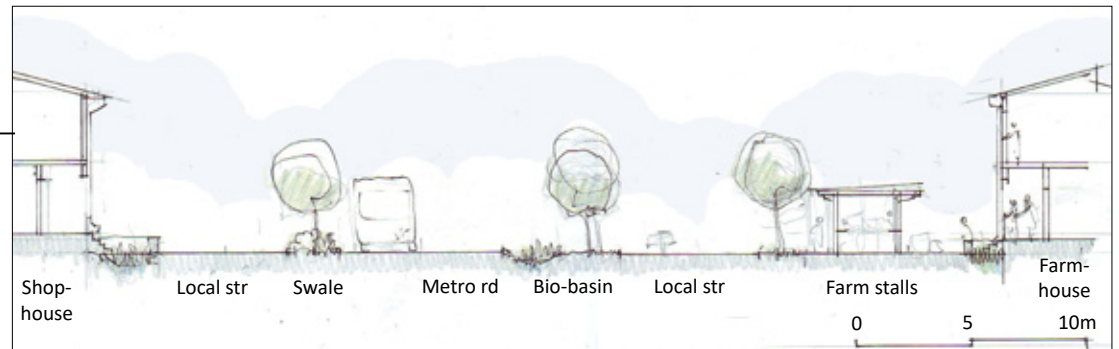
SECTION APPROACHING UNDERPASS



CROSS SECTION THROUGH EVENTS PLAZA/DETENTION BASIN



SECTION THROUGH UPPER DUINEFONTEIN



SECTION THROUGH LOWER DUINEFONTEIN



SECTION THROUGH UPPER DUINEFONTEIN - ORCHARD PLAZA



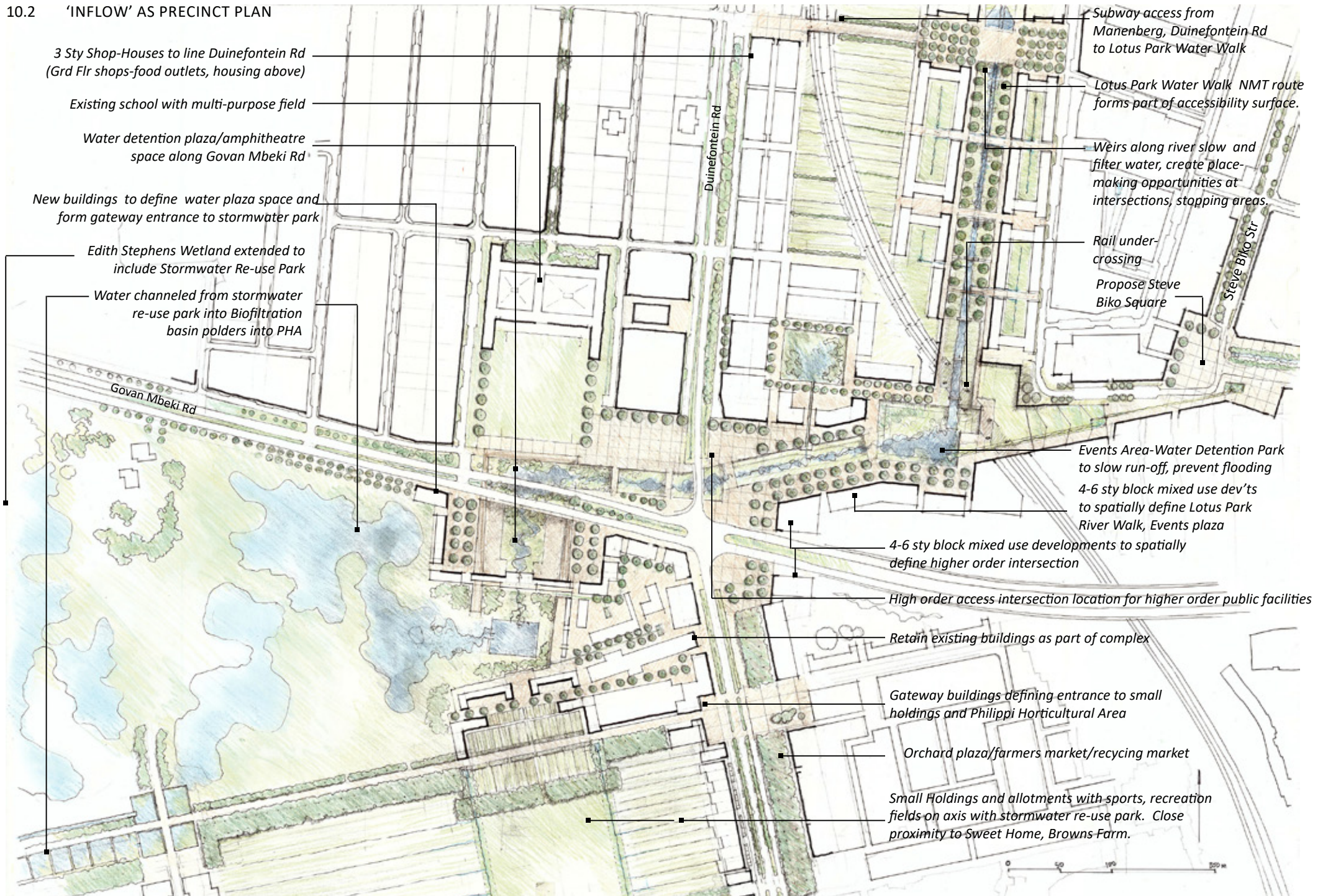
## 10.0 INFLOW: APPLIED AT THE PRECINCT SCALE

### 10.1 AERIAL VIEW OF EXISTING AREA



*InFlow: Spatially Integrating Local Water Capture into Gugulethu and surrounds, Cape Town*

10.2 'INFLOW' AS PRECINCT PLAN



- AS VIEWED FROM LOTUS PARK RIVER WALK LOOKING SOUTH



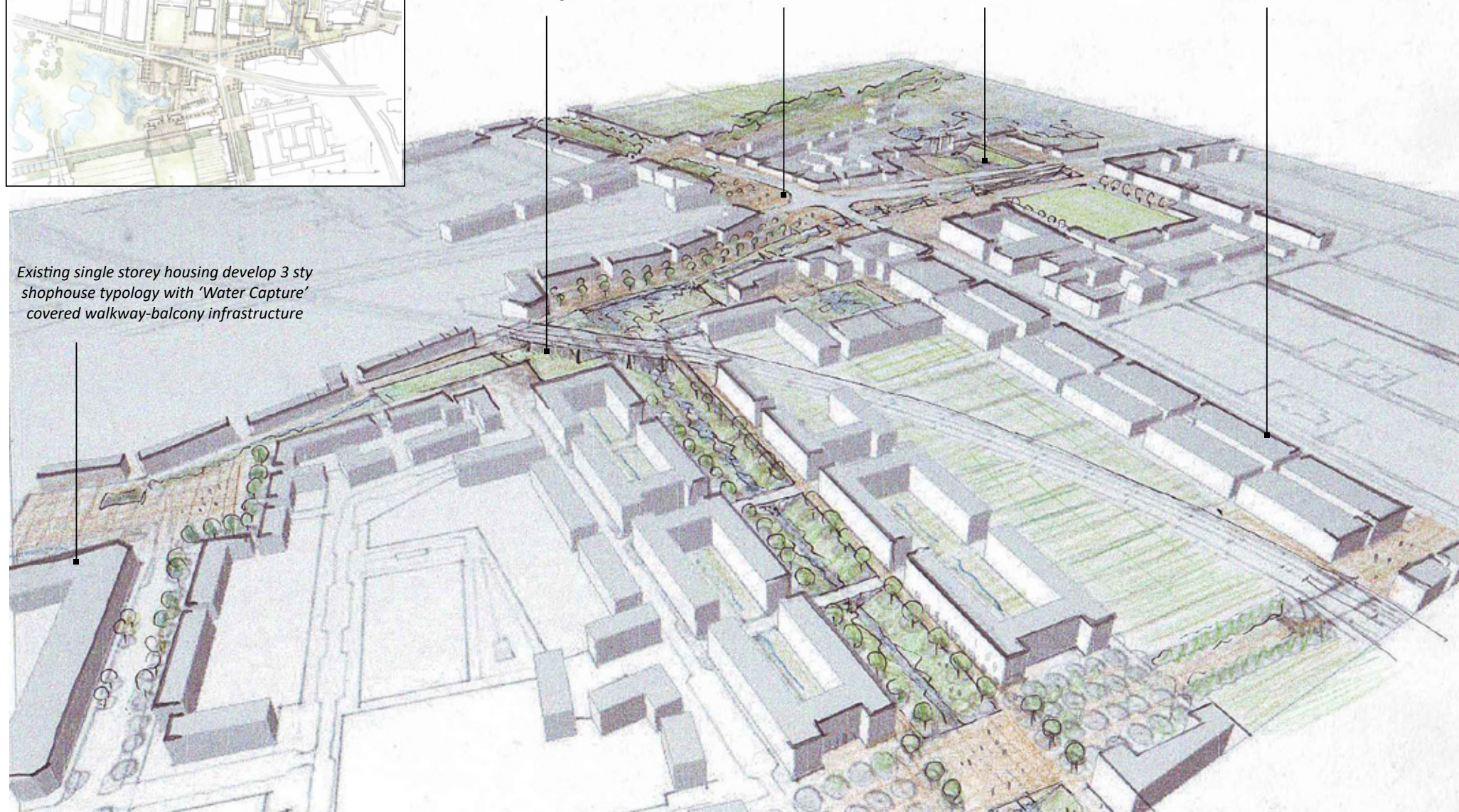
Rail under-crossing

High order access intersection as location for higher order public facilities

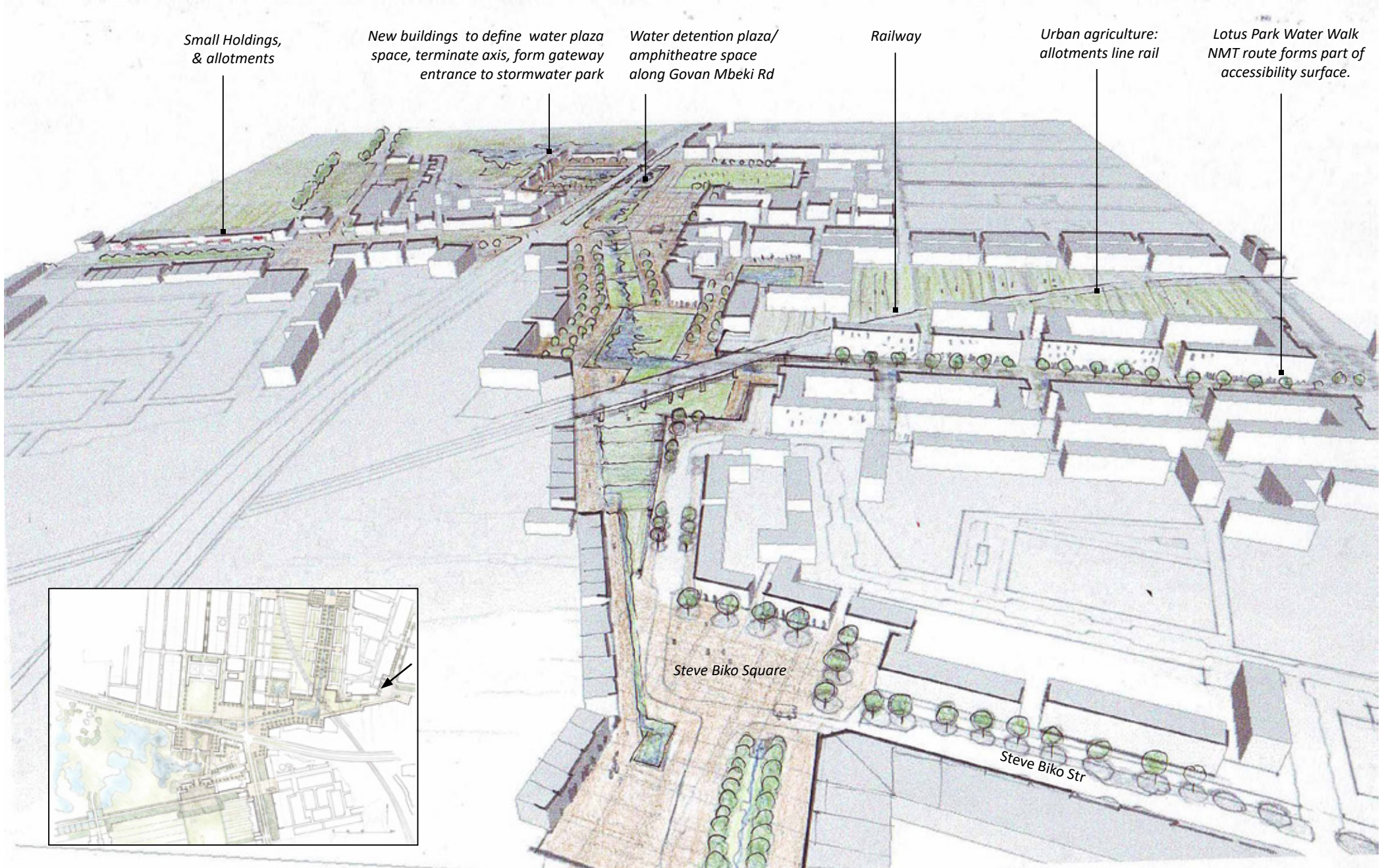
Water detention plaza/ amphitheatre space along Govan Mbeki Rd

3 Sty Shop-Houses to line Duinefontein Rd (Grd Flr shops-food outlets, housing above)

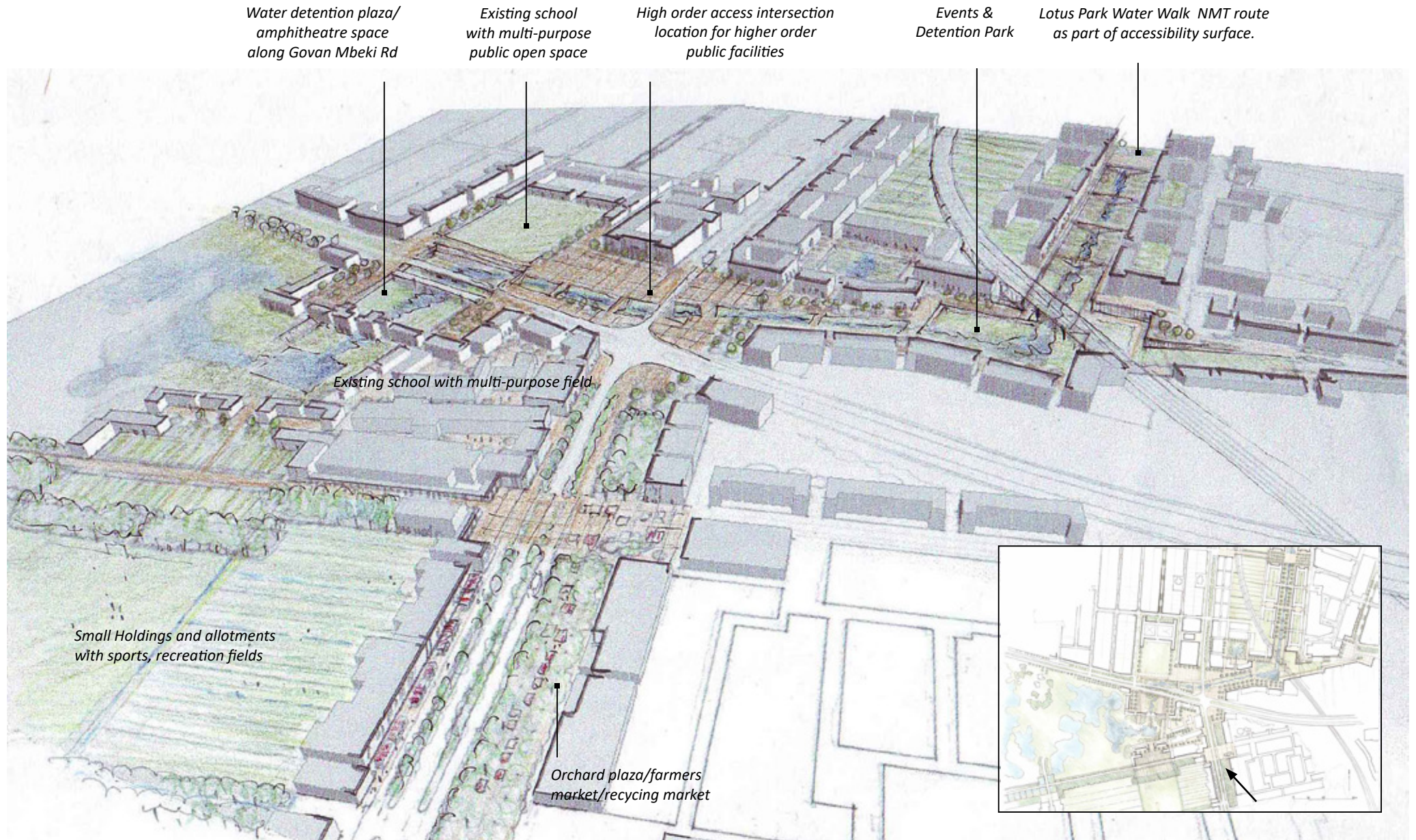
Existing single storey housing develop 3 sty shophouse typology with 'Water Capture' covered walkway-balcony infrastructure



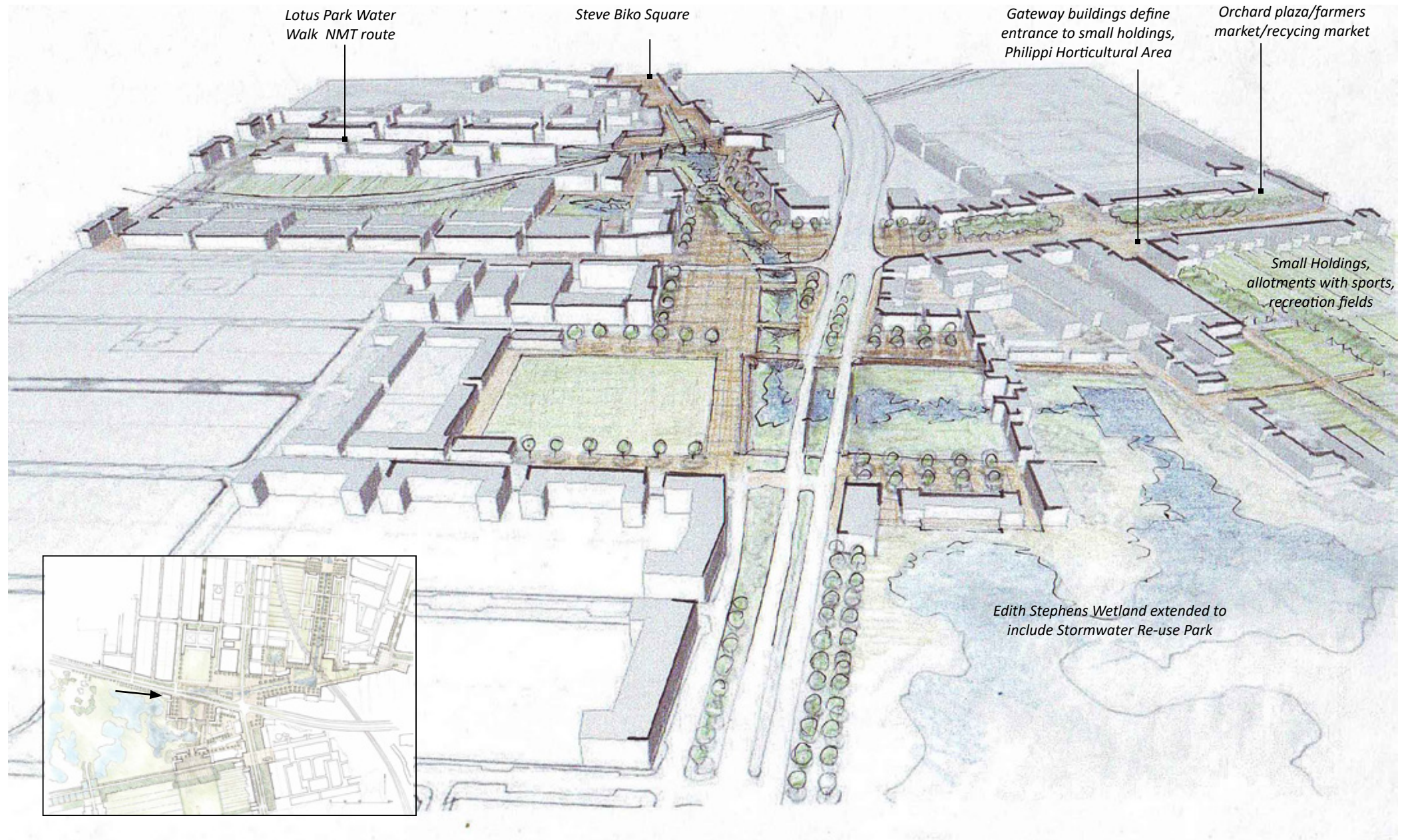
- AS VIEWED FROM STEVE BIKO STREET LOOKING WEST TO GOVAN MBEKI RD



- LOOKING NORTH UP DUINEFONTEIN RD

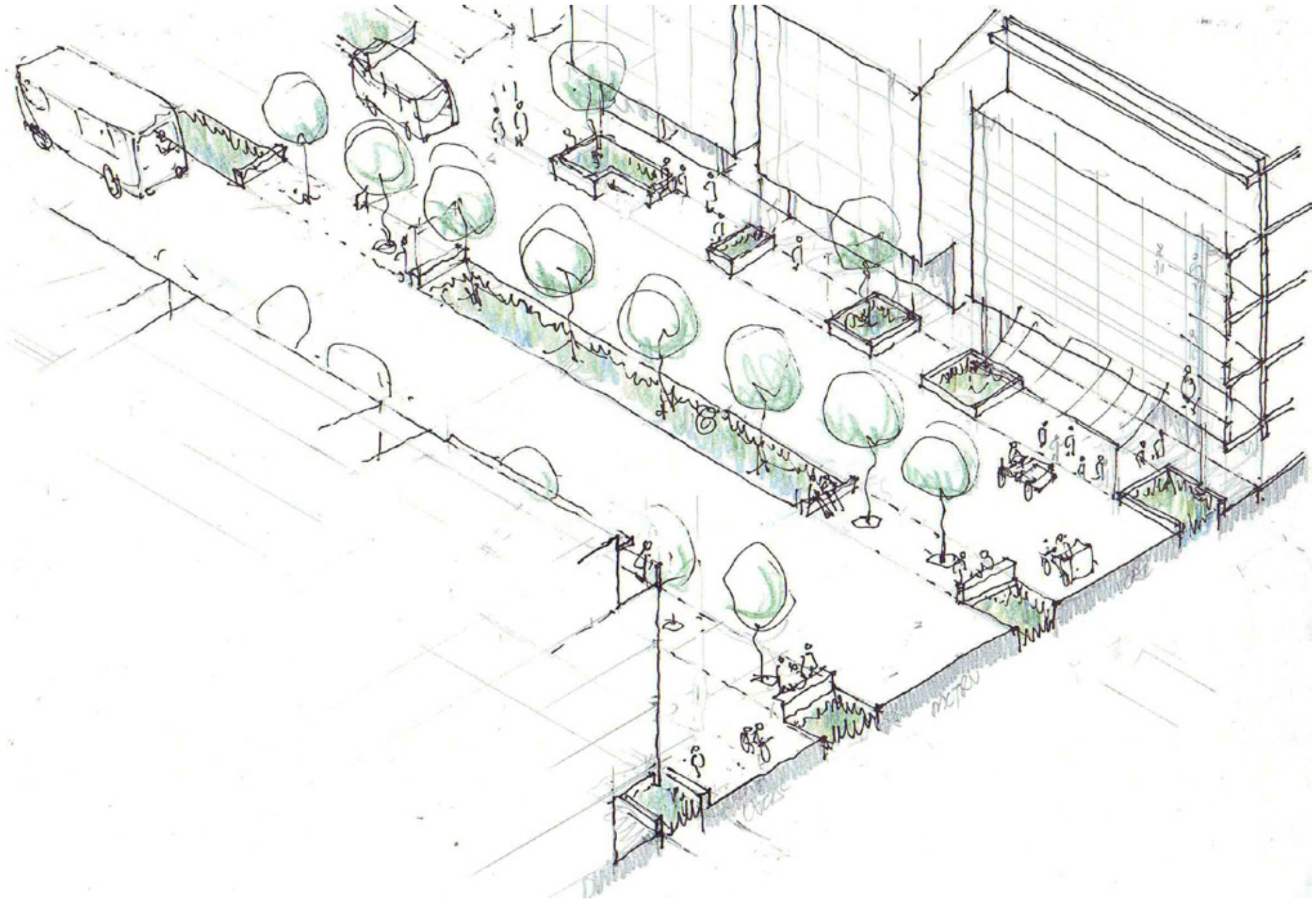


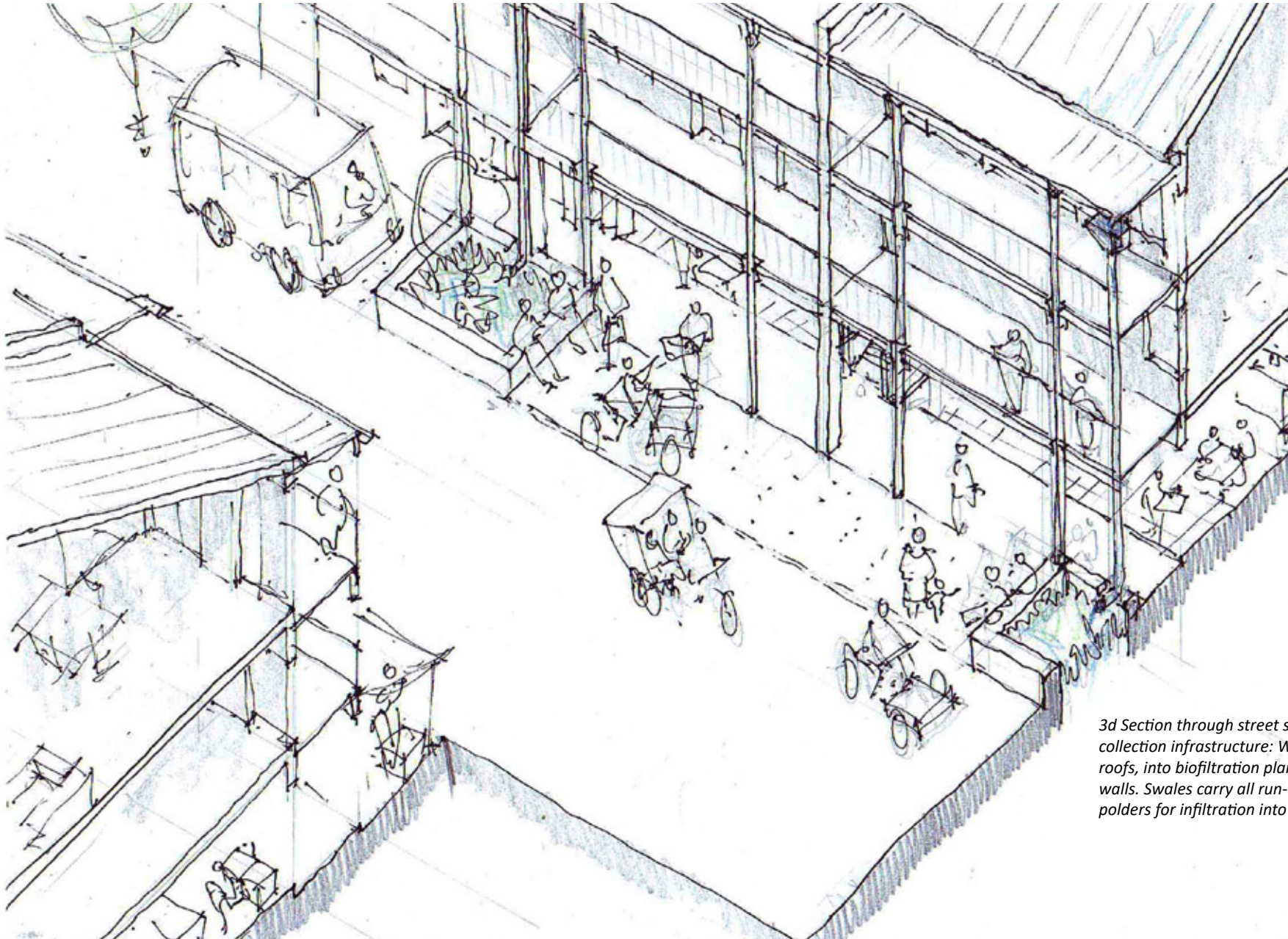
- LOOKING EAST ALONG GOVAN MBEKI RD



10.4 'INFLOW': LOCAL WATER CAPTURE IN DETAIL

WATER CAPTURE INFRASTRUCTURE AS BOULEVARD





3d Section through street showing water collection infrastructure: Water collected from roofs, into biofiltration planters that form seat-walls. Swales carry all run-off to biofiltration polders for infiltration into aquifer.

## 11.0 INFLOW: THE CONCLUSION

An 'Inflow' approach that incorporates the surface water systems (including stormwater) as part of an 'accessibility surface', provides a suitable basis for structurally and spatially integrating local water capture into settlement.

Furthermore it addresses the problem of barriers of flow that spatially segregate and reduce accessibility.

It does this by providing a geometry of points and lines that form part of a hierarchical system in which 'different levels of access' create 'different types of opportunities'(Dewar, 2015:240) allowing within it, a gradation from very public to private spaces.

'Inflow' therefore creates the opportunities for stopping or pause moments that allow for permeability and improved access to various opportunity by providing seams that stitch across the existing 'barriers of flow'.

### A WORLD ENVISAGED



LOTUS PARK WATER WALK



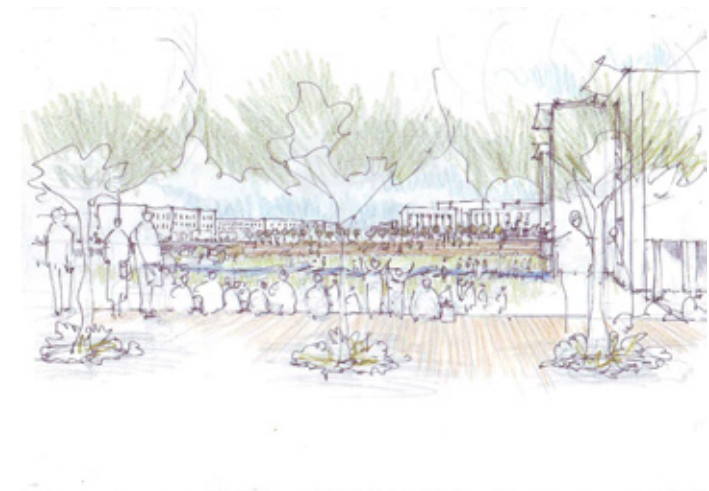
EVENTS & DETENTION PARK AT RAILWAY UNDERCROSSING



DUINEFONTEIN BOULEVARD LOOKING SOUTH



DUINEFONTEIN BLVD FARMERS & RECYCLING MARKET



WATER PLAZA & PERFORMANCE SPACE ALONG GOVAN MBEKI RD

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13.0 APPENDICES

13.1 APPENDIX A

**UNIVERSITY OF CAPE TOWN**  
**MEMORANDUM OF UNDERSTANDING (MOU)**  
**between the**  
**POSTGRADUATE STUDENT AND SUPERVISOR**

**FIRST YEAR OF REGISTRATION FOR MASTER'S AND DOCTORAL STUDENTS**

This document lays out the expectations of both supervisor and student, and is designed to ensure the supervision experience is mutually productive. The MOU should be completed by postgraduate students and their supervisor(s) when the student registers for the first time for either their Master's or Doctoral degrees. A progress and planned activity (PPA) report must be completed for each subsequent year as condition for renewal of registration.

Care should be taken in completing this MOU in full, as it is a contractual agreement. The MOU will be used in any disputes that may arise during the period a student is registered for a postgraduate degree.

**A. STUDENT AND SUPERVISOR DETAILS:**

<b>A.1</b>	<b>Personal particulars:</b>		
	Student number:	MCLJUL004	
	First name(s):	TILIA LOUISE	
	Last name:	MCLACHLAN	
	Contact address:	32 PARADISE RD	
	Email:	tilia.mclachlan@gmail.com	
	Telephone number	021 671 1039	Mobile number 071 795 8013
	Department(s)	Architecture, Planning and Geomatics	

<b>A.2</b>	<b>Degree (Tick the appropriate degree option)</b>	
	PhD	<input type="checkbox"/>
	Master's (by research); 180 credit dissertation	<input type="checkbox"/>
	Master's (with coursework); 120 credit dissertation	<input type="checkbox"/>
	Master's (with coursework); 90 credit dissertation	<input type="checkbox"/>
	Master's (with coursework); 60 credit dissertation	<input checked="" type="checkbox"/>

<b>A.3</b>	Is this a jointly awarded or co-badged degree* <sup>1</sup>	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/>
	If YES, name the other universities involved	N/A	

<sup>1</sup>: A jointly awarded research degree means that you will be registered at two Universities for the same degree in terms of a formal contract. A co-badged degree is awarded by one institution which recognises the contributions of one or more partner institutions by co-badging. The following URL provide a reference for information on jointly awarded and co-badged degrees: [https://www.uct.ac.za/downloads/uct.ac.za/about/policies/joint\\_degrees\\_policy.pdf](https://www.uct.ac.za/downloads/uct.ac.za/about/policies/joint_degrees_policy.pdf)

<b>A.4</b>	<b>Word limit (Tick the appropriate word limit option) N/A</b>
	I understand that the word limit for a N/A
	Doctoral (PhD) thesis must not be more than 80 000 words in length <sup>*1</sup> <sup>*1</sup> Students may motivate to their Dean for permission to exceed the stipulated word limit prior to submission of their thesis. <input type="checkbox"/>
	I have checked my Faculty-specific requirements for the word limit for a Master's dissertation For example <input type="checkbox"/>
	- a Research Master's dissertation may be 50,000 words or 90 pages N/A
	- a Coursework Master's dissertation may be 25,000 words or 60 pages N/A

<b>A.5</b>	<b>All academic qualifications to date<sup>1</sup>:</b>
	<sup>*1</sup> This is important information for students registering for interdisciplinary degrees
	B. ARCH. (WITS) ; MLA (UCT)

<b>A.6</b>	<b>Provisional thesis/dissertation title or area of study:</b>
	IN-FLOW: SHAPING THE CITY AS WATER CATCHMENT.
	Please attach a 1-3pg provisional research proposal or statement of research interest (Product 1) <sup>*1</sup> .
	<sup>*1</sup> Please check your specific Faculty guidelines for how the candidacy process is approved.

<b>A.7</b>	<b>Supervisor:</b>			
	Staff no:	T0066858	Title:	DR
	First name(s):	KATHRYN	Last name:	EWING
	Telephone no(s):	-	Mobile number	083 4080808
	Department:	APG	Email:	Kathryn.ewing@uct.ac.za

<b>A.8</b>	<b>First co-supervisor if any: N/A</b>			
	Staff no:		Title:	
	First name(s):		Last name:	
	Telephone no(s):		Mobile number	
	Department:		Email:	
	Institution:			

<b>A.9 Second co-supervisor if any: N/A</b>			
Staff no:		Title:	
First name(s):		Last name:	
Telephone no(s):		Mobile number	
Department:		Email:	
Institution:			

**B. SUPERVISOR'S EXPECTATIONS AND COMMITMENTS:**

<b>B.1</b>	<p><b>Supervisor's expectations:</b></p> <p>The supervisor must set out what they expect of the candidate in terms of reaching certain milestones or goals during the research for the degree.</p> <p>The milestones expected to be reached are stated in the Urban Design Research Project (UDRP) programme available on Vula under Resources.</p> <p>The following are the outcomes listed for the Urban Design Research Project, and it is expected that the student demonstrates progression toward attaining these goals:</p> <ul style="list-style-type: none"> <li>- Competency in techniques of problem diagnosis, design methodology and concept formation, using critical and reflective thinking (rigorous thinking).</li> <li>- Competency to research and design across a wide range of scales, from regional and citywide (including landscape and environment) to the level of individual buildings (including interface, threshold, land use, 3-D form of the built fabric within the context).</li> <li>- Ability to critically analyse and spatially represent complex urban social and economic dynamics related to the local context.</li> <li>- Ability to evaluate natural environments and related settlement pressures in order to determine and stipulate appropriate guidelines for development impacts and land use.</li> <li>- Competency in understanding and design urban structure and linkages relating to the study area and its wider context to assess sustainability, resilience and infrastructure operations and their impacts on urban form.</li> <li>- Competency to design and propose strategic spatial plans that are fundamentally rooted in sound urban design principles and theory. This includes the understanding of the potential of urban design guidelines that can be used for a range of built environment components such as, mixed-use precincts, street design and interface, landscape systems and public space, cityscape and heritage / culture.</li> <li>- Competency in communicating and presenting the urban design research project effectively, using verbal, graphic and spatial analytic, models and report writing skills. This includes the ability to communicate and listen effectively with a wide range of stakeholders i.e. representation of relevant information on urban design processes and solutions.</li> </ul> <p>It is noted that this is a design-research project.</p> <p>A summary of any other expectations that the supervisor has from the candidate (for example teaching in Department, attending Departmental seminars etc).</p> <p>None</p>
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<b>B.2</b>	<b>Supervisor's commitments:</b>
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	<p>The supervisor must set out their plans for providing supervision, including the pattern and intended frequency of meetings, and their commitment to turnaround time for written responses to work submitted by students.</p> <p>A minimum of one recurring thorough crit session weekly with supervisor, or as part of the occasional joint progress presentations on Friday mornings. One additional brief meeting per week on request from the student on ad-hoc basis.</p>
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<b>B.3</b>	<p><b>Supervision Leave arrangements:</b></p> <p>(a) <b>Summarize</b> expected absence of supervisor(s) on research leave/sabbaticals. Explain what arrangements will be made for supervision during periods of absence, and how lines of communication will be maintained.</p> <p>N/A</p>
<b>B.4</b>	<p><b>Co-Supervisory roles (if applicable):</b></p> <p>The role of co-supervisors should be specified.</p> <p>N/A</p>

**C. EXPECTATIONS AND PLANS OF THE STUDENT:**

<b>C.1</b>	<p>The student must set out in detail the expectations from the supervisor(s) and the department (for example, access to supervisor and facilities, etc):</p> <p>As per B.2 above</p> <p>The student and supervisor must set out their agreed plan and broad timetable for the research project <sup>1</sup>. Re-registration will be dependent on the student meeting the commitments stated below.</p> <p>As per B.2 above</p>
<b>C.2</b>	<p>Comment by supervisor on this plan:</p> <p>Acceptable</p>

C.3	Logistics: outline arrangements to support the research plan (e.g. field work, laboratory work, access to computational resources and equipment, data collection and storage, performance, interviews etc). As per usual access to facilities in Centlivres
C.4	Employment and teaching commitments at UCT by the student, and what mentorship/support is given to enable students to undertake these activities: t.b.c. with each student
C.5	Skills required, courses and classes: List any lectures, workshop or course(s) that the student must attend, to enhance their research skills or knowledge. Clarify the responsibility for costs associated with these (if any). As per the Faculty Handbook
C.6	Student's leave arrangement: The student and supervisor should state their agreement below on the timing and length of the student's leave entitlement.
	Student's presence on campus: How many days, on average, do you expect to be working on campus. Every day <input type="checkbox"/> or Days per month <input type="checkbox"/> 1/week minimum.

**D. FUNDING**

D.1	<b>Funding plans:</b> Specify funding secured by the student, or financial assistance to be provided, or organized, by the supervisor(s) to support this study (e.g. bursaries, teaching allowance etc.). N/A
	Has a bursary/scholarship been secured? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
	Scholarship/bursary name (s):
	Amount:
	Expected disbursement dates:
	Duration of bursary/scholarship, and what the requirements are for renewal (for e.g. submission of progress reports):
	If funding has not been secured, detail financial support that has been applied for (if any). /
	Explain how you (the student) propose to pay your fees and support your living costs for the duration of your studies:

Are there funds available for the planned research components (e.g. consumables, equipment, analyses and travel) (see C3)?	YES <input type="checkbox"/> IN PART <input type="checkbox"/> NO <input type="checkbox"/>
If yes, specify the source of funds:	N/A
If not, or if in part, please detail how you (student and/or supervisor) propose to meet the costs associated with the proposed research:	
<b>Please note that most bursaries require repayment if the degree is not completed.</b> The student is responsible for understanding the conditions of the bursary, before accepting it.	

**E. AUTHORSHIP, INTELLECTUAL PROPERTY AND DATA MANAGEMENT ISSUES:**

E.1	<b>Authorship</b> UCT's guidelines are that all who contribute significantly to the conception, execution and writing-up of a paper should be listed as authors. Indicate the agreement on authorship of papers submitted for publication from this postgraduate research, including arrangements about the order of listing of all co-authors (if appropriate). The following URLs provide a reference for information on authorship practices policy. <a href="http://www.uct.ac.za/downloads/uct.ac.za/about/policies/authorship_practices_policy.docx">http://www.uct.ac.za/downloads/uct.ac.za/about/policies/authorship_practices_policy.docx</a> <a href="http://www.ebe.uct.ac.za/usr/ebe/resources/Authorship%20practices%20policy.pdf">http://www.ebe.uct.ac.za/usr/ebe/resources/Authorship%20practices%20policy.pdf</a> Are you aware of UCT's guidelines on authorship? Supervisor YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Student YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Any additional points on authorship must be noted here by the supervisor.
E.2	<b>Use of third party data</b> Graduate students often use data that belongs to the University, or a research group, or a funder. If relevant, any issues relating to permission to use third party data should be noted here: Are you aware of issues relating to permission on the use of third party data? Supervisor YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Student YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> Any additional points on the use of third party data must be noted below.

**E.3 UCT Intellectual Property (IP) Policy**

(a) In terms of the UCT IP Policy, the university owns the IP arising from postgraduate research (unless ownership has been assigned to a third party), this includes inventions, discoveries and other developments of a technical nature whether or not these may be the subject of legal protection, as well as tangible research property arising from research activities such as prototypes, drawings, designs and diagrams, biological organisms and material, reagents, integrated circuit chips, software and data. Students and supervisors have the responsibility to familiarize themselves with the terms of UCT's IP Policy. ([https://www.uct.ac.za/downloads/uct.ac.za/about/policies/intellect\\_property.pdf](https://www.uct.ac.za/downloads/uct.ac.za/about/policies/intellect_property.pdf))

Copyright in publications is automatically assigned by UCT to the author and in particular, a student owns the copyright in their thesis or dissertation.

(b) In terms of the funding arrangement, has the intellectual property (IP) been assigned to the funder (i.e. either because the full cost model has been applied to the project, or in terms of the research contract)  
YES  NO

(c) In terms of the IP Rights from Publicly Financed Research and Development Act, the Student and Supervisor acknowledge that in all cases where the answer to (b) is "No" there is an obligation to disclose an invention to Research Contracts and Innovation (RC&I) within 90 days of the discovery, using an Invention Disclosure Form (download from [www.rci.uct.ac.za/rci/overview/](http://www.rci.uct.ac.za/rci/overview/)). There is an obligation to maintain the invention confidential within UCT until the IP has been evaluated by RC&I to determine its ability to be protected. RC&I should be contacted well in advance of any planned public disclosure, such as presentation at an external meeting or conference, publication in a journal, submission of an abstract, publication on a website or blog and the submission of a thesis for examination.

Have you read and understood the UCT IP Policy?  
Student YES  Supervisor YES

Any comments can be noted below:

**F. ETHICS IN RESEARCH AND BIOSAFETY:**

**F.1 Ethics review:**

Note: ALL EBE students must apply for Ethics clearance – refer to <http://www.ebe.uct.ac.za/ebe/research/ethics1>

(a) Does your research require ethics approval? YES  NO

(b) Does your proposed research involve human and/or animal/plant subjects?  
Human  Animal  Plants  Not applicable

(c) If you require approval, have you submitted an ethics application to your Faculty Ethics Committee? YES  NO

(d) If you answered No to (c), in consultation with your supervisor(s), please indicate when you expect to submit this form:

(e) If you answered yes to (c), what is the reference for the approval of your ethics application and what date was it received from your Faculty Ethics Committee? If this is not available yet, indicate date of submission of ethics approval application.  
AS ATTACHED. DATE APPROVED 06/07/2018.

Please note  
I. approval is required prior to commencement of your data collection.  
II. that a thesis/dissertation submitted without ethics clearance, obtained beforehand, will not be examined

**F.2 Biosafety review:**

Confirm that you have read your Faculty rules regarding the use of potentially hazardous biological agents and that you will comply with these regulations.  
YES  NO  NOT APPLICABLE

<http://www.researchsupport.uct.ac.za/biosafety>

**G. PRESENTATION OF RESEARCH FINDINGS AND SUBMISSION OF THE THESIS/DISSERTATION:**

**G.1 UCT treats plagiarism as a disciplinary offence. Confirm that the candidate and supervisor have discussed UCT's plagiarism policy and requirements**  
<http://www.uct.ac.za/main/about/policies>  
Yes, I ..... JULIA L. MCLACHLAN ..... (insert student name) have read and understood my Faculty and the University's guidelines on what constitutes plagiarism.

**G.2 Requirements for Archiving Theses and Dissertations**  
Note the requirements of the UCT Open Access Policy. Link: [http://www.uct.ac.za/downloads/uct.ac.za/about/policies/OpenUCT\\_Policy.pdf](http://www.uct.ac.za/downloads/uct.ac.za/about/policies/OpenUCT_Policy.pdf)  
After examination, an approved final version of the thesis or dissertation must be submitted to UCT institutional repository (OpenUCT) as required under the UCT Open Access Policy.  
I have read and understood the requirements for archiving theses or dissertations: YES

**G.3 NRF Scholarship / Bursary Holders**  
The library shall provide the Electronic Thesis & Dissertation (ETD) handle/link to students who are recipients of NRF scholarships, who should then submit the handle/link and other information

Are there funds available for the planned research components (e.g. consumables, equipment, analyses and travel) (see C3)?	YES <input type="checkbox"/> IN PART <input type="checkbox"/> NO <input type="checkbox"/>
If yes, specify the source of funds:	N/A
If not, or if in part, please detail how you (student and/or supervisor) propose to meet the costs associated with the proposed research:	
<b>Please note that most bursaries require repayment if the degree is not completed.</b> The student is responsible for understanding the conditions of the bursary, before accepting it.	

**E. AUTHORSHIP, INTELLECTUAL PROPERTY AND DATA MANAGEMENT ISSUES:**

<b>E.1 Authorship</b>	<p>UCT's guidelines are that all who contribute significantly to the conception, execution and writing-up of a paper should be listed as authors. Indicate the agreement on authorship of papers submitted for publication from this postgraduate research, including arrangements about the order of listing of all co-authors (if appropriate). The following URLs provide a reference for information on authorship practices policy.</p> <p><a href="http://www.uct.ac.za/downloads/uct.ac.za/about/policies/authorship_practices_policy.docx">http://www.uct.ac.za/downloads/uct.ac.za/about/policies/authorship_practices_policy.docx</a>  <a href="http://www.ebe.uct.ac.za/usr/ebe/resources/Authorship%20practices%20policy.pdf">http://www.ebe.uct.ac.za/usr/ebe/resources/Authorship%20practices%20policy.pdf</a></p> <p>Are you aware of UCT's guidelines on authorship?</p> <p>Supervisor YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>          Student YES <input checked="" type="checkbox"/> NO <input type="checkbox"/></p> <p>Any additional points on authorship must be noted here by the supervisor.</p>
<b>E.2 Use of third party data</b>	<p>Graduate students often use data that belongs to the University, or a research group, or a funder. If relevant, any issues relating to permission to use third party data should be noted here:</p> <p>Are you aware of issues relating to permission on the use of third party data?</p> <p>Supervisor YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>          Student YES <input checked="" type="checkbox"/> NO <input type="checkbox"/></p> <p>Any additional points on the use of third party data must be noted below.</p>

<p>to the NRF at the following address:  <a href="http://www.nrf.ac.za/nrf_funded_thesis_dissertation_requirements">http://www.nrf.ac.za/nrf_funded_thesis_dissertation_requirements</a>. This must be within a month after your graduation ceremony. Failure to comply with this requirement, could result in the scholarship/ bursary- holder being liable to refund all support provided by the NRF for the degree under which the funding was awarded.</p> <p>Scholarship funded by NRF? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Any comments can be noted below:</p>
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**H. SOCIAL MEDIA**

<b>H. Social media</b>	<p>While UCT welcomes and encourages open discussion on social media sites, including but not limited to Facebook, Twitter, LinkedIn, YouTube pages, online story-sharing forums and blogs- as a student, by signing this document, I accept that information posted on any of the social media platforms should not include:</p> <ul style="list-style-type: none"> <li>• abusive, harassing, defamatory or hurtful comments about any student or member of staff</li> <li>• foul or threatening language or "hate speech"</li> <li>• material that may infringe on any patent, copyright or intellectual property</li> </ul>
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**I. GRIEVANCE PROCEDURES AND COMMUNICATION CHANNEL**

<b>I. Grievance procedures</b>	<p>The supervisor(s) and candidate acknowledge by checking the boxes below, that they have read their Faculty grievances procedures and agree to follow these guidelines in the event of disputes arising from the agreement reached in this MoU.</p> <p>Supervisor Yes <input checked="" type="checkbox"/> Candidate Yes <input checked="" type="checkbox"/>          Co-supervisor Yes <input type="checkbox"/></p> <p>Any comments can be noted below:</p>
<b>Communication channel</b>	<p>Are you aware of the channel to be followed if there is a supervisor/student communication break down? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p>

**J. APPROVAL BY ALL PARTIES INCLUDING THE HOD/ DEAN/DEAN'S NOMINEE:**

<b>J.1 Approval by Supervisor, Co-supervisor and student</b>	<p>I have read and agree with this MOU.</p> <p>Approval by supervisor Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Comment</p>
--------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------

Signature		Date	08/08/2018
Approval by co-supervisor	Yes <input type="checkbox"/> No <input type="checkbox"/>		
Comment			
Signature		Date	
Approval by student	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
Comment			
Signature		Date	08/08/2018
<b>J.2 Approval by the HOD</b>			
I have seen this completed MoU and I have the following comments:			
Approval by HoD	Yes <input type="checkbox"/> No <input type="checkbox"/>		
Signature		Date	
<b>J.3 Approval by the Dean/Dean's nominee</b>			
I have seen this completed MoU and I have the following comments:			
Approval by Dean/Nominee	Yes <input type="checkbox"/> No <input type="checkbox"/>		
Signature		Date	

**APPLICATION FORM**

**Please Note:**

Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form before collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the EBE Ethics in Research Handbook (available from the UCT EBE, Research Ethics website) prior to completing this application form: <http://www.ebe.uct.ac.za/eberesearchethics/>

<b>APPLICANT'S DETAILS</b>		
Name of principal researcher, student or external applicant	Julia Louise McLachlan	
Department	EBE APG	
Preferred email address of applicant	Julia.Mclachlan@gmail.com	
If Student	Your Degree: e.g., MSc, PhD, etc.	MUD
	Credit Value of Research e.g., 60/120/180/360 etc	60
	Name of Supervisor (if supervised):	TBA
If this is a research contract, indicate the source of funding/sponsorship	NA	
Project Title		

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available, and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

<b>SIGNED BY</b>	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Julia Louise McLachlan		20 Jun 2018

<b>APPLICATION APPROVED BY</b>	Full name	Signature	Date
Supervisor (where applicable)	JULIAN ter to: MAXWORTHY		20/05/2018
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section 1, and for all Undergraduate research (Including Honours).	PROF. T. BERLANDA		6/7/2018
Chair: Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions			

Project Title	<b>In-Flow: Integrating storm-water harvesting systems into the settlement of Cape Town</b>	06/25/2018
	by <b>Julia McLachlan</b> in <b>EBE APG (Landscape and Conservation) Submissions</b>	id. 10611872
	julia.mclachlan@gmail.com	

### Original submission 06/25/2018

Cover Letter	<p>In the past few years, Cape Town has been experiencing a water crisis. Alternative water sources are being explored, one of which involves using storm-water (essentially urban surface water run-off), to recharge aquifers. In this approach, storm-water run-off is an asset and not something to be disposed of, seeing the city as water catchment and water source.</p> <p>This local water capture strategy however, needs to be integrated into settlements, 'becoming an important part of the spatial planning agenda' of the city as argued by Dewar (2018).</p> <p>However, South African cities, like Cape Town, have significant developmental problems that also need to be addressed. These include high levels of poverty, unemployment, issues of food security and water scarcity, amongst others. These problems are being compounded by the spatial patterns of sprawl, separation and fragmentation that have resulted from modernism and apartheid political ideologies (Dewar, 2017).</p> <p>To be effective, it is argued that the design of any local water capture strategy needs to consider and address these developmental problems too. Local water capture strategy needs to consider ways in which it is spatially integrated into the settlement designs, and the potential productive and economic opportunities, amongst others, that might also be possible.</p> <p>The proposal examines the Water Research Commission reports as prepared by J Okedi and N Armitage (2018) in which it suggests that storm-water in the Seekoeflei water catchment area is a viable water source for aquifer recharge. The proposal looks to test how the engineered proposal could be spatially designed and integrated into Cape Town only in terms of systems and space. It does not involve test subjects.</p>
Application Checklist	<p><b>Read the EBE Ethics in Research Handbook before completing this application</b></p> <p><b>Questionnaire to be used in the research (where applicable)</b></p> <p><b>If needed a letter motivating an expedited review. This letter should be included in the cover letter.</b></p>
Researcher(s)	<b>Julia McLachlan</b>

Department	<b>Architecture and Planning and Geomatics</b>
E-mail	<b>julia.mclachlan@gmail.com</b>
Status of Applicant	<b>Student</b>
Degree Being Studied (For Students Only)	<b>Master of Urban Design</b>
Name of Supervisor (For Students Only)	<b>TBA Dr Julian Raxworthy/ Dr Matteo Frascini/ Dr Katie Ewing</b>
Review Track	<b>Normal</b>
Motivation for an Expedited Review	n/a
Signature	
Appl_Form.pdf	
J_McLachlan.pdf	
Question 1: Harm to Third Parties	<b>No</b>
Question 2: Human Subjects as Sources of Data	<b>No</b>
Question 3: Participation or Provision of Services To Communities	<b>No</b>
Question 4: Conflicts of Interest	<b>No</b>
Research Proposal	
RESEARCH_PROPOSAL_JLM.pdf	
Question 2.1: Discrimination	<b>No</b>
Question 2.2: Participation of socially or physically vulnerable people	n/a
Question 2.3: Informed consent	n/a

Question 2.4: Confidentiality	n/a
Question 2.5: Anonymity	n/a
Question 2.6: Risks of physical, psychological or social harm	n/a
Question 2.7: Payments and giving of gifts	n/a
Interview Schedule	n/a
Consent Form	n/a
Additional Comments	n/a
Question 3.1: Community participation	n/a
Question 3.2: Termination of economic or social support	n/a
Question 3.3: Provision of sub standard services	n/a
Additional Comments	n/a
Question 4.1: Conflicts of interest	n/a
Question 4.2: Sharing of information	n/a
Question 4.3: Conflict of interest with other research	n/a
Additional Comments	n/a

### DECLARATION OF FREE LICENSE

I, Julia L McLachlan, student number MCLJUL004 hereby:

- a) Grant the University free license to reproduce the above thesis in whole or in part, for the purpose of research.
- b) Declare that:
  1. The above thesis is my own unaided work, both in composition and execution, and that apart from the normal guidance of my supervisor, I have received no assistance apart from that stated below;
  2. Except as stated below, neither the substance nor any part of the thesis has been submitted in the past, or is being, or is to be submitted for a degree in the university or any other University.
  3. I am now presenting the thesis for examination for the Degree of Master of Urban Design"

### PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the Harvard convention [or insert appropriate] for citation and referencing. Each contribution to and quotation in this project from the work(s) of other people has been attributed and has been cited and referenced.
3. This project is my own work.
4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

Signature: 

Date: 27/11/2018

