URBAN LANDSCAPE INFRASTRUCTURES IN ANURADHAPURA, SRI LANKA

AN INTEGRATED URBAN REGENERATION STRATEGY EMPLOYING URBAN LANDSCAPE INFRASTRUCTURES AS ARMATURES FOR SUSTAINABLE DEVELOPMENT

JEAN-BAPTISTE PETER, 2018

TU DELFT, FACULTY OF ARCHITECTURE, DEPARTMENT OF URBANISM

EMU – EUROPEAN POST-MASTER IN URBANISM

Urban Landscape Infrastructures in Anuradhapura, Sri Lanka

An integrated urban regeneration strategy employing urban landscape infrastructures as armatures for sustainable development

Jean-Baptiste Peter

TU Delft, Faculty of Architecture, Department of Urbanism
EMU – European Post-master in Urbanism
jbpeter@outlook.com

Supervisors

Steffen Nijhuis
Delft University of Technology

Taneha Kuzniecow Bacchin
Delft University of Technology

Paola Viganò
Università Iuav di Venezia

Readers

Eliana Barbosa
KU Leuven

Joan Moreno Sanz
UPC

TU Delft

Acknowledgement

This research is the outcome of a semester-long graduation project conducted at the Faculty of Architecture and the Build Environment at Delft University of Technology. It builds on the different approaches and methods that I learned during the past two years in the European Master of Urbanism. I would like to take a moment to thank the people who followed my journey.

To my mentors - Steffen Nijhuis, Taneha Bacchin, and Paola Vigano who provided critical guidance in my research and always encouraged me to work harder.

To all the experts I had the opportunity to meet while working in Sri Lanka in the past years. I have learned a lot from you about this fascinating country.

To my fellow graduates, friends and family, who helped me during the master and in particular in the last months when the stress was there.

And to Sowmya Parthasarathy, who makes every day of my life better.

Table of contents

PART 2 - Analysis

Interpretation of the landscape

PART 3 - Design

Transformation of the landscape

FIG. 10 Aerial view of the ancient city of Anuradhapura, Sri Lanka (SCDP, 2018)

“Landscape urbanism - understood as structuring landscapes to guide their occupation, use and urbanization - is not new, but has indeed been in practice for several millennia.”

(Shannon & Manawadu, 2007)

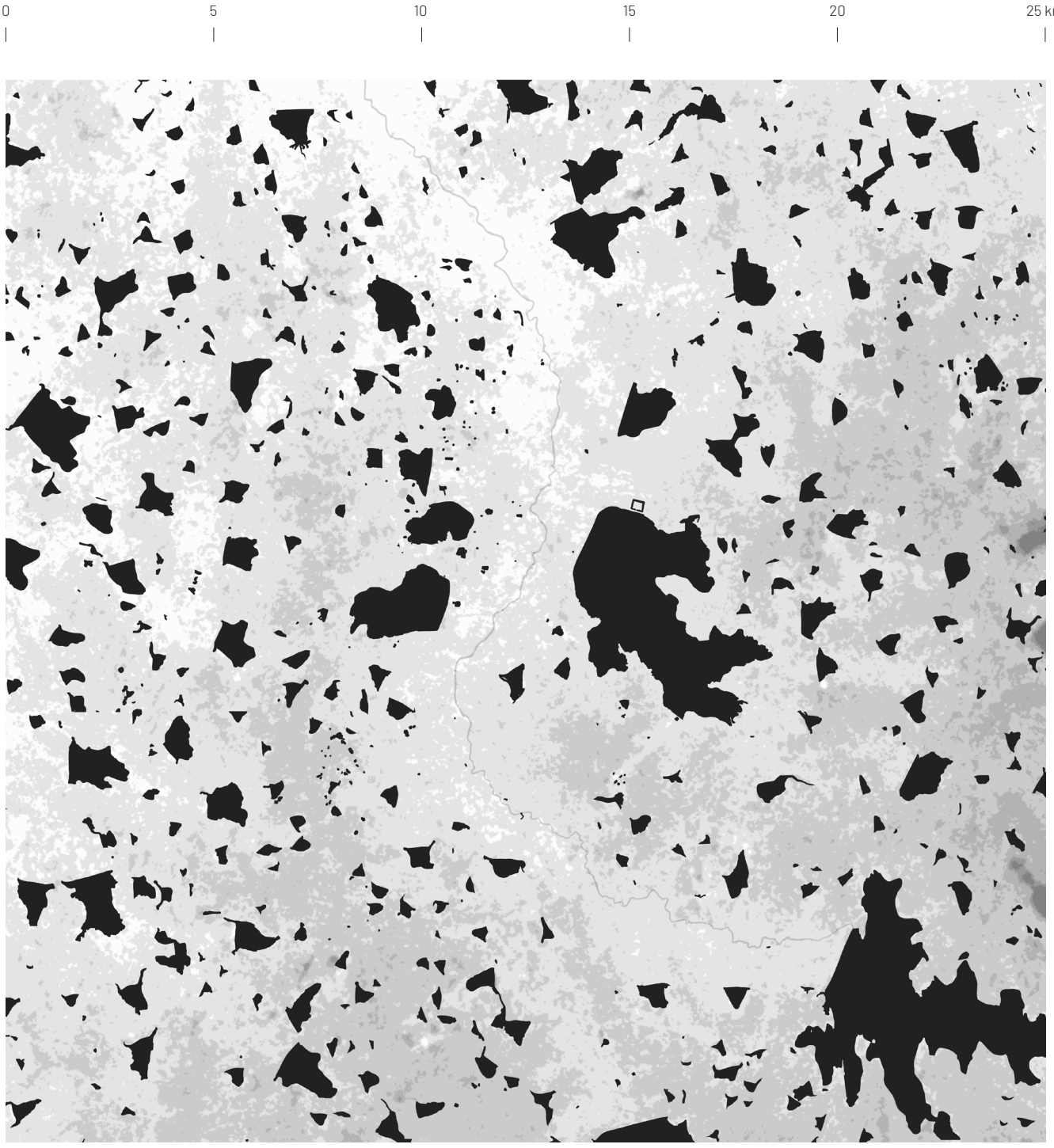


FIG. 1.2 The landscape of man-made tanks in Anuradhapura, Sri Lanka (Peter, 2018)

Description of the map

The map on the left shows the distribution of the tanks in the region of Anuradhapura. Almost all the tanks which can be seen on this map were built by humans taking benefits of the natural terrain and using ingenuous water management systems.

Without this large-scale transformation of the landscape, it would have been impossible to sustain large human settlements in this dry region of Sri Lanka.

Data sources:

- SCUDP, 2018
- ASTER GDEM

Background

The city of Anuradhapura has been studied as an example of indigenous landscape urbanism along with other remarkable sites in southeast Asia such as Angkor in Cambodia. During the Kingdom of Anuradhapura, which lasted from 377 BCE to 1014 AC, the population of this Dry Zone of Sri Lanka developed a complex irrigation system which supported human activities such as agriculture, habitation, and religion as well as ecosystem services such as water filtration, climate control, and so forth.

Due to the strategic importance of water, the urbanisation of this region was structured according to the intrinsic logic of the landscape. The architect and urbanist Kelly Shannon defends that this is one of the first cases of landscape urbanism, which is defined as structuring landscapes in order to guide their occupation, use and urbanisation (Shannon & Manawadu 2007). The ingenuity of ancestral methods to manage water can still be observed as many of the ancient irrigation systems and monuments have been preserved.

However, the idea that it is possible to shape the landscape in order to provide conditions for humans and ecological systems is not steering urban development anymore. As a result, the deep relation between landscape and urbanisation has been lost over time and landscape is currently considered more as a residual element than a strategic asset to guide urban development.

This lack of interest for the landscape impacts both ecological and social systems. For instance, large extents of land were urbanised in the tank catchment areas and river streams were encroached by constructions. This has a dramatic impact on all the ecosystems which depends on the tank system. Regarding social systems, the urban landscape of Anuradhapura is dominated by cars and provides few spaces that support human activities.

Due to these new conditions, there is a growing awareness that a new model of development is needed. This new awareness is due in part to the extreme weather events that affected the city several times in the past years. Now that more importance is given to environmental and social aspects of the debate, there is a great need to explore approaches which takes into account the landscape as a medium to address contemporary challenges.

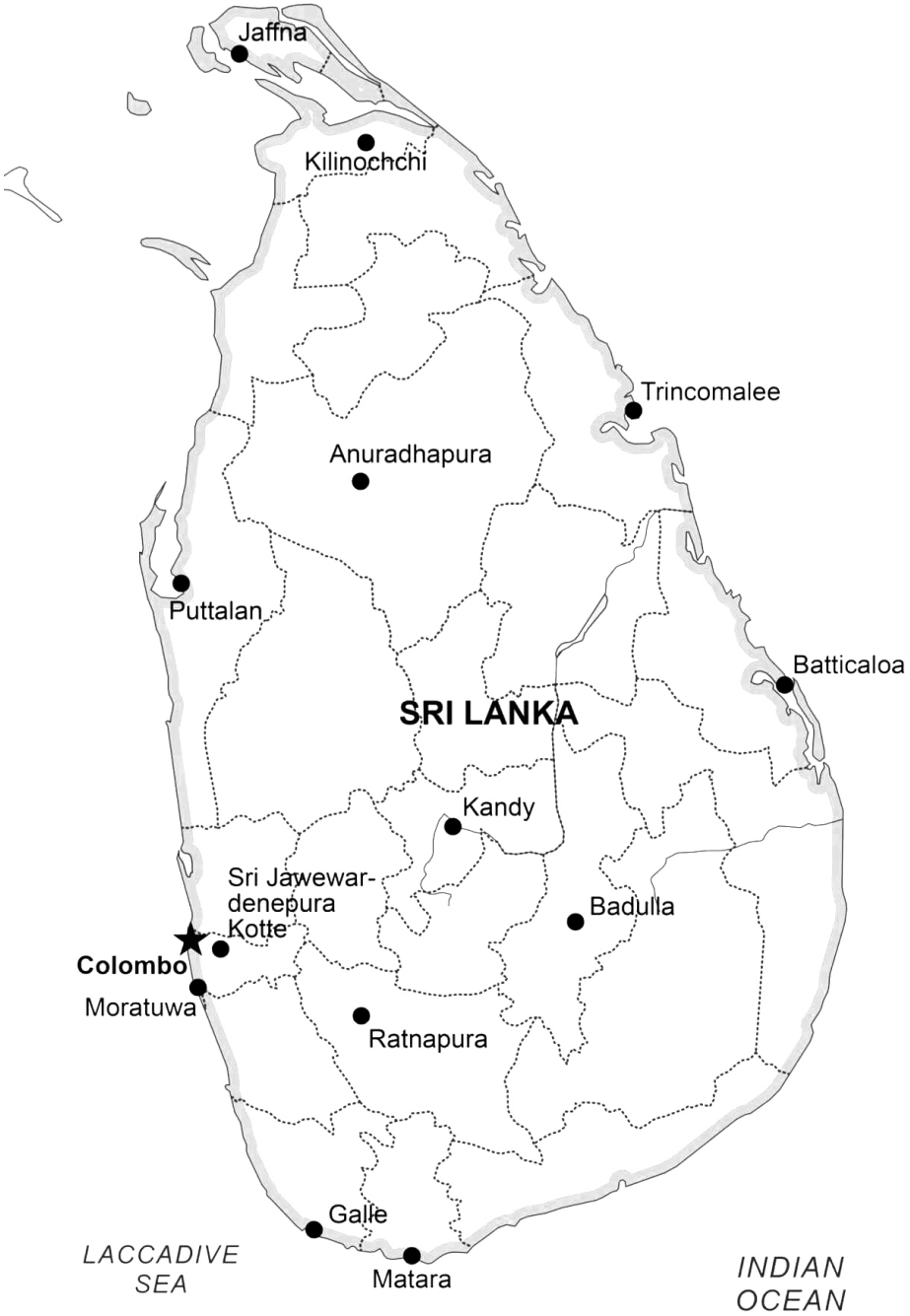


FIG. 1.3 Administrative map of Sri Lanka (Peter, 2018)

The context

In order to understand the condition of the urban landscape of Anuradhapura, it is necessary to be aware of the overall context of the city. There are several economic, social and environmental external factors which influence its development:

1 The end of the Sri Lankan civil war

The civil war in Sri Lanka between the Liberation Tigers of Tamil Eelam (LTTE) and the Sri Lankan army lasted for 25 years. It is estimated that 80,000 to 100,000 people were killed during this period (Wikipedia, 2018). The war had a significant impact on the population, the environment, and the economy of the country. Located close to the limit of the area controlled by the LTTE, Anuradhapura remained relatively isolated during the conflicts. For instance, the northern railway line which deserves Anuradhapura, was damaged during the war and did not operate fully. Since the end of the war in 2009, the government of Sri Lanka initiated several projects to develop critical infrastructures and to support urban development.

2 The globalization of the economy

In the last decade, the Sri Lankan government also took several initiatives to open and globalize the Sri Lankan economy in an attempt to encourage economic growth and to reduce poverty. It is impressive to see how fast the urban landscape of the capital is changing due in part to the inflow of foreign investment. However, the city of Anuradhapura remains relatively far from the economic boom of the capital due in part to the poor accessibility of the city. However, there is a growing interest to valorize the cultural heritage of Anuradhapura and to develop an offer for international tourism in this region of Sri Lanka.

3 The impact of climate change

Due to its insular location, Sri Lanka is extremely vulnerable to climate change and is regularly affected by severe natural hazards. In the case of Anuradhapura, these are mainly floods and droughts which damage structures and crops. They cause heavy social, economic and environmental losses. There are several ongoing projects conducted by different governmental, international, and civil organization which aim to adapt the country to climate change and to mitigate the impacts of natural hazards.

FIG. 1.4 Undervalued heritage:

The picture shows the large parking lot in front of the Bodhi Tree which is serves only during festivals and which is not designed to provide any permeable surfaces, trees for shading or services for the visitors (Peter, 2018)

FIG. 1.5 Deteriorating infrastructure:

The picture shows the main commercial street of Anuradhapura which is dominated by motorized traffic. There is currently no bypass road and most of the traffic passing through the city use this road. The sidewalks are in a bad condition and are interrupted by all kind of obstacles such as electric poles, advertisement boards, etc. There is no vegetation on the main streets which makes this space very uncomfortable for pedestrians. (Peter, 2018)

FIG. 1.6 Vulnerable environment:

The picture shows a flood event in the district of Anuradhapura. The city is regularly affected by river and surface floods during the rainy season. (Unknown, 2018)

Problem statement

The city of Anuradhapura in Sri Lanka has the potential to be a very attractive, comfortable and sustainable city. It is renowned for its UNESCO World Heritage site which is over 2,000 years old and covers an area over 40 km2. The city is the administrative capital and the largest city of Anuradhapura District which has a population of 856,232 inhabitants (DCS 2012). It benefits of a rich cultural landscape with numerous tanks, an abundant tropical vegetation, and a rich fauna. It is also a major place of pilgrimage for Buddhist pilgrims who come from all over the country and from abroad to give offers in the main temples of the city.

However, the city of Anuradhapura is currently facing a process of urban decay which put the future of the city at risk if no action is taken. This process is characterized by several economic, social, and environmental challenges which can be described as follows:

1 **Undervalued heritage.** The city of Anuradhapura is not taking full benefit of its resources. Despite its impressive natural and cultural heritage, the quality of the urban environment is very low. This is due to the fact that the strengths of the landscape such as the cascading tanks or the ancient ruins are not valorised. As a result, the quality of life for the inhabitants is low, and tourists tend to prefer other heritage sites in the region.

2 **Deteriorating infrastructure.** Anuradhapura is facing the degradation of its infrastructures which has a negative impact on the attractiveness of the city. For instance, the drainage network needs to be upgraded to prevent recurrent surface floods in the modern city. The city is overwhelmed by automobile traffic and is extremely unfriendly to pedestrians and cyclists. The natural infrastructure is not performing properly as well due to uncontrolled urbanization and encroachments on tank reservation areas in the last decades.

3 **Vulnerable environment.** The city of Anuradhapura is a fragile landscape which is affected by external factors. In the last decade, the increasing frequency of major natural hazards such as river floods and droughts shows the consequences of climate change in this region of the world. The city is also facing the risk of losing its identity due to the transformation of the urban landscape by private interests without attention of the character of the place.

It is interesting to observe that most of these challenges are related to the design of the urban landscape such as the streets, open spaces, drainage networks, and so forth. Therefore, the main hypothesis of this research is that an approach through the urban landscape is the best way to tackle these challenges.

TO DEVELOP AN URBAN REGENERATION STRATEGY EMPLOYING URBAN LANDSCAPE INFRASTRUCTURES AS ARMATURES FOR SUSTAINABLE DEVELOPMENT?

1. THEORY

WHAT COULD BE DONE?

Identify the main theoretical concepts and develop a method to address the reserarch question.

Theoretical tools:

- Literature review
- Case studies

2. ANALYSIS

HOW DOES IT WORK?

Understand how the landscape is structured and highlight the challenges and opportunities.

Analytical tools:

- Landscape perspectives
- Microhistories
- Mapping of systems

3. DESIGN

HOW CAN IT BE APPLIED?

Apply the concept of urban landscape infrastructures to the case of Anuradhapura.

Design tools:

- Landscape operative structures
- Performance objectives
- Design prototypes

4. REFLECTION

WHAT CAN BE LEARNED?

Discuss until which extent the aim of the research was addressed.

Reflection aspects:

- Methodology
- Transferability
- Application

Aim and methodology

Based on this understanding of the urban condition, the aim of the research is to develop an integrated urban regeneration strategy employing urban landscape infrastructures as armatures for sustainable development. In order to successfully address the complex economic, social and environmental challenges raised by the research question, a research-by-design methodological approach was chosen linking theory and practice into a process of multiple feedback. The research is subdivided in four main parts which address different sub-questions:

1. Theory - What could be done?
The objective of the first part of the research is to identify the main concepts which could be used to address the problematic. This is based on a review of relevant academic literature in the field of landscape urbanism, focusing in particular on the landscape as infrastructure approach and putting forward the concept of urban landscape infrastructure. Different projects will be analysed in order illustrate the specificities of urban landscape infrastructures.

2. Analysis – How does it work?
Based on the theoretical framework, the objective of the second part is to break the complexity of the urban landscape and to understand how the landscape system is working. This part uses the concept of landscape perspective to analyse the landscape from different points of view and identify potentials and challenges. The learning is then combined using the concept of space of flows as an integrating device. Different analysis tools are used in order to understand the structure and elements of the landscape such as microhistories and mapping of systems.

3. Design – How can it be applied?
The objective of the third part of the research is to apply the concept of urban landscape infrastructures to the case of Anuradhapura using the learning of the analysis of the landscape. This part is a design exercise which shows the potential of developing three landscapes operative structures in order to address the challenges and opportunities identified. This design experiment works through the scales from the overall structure of the city to the urban design of different strategic locations.

4. Reflection – What can be learned?
The objective of the last part of the research is to reflect on the outcomes of the work and to analyse until which extent the aim of the research was addressed. This part discusses the relevance of the research methodology and potential improvements which could be made. It poses the question of the transferability of the proposed approach to other situations and concludes on the potentials and challenges for an application in practice.

FIG. 1.7 Methodological framework (Peter, 2018)

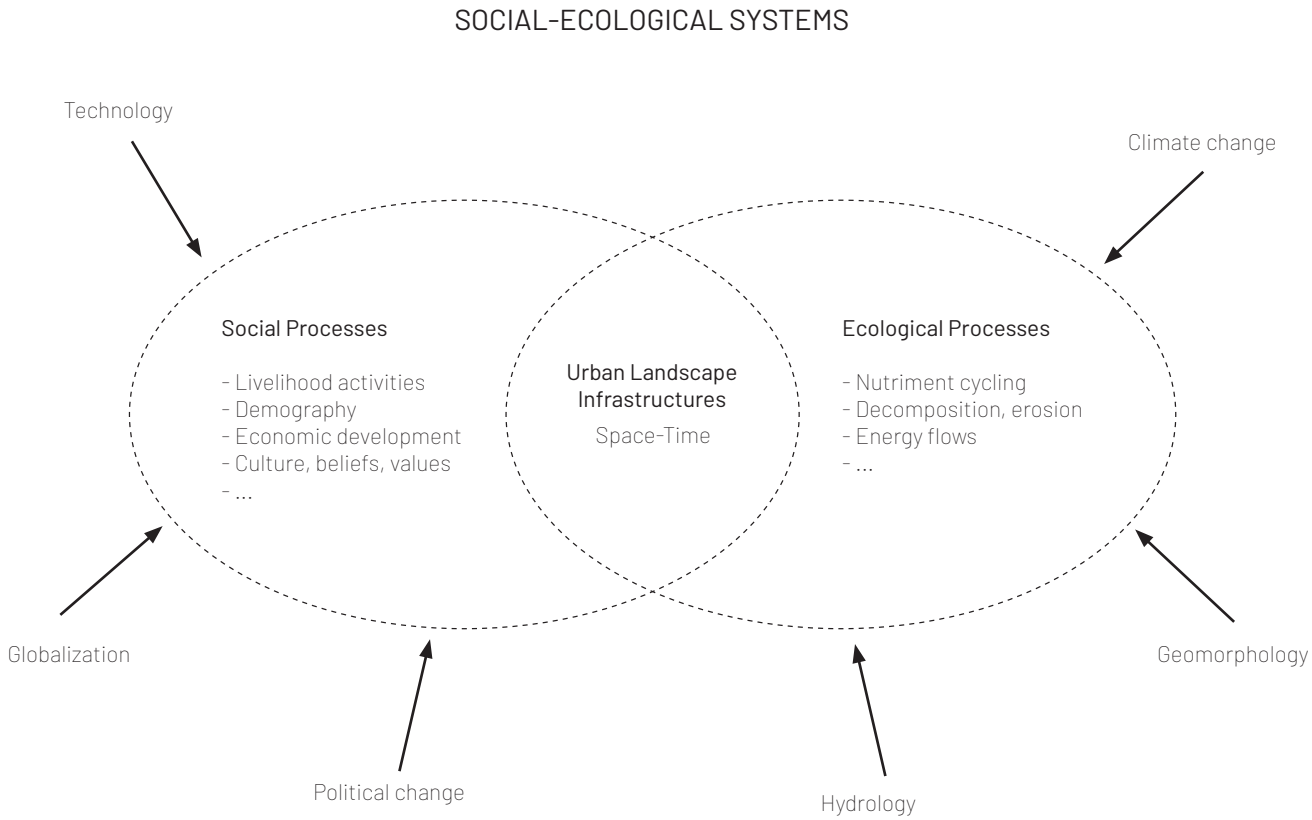


FIG. 1.8 Diagram of socio-ecological systems (adapted from SNRE, University of Florida, 2015)

Academic relevance

In the last decade, a lot of academic research has been conducted in the field of landscape urbanism and in particular looking at the landscape as infrastructure. In most of the cases, a reductionist approach was chosen and the holistic nature of the landscape was not taken into account. These researches tend to focus on one aspect of the landscape, such as natural processes, and disregard other aspects such as the sociocultural processes (Nijhuis & Jauslin 2015). This reductionist view of the landscape lead to a "landscape of landscape urbanism" (Swedish University of Agricultural Science 2016), which is characterized by several urbanism such as infrastructural urbanism (Hauck et al. 2011), water urbanism (Shannon & Meulder 2008), ecological urbanism (Mostafavi & Doherty 2010).

However, the holistic nature of the landscape implies that the whole is more than the sum of its composing parts. Therefore, it is necessary to understand the complexity of the relationships between the different elements of the landscape which is not possible with a reductionist approach. There is a great need to develop design methods which build on knowledge from several fields such as geography, history, ecology, archaeology, sociology, and so forth. Design is about putting things together rather than taking them apart, integration rather than reduction: it is about relations between things and not the things alone (Nijhuis & Jauslin 2015).

In order to address the holistic nature of the landscape, the present research is based on the principle that landscape can be described as a socio-ecological system which is a complex and integrated system in which humans are part of nature (Berkes & Folke 1998). These systems emphasise the fact that the delimitation between human and social systems is arbitrary. In this view, ecological and human systems interact constantly and space and time are the medium which provides the conditions for these relationships. From this perspective, the role of the designer is to imagine the transformation of the landscape in order to create synergies between social and ecological systems.

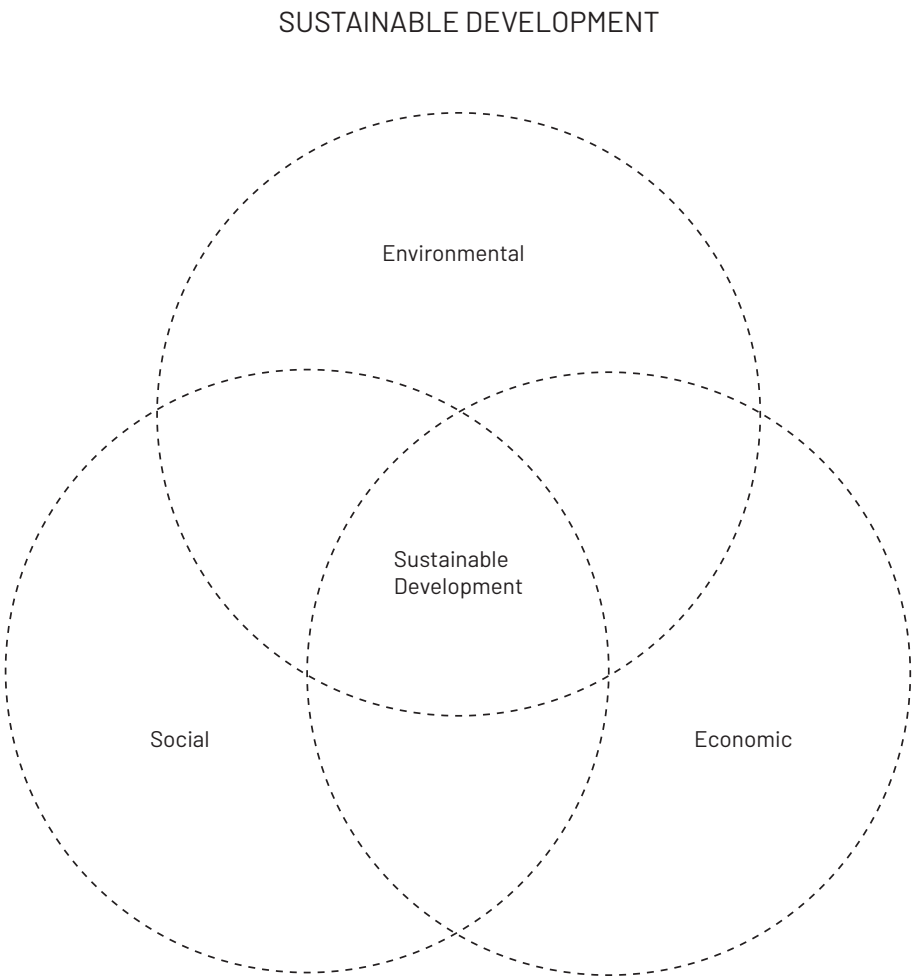


FIG. 1.9 The three pillars of sustainability (adapted from the Brundtland Report, 1987))

Social relevance

The current urban regeneration strategies employed in Sri Lanka and elsewhere in southeast Asia are not able to address contemporary urban conditions related to climate change, urbanization, and ecological crisis. These changing conditions require new approaches which takes into account the complexity of the landscape system and do not just focus on the improvement of the character of the urban landscape. These kinds of "beautification" strategies are successful to attract investment and to support economic growth. However, they also generate a lot of new urban challenges which affect the sustainability of the strategy on the long-term.

In 1987, the Brundtland Report acknowledged the fact that economic growth alone is not enough, and that the economic, social and environmental aspects of any action are deeply interconnected (Bayley & Strange 2008). This perspective implies that sustainable development requires new holistic approaches which integrate all the different elements of the landscape and which break the traditional disciplinary and territorial borders. It is also necessary to envisage the transformation of the landscape on the long-term and to consider the impact of the actions for future generations.

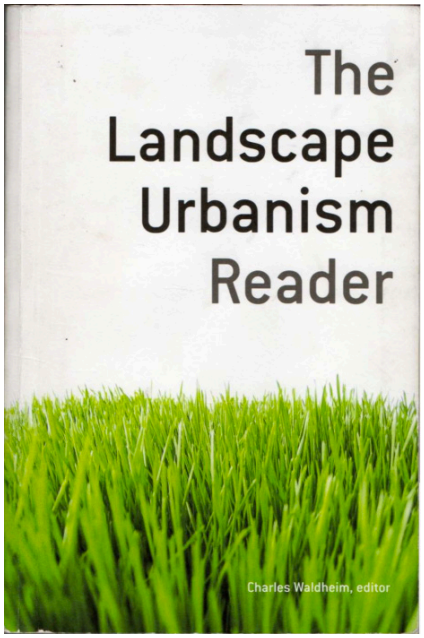
Based on these new requirements, the research explores the potential of urban landscape infrastructures to create sustainable urban landscapes. Indeed, urban landscape infrastructures have the capacity to integrate economic, social, and environmental aspects. By creating conditions for ecological and social systems, they can provide many benefits such as stimulating local economy, providing places for people to interact, and protecting natural ecosystems. Urban landscape infrastructures re-establish the link between urban form and processes and therefore contribute to strengthening local and regional identities.

PART 1

Theory

Theoretical framework

The objective of the first part of the research is to identify the main concepts which could be used to address the problematic. This is based on a review of relevant academic literature in the field of landscape urbanism, focusing in particular on the landscape as infrastructure approach and putting forward the concept of urban landscape infrastructure. Different projects will be analysed in order illustrate the specificities of urban landscape infrastructures.


The
Landscape
Urbanism
Reader
Charles Waldheim, editor

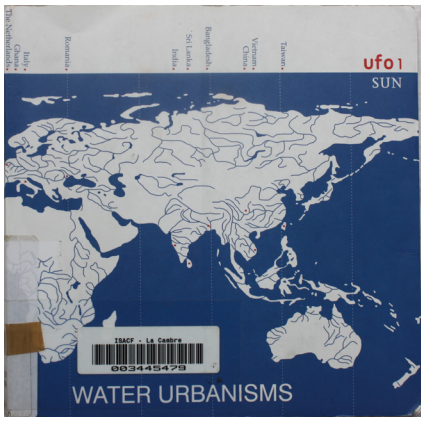
1


The Infrastructure Research Initiative at SWA (ed.)
INFRA
LAND
STRUC
SCAPE
TURE
Case Studies by SWA
Charles Waldheim
Julia Czerniak
Ying-Yu Hung
Gerdo Aquino
Alexander Robinson

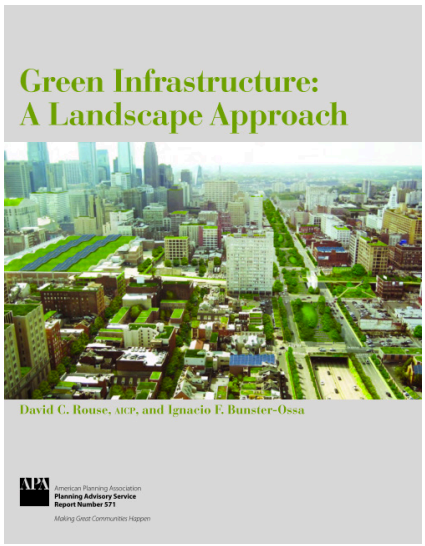
2


Flowscapes
Designing
infrastructure as
landscape
RESEARCH IN URBANISM SERIES VOL. 3
STEFFEN NIJHUIS, DANIEL JAUSLIN,
FRANK VAN DER HOEVEN (EDS.)

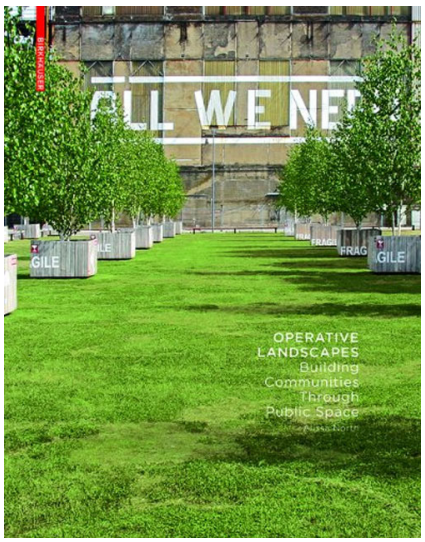
3


ufo 1
SUN
WATER URBANISMS

4


Green Infrastructure:
A Landscape Approach
David C. Rouse, AICP, and Ignacio F. Bunster-Ossa
American Planning Association
Planning Advisory Service
Report Number 571
Making Great Communities Happen

5


OPERATIVE
LANDSCAPES
Building
Communities
Through
Public Space

6

FIG. 1.1 The main body of knowledge used in this research (Peter, 2018)

1. The Landscape Urbanism Reader (Waldheim 2006)

2.Landscape Infrastructure: Case studies by SWA(Hung et al. 2011)

3. Flowscapes: Designing infrastructure as landscape (Nijhuis et al. 2015)

4. Water urbanisms (Shannon & Meulder 2008)

5. Green Infrastructure: A Landscape Approach (Rouse & Bunster-Ossa 2013)

6. Operative Landscapes (North 2012)

1 – Landscape urbanism

A theory to valorise the potential of the landscape

The current condition of the city of Anuradhapura can be understood under the scope urban decay, which is a process by which a previously functioning city falls into disrepair. In Anuradhapura, this process is characterized by a combination of inter-related conditions such as the progressive deterioration of the urban infrastructure, the undervaluation of the rich heritage, and the increasing vulnerability of the environment. If nothing is done to end this process, the city could face irreparable losses in the future.

Changing urban conditions

In the last decades, the problem of urban decay has been a major issue for many cities around the world due mainly to rapidly changing economic conditions. Traditional urban design approaches have not been able to come to terms with the rapid pace of urban change, to deal with the environmental conditions left in the wake of deindustrialization, and to address the need for ecologically informed urbanism (Hung et al. 2011). As a result, the theory of landscape urbanism appeared in the early 90s. This new body of knowledge was initially applied to post-industrial cities in the Rust Belt of the United States. Since then, it has been used in a large corpus of practices and scholarly research on contemporary urban conditions such as climate change, ecological crisis, rapid urbanization, and urban infrastructures.

Definition of landscape urbanism

The term "Landscape Urbanism" was coined by Charles Waldheim and describes a "disciplinary realignment currently underway in which landscape replaces architecture as the basic building block of contemporary urbanism. Landscape has become a lens through which the contemporary city is represented and a medium through which it is constructed" (Waldheim 2006). Another definition formulated by Allen considers that landscape is emerging as a new model for urbanism. "Landscape has traditionally been defined as the art of organizing horizontal surfaces. By paying close attention to these surface conditions – not only configuration, but also materiality and performance – designers can activate space and produce urban effects without the weighty apparatus of traditional space making" (Allen, 2001).

FIG. 1.2 Geographic der Pflanzen in den Tropenlandern, ein Naturgemalde der Anden. (Humboldt, 1805)

This chart is an illustration of the mount Chimborazo realized by Alexander von Humboldt during his expedition in the Andes Mountains. During his ascension, Humboldt recorded with dozens of scientific instruments the properties of landscape elements such as trees, soils, and species and represented them in this chart. This is one of the first representations showing the relations between different natural elements in the landscape.

"Exploring the landscape is zooming in and out, and is about changing scales and perspectives all the time. Thus, the landscape becomes the whole that is more than the sum of its composing parts. It integrates nature and culture, science and aesthetics, geography and history, humans and their environment at all scales and in all aspects. The landscape is where natural and social sciences integrate, a place where space and time meet. "

(Antrop & Eetvelde 2017)

2 – Landscape as complex system

The world-view to interpret the landscape

One of the main ideas in the field of landscape urbanism is that social and natural processes should guide the urban form. Therefore, the landscape urbanism approach involves understanding large-scale systems first and allowing them to inform and even structure proposals in order to develop schemes that engage and inaugurate ecological and social dynamics (Steiner 2011).

Holistic nature of the landscape

The viewpoint of landscape as a living system is a relatively new way to interpret the landscape. System is defined by the American environmental scientist Donella Meadows as "a set of elements or parts that is coherently organized or interconnected in a pattern or structure that produces a characteristic set of behaviors, often classified as its function or purpose". Compared to other ways of interpreting the landscape, this viewpoint is holistic and integrative in the sense that it is characterized by the idea that the parts of the landscape are deeply interconnected and explicable only by reference to the whole. In this mindset, people and nature are not considered separately and landscape is the entity understood and managed for human and environmental well-being (Motloch 1990).

Landscape as a complex system

Urban landscape systems are usually considered as complex systems which are difficult to model due to the large number of components which interact at the same time. Therefore, it is necessary to use specific methods in order to reduce the complexity of the urban landscape systems. One way to do so is to decompose the landscape into different thematic layers which can be studied individually. In this research, these thematic layers are referred to as "landscape perspectives" to insist on the fact they do not represent the overall landscape but just a part of it. This approach makes it possible to analyse data from a wide range of disciplines. Once the analysis of the perspectives is completed, the aim is to recompose the "whole" in order to maintain the holistic nature of the landscape.

Representation of the systems

There are several models available to represent the properties of systems such as the patch, corridor, matrix, mosaic model which has been used extensively in the field of landscape ecology. The model chosen for this research is based on the spatial properties of the landscape in order to represent social and ecological systems properly. It defines three main components of the landscape which are the elements, the components, and the structure. Elements are clearly defined discrete phenomena such as objects such as a tree, a house, or a field. Components are phenomena that vary continuously through space such as the soil condition. Structures are ways in which elements or components are linked and related spatially or functionally (Antrop & Eetvelde 2017).

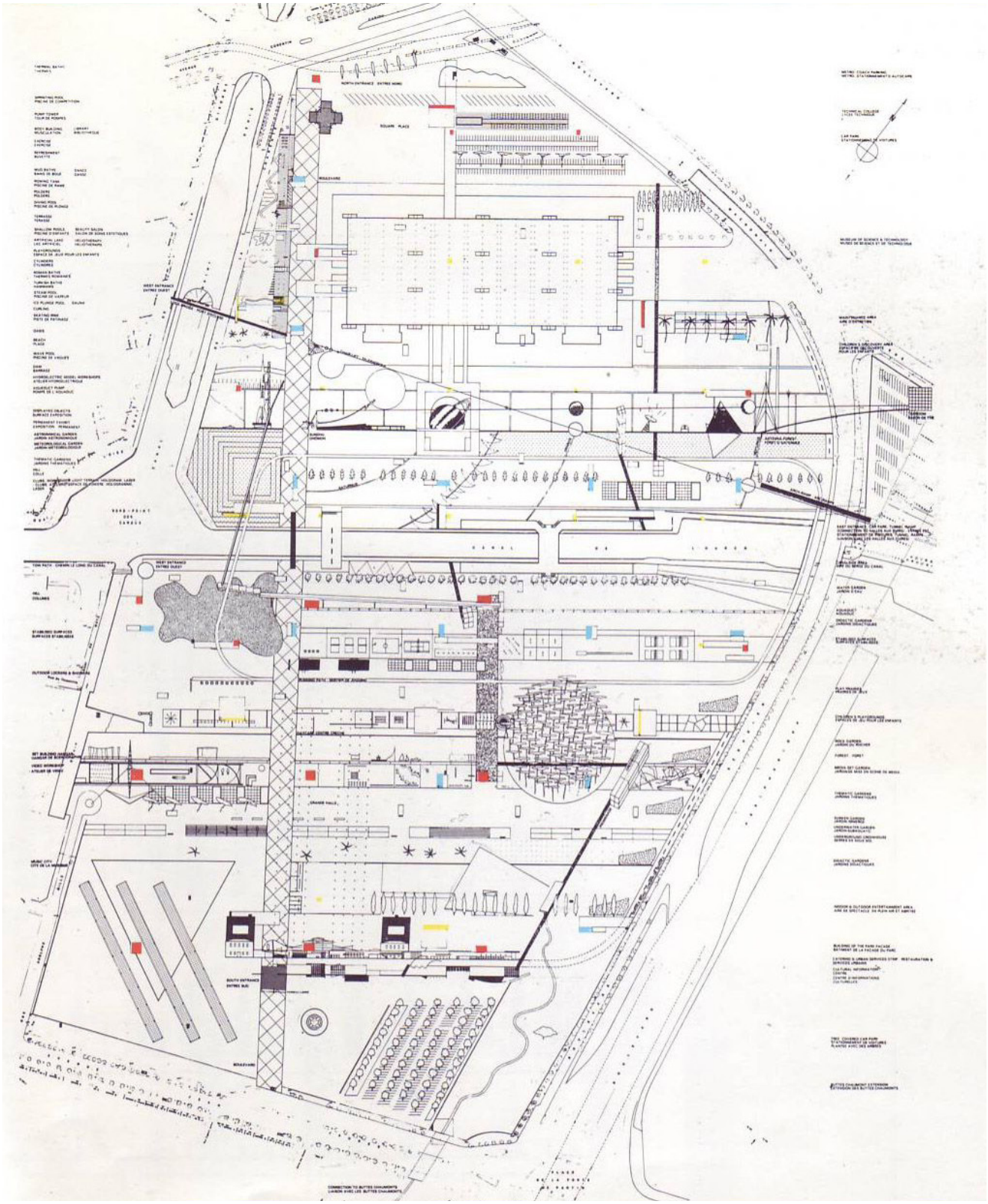


FIG. 3.1 Proposal for the park of La Vilette in Paris (Office for Metropolitan Architecture, 1982)

The proposal of OMA for the park de la Vilette is one of the first projects using landscape as a complex medium capable of articulating relations between urban infrastructure, public events, and indeterminate futures for large post-industrial sites (Waldheim 2006).

3 – Landscape as infrastructure

An approach integrating landscape and infrastructure

In our society, the historic role of infrastructure and landscape is changing due to several factors. On the one hand, public infrastructures must address new performance criteria such as the integration of sustainable energy, water sensitive design, and active modes of transportation (Hung et al. 2011). Traditional engineered infrastructures are not able to address these new demands efficiently in part due to the fact that they are usually designed to serve a single purpose. On the other hand, the traditional role of the discipline of landscape architecture working with nature is challenged in an increasingly urbanized world. Indeed, the distinction between nature and urban is becoming irrelevant in the Anthropocene epoch.

Towards a new definition of the concepts

Based on this observation, researchers proposed to redefine the relationship between the two concepts and to imagine that landscape could perform as infrastructure. In this perspective, landscape becomes the medium through which to formulate and articulate solutions for integration of infrastructure with viable programming that can address many pressing issues facing many cities all over the world (Hung et al. 2011). This approach reposition landscape as a complex, instrumental system of essential services, resources, and processes that underpin contemporary urban economies and acts as a kind of performative hybrid infrastructure that is as much about culture as about engineering (Hung et al. 2011).

The "landscape of landscape urbanism"

However, this conception of the landscape as infrastructure has led to the emergence of a "landscape of landscape urbanism" characterized by several different thematic views on the landscape (Swedish University of Agricultural Science 2016). One of the main critics against these views is that they usually over emphasize the natural processes and neglect sociocultural aspects. At the same time, many of these approaches tend to give more importance to processes over form (Nijhuis & Jauslin 2015). This kind of thinking does not address the holistic nature of the landscape and there is a need to explore new design approaches which integrate these different aspects.

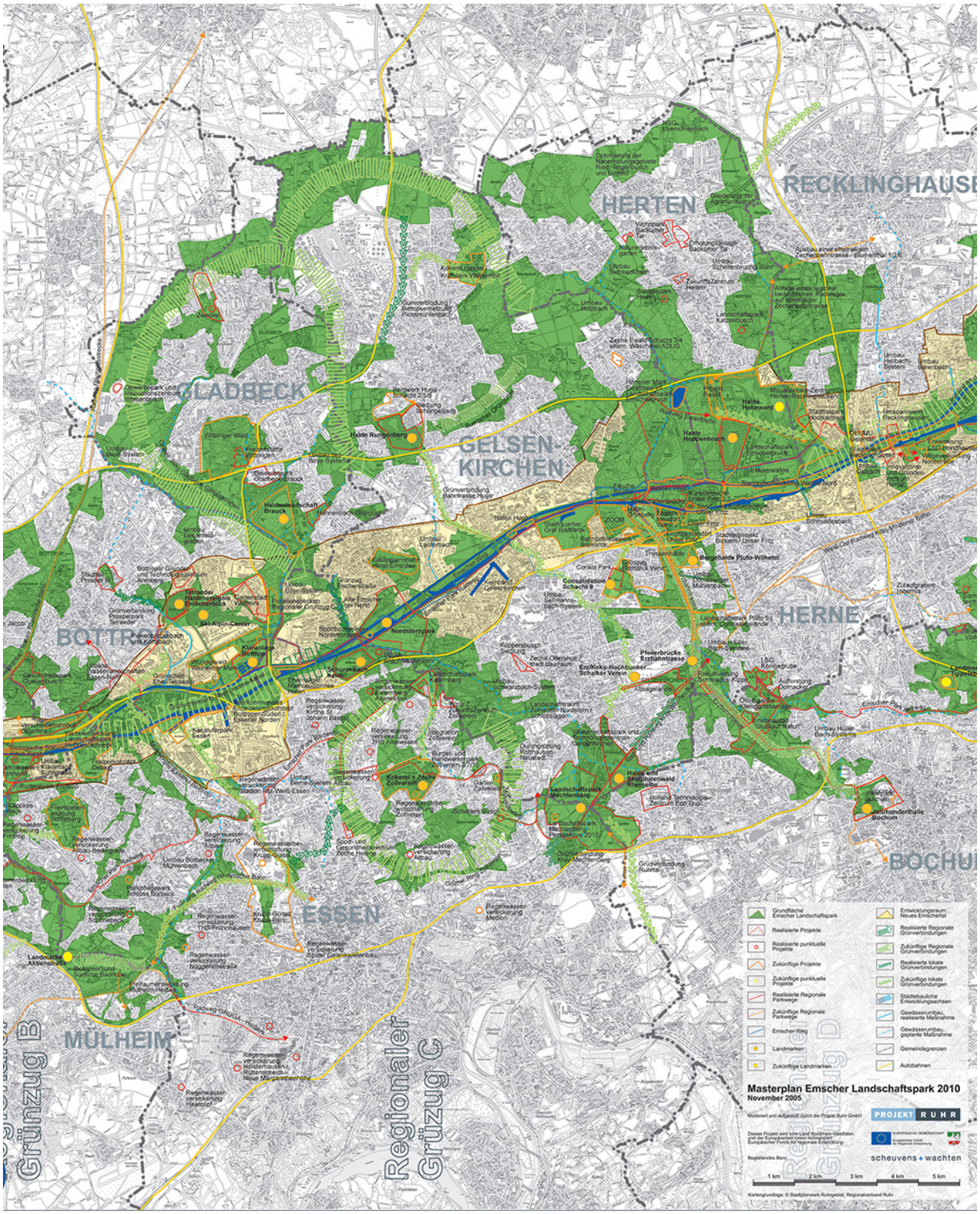

HERTEN
RECKLINGHAUSEN
GLADBECK
GELSENKIRCHEN
BOTTROP
HERNE
BOCHUM
ESSEN
MÜLHEIM
Grünzug B
Regionaler Grünzug C
Masterplan Emscher Landschaftspark 2010
November 2005
PROJEKT RUHR
scheuvens + wachten

FIG. 4.1 Emscher Landscape Park in Germany (Regionalverband Ruhr, 2010)

The Emsher Landscape Park is an example of green landscape infrastructure which uses a network of interconnected green spaces such as agricultural land, forests, industrial brownfields, and railway corridors in order to provide ecological, social and cultural benefits.

4 – Urban landscape infrastructures

A method based on the space of flows

In order to address the holistic nature of the landscape, the concept of urban landscape infrastructures is based on the idea that the landscape is a complex system which can be understood using the network theory. In this perspective, the urban landscape is a constellation of networks and locations with multiple levels of organization (Nijhuis & Jauslin 2015). Castell describes the spatial dimension of the networks and locations using the terms of space of flows and spaces of places (Castells 1989). Traditionally, design disciplines focused on the space of places which are a locale whose form, function, and meaning are self-contained within the boundaries of physical contiguity (Maitra et al. 2002).

Definition of urban landscape infrastructures

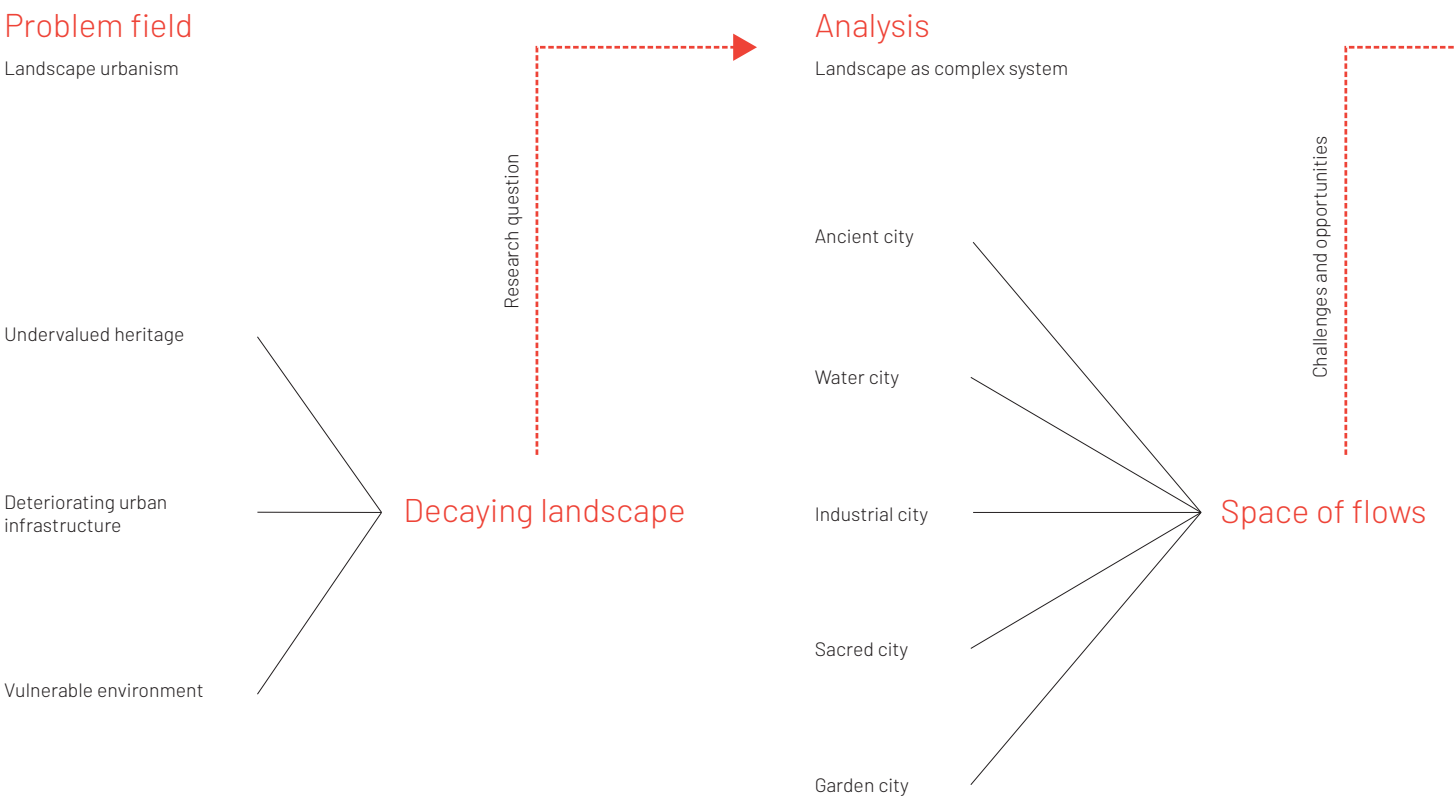
However, the space of flows which is the physical structure enabling the different social and ecological flows, could play a much more important role in the territorial transformation processes (Nijhuis & Jauslin 2015). Urban landscape infrastructures regard the space of flows as an armature that direct and facilitate urban development, stimulate social and ecological interaction and establish the relation between process and form, between 'flows' and 'scapes' (Nijhuis & Jauslin 2015). In this perspective, the main role of design becomes to establish a relationship between urban form and social-ecological systems.

Main underlying principles

There are at least four main principles which are important for the design of urban landscape infrastructures (Nijhuis & Jauslin 2015). First, the design focuses on the preparation of surfaces for future appropriation and not on the development of objects in the landscape. It is about creating conditions for ecological and social systems. Second, the design must work through the scales from regional to local. It is not limited to a specific scale. Third, the design objective is to create systems which are open to change. The systems must be robust in order to withstand challenges, while flexible enough to reorganize. Finally, the design supports the participation of multiple actors and is interdisciplinary.

Different fields for design

It is possible to distinguish at least three different fields for the design of urban landscape infrastructure based on the type of flows that they support. Transport landscape infrastructures focuses on the design of multifunctional transport infrastructures which facilitate the flow of peoples, energy, waste, and information. The concern of green landscape infrastructures is the design of networks of interconnected open spaces which support ecological, cultural and recreational flows. Finally, the design of water landscape infrastructures focuses on water management systems from a multifunctional perspective (Nijhuis & Jauslin 2015).

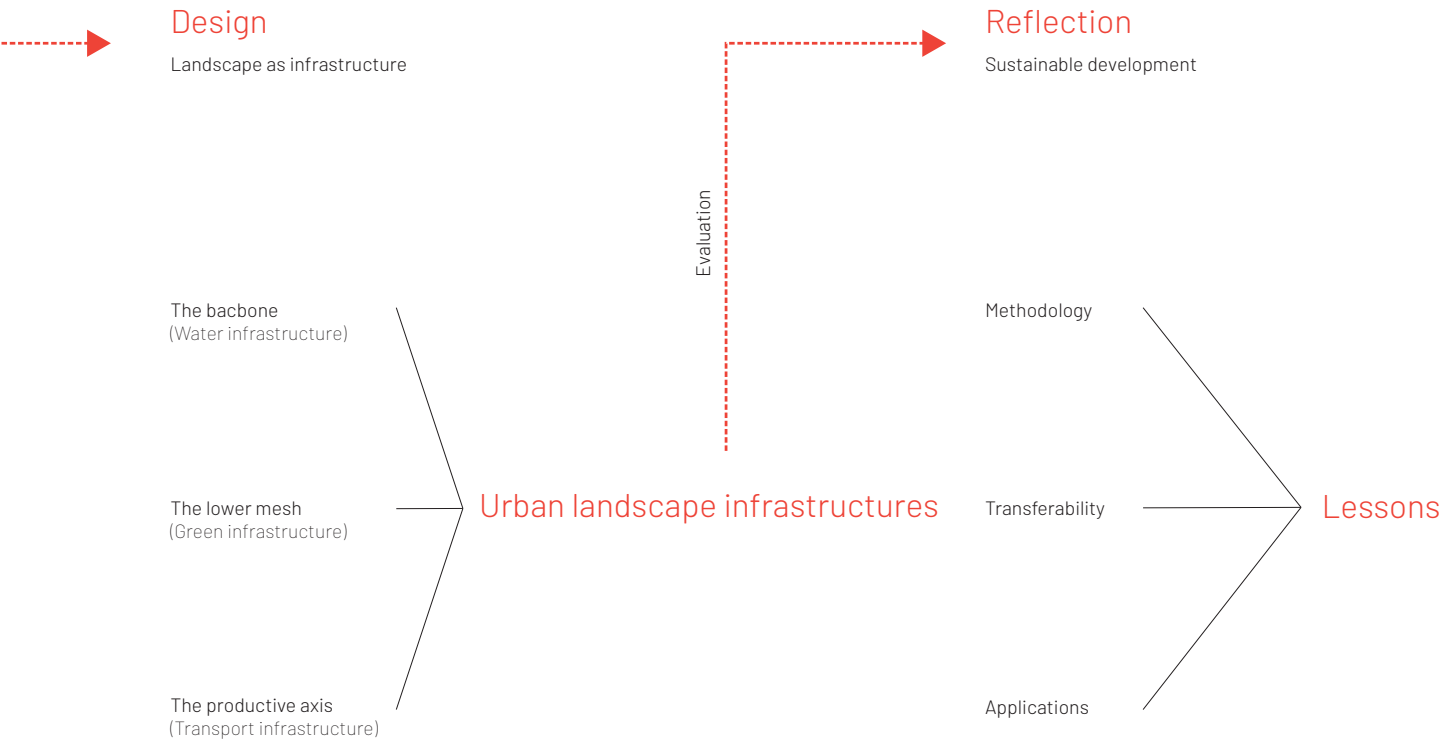


Tools:
Litterature review
Site visits
Interviews

Tools:
Landscape perspectives
Microhistories
Mapping of systems

5 – Theoretical framework

Utilisation of the main theoretical concepts



Tools:
Landscape operative structures
Performance objectives

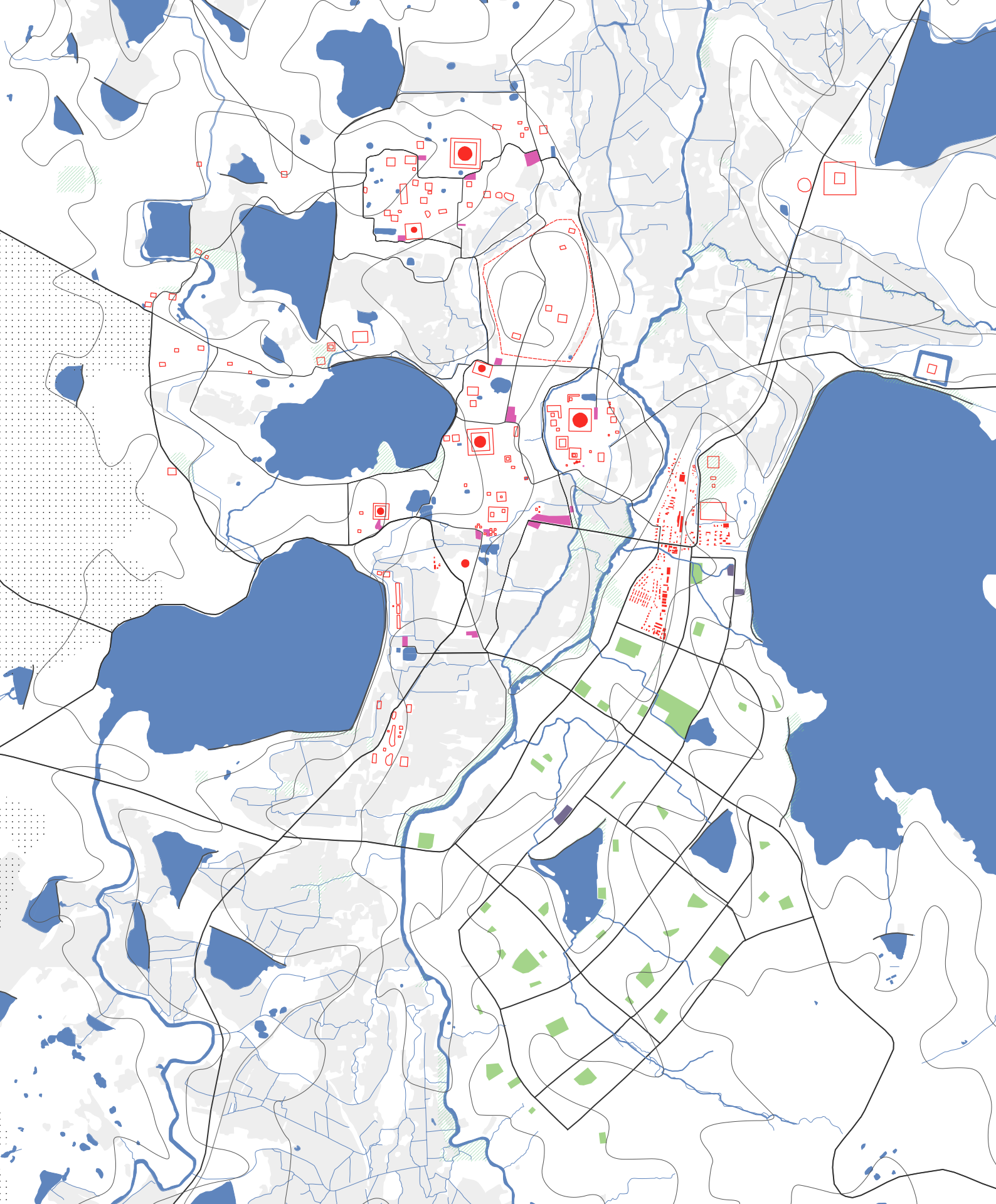
FIG. 5.1 Diagram of the theoretical framework (PETER, 2018)

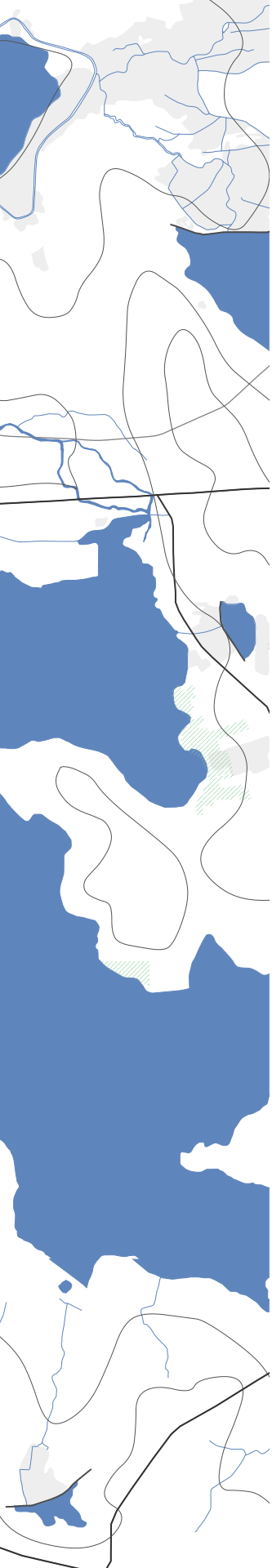
PART 2

Analysis

Interpretation of the landscape

Based on the theoretical framework, the objective of the second part is to break the complexity of the urban landscape and to understand how the landscape system is working. This part uses the concept of landscape perspective to analyse the landscape from different points of view and identify potentials and challenges. The learning is then combined using the concept of space of flows as an integrating device. Different analysis tools are used in order to understand the structure and elements of the landscape such as microhistories and mapping of systems.





6 – Complex urban landscape

Breaking down the complexity of the system

The urban landscape of Anuradhapura is composed of a large number of elements which serve multiple social, ecological and economic functions. These elements, which are water tanks, streets, parking, forests, and so forth, interact and form a complex system. For instance, an action on a tank can impact many other elements such as the rice paddies, the ecosystems, the urban drainage, and so forth. It is therefore necessary to understand the role of the different landscape elements, and how they interact.

Main roads

Hydraulic systems

Rice paddies

Open spaces

Parking spaces

Cultural heritage

Forest patches

FIG. 6.1 The urban landscape structure of Anuradhapura (Peter, 2018)

The Ancient City

The first perspective looks at the urban landscape from the lens of heritage. It analyses the ancient systems of settlements and look at dominant natural features.

The Water City

The second perspective focus on aspect related to water management. The complex irrigation system of Anuradhapura is analysed in this part.

The Industrial City

The third perspective analyses the landscape from the productive systems in Anuradhapura, looking at the industries and main infrastructure systems.

The Sacred City

The fourth perspective interpret the religious system of pilgrimage and tries to grasp the complex logic of the cultural systems.

The Garden City

The last perspective looks at the landscape of the garden city of Anuradhapura in order to understand the modernist urban grid system.

6.1 – **The five landscape perspectives**

In order to interpret the landscape system, the research was structured using five landscape perspectives which organizes the analysis into different coherent parts which are later recomposed in order to form a whole. Each of these perspectives look at an important thematic of the landscape.

Depending on the element of interest, different scales of analysis might be more relevant but it is still possible to define a set of scales which are critical for most of the elements:

- The city scale is absolutely necessary in order to look at urban systems such as constructions, drainage, mobility systems, green and blue networks, etc.
- The region scale is adapted to understand how large-scale landscape elements such as rivers, soils, forest patches, urbanised areas, etc. interact.
- The country scale is very important in Sri Lanka, especially when it comes to critical infrastructures such as transportation systems.
- The world scale is useful in order to describe the impact of external factors such as climate change, globalisation, etc.

Beside the different scales of analysis, it is also necessary to take into account that the elements of the landscape have different temporalities of change. For instance, the Dutch layer approach is based on three main temporalities which are:

- The substratum layer (100-500 years),
- The infrastructure layer (50-100 years),
- The occupation layer (25-50 years).

Finally, it is also very important to understand who the different actors of the landscape are. Indeed, there are different groups of actors which use the landscape in a completely different way. A broad classification of the actors could be:

- The inhabitants of Anuradhapura
- The visitors from Sri Lanka and abroad
- The pilgrims
- The animals and plants

7 – The Ancient City

Interpretation from the perspective of heritage

The city of Anuradhapura is one of the most important places to understand the history of Sri Lanka. According to the Chronicles of Mahanama , the city was founded in 380 BCE and remained for ten centuries the political and religious capital of the kingdom. It is only after a succession of Tamilian invasions during the 9th century CE that the city was abandoned and the capital transferred to Polonnaruwa (ICOMOS 1982). Since the beginning of the 19th century, several extensive archaeological campaigns were conducted by the British and later by the Department of Archaeology. While many areas such as the ancient citadel remain largely not excavated, most of the largest monuments are now well documented and restored.

However, the surrounding landscape which form the setting of the monuments has been given less importance. It is interesting to note that the Sacred City of Anuradhapura is inscribed on the UNESCO World Heritage List since 1982 for its remarkable architectural monuments, for its testimony to the Sinhalese civilization, and for its association with leaving traditions and beliefs (ICOMOS 1982). But the statement of outstanding universal value does not mention the exceptional cultural landscape which surrounds the city of Anuradhapura despite the fact that most monasteries demonstrate a rich interplay between nature and culture (Abeywardana et al. 2017).

In the last decades, the importance of taking into account the conservation of cultural landscapes was acknowledged first by the Venice Charter in 1962 and the concept of cultural heritage continued to broaden since then. This relative lack of interest for the conservation of the surrounding landscape is dangerous as most of the monuments are deeply interrelated with the territory. Therefore, it is necessary to analyse the structure and to identify the landscape elements of the ancient system of urban settlements.

[1] The Chronicles of Mahanama is an epic poem written by a monk in the 6th century CE which relates the early history of Buddhism in Sri Lanka. While the historical accuracy of the text is debated, it is an important source of information concerning the development of the ancient city of Anuradhapura.

FIG. 7.1 Ancient street in the monastery of Abhayagiri (Peter, 2018)

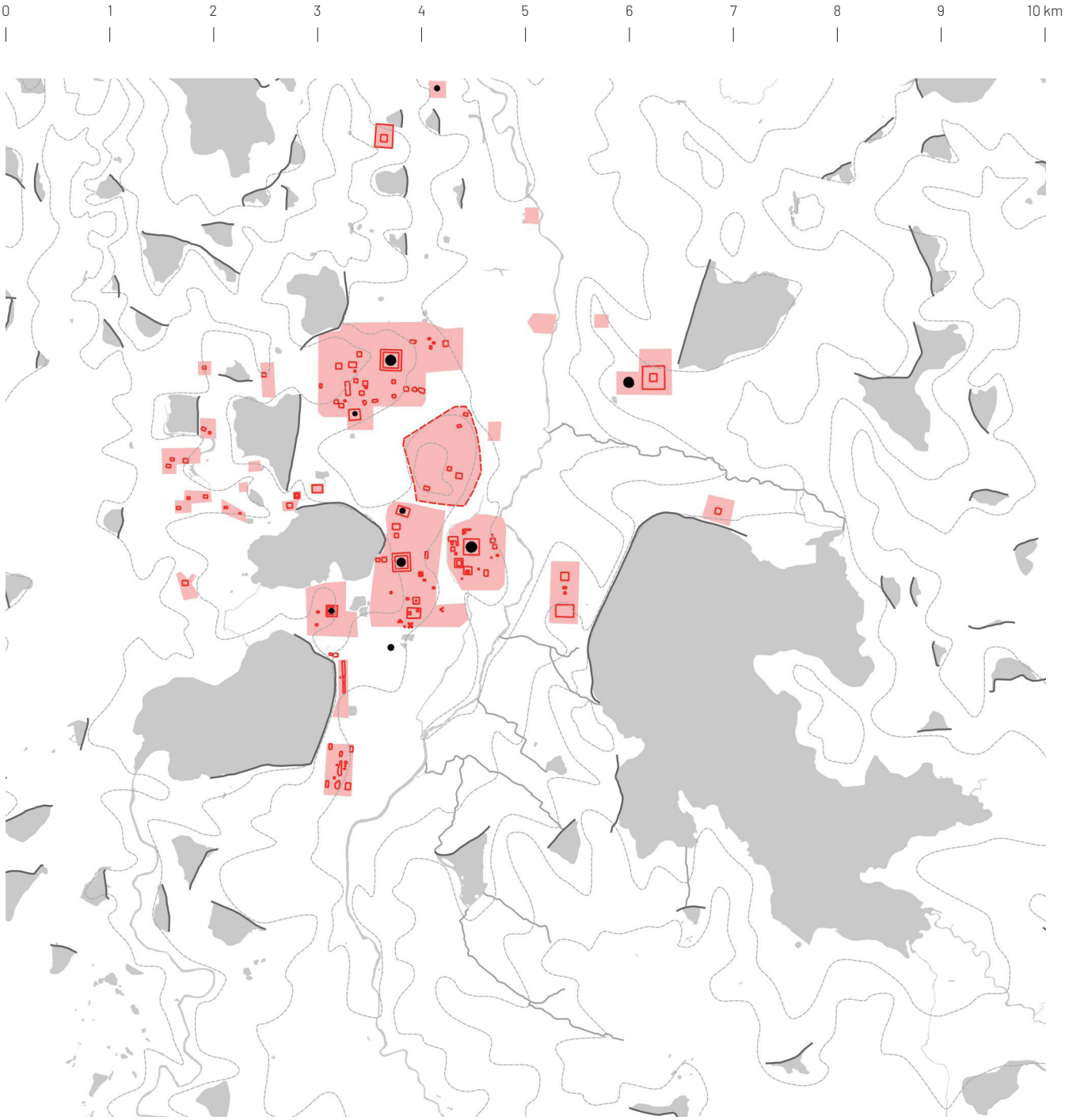
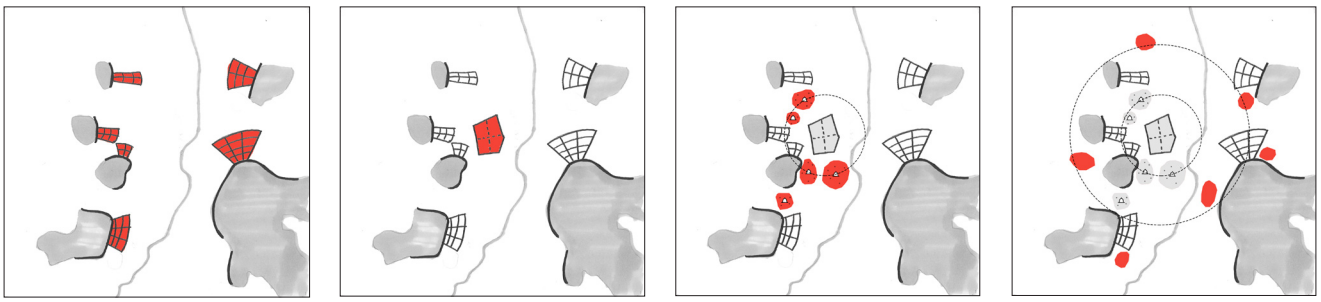


FIG. 7.2 The structure of the ancient city (Peter, 2018)

7.1 – **The ancient system of settlement**

It took several centuries for the ancient city of Anuradhapura to grow and to become the spiritual and religious capital of the Kingdom. Archaeologist identified four main phases of development:

FIG. 7.3 The phases of development of the ancient city (Peter, 2018)



Phase 1: The agrarian communities
(before 400 BCE)

The region of Anuradhapura has been populated at least since the 9th century BCE (Coningham et al. 2006). In the early phase of development, agrarian communities were established next to the main tanks on both side of the Malvathu river. Progressively, agricultural surplus enabled the development of larger settlements.

Phase 2: The fortified citadel
(around 400 BCE)

In the second phase, a quadrangular citadel was created on elevated ground in a strategic location near the river. This citadel was the secular centre where the king was established. The citadel was protected with a fortified moat and gates. This is a very important archaeological site which has not yet been excavated for most of it.

Phase 3: The main monasteries
(around 100 BCE)

During the third phase, a first ring of monasteries was created in the direct proximity of the citadel. These monasteries benefited from a certain degree of autonomy and were in competition. The three largest monasteries (Mahavihara, Abhagiriya, and Jetavana) were the seat of the three main monastic orders and they exercised an influence over all other monasteries in the country.

Phase 4: The forest monasteries
(around 700 AD)

Much later than the main monasteries, several forest hermitages were created in the outskirts of the city forming an outer ring of monasteries.

1

2

3

4

5

6

7

8

9

10

FIG. 7.4 Archaeological remains in the monastery of Abhayagiri

1. Abhayagiri stupa. *This is the most sacred structure in the monastery rising up to a height of 75m. (Kids Academy Pro, 2018)*

2. Elephant pond. *The largest pond in the monastery. It is 150 meters long, 50 meters wide, and 10 meters deep (Huang, 2018)*

3. The twin ponds. *A smaller but well decorated pond (Cyril Tours, 2018)*

4. Cave shelters. *The monks used natural rock outcrops as shelters (Peter, 2018)*

5. Stone bridge. *There was several bridge such as this one to cross the river (Peter, 2018)*

6. Moonstone. *The moonstones are decorative elements which were placed at the entrances of the buildings (Peter, 2018)*

7. Samadhi Buddha Statue. *It is considered as one of the best sculptures in the Anuradhapura era (Peter, 2018).*

8. The main refectory. *It was a four story building were the monks used to eat (Peter, 2018).*

9. The relic shrine. *This building served for ritual purposes associated with relics of Buddha. (Peter, 2018).*

10. Large tree. *The ruins are covered by majestic trees (Peter, 2018).*

7.2 – **The microhistory of Abhayagiri monastery**

In order to understand the logic of the ancient city, it is interesting to look closely at one of its components.

The monastery of Abhayagiri is one of part of the ancient city which is well preserved and has been studied extensively. According to the Chronicles of Mahanama, it was established by King Vattagamini Abaya in the first century BCE. The fraternity of monks rapidly became a very important Buddhist institution in Sri Lanka having well-established relations with China, Java, and Kashmir (Wikipedia, 2018). After the abandonment of the capital in the 9th century, the monastery was abandoned and was rediscovered in the end of the 19th century. Since then the monastery has been excavated and restored and has become a major attraction of Anuradhapura.

The monastery is located on the top a small hill which protects the site from river floods. It covers an area of approximately 240 hectares and is largely covered with large trees which provide shade, fresh air, and protect the soils from erosion. It is still possible to observe the remains of the main structures such as the sacred buildings and the residence quarters. The stupa, which is the most sacred structure, is located at the centre of the monastery. Rising at 75m above the ground, if forms a landmark visible from far away in the landscape.

The monastery was planned using perpendicular axes in the cardinal directions. Several road systems were discovered such as a stone bridge in the north of the monastery. The streets in the monastery are usually parallel to the main axes and 10 meters wide. A complex network of underground pipes and ponds provided water for consumption, spiritual practices, recreation, and gardening. Ancestral waste water filtration systems were also discovered showing the advanced knowledge of water management of the ancient civilisation.

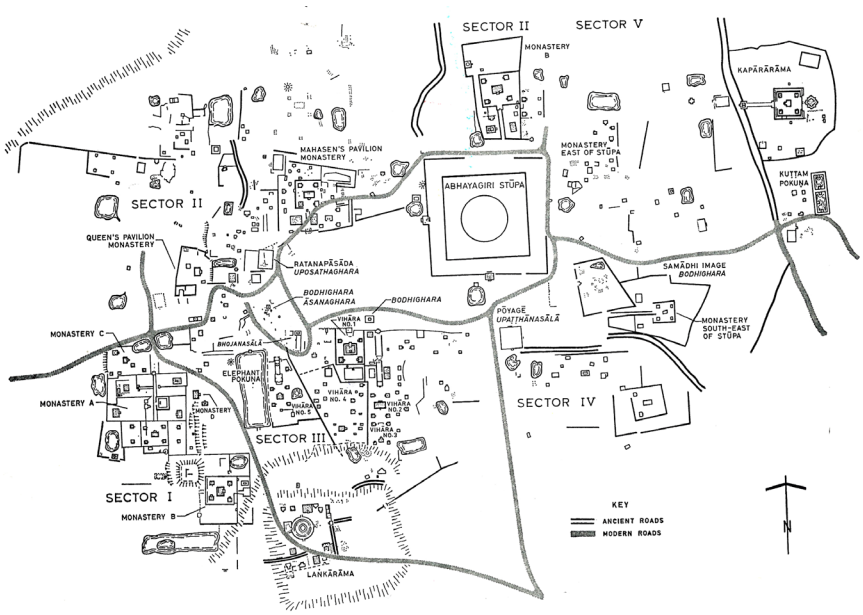


FIG. 7.5 Map of Abhayagiri monastery (Bandaranayake, 1974)

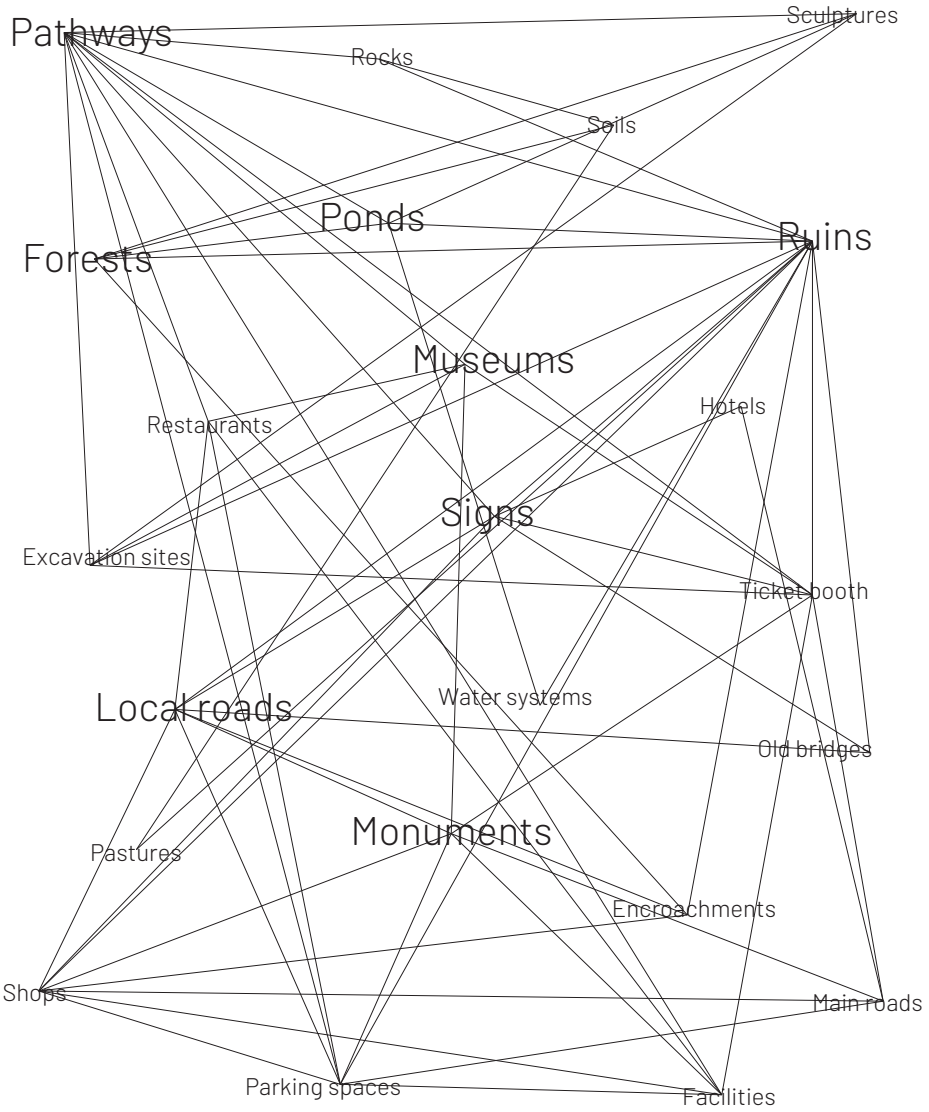
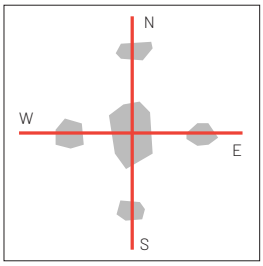


FIG. 7.6 Relations between the elements of the ancient city (Peter, 2018)

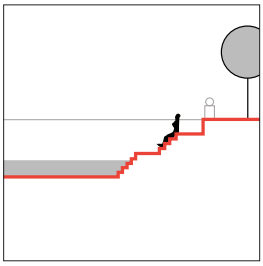
7.3 – **Strategic elements of the Ancient City**

Based on this analysis, it is possible to identify a few strategic elements which could be transformed in order to strengthen the perspective of the ancient city:



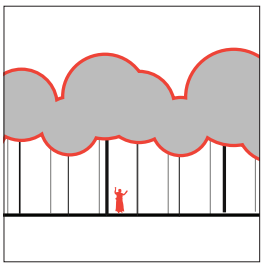
The local roads and pathways

The ruins of the ancient city are scattered over a large territory and are accessible through the local roads and the numerous pathways. However, this network is designed mostly for motorized vehicles and there is a lack of infrastructure for pedestrians and bicycles. It is necessary to completely reorganized the traffic in the ancient city in order to reduce the number of cars, and to develop new circuits of the visit. This reorganisation could be a great opportunity to valorise the heritage with a new scenography.



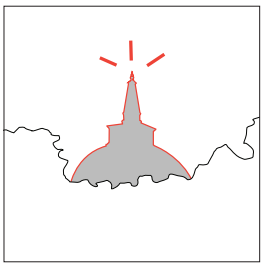
The water features

The numerous ponds scattered all over the territory are the most impressive remaining elements that demonstrate the advanced skills of the ancient builders in the field of landscape architecture and hydrological engineering. There is a great potential to valorise this rich heritage as many of the ponds are currently not accessible or functioning anymore. Restoring the original character of the ponds by reintroducing water has been done successfully in Angkor, Cambodia but requires a lot of time and investment.



The urban forests

The trees are an important but often neglected part of the heritage of Anuradhapura. The protection and development of "urban forest" was an important planning concept of the ancient city. These forests served multiple roles such as reducing heat and providing shade. In the last decades, the tree canopy has been affected by uncontrolled urbanization and the development of transport infrastructures. There is a great potential to improve the management of the "urban forests", to increase the tree canopy, and to protect heritage trees.



The monumental structures

Other important elements of the ancient city are the monumental structures such as the stupas. These structures act as a landmark in the landscape and help to orient in this very large site. Therefore, the view corridors in the landscape should be protected and valorised as much as possible. This can be done for instance by controlling new constructions and managing the vegetation in order to open perspectives from some places.

8 – The Water City

Interpretation from the perspective of water management

The city of Anuradhapura has a tropical climate and receives rainfalls mainly during two well-defined rainy seasons. However, due to important evaporation rates, severe water shortage occurs and the term "Dry Zone" is often used to qualify this region of Sri Lanka. Due to the small relative thickness of the soil mantle and the underlying bed rock it is not possible to use the ground to store large quantities of water for irrigation except in few places. Groundwater is most of the time just sufficient to cover domestic usage (Handawela 1992).

Under such conditions, human settlement would not have been possible in this region without artificial methods to store water (Agrarian Research & Training Institute 2007). In order to overcome the difficult climate of this region, Sri Lankan people developed an ingenious system of irrigation using the specific low-relief landscape of the peneplain to store water. This complex system has been used since ancient times to collect, store, and distribute water for the cultivation of rice.

However, the system is under stress due to new factors such as the urbanisation of the region and climate change. Urbanisation has led to the development of land which is crucial for the irrigation system and to the degradation of the infrastructures due to illegal constructions. The impact of climate change can already be observed looking at the extreme weather events that affected the city in the last years. For instance, severe flooding due to heavier rain impacted the population, damaged buildings, and destroyed crops. Droughts also affected the production of rice during the dry season and put ecosystems at risk.

In the last decade, there has been a lot of research looking at the potential to integrate indigenous water management experience into modern water management. Indeed, these systems provide several social, economic and environmental benefits which should not be neglected and replaced by modern solutions without care. Therefore, the following part of the research analyses the irrigation system of Anuradhapura in order to highlight the different challenges and opportunities related to this system.

FIG. 8.1 Nuwara Weva, the largest man-made tank in Anuradhapura (Peter, 2018

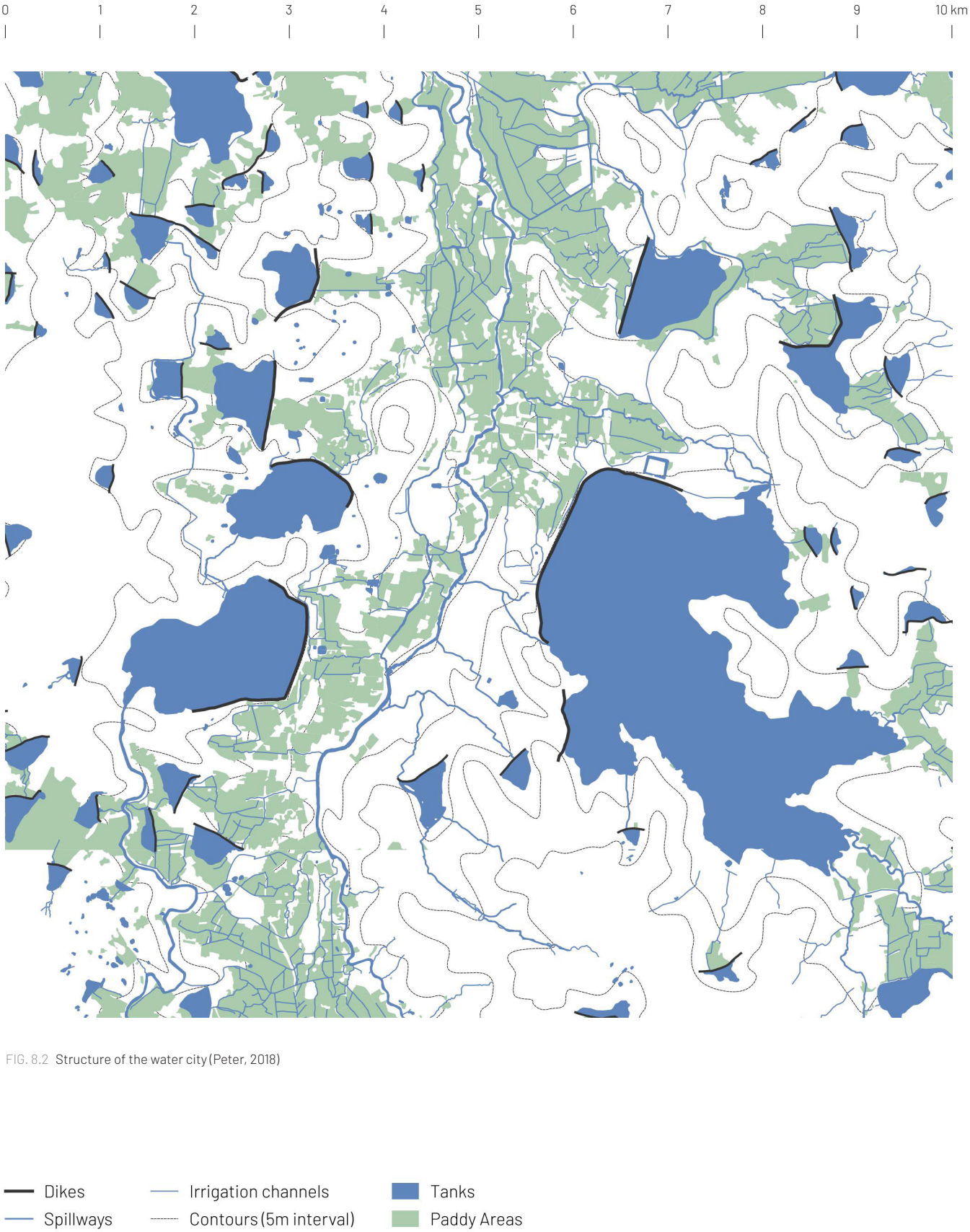


FIG. 8.2 Structure of the water city (Peter, 2018)

8.1 – **The system of cascading tanks**

FIG. 8.4 Main rainfall zones in Sri Lanka (Wikipedia, 2018)

In Anuradhapura, the main agricultural product is rice which requires a large quantity of water and a constant supply over the year to be cultivated. However, the region receives water only during two well-defined rainy seasons. The main rainy season is called the Maha and last from October to mid-January. The second season, which receives less rainfall, is called the Yala and last from mid-March to mid-May. In between these seasons, the average rainfall is not sufficient to cultivate rice. Due to the soil conditions and the hydrology, other sources of water such as rivers and groundwater cannot sustain agriculture during the dry periods.

Cascading tanks system

In order to overcome this situation, people of Sri Lanka developed a system of cascading tanks which is an extremely efficient way to collect, store and reuse water. The tanks are constructed taking benefit of the hilly terrain by blocking the shallow stream valleys with embankments. This creates an artificial water tank which collects the rainfall during the rainy season and distribute it during the dry season. As the tanks are connected in a cascade, the water is used multiple times before to be released in the main river channel. The system works entirely using gravity to distribute water, and man power is only needed to operate the sluices and maintain the system.

Multiple services

The cascading tank system provides many services beside its main function to store water for agriculture. For instance, many ecosystems depend directly on the tanks to prosper. Several species of birds, wild animals, fishes can be observed around the tanks. The tanks also contribute to replenishing groundwater and help to control soil erosion. They are also very important for social systems providing spaces for recreation, social cohesion, and community leadership due to the maintenance requirements.

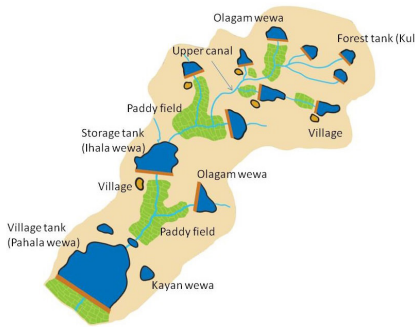


FIG. 8.3 Example of a cascading tank system (Vidanage, 2018)

Indigenous knowledge

Over the time, people of Sri Lanka have learned to maximise the services provided by this complex irrigation system. For instance, all the tanks do not serve the same function. The forest tanks, located in the upper part of the system, are used to provide water for the wide animals and keep them away from the villages. The erosion control tanks are designed in order to collect the deposits and reduce the sedimentation of the large tanks. Landscape was used in many ways to support the system. Vegetation was used on the side of the lakes to control the wind reducing the loss of water through evaporation. The mud extracted from the lakes was used for the construction of the stupas.

1

2

3

4

5

6

7

8

9

10

FIG. 8.5 The main components of a Nuwara Wewa (Peter, 2018)

1. The tank embankment. *(Peter, 2018)*

2. Bathing spot. *There are several places where people can access the water easily to bath (Peter, 2018).*

3. Fishermen. *The tanks provide fisheries which are consumed locally (Peter, 2018).*

4. Pumping station. *This station supplies drinking water for the modern city (Peter, 2018).*

5. Sluice of the tank. *The sluice is the gate which control the flow of water distributed in the irrigation channels (Mapio, 2018).*

6. Irrigation channel. *This channel distribute the water to the different rice paddies (Peter, 2018).*

7. Aerial view of the rice paddies *(SCDP, 2018).*

8. Spillway. *When the tank is full, the overflow of water is directed towards the spillway channel. (Peter, 2018)*

9. Spillway channel. *The spillway channel is a deep channel which can support large quantities of water during heavy rainfalls (Peter, 2018).*

10. Malwathu River. *The spillway channel is connected to the main river (Peter, 2018).*

8.2 – **The microhistory of Nuwara Wewa**

In order to understand the logic of the water city, it is interesting to look closely at one of the tanks and understand the role of each of its elements.

The tank of Nuwara Wewa, which is the largest tank of Anuradhapura, was built in the 1st century BCE by King Vattagamini Abay (Wikipedia, 2018). It has a catchment area of 8,411 hectares and is categorised as a major tank (ID, 2018). It supplies water for agriculture purpose and also for the city of Anuradhapura.

The water stored in the tank comes from two sources. A part of it comes from the natural catchment area of the tank. This source was probably not sufficient to fill the tank, and a canal was created in order to divert water from the Malwathu River into the tank.

Due to the topography of the area, the embankment of the tank is divided in three parts. In total, it is 5 km long and 10.6 meters height at its highest point (ID, 2018). The embankment is accessible to the public but is not adapted for bicycles.

There are two sluices located at different levels which control the flow of water entering the irrigation channels. There are also two spillways (flood escape systems) which are used when the tank is full and connected to Malwathu River.

The command area is the name given to the area which is irrigated by the tank. Traditionally, the government provide annually 1.5 meters of water per unit of land to the farmer in the command area free of charge.

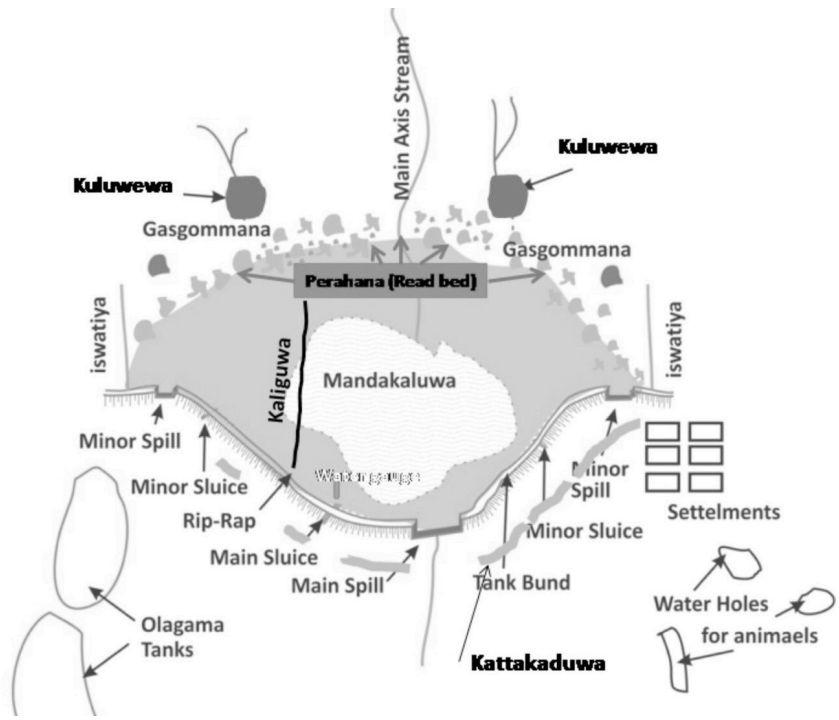


FIG. 8.6 The main elements of the tank system (Tennakoon, 2018)

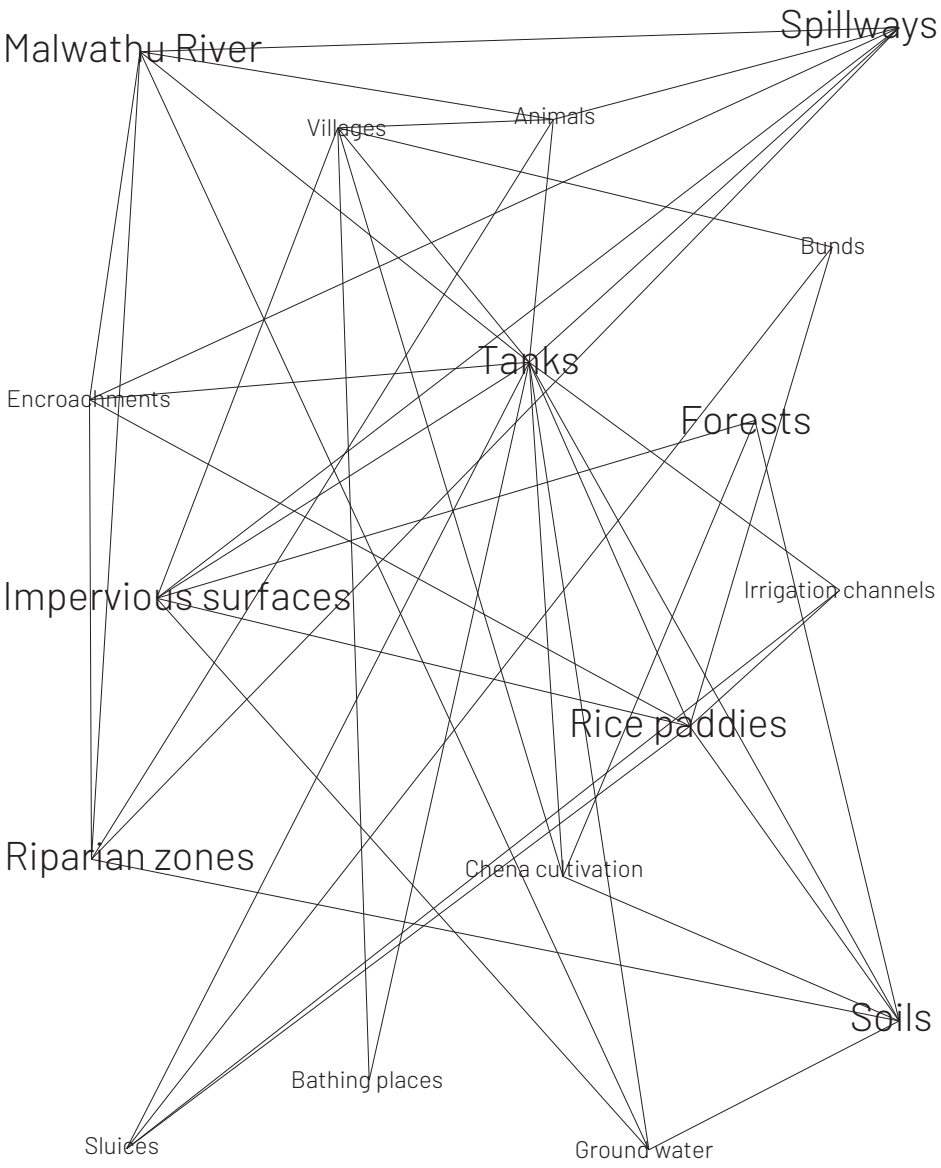
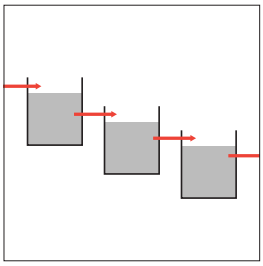


FIG. 8.7 Relations between the elements of the water city (Peter, 2018)

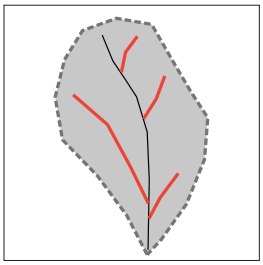
8.3 – **The strategic elements of the Water City**

Based on this analysis, it is possible to identify a few strategic elements which could be transformed in order to strengthen the perspective of the water city:



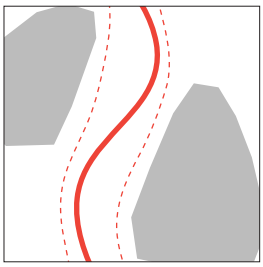
The cascading tanks

The cascading tanks are extremely important elements in the urban landscape of Anuradhapura. However, they have been damaged by urbanisation along the embankments and in the catchment areas. It is therefore necessary to protect the tanks from urbanisation and to restore the systems when it is possible. At the same time, there is a great potential to valorise the services provided by the tanks such as climate control, recreational activities, habitats, and so forth.



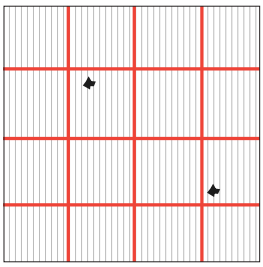
The main spillways

The spillways which pass through the city are currently treated as residual spaces. They are heavily polluted due to waste water and encroachments block the water flow. However, these spaces have a real potential to work as green and blue corridors passing through the city and connecting the tanks to the river. These green and blue corridors could provide space for human activities and take benefit of ecosystem services to clean urban waste water naturally.



The Malwathu River

The Malwathu river is the one of the rare elements of the landscape which was not created by humans. However, the current trend is to control the flow of the river using different engineering systems such as bypasses, dams, and so forth. While these systems initially reduce the impact of the floods, they will require constant upgrading of the defence infrastructure on the long-term. Therefore, an adaptation strategy should be preferred and the natural character of the river should be valorised.



The rice paddies

In the last decades, the trend in agriculture has been to industrialize the production using pesticides, fertilizers, and mechanical systems. This has caused several issues which are well documented such as the high prevalence of kidney diseases in the region, the development of resistant pests, the loss of biodiversity, and so forth. There are different programs which have shown the benefits of reintroducing traditional rice varieties, to cultivate different types of crops based on water availability, and to develop agro-tourism to provide a second source of income to the farmers.


MALES

9 – The Industrial City

Interpretation from the perspective of transportation

From 1815 and 1948, Sri Lanka was a British colony administered by a colonial Governor (Wikipedia, 2018). The British undertook large-scale infrastructure works in order to exploit the agricultural resources of the country such as rubber, coffee, tea, and coconuts. In Anuradhapura, the British restored several of the ancient irrigation systems in order to increase the production of rice and established the city as the administrative capital of the North-Central Province in 1873. They developed a railway line connecting the northern part of the country with the capital and passing by Anuradhapura.

However, the development of road transport in the end of the 20th century led to the relocation of industrial activities in the outskirts of the city next to the main roads where land was available. This shift was probably accentuated by the civil war which impacted the railway system. The colonial railway system progressively felt into disrepair leading to the decline of the activities which depended on it such as the railway warehouses. Currently, little attention is given to these elements which are not perceived as part of the heritage of the city. Therefore, large extent of land remains abandoned or underutilized in some of the most strategic locations of the city.

Since the end of the civil war in 2009, the government of Sri Lanka started to invest in order to upgrade the railway system of Sri Lanka focusing on passenger service. In the future, Anuradhapura could greatly benefit of an efficient rail connection with the rest of the country as the city is not connected by expressways. This would have a lot of implications on the industrial landscape which could be valorised and become a part of the city. Therefore, it is necessary to look in detail to the structure of the industrial city, and to understand the potential and challenges of each of its strategic elements.

FIG. 9.1 Train waiting at the railway station of Anuradhapura (Peter, 2018)

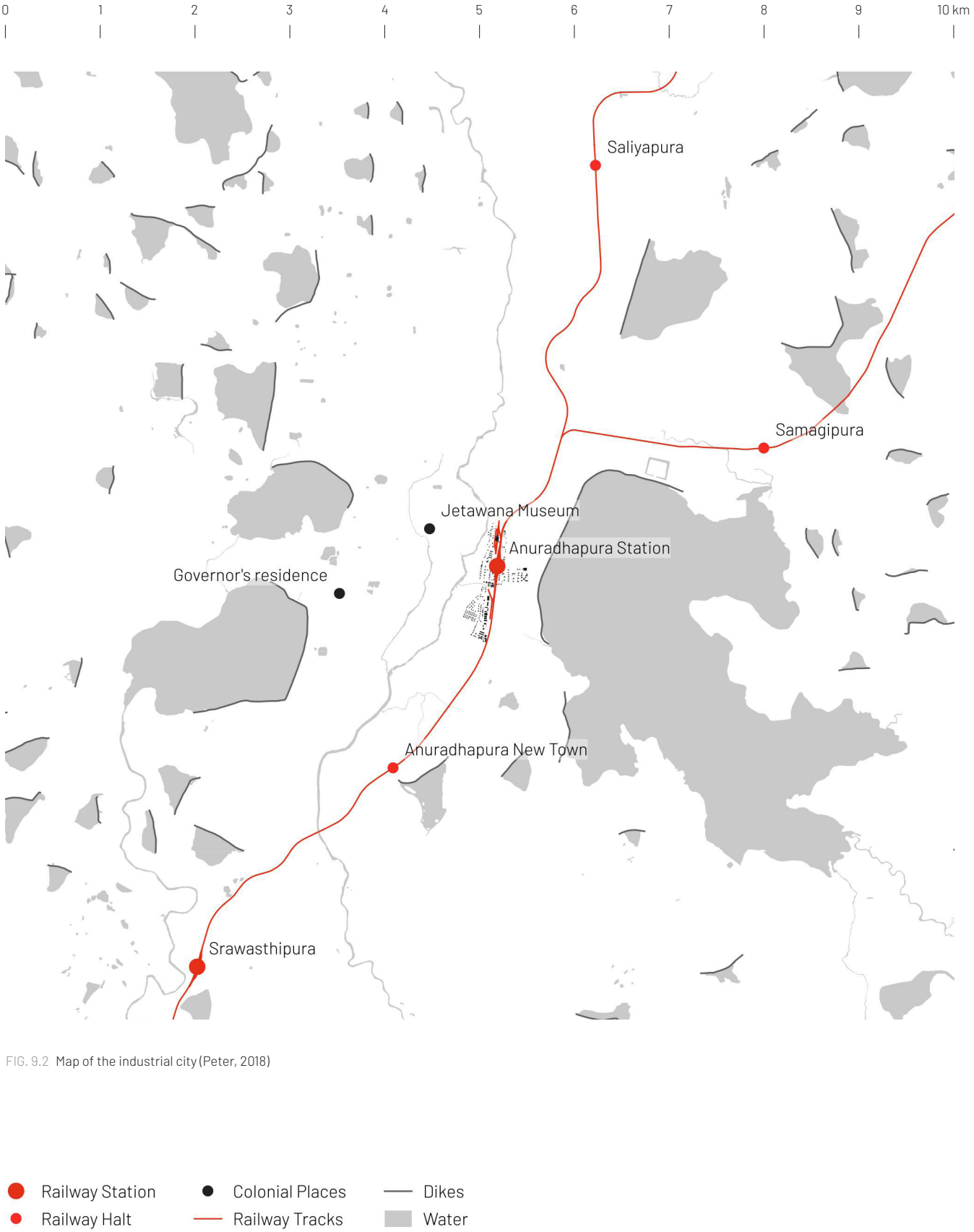


FIG. 9.2 Map of the industrial city (Peter, 2018)

FIG. 9.3 Main railway lines and stations in Sri Lanka (Wikipedia, 2018)

9.1 – **The main transportation systems**

Railway system

The northern railway, constructed from 1892 to 1905 by the British colonial government, is the longest line in Sri Lanka. Anuradhapura is located in the middle of the railway line between Jaffna in the north and Colombo in the south. The port of Colombo was one of the most important port in the world at the British time and it was therefore extremely important to connect the country with this gateway. The line was severely damaged during the civil war and the service was interrupted from 1990 until recently. Since 2009, the government reconstructed the parts which were destroyed and reopened the line progressively.

However, the level of service is very low due in part to the aging infrastructure. Most of line is a single railway track and the trains need to cross at the stations where the line is doubled. The line is not electrified and the operating speed of the trains is quite low. As a result, train is currently not very competitive for passengers compared to road transport but could this could change if the infrastructure is modernized. In terms of freight, the share of rail transport is extremely low and it is unlikely to change in the near future.

Main road system

Looking at the main road network, Anuradhapura is located at the interface in between the northern part of the country and the rest of the island. There is currently no bypass road, which means that most of the traffic passes through the city even if it is not the final destination. There are several bottlenecks in the city center which block the traffic flow. There are also a lot of shops along the main roads and the lack of parking management leads to traffic jams.

The main public transport system in Sri Lanka is the bus network which follows the main roads. There are three main bus stations in Anuradhapura and one depot for government buses. For different operational and structural reasons, the current bus stations are not working very well. They also are completely disconnected from the railway network which could be a problem in the future if the railway service increases.

Industrial areas

There are three main industrial areas which are currently active. In the north of the city, there is a cluster of agriculture and food processing related industries organized around the Faculty of Agriculture of Rajarata University. In the area of Anuradhapura railway station, there are still a few active industries for the maintenance of the trains but most of the warehouses and distribution buildings are abandoned. Finally, the area in the south of the city is mainly used by automotive industry.

1

2

3

4

5

6

7

8

9

10

FIG. 9.4 The main elements of the railway station area (Peter, 2018)

1. Anuradhapura Railway Station. *The main building of the station is a typical colonial building (Peter, 2018).*

2. Public square. *The public square in front of the station is not accessible and some buildings were constructed recently reducing the open space (Peter, 2018).*

3. The railway tracks. *They form a 100 meters wide green corridor cutting through the city (Peter, 2018).*

4. Encroachments. *Illegal constructions on railway reservation areas (Peter, 2018).*

5. Industrial open space. *The industrial open spaces extend the green corridor in some places (Peter, 2018).*

6. Industrial warehouse. *Many of the warehouses are currently abandoned (Peter, 2018).*

7. Colonial house. *The colonial houses form an interesting architectural ensemble (Peter, 2018).*

8. Old bridge. *The bridge constructed by the British partially collapsed after a flood (Peter, 2018).*

9. Intersection. *The railway crossing creates a bottleneck for the traffic (Peter, 2018).*

10. Water tank. *There are several elements which remind the history of the place such as the water tank for the steam engines (Peter, 2018).*

9.2 – **The microhistory of Anuradhapura Railway Station**

The railway station of Anuradhapura was constructed in 1903 by the British. It is a major station on the Northern Line connecting Colombo to Jaffna. The architecture of the building represents the very modernist colonial architectural style. The architecture is based on simple and repetitive elements which can be found in other many other British stations from this period.

In the area of the train station, the British developed all the functions required for a provincial capital such as a hospital and a post office. A residential neighbourhood was created in order to host the workers of the railway company. These houses are also very typical and constitute an architectural ensemble which should be valorised. Parallel to the railway tracks, several warehouses and mills were used to process and store rice for export. While most of these buildings are still existing, a lot of them are unoccupied and need repairs.

In this area of the city, the vegetation is abundant due in part to the lack of maintenance. The railway tracks and their reservation area generate a 100 meter-wide green corridor which cut through the city. The industrial open spaces, which served to manoeuvre the vehicles, enlarge this corridor in some places. However, there are several illegal constructions encroaching on railway land and there is no access road along the tracks.

There are currently eight trains per day going to Colombo from Anuradhapura station and the same amount travelling in the other direction. The fastest train takes 3 hours 30 minutes to reach the capital, which is equivalent to the travel time by car with good traffic conditions. There is also a local train shuttle which deserves surrounding cities.

Direct Trains

Your Station	Arrival Time	Departure Time	Destination / Time	End Station / Time	Frequency	Name	Type
ANURADHAPURA	00:50:00	01:10:00	COLOMBO FORT 06:00:00	COLOMBO FORT 06:00:00	DAILY	5068	LONG DISTANCE
Available Classes: 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 06:00:00			**Train No:** 5068	
ANURADHAPURA	04:45:00	05:00:00	COLOMBO FORT 10:20:00	COLOMBO FORT 10:20:00	DAILY	Rajarata Rejini	EXPRESS TRAIN
Available Classes: 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 10:20:00			**Train No:** 4086	
ANURADHAPURA	06:38:00	06:40:00	COLOMBO FORT 10:36:00	COLOMBO FORT 10:36:00	DAILY	INTERCITY	INTERCITY
Available Classes: 1st Class , 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 10:36:00			**Train No:** 4004	
ANURADHAPURA	09:02:00	09:15:00	COLOMBO FORT 12:55:00	COLOMBO FORT 12:55:00	DAILY	UTTARA DEVI	A.C. - INTERCITY
Available Classes: 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 12:55:00			**Train No:** 4018	
ANURADHAPURA	10:30:00	10:50:00	COLOMBO FORT 16:05:00	COLOMBO FORT 16:05:00	DAILY	5868	LONG DISTANCE
Available Classes: 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 16:05:00			**Train No:** 5868	
ANURADHAPURA	13:38:00	13:50:00	COLOMBO FORT 18:35:00	COLOMBO FORT 18:32:00	DAILY	YAL DEVI	LONG DISTANCE
Available Classes: 1st Class , 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 18:35:00			**Train No:** 4078	
ANURADHAPURA	16:27:00	16:32:00	COLOMBO FORT 20:05:00	COLOMBO FORT 20:00:00	DAILY	INTERCITY	A.C. - INTERCITY
Available Classes: 1st Class , 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 20:05:00			**Train No:** 4022	
ANURADHAPURA	23:02:00	23:10:00	COLOMBO FORT 04:05:00	COLOMBO FORT 04:05:00	DAILY	Night Mail	Night Mail Train
Available Classes: 1st Class , 2nd Class , 3rd Class			**Train ends at** COLOMBO FORT **at** 04:05:00			**Train No:** 4090	

FIG. 9.5 Timetable of the trains starting from Anuradhapura to Colombo during the week (Sri Lanka Railways, 2018)

FIG. 9.6 Relations between the elements of the industrial city (Peter, 2018)

9.3 – **Strategic elements of the Industrial City**

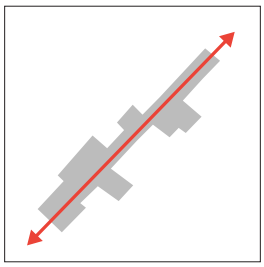
Based on this analysis of the industrial landscape, it is possible to identify a few strategic elements which have a great potential for transformation:

The infrastructure skeleton

In order to revitalise the economy of the city, it is critical to strengthen the infrastructure skeletons such as the railways, the main roads, the energy supply, and so forth. Indeed, these systems are currently not very efficient leading to the poor economic attractiveness of the city. While upgrading the railway system will take a long time, some smaller interventions can have an immediate impact such as parking management or the suppression of bottlenecks.

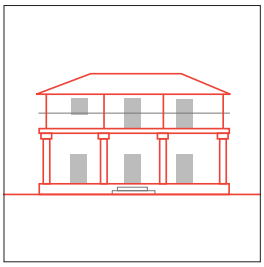
The transportation hubs

There is currently one railway station, one railway halt, three bus stations, and one bus depot in Anuradhapura. None of these are interconnected, which is highly inefficient in terms of multimodality. There is therefore a great potential to relocate or reconnect these different stations and to develop multimodal hubs. However, the planning of these new centralities should be respectful of the character of the urban landscape.



The industrial open spaces

There are a lot of residual spaces along the infrastructure lines and between industrial buildings. These green spaces are currently disconnected and not valorised. However, there is a great potential to use these spaces for human activities such as urban farming, playgrounds, and so forth. Ecosystem services could also be valorised in order to bring nature within the city.



The architectural ensembles

There are several structures which are representative of the colonial architecture. Taken separately, they may not be impressive but as a whole they form an architectural ensemble which should be protected and valorised. For instance, the old warehouses could be converted and used in order to support local handicrafts. The objective should be to find a new function to these elements in order to avoid their destruction and make sure that they are do not require constant maintenance.

10 – The Sacred City

Interpretation from the perspective of religion

According to the religious chronicles, Buddhism was introduced into Sri Lanka during the third century BCE. Since then, Anuradhapura has been the most sacred place for Buddhists in Sri Lanka due to the presence of several of the most important pilgrimage sites such as the Bodhi Tree. Theravada Buddhism is the religion of over 70 percent of the population of Sri Lanka (Census of population, 2012). During the main festivals which are called "Poya Days", people travel from all across the country to come to Anuradhapura and give offers in the main sacred places.

While people are extremely respectful of the place in general, the great affluence during Poya Days generates a lot of pressure on the city. As most of the people travel to Anuradhapura by bus or by individual vehicles, the traffic becomes completely congested all over the city. The parking lots near the sacred place get full, and people park outside wherever they can. Many pilgrims eat and spend the night in the historical site which requires organisation in terms of water supply, waste collection, toilets, and so forth. Therefore, there are real challenges in terms of traffic management, safety, sanitation, and heritage protection which needs to be addressed.

In the last decades, the importance of safeguarding intangible cultural heritage such as traditions, rituals, festive events, and so forth has been widely recognised by the international community. These manifestations are an integral part of the urban landscape of Anuradhapura which must be understood. While this landscape is ephemeral, there are physical elements which support these activities. Therefore, it is possible to act on these elements in order to valorise the sacred character of Anuradhapura.

FIG. 10.1 Traditional religious procession in Anuradhapura (Peter, 2018)

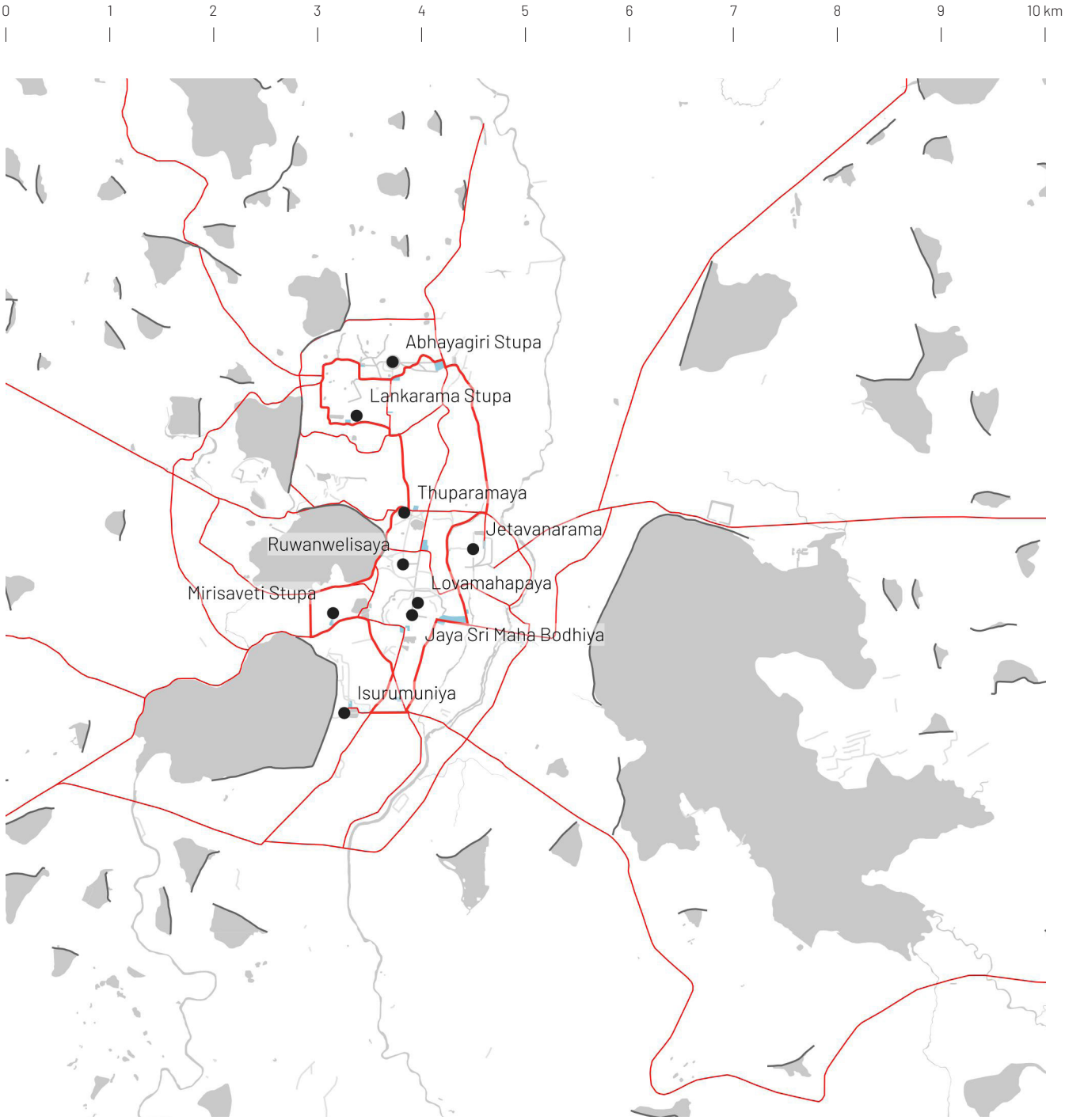


FIG. 10.2 Structure of the sacred city (Peter, 2018)

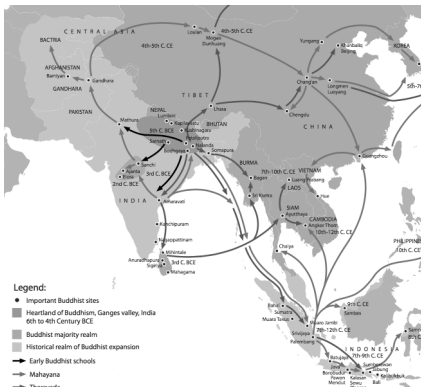


FIG. 10.3 Propagation of Buddhism in Asia (Wikipedia, 2018)

10.1 – **The religious pilgrimage system**

In the Buddhist religion, worshipping involves making offerings to the Buddha which can be done at different places. In Anuradhapura pilgrims usually go to the "Atamasthana" which are the eight sacred places visited by the Buddha.

The eight sacred places

The most sacred place in Anuradhapura is the Bodhi Tree which is said to be a branch of the original Bodhi Tree under which Lord Buddha attained enlightenment in India. The Bodhi Tree was planted in 288 BCE, which makes it the oldest living human-planted tree in the world with a known planting date (Wikipedia, 2018). Any construction is forbidden in a 500-meter radius in order to protect the tree. Other important places of pilgrimage are the stupas which contain a physical relic of the Buddha. The seven stupas of Anuradhapura are Jethawanarama, Abhayagiriya, Thuparamaya, Ruwanweliseya, Mirisawetiya, and Lankarama. Lowamahapaya, which is the chapter house of the Bodhi Tree complex, is the last of eight sacred places.

Services for the pilgrims

Next to each of these locations, there are large parking lots which make it possible for the pilgrims to travel by bus or minibus to their destination. There are several shops on the parking lots which provide low-quality items for the visitors. From the parking lots, many pilgrims walk barefoot to the sacred places. Water points are available all over the site during the Poya Days and there are a few mobile toilets but not in a sufficient quantity.

In the last decade, the National Physical Planning Department initiated the so-called "ring road project" which aims at improving the accessibility of the site for the pilgrims. It consists of a circular road with new large-scale parking lots next to each of the main sacred places. The project has only been partially implemented until now.

Enclosed areas

In 1985, the Liberation Tigers of Tamil Eelam committed a massacre in the city of Anuradhapura and at the complex of the Bodhi Tree killing 146 Sinhalese people (Wikipedia, 2018). Since then, there is a fence enclosing the complex of the Bodhi Tree and several check points at the entrances. There are several other enclosed areas in the sacred city such as a military complex, private properties, and so forth. It is important to take these elements into account, as they greatly impact the routes used by people in the landscape.

1

2

3

4

5

6

7

8

9

10

FIG. 10.4 The main elements during the Poya days

1. Ruwanweliseya. *Aerial view of the pilgrim praying at Ruwanweliseya (Trover, 2018)*

2. Flower stand. *There are several flower stands along the roads during Poya Days (Trover, 2018).*

3. Night parade. *Esala Poya parade in Anuradhapura (Unknown, 2017)*

4. Dan Sala. *Stand distributing food along the road for the pilgrims (Wickramarachchi, 2017)*

5. Resting spots. *Pilgrims rest in the grass next to the sacred places (Secret Lanka, 2018)*

6. Light at night. *Illumination of Thuparamaya stupa (Kularatne, 2018)*

7. Religious procession. *(Dailymirror, 2018)*

8. Mobile toilets. *Only the base of the toilets is permanent (Peter, 2018).*

9. Parking lot. *The parking lot of the Bodhi Tree is full only during Poya days, the rest of the time it is mostly empty (Peter, 2018).*

10.Bathing spot. *During Poya days, pilgrim bath in the tanks (ITN News, 2018).*

10.2 – **The microhistory of Poya Days**

Poya is the name given in Sinhala language to the Buddhist holiday which happens every month usually on full-moon day. Each Poya day celebrates a different event which is important in the Buddhist religion such as the birth of Buddha or his visits in Sri Lanka. Therefore, some of the Poya days have a greater importance and attract more pilgrims such as Vesak and Poson Poya which celebrate respectively the birth of Buddha and the arrival of Buddhism in Sri Lanka.

On Poya days, pilgrims usually go to the temples early in the morning carrying flowers. The celebration lasts all day and each temple as a different programme of activities. The most common activities are recitals, sermons, readings, and giving offers to the Buddha. As the activities finish late in the night, a lot of pilgrims spend the night camping near the temples. Shops are usually closed on Poya days, and the sale of alcohol is prohibited.

There are no official statistics available about the frequentation of the site during festivals but it is estimated that there are about 30,000 pilgrims visiting Anuradhapura on normal Poya days. During the most important Poyas, there would be from 500,000 to 1,000,000 million pilgrims visit the city over a few days (A'Urba, 2015).

In order to provide basic services to the pilgrims, a lot of temporary structures are installed on Poya days. For instance, there are stand which distribute free food for the pilgrims along the roads. Mobile toilets are installed in some places, water points are available in most of the sites, and the pilgrims use the tanks to bath.

FIG. 10.5 Calender of the Poya days in 2018 (Kays, 2018)

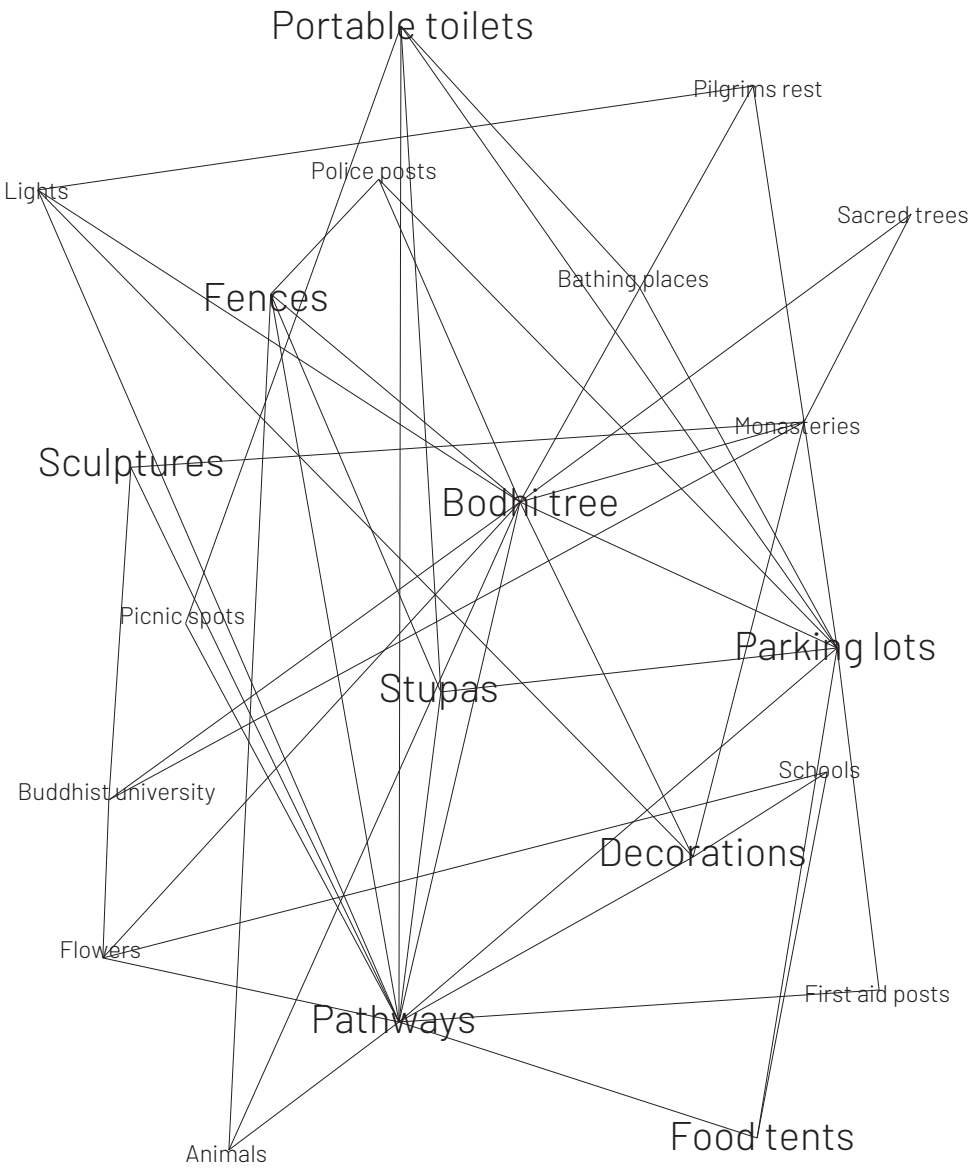
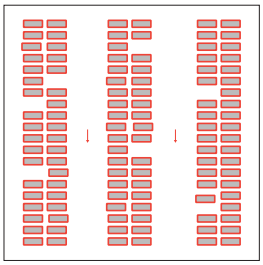


FIG. 10.6 Relations between the elements of the sacred city (Peter, 2018)

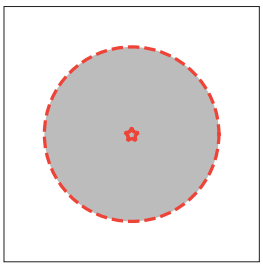
10.3 – **Strategic elements of the Sacred City**

Based on this analysis, it is possible to identify a few strategic elements which could be transformed in order to strengthen the perspective of the sacred city:



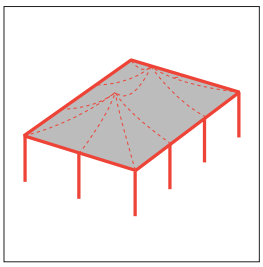
The parking spaces

There is not really any strategy in terms of parking management in the Sacred City. The parking lots are dimensioned for Poya days and are way too large during the rest of the month. As a result, a lot of space is artificialized but does not have any function most of the time. The low quality of the landscaping of the parking lots makes it even worse as there is no vegetation, porosity of the pavements, proper services, and so forth.



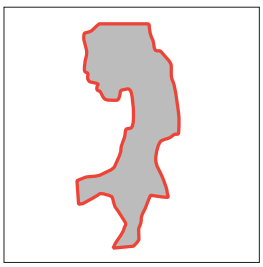
The enclosed spaces

As much as possible, the sacred city should remain open and accessible to everyone. However, when there is a need to control the flow of pilgrims or to protect an area, this should be done using landscape elements which integrate well in the site and not basic fence systems as this is currently the case. For instance, this could be done using water elements such as ditches and channels which are very common in the landscape.



The temporary structures

There are all kinds of elements which are installed temporarily in the Sacred City during Poya days such as decorations, lights, tents, resting spots, and so forth. These elements are part of the living heritage of the site and should be valorised. It is therefore very important to provide flexible spaces which can accommodate these kinds of light structures.



The ring road

The project of the ring road shows that there is a need to provide an efficient way for the pilgrims to access the eight sacred places. However, there are different ways to do it and the risk of the current proposal is that it will encourage more people to use individual vehicles. The ring road could be envisaged as a public transportation system which works during Poya days.


Salon

11 – The Garden City

Interpretation from the perspective of urban development

After the independence of Sri Lanka in 1948, the government decided to develop a new town next to the historic site in order to relocate the inhabitants who were living in the ruins of the ancient city and to manage the rapid urban population growth. Inspired by the British Garden City model, the new town of Anuradhapura was designed based on modernist principles such as separating urban functions and using a grid composition. The new town has now become the city of Anuradhapura, which has a population of 50,000 inhabitants (Census of population, 2012).

The postmodern critic of modernism takes all its sense looking at the urban landscape of the new town of Anuradhapura. Comprehensive urban planning has led to the development of a homogenous urban landscape based on the principle "one size fits all". In order to compensated the lack of identity, people use all kinds of decorative elements which create landmarks and provide a sense of place. However, the new town also has qualities which should not be lost. For instance, low density residential areas make it possible to have a lot of vegetation within the city which is important in this hot climate.

Recent researches have shown that urban landscape infrastructures have the potential to reinforce local and regional identity by reconnecting the urban form with the social and ecological processes (Nijhuis & Jauslin 2015). Some of the elements of the Garden City could be transformed and connected with other elements in order to constitute a new urban landscape infrastructure. It is therefore important to analyse the structure of the urban landscape of the Garden City and to understand the potential and challenges related to its main elements.

FIG. 11.1 Typical residential street in the modern city of Anuradhapura (Peter, 2018)

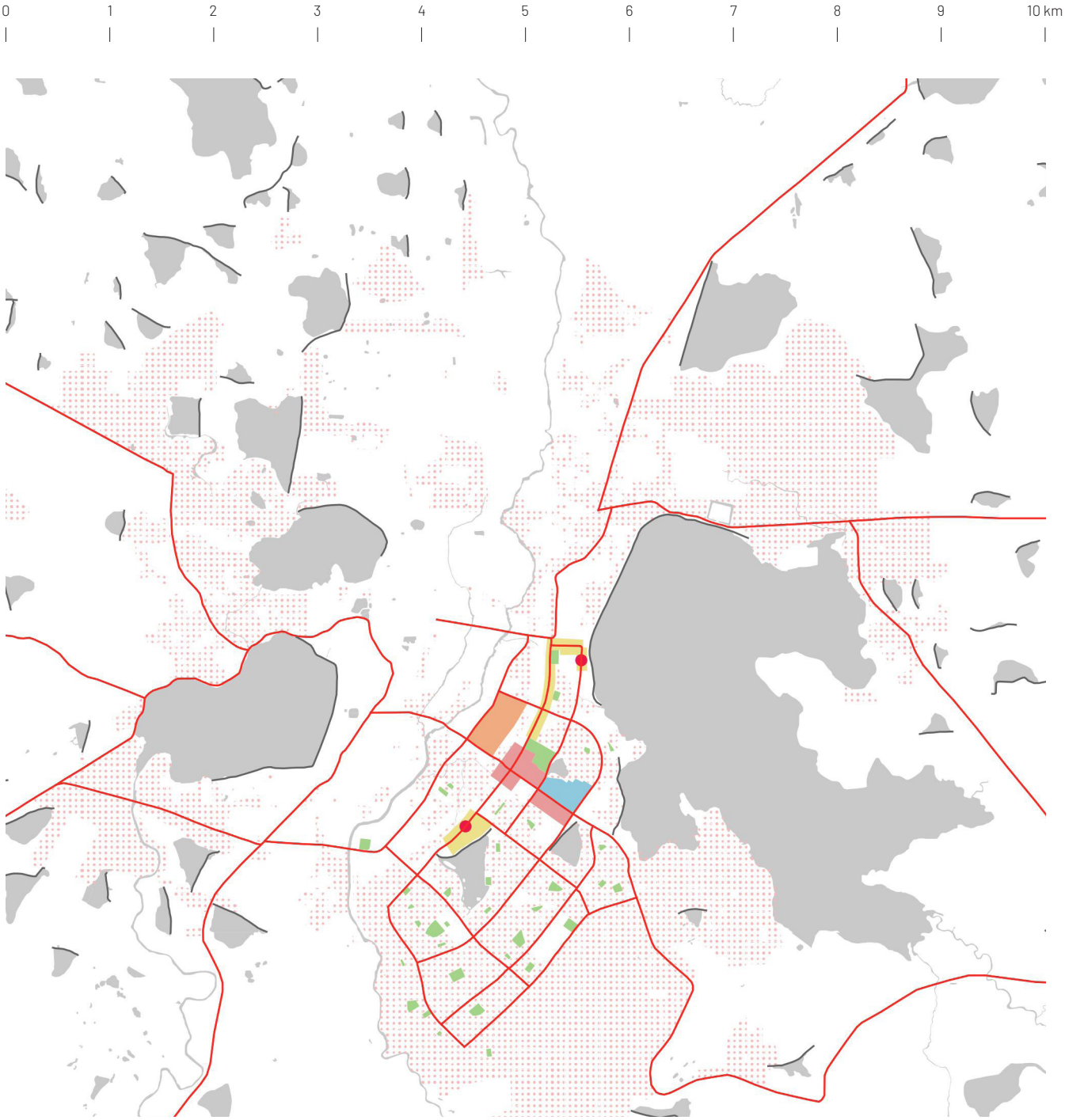


FIG. 11.2 The structure of the garden city (Peter, 2018)

11.1 – **The modernist grid system**

The planning of the new town of Anuradhapura was done by Oliver Weerasinghe which was one of the few Sinhalese urban planners at the time of independence. Oliver Weerasinghe was trained in Engand by Sir Patrick Abercrombie, first as a student and later as a collaborator. One of the main plan of Sir Patrick Abercrombie is the Greater London Plan of 1944, which defines most of the concept used for the development of the new towns at that time.

Grid network of main streets

The basic layout of Anuradhapura is based on a grid network of main streets which are 20 to 30 meters wide. The grid is oriented based on the natural topography parallel to the Malwathu river. There is usually a spacing of 500 meters between two main streets except when there is an obstacle such as a tank or the railway. The main infrastructures for drainage, power lines, telecoms, and so forth are usually using this grid. All the main streets intersections are treated as roundabouts in order to facilitate the flow of vehicles. There is a lot of on-street parking which serves for the shops along the road. There is almost no tree planted in the public realm which makes the main streets very unpleasant for pedestrians.

The commercial areas

Within the grid of main streets, a strict zoning plan is used to separate the different urban functions. There are two main commercial areas and one ribbon development along the main street of Anuradhapura. One typology of commercial buildings is repeated everywhere. It is a narrow 2-3-storey building with a front and back side (4.5 meters wide and 10 meters deep). These buildings are arranged into regular blocks. Most of the time, the shop is located on the ground floor and the shop owner lives with his family on the upper floors.

Residential areas

Most of the residential areas are planned using a warped parallel residential street pattern with long and curved street which reduce the visual length and traffic speed. The residential buildings are usually low density individual houses with a large garden. Due to this housing typology, there are a lot of trees in the residential areas. In the centre of each residential unit, there is a large playground to play cricket.

Public services area

The public services such as the hospital, the university, the police station, the city hall, and so forth are all located along the main road in the east-west direction.

1

2

3

4

5

6

7

8

9

10

FIG. 11.3 The roundabouts of Anuradhapura

1. Lion Pillar roundabout. *(Peter, 2018)*

2. Clock tower roundabout. *(Google, 2018)*

3. King Dutugemunu roundabout. *(Google, 2018)*

4. Buddha Jayanthi roundabout. *(Google, 2018)*

5. DS Senayake roundabout. *(Google, 2018)*

6. Ayurveda roundabout. *(Google, 2018)*

7. Hospital roundabout. *(Google, 2018)*

8. Dahaiagama Junction. *(Google, 2018)*

9. Unknown location name. *(Google, 2018)*

10. Unknown location name. *(Google, 2018)*

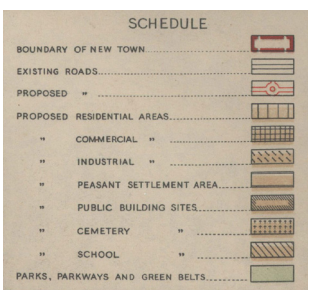
11.2 – **The microhistory of the roundabouts**

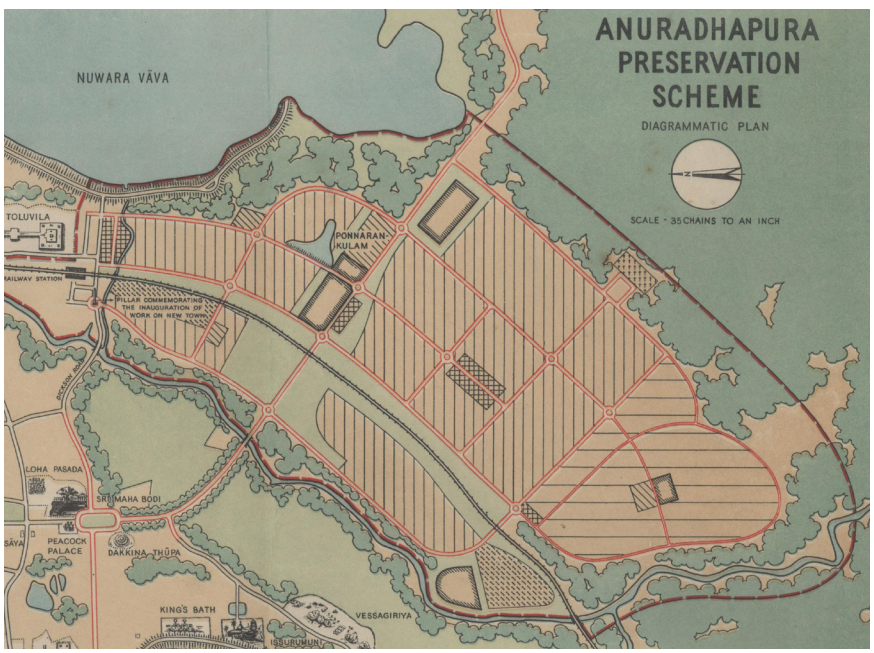
In 1949, to celebrate the beginning of the construction of the new town of Anuradhapura, the former Prime Minister of Sri Lanka D.S. Senanayake inaugurated the "Lion Pillar" which is a sculpture located on a roundabout at the entrance of the new town. The choice of this symbol as the memorial of the creation of the new town shows the strong belief placed into modernist traffic systems at that time.

This roundabout is only one among many planned at that time. It is interesting to look at the original plan of the city, which already indicated the position of each of the roundabouts at the intersections of the main streets. On each of these roundabouts, there is an element such as the sculpture of someone important in the history of Sri Lanka.

The fact that people use these landmarks to orient and identify places in the city shows quite well the extreme homogeneity of the urban landscape and the lack of specific identity of the different public spaces.

FIG. 11.4 Original plan of Anuradhapura new town (UDA, 1948)





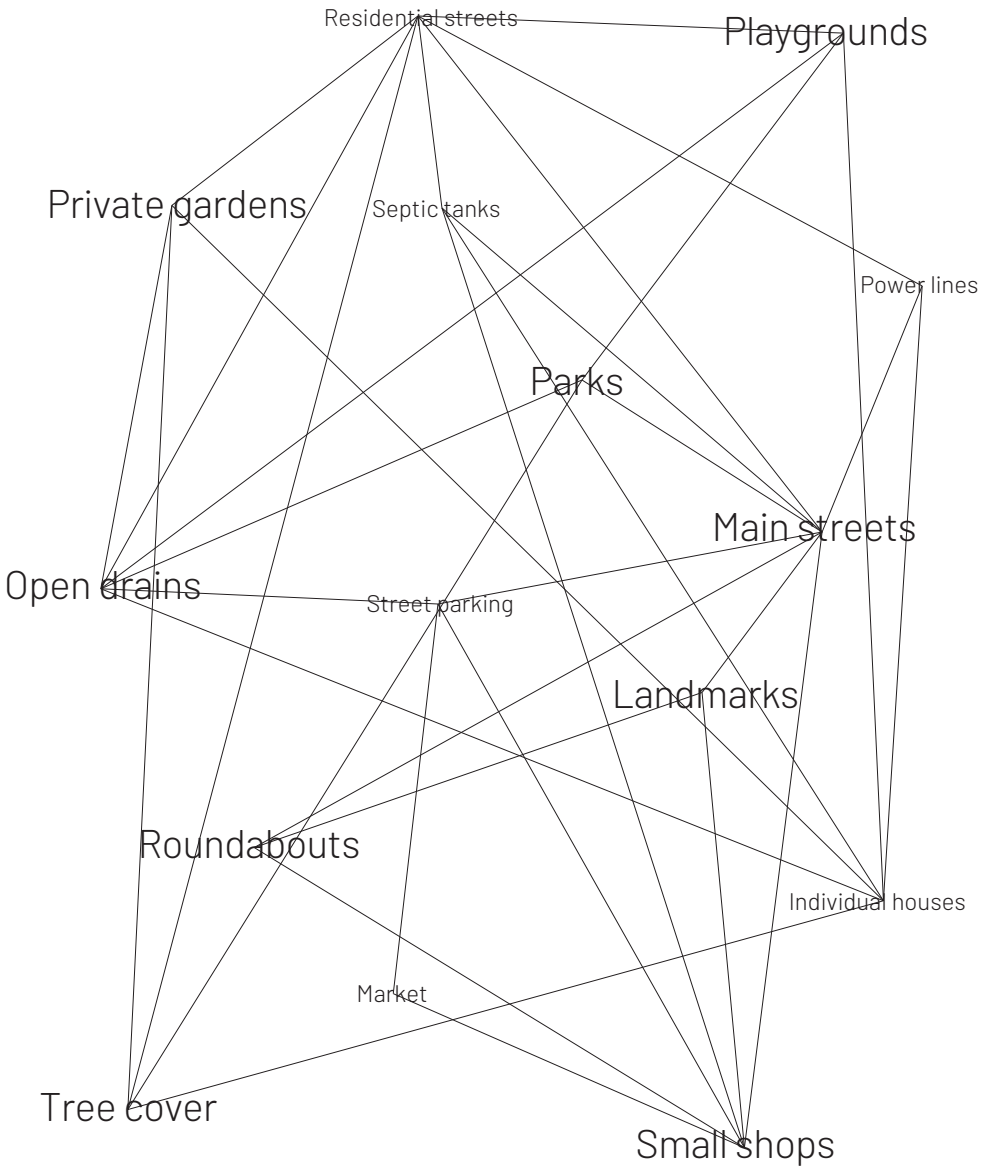
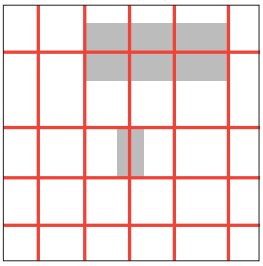


FIG. 11.5 Relations between the elements of the garden city (Peter, 2018)

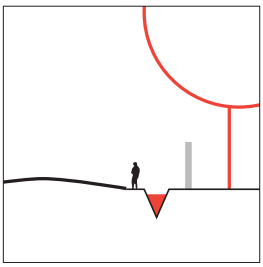
11.3 – **Strategic elements of the Garden City**

Based on this analysis, it is possible to identify a few strategic elements which could be transformed in order to strengthen the perspective of the garden city:



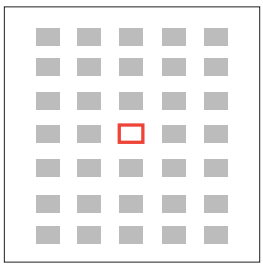
The main streets

The main streets of Anuradhapura are currently dominated by the motorized traffic. There is a need to redistribute the space more equally between the different users and give more room for active modes of transportation such as walking and cycling. The design of the street should be adapted to their specific context using different landscape elements to create a sense of place.



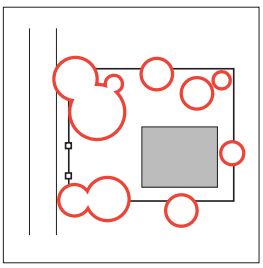
The open drainage

The drainage network of the city is aging and need to be upgraded. There is a great potential to valorise water in public spaces which provides many benefits such as fresh air, biodiversity, and aesthetic value. Traditional methods of rainwater collection such as side ditches should be preferred over technical solutions such as underground collectors.



The community places

There are several open spaces scattered all over the city and which serve mainly as cricket playgrounds. There is a great potential to diversify to the functions of these open spaces promoting multiple social and ecological services. There is also a need to reconnect and integrate these open spaces into larger social and ecological networks and not to treat them as isolated elements.



The individual gardens

There is a rich culture of home gardening in Sri Lanka. The original intention of the Garden City was to facilitate the installation of people from rural areas by providing large individual gardens. These individual gardens play multiple roles such as reducing urban heat island effect, infiltrating water, providing habitats, and so forth. They should therefore be protected and their services could be more valorised.

FIG. 11.6 Combining the different landscape perspectives (Peter, 2018)

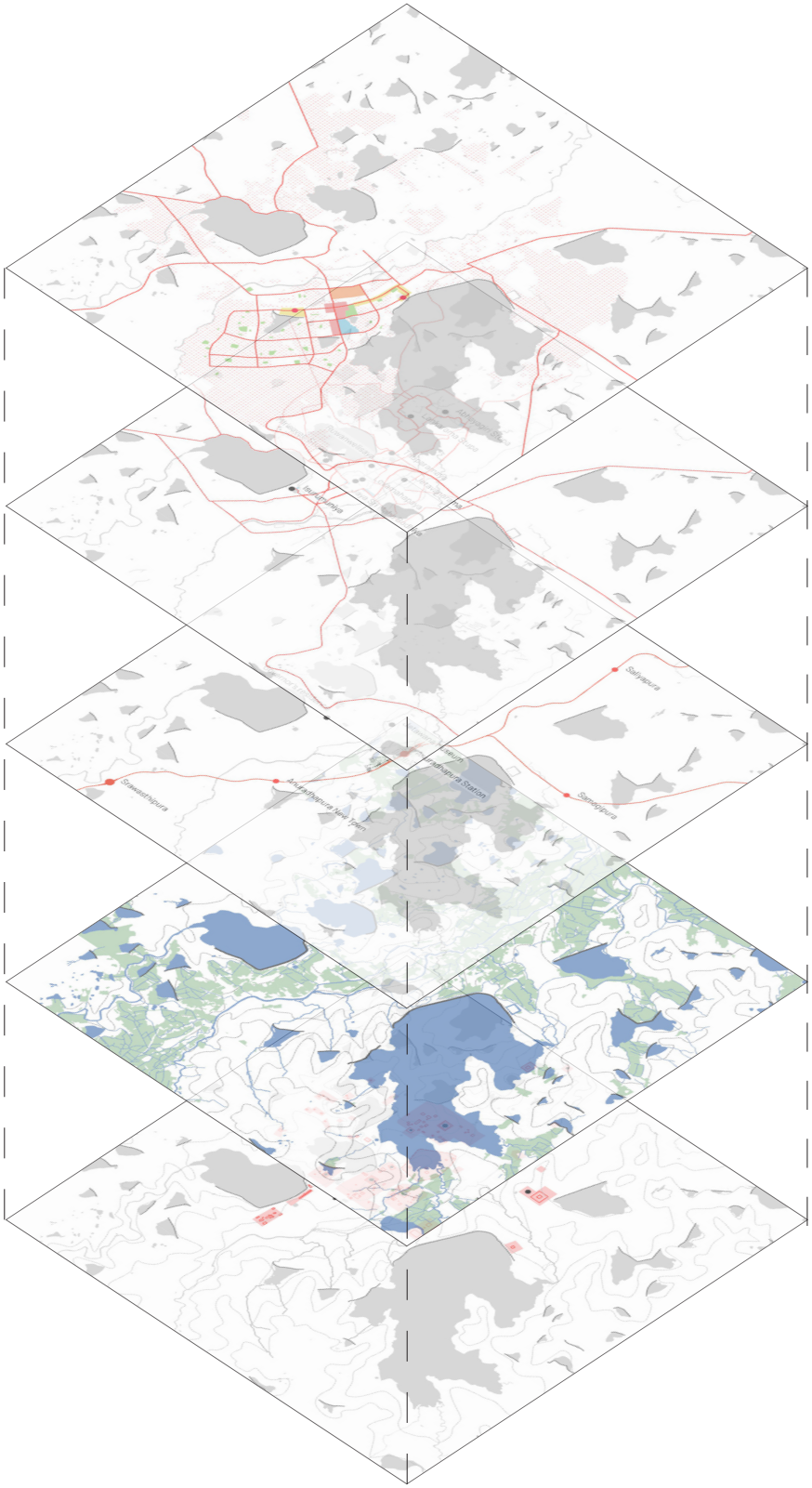
The flows of the Garden City
- Local economy
- Social interactions
- Air and plants

The flows of the Sacred City
- Religion
- Traditions

The flows of the Industrial City
- Goods
- Transport
- Energy
- Knowledge
- Waste

The flows of the Water City
- Water
- Food
- Animals

The flows of the Ancient City
- Culture
- Tourism



12 – Combining the perspectives

Identifying social and ecological spaces of flows

The analysis of the five perspectives permitted to understand the relationships between the different elements that constitute the landscape of Anuradhapura. For instance, the perspective of the Water City described how the forests, tanks, soils, spillways, and rivers form a physical structure which guides different flows such as water, air, and animals. Both ecological and social structures were identified. For instance, the perspective of the Sacred City showed how the temples, parking spaces, local roads, and temporary structures are interconnected in order to support the flow of pilgrims and traditions.

In order to address the holistic nature of the landscape, it is not sufficient to look at these structures independently. It is also necessary to understand how these different structures are interrelated. Therefore, the final step of the analysis is to understand how these different structures work together to support social, economic, and ecological flows.


Abhayagiri
Lankarama
Thuparamaya
Jetavanaramaya
Ruwanwelisaya
Mirisawetiya
Bodhi Tree
Isurumuniya
Kumbichchan
Kulama

12.1 – **Social spaces of flow**

The social spaces of flow are all the spaces which enable social flows such as recreational, cultural, religious, educational activities.

Main roads supporting social activities

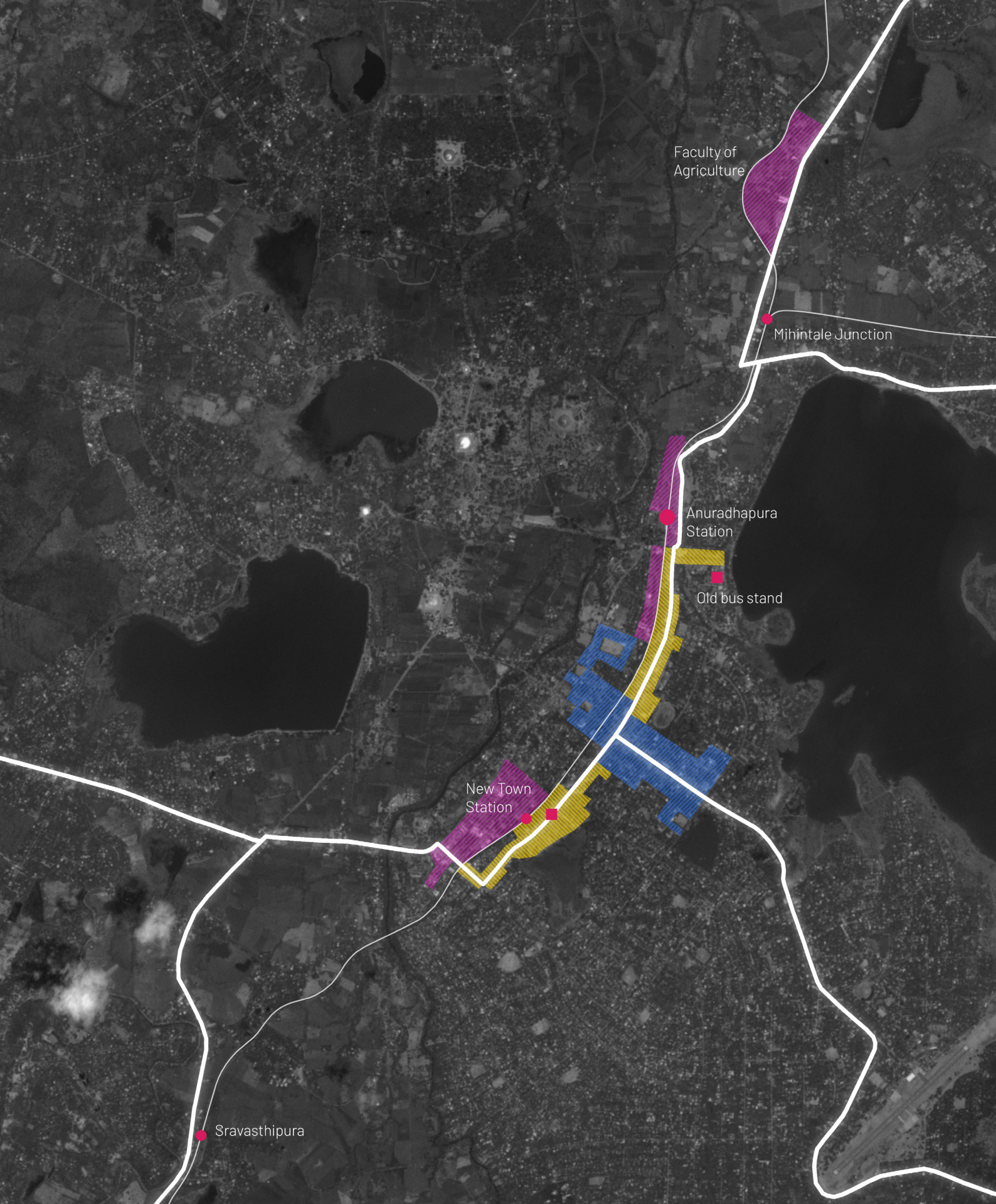
Promenade along the tanks

Parking lots

Recreational spaces

Places of religious importance

FIG. 12.1 Social spaces of flows (Peter, 2018)


Faculty of
Agriculture
Mihintale Junction
Anuradhapura
Station
Old bus stand
New Town
Station
Sravasthipura

12.2 – **Economic spaces of flow**

The economic spaces of flow are all the spaces which enable economic flows such as transport, trade, knowledge, energy, etc.

Main roads supporting economic activities

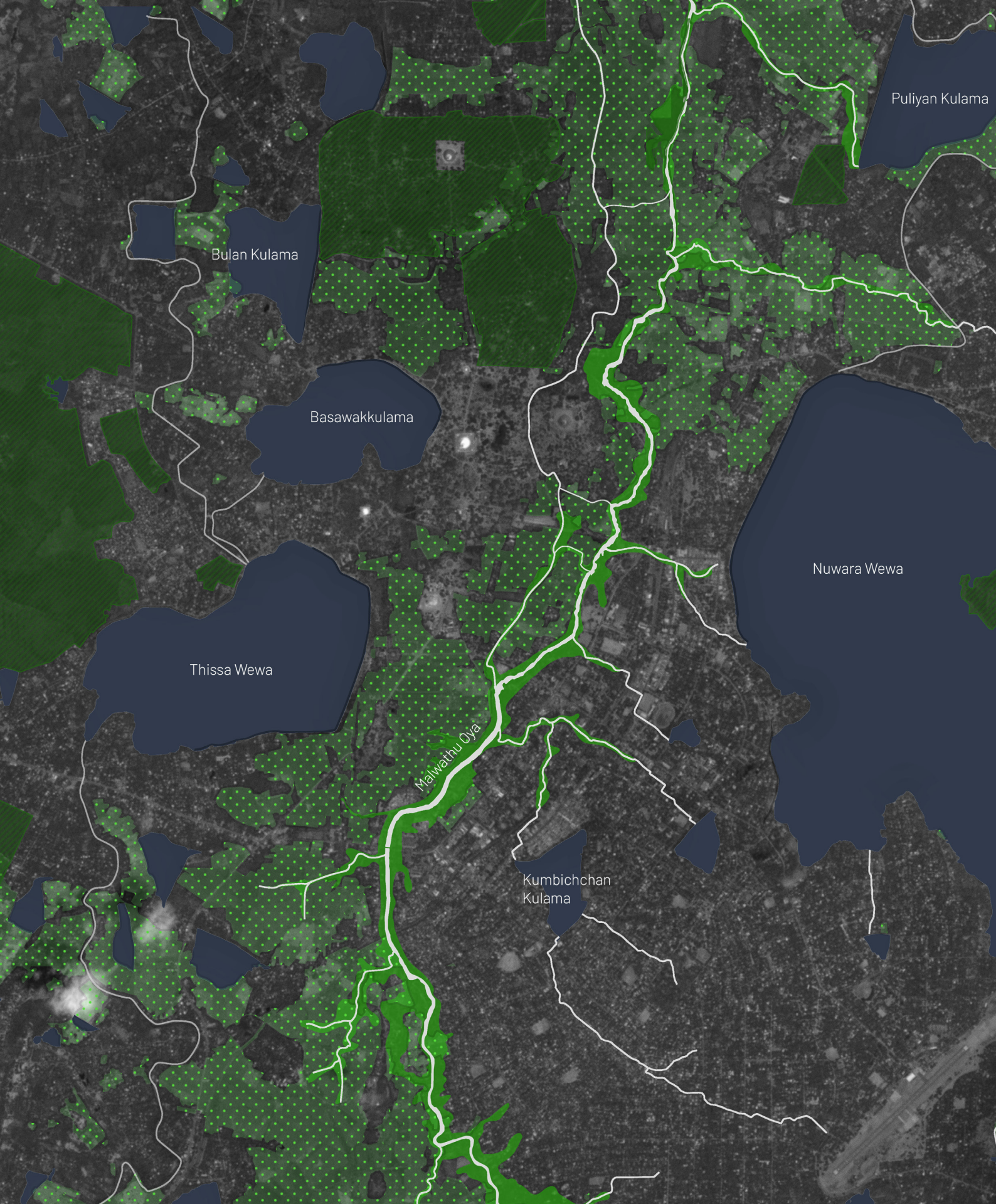
Commercial areas

Public services areas

Industrial areas

Main transportation hubs

FIG. 12.2 Economic spaces of flows (Peter, 2018)


Puliyan Kulama
Bulan Kulama
Basawakkulama
Nuwara Wewa
Thissa Wewa
Malwathu Oya
Kumbichchan
Kulama

12.3 – **Ecological spaces of flows**

The ecological spaces of flow are all the spaces which enable ecological flows such as water, air, food, and animals.

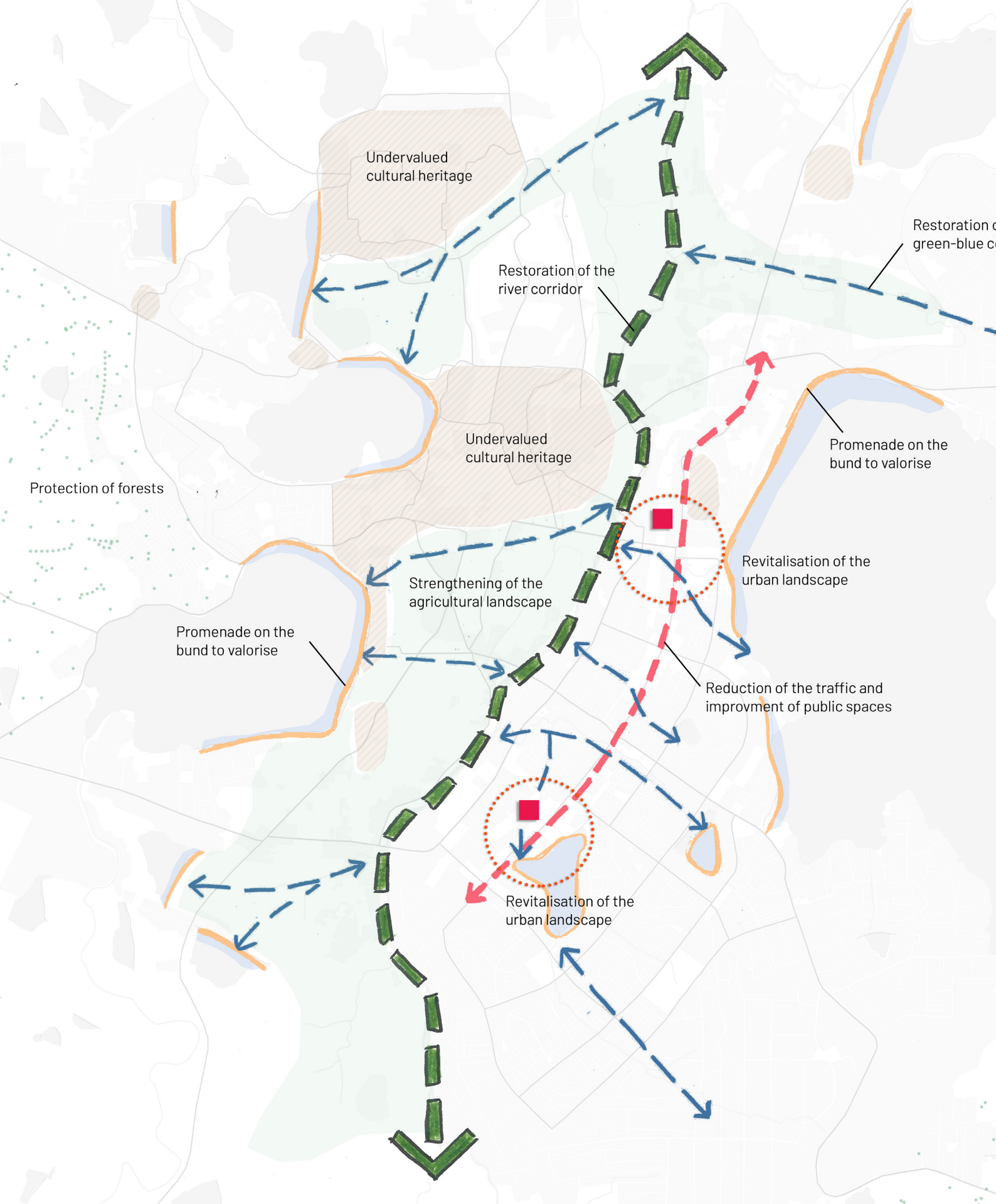
Rivers and riparian zones

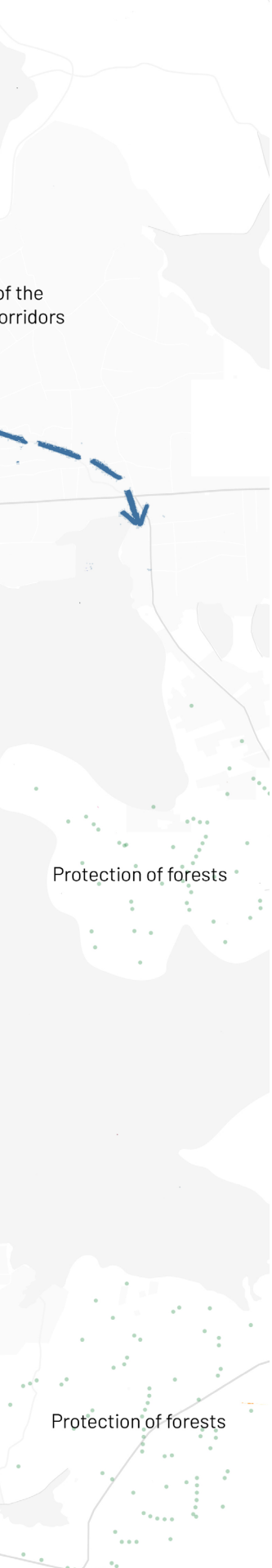
Rice paddies

Forest patches

Water tanks

FIG. 12.3 Ecological spaces of flows (Peter, 2018)


Undervalued
cultural heritage
Restoration
green-blue c
Restoration of the
river corridor
Undervalued
cultural heritage
Promenade on the
bund to valorise
Protection of forests
Revitalisation of the
urban landscape
Strengthening of the
agricultural landscape
Promenade on the
bund to valorise
Reduction of the traffic and
improvment of public spaces
Revitalisation of the
urban landscape



12.4 – **Challenges and opportunities**

While looking at the elements and structures supporting social , economic, and ecological systems in Anuradhapura, several challenges and opportunities were identified.

Ecological challenges and opportunities:

- **Damaged ecological corridors.** There is a great potential to restore the spillways and the river in order to support ecological flows.
- **Destruction of natural and agricultural areas.** The forest areas and rice paddies should be protected and valorised.
- **The mitigation of natural hazards.** The impact of floods and droughts could be reduced in part with structural measures but will require adaptation measures on the long-term.

Social challenges and opportunities:

- **Undervalued cultural and natural heritage.** There is a potential to valorise different landscape elements such as the ancient ruins, the diverse fauna, and the heritage trees.
- **Lack of infrastructure for pedestrians and bicycles.** There is a lack of walkways and dedicated bicycle lanes all over the city.
- **Monofunctional public spaces.** There is a need to increase the flexibility of public spaces which are currently designed to serve one function.

Economic challenges and opportunities:

- **Traffic congestion and parking.** There is a need to reorganize the main flows of vehicles in the city in order to reduce the nuisances caused b y heavy traffic.
- **Inefficient public transport.** Public transport needs to be organized more efficiently in order to be competitive against other modes.
- **Underutilized industrial spaces.** There are a lot of industrial open spaces which are currently abandoned but could be reactivated and serve different functions.
- **Low quality of the urban landscape.** There is a need to revitalize the main centralities of the city which are currently not attractive.

FIG. 12.4 Summary of the challenges and opportunities (Peter, 2018)

PART 3

Design

Transformation of the landscape

The objective of the third part of the research is to apply the concept of urban landscape infrastructures to the case of Anuradhapura using the learning of the analysis of the landscape. This part is a design exercise which shows the potential of developing three landscape operative structures in order to address the challenges and opportunities identified. This design experiment works through the scales from the overall structure of the city to the urban design of different strategic locations.

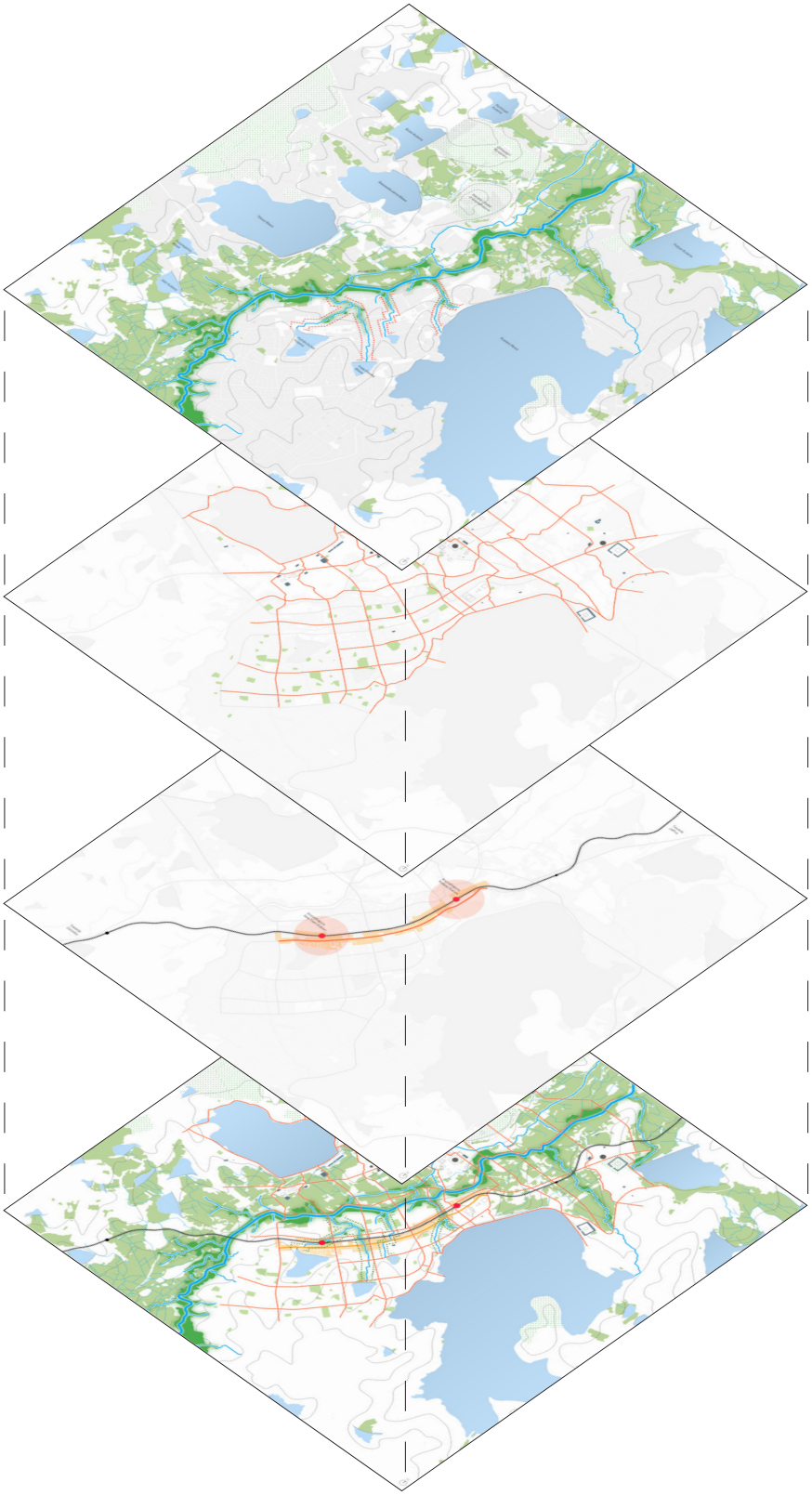
FIG. 12.5 The overlapping of the three landscape operative structures (Peter, 2018)

The Backbone

The Lower Mesh

The Productive Axis

Urban landscape infrastructures



13 – Urban landscape infrastructures

Three landscape operative structures

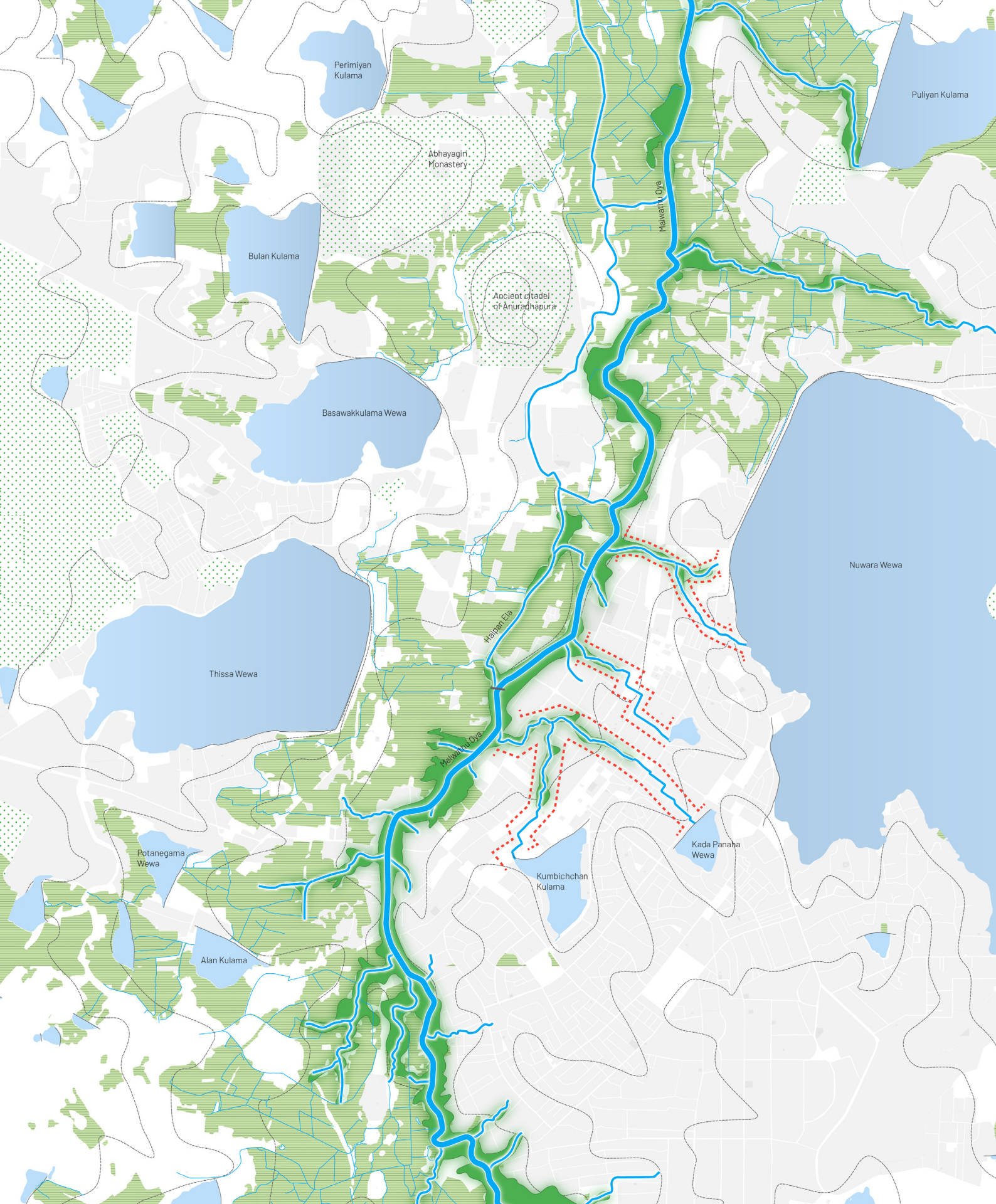
The analysis of the landscape revealed the logic of the ecological, social, and economic systems and the different spaces of flow which support these systems. The potential and challenges of the different landscape elements which constitute these spaces of flows were also highlighted. The next step is now to explore how to transform these different spaces in order to create armatures which provide conditions for multiple activities and guide urban development. In order to do so, the proposed strategy employs three landscape operative structures which make use of the different landscape potentials and challenges identified in the analysis.

The backbone
The idea of the backbone is to develop a landscape operative structure which reduces the vulnerability of the landscape by providing conditions for different flows, such as water, air, species, and peoples. By transforming different strategic elements of the landscape, the backbone will provide multiple social and ecological services such as habitat for species, moderating extreme weather events, improving local climate and air, and recreational activities.

The lower mesh
The aim of the lower mesh is to valorise unexploited potentials in the landscape such as the rich cultural and natural heritage of Anuradhapura. The idea is to reconfigure different landscape elements such as the local roads, the parking spaces, the public spaces, and water features in order to mesh the territory with a network of soft infrastructures. This network serves multiple functions such related to cultural heritage, green-blue continuities and recreational activities.

The productive axis
The productive axis is an operative structure addressing the challenge of the decaying infrastructure of the city. This landscape structure uses the potential and challenges of the transportation infrastructure, the mobility hubs, the industrial open spaces, etc. in order to strengthen the local economy and improve the mobility in the city. It is imagined as a landscape which supports different flows such as people, food, raw materials, goods and knowledge.

The overlapping of these three landscape operative structures creates a long-term strategic urban vision which uses urban landscape infrastructures to reconnects the urban form with the social, ecological, and economic processes of the territory.


Perimiyan Kulama
Puliyan Kulama
Abhayagiri Monastery
Malwathu Oya
Bulan Kulama
Ancient citadel of Anuradhapura
Basawakkulama Wewa
Nuwara Wewa
Thissa Wewa
Halmal Ela
Malwathu Oya
Potanegama Wewa
Kada Panaha Wewa
Kumbichchan Kulama
Alan Kulama

14 – The backbone

Landscape operative structure

The backbone is a strong structure which provides conditions for a set of critical ecological and social processes. It is made of large landscape elements such as forest patches, cascading tanks, streams and river corridors. The aim of the backbone is to transform these elements in order to support different processes providing services such as flood mitigation, waste water treatment, habitat for species, and recreation.

14.1 – **The challenges and opportunities**

The backbone addresses three main challenges and opportunities identified during the analysis of the landscape system:

- The degradation of the ecological corridors such as the Malwathu River and the main spillways. These elements are currently encroached by constructions, lack of maintenance, and are not accessible.
- The destruction of natural areas such as the forest on the upper hills and the rice paddies. The stress on these resources is due to uncontrolled urbanisation and industrial agriculture methods.
- The impact of natural hazards, such as floods and droughts, which could be reduced in part with structural measures but will require adaptation measures on the long-term.

14.2 – **The strategies of the backbone**

In order to address these challenges and opportunities, the backbone uses four main strategies to guide the transformation of the landscape:

Creating space for water

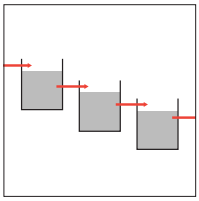
Strengthening ecological corridors

Protecting large green patches

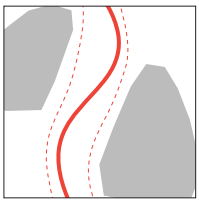
Valorising the urban edges

FIG. 13.1 Strategic map of the backbone (Peter, 2018)

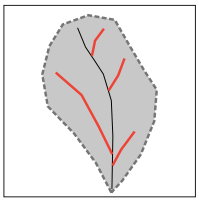
Strategic components



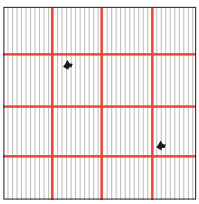
The cascading tanks



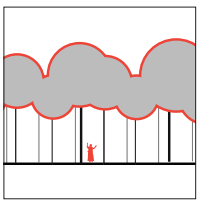
The Malvathu River



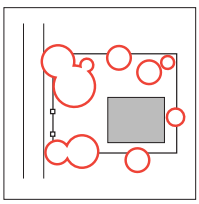
The main spillways



The rice paddies

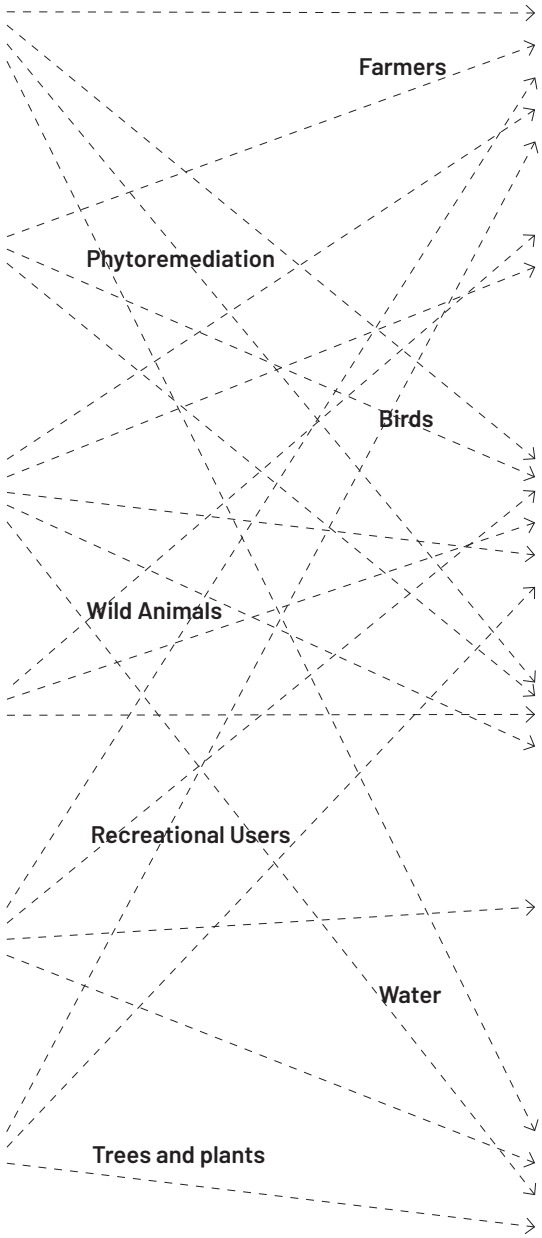


The urban forests



The individual gardens

Actors and processes



Performance objectives

Moderation of extreme events

Mitigation of floods and droughts and adaptation to climate change

Wastewater treatment

Treatment and re-utilisation of municipal wastewater in agriculture

Habitat for species

Creation, preservation and restoration of critical habitats

Recreation

Support human activities such as fishing, hiking, birdwatching, kayaking, etc.

Erosion prevention

Creation, preservation and restoration on the soils

Local climate and air

Reduce urban heat island effect, air pollution, wind, etc.

14.3 – **The new performance objectives**

These four strategies assign new functions to the different strategic landscape elements which were identified in the analysis.

Providing space for water

Providing space for water aims to increase the capacity of the hydraulic network to handle large quantities of water during the rainy seasons. The main landscape elements which can be transformed in order to achieve this goal are the Malwathu River, the main spillways, and the cascading tanks. Typical interventions consist of relocating inhabitants, clearing the riverbed, creating flood extension areas, and so forth. The main benefit of this strategy will be the moderation of extreme weather events.

Strengthening ecological corridors

Improving ecological corridors will facilitate the movements of species and ensure that ecological habitats are interconnected which is important to maintain biodiversity. The main elements which can be transformed are the Malwathu river and the main spillways which form the main regional ecological structure. Interventions under this strategy consists of restoring riparian zones, depolluting soils, removing ecological barriers, and so forth.

Protecting large green patches

The aim of this strategy is to protect and strengthen large green patches such as the rice paddies, the urban forests, the individual gardens, or the cascading tanks. This requires to control urbanization, replant forest areas, diversify agriculture, and so forth. The benefits of this strategy are to prevent soil erosion, control pest, provide habitat for species, and improve local climate and air.

Valorising the urban edges

The aim of this strategy is to reinforce the relationships between natural and urban areas. This can be done along the main spillways and along some of the cascading tanks which are located in urban areas. This involves developing new recreational spaces, natural waste water treatment systems, and to restructure the urban form towards the open spaces.

The different benefits provided by the strategic landscape elements once assigned a new function in the backbone are synthesized in the diagram on the left page.

FIG. 14.1 Map of the backbone in 5 years (Peter, 2018)

14.4 – **The backbone in 5 years**

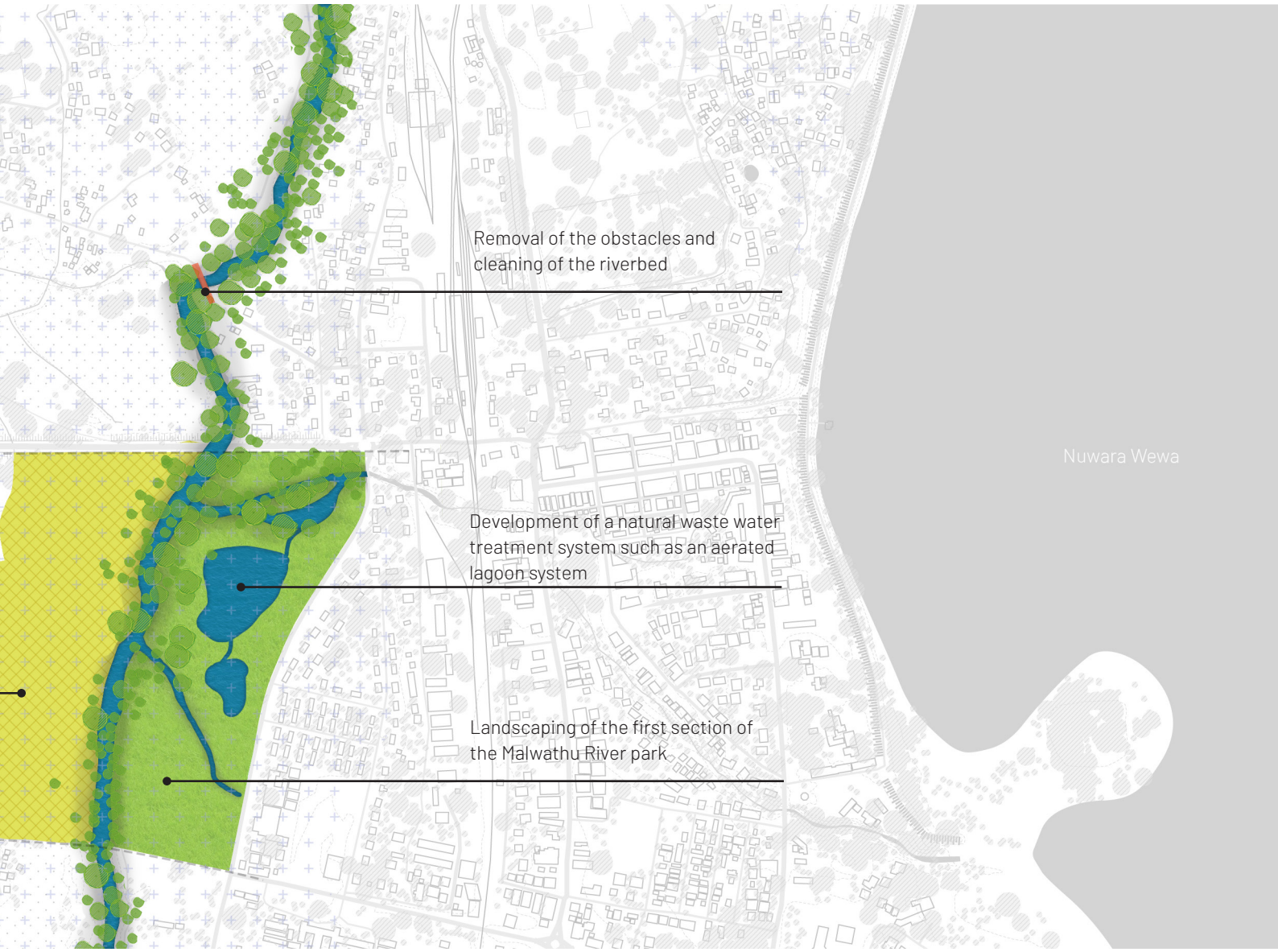
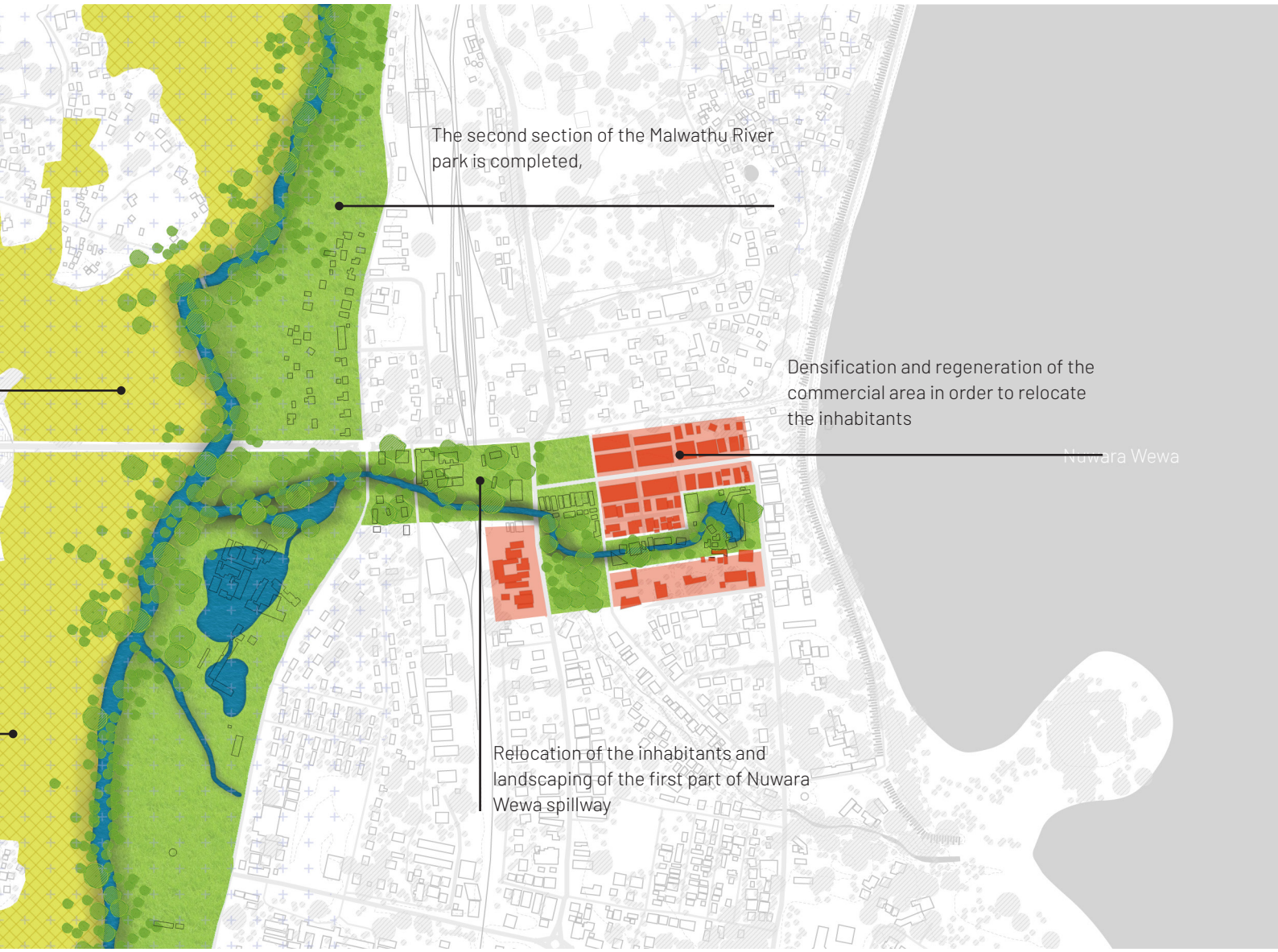


FIG. 14.2 Map of the backbone in 10 years (Peter, 2018)

14.5 – **The backbone in 10 years**



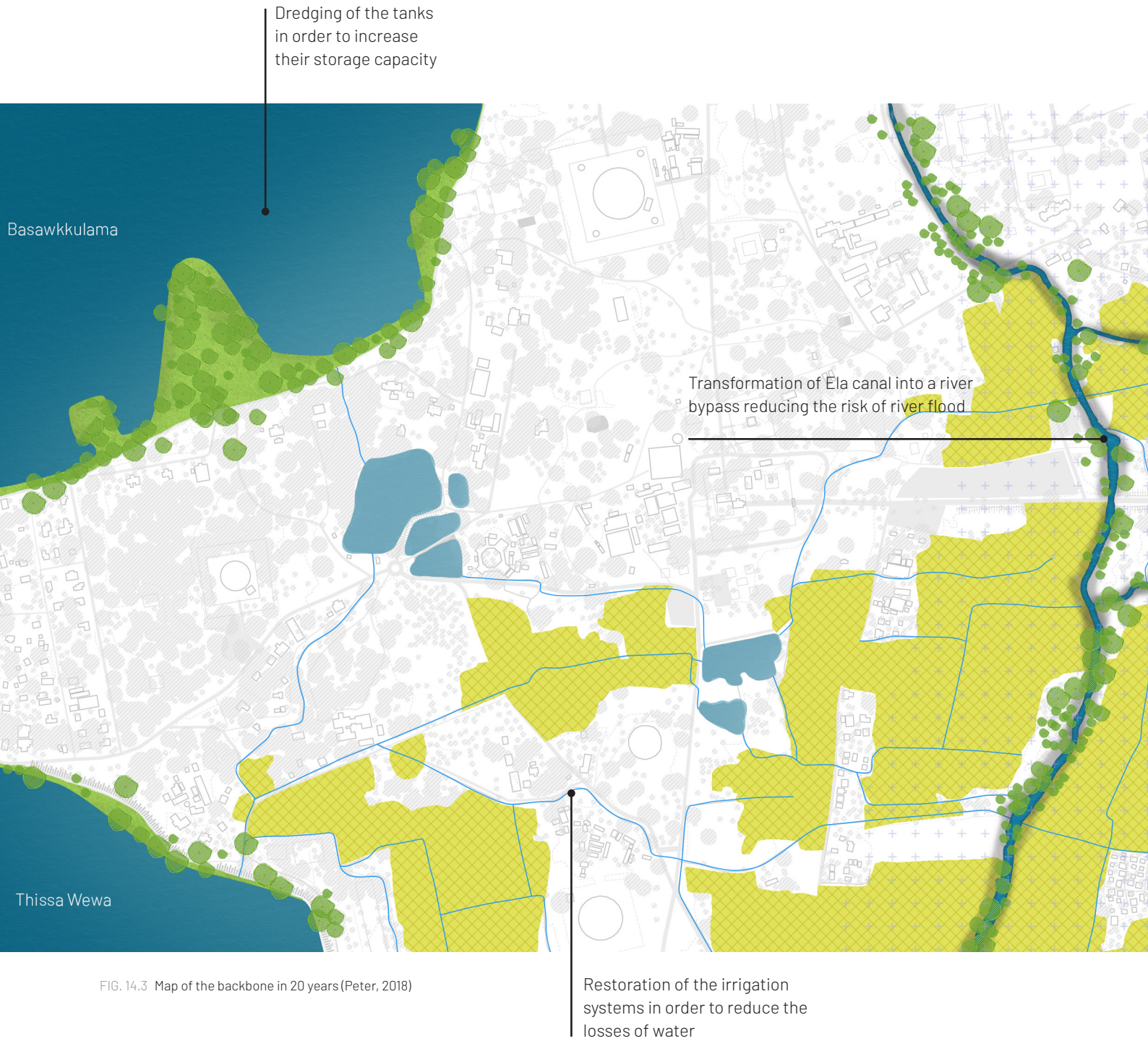


FIG. 14.3 Map of the backbone in 20 years (Peter, 2018)

14.6 – **The backbone in 20 years**

14.7 – **Prototype for the backbone**

Current situation

There are several constructions encroaching on the spillway which conveys the excess water of the tanks to the river during the monsoons. The canal is polluted with the wastewater of the neighborhood which is not collected and treated. There is a lot of solid waste which is illegally dumped in the depression and the water is blocked by all kinds of obstacles such as dead trees. The canal is "the back side" of the neighborhood and nobody goes there. It is a dangerous space causing all kinds of problems such as floods and diseases.

Proposed intervention

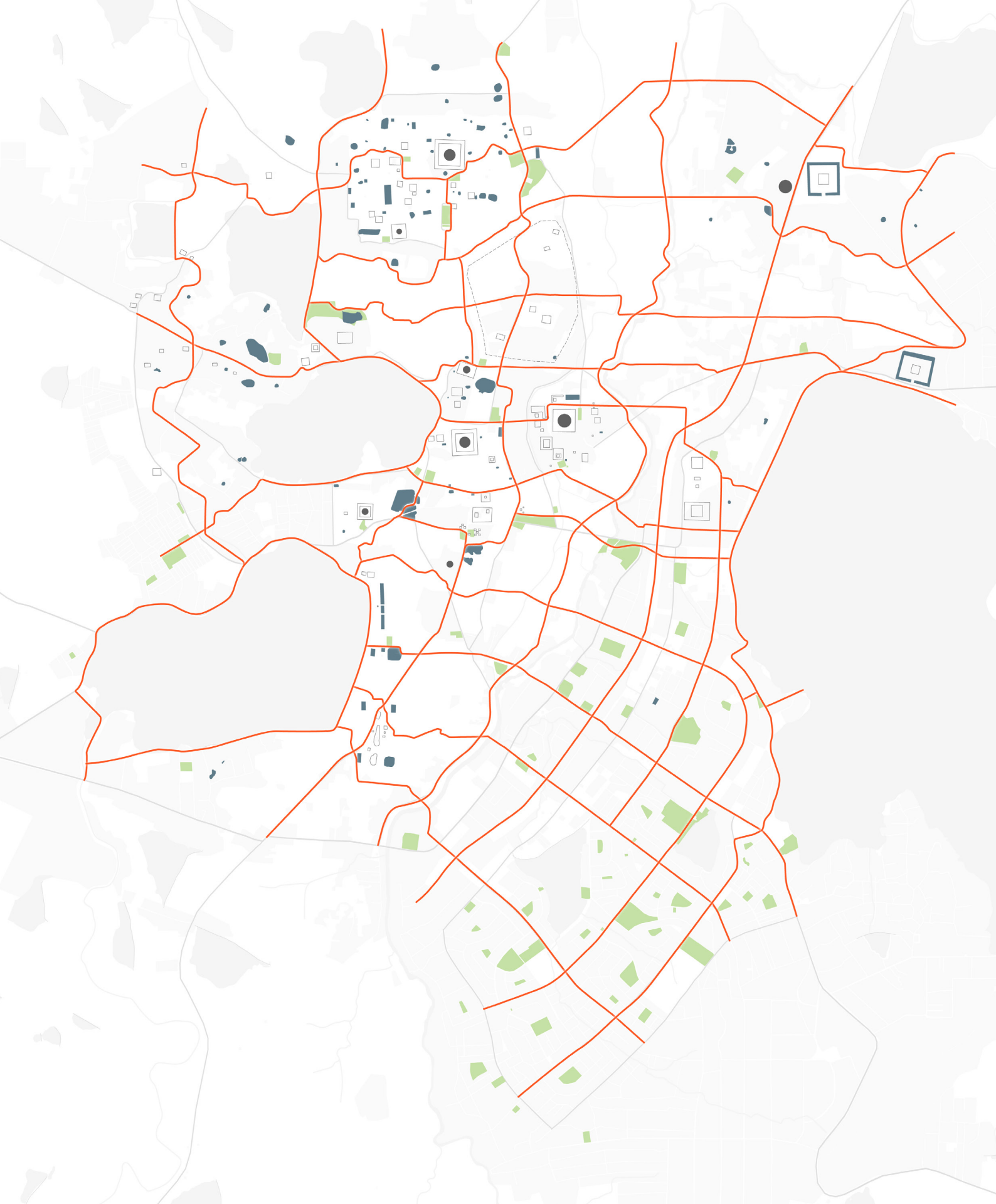
The proposed intervention consists of relocating the inhabitants encroaching on the spillway in order to give more space to the water. These inhabitants should be relocated as close as possible in order to avoid changing the social structure of the area. It is also a great opportunity to upgrade the buildings of this area which are in really poor condition, and to reorient the urban form towards the spillway. Once the land is cleared, the canal needs to be landscaped in order to manage different regimes of water and to improve the accessibility of this space. However, playing with the contrast between an abundant tropical vegetation in the middle of an urban area.

Flexibility of the design

The design of the spillway should take into consideration the different seasonal regimes of the canal. During the monsoons, there is a need to maximize the flow of water and to avoid any obstacle as there is an enormous amount of water to be evacuated to the river. The rainwater of the neighborhood should be infiltrated as much as possible. During the dry seasons, most of the water in the canal is urban waste water. Therefore, it is necessary to create steps and natural filtration systems in order to improve the quality of the water during this period.

FIG. 14.4 Proposed transformation of the Nuwara Wewa spillway (Peter, 2018)

Top: Current situation
Middle: Proposed intervention
Bottom: During the monsoon



15 – The lower mesh

Landscape operative structure

The lower mesh is an isotropic landscape operative structure which provides conditions for cultural activities such as religious activities and tourism. It is structured by a mesh of local roads and pathways and a lot of small open spaces which are scattered over the territory such as playgrounds, parking lots, ponds, and so forth. The aim of the lower mesh is to transform these different landscape elements in order to support the movement of people, culture, and practices.

15.1 – **The challenges and opportunities**

The backbone addresses three main challenges and opportunities identified during the analysis of the landscape system:

- The undervalued cultural and natural heritage. There is a potential to valorise different landscape elements such as the ancient ruins, the diverse fauna, and the heritage trees.
- The lack of infrastructure for pedestrians and bicycles. There is a lack of walkways and dedicated bicycle lanes all over the city.
- The monofunctional character of public spaces. There is a need to increase the flexibility of public spaces which are currently designed to serve one function.

15.2 – **The strategies of the lower mesh**

In order to address these challenges and opportunities, the lower mesh uses three main strategies to guide the transformation of the landscape:

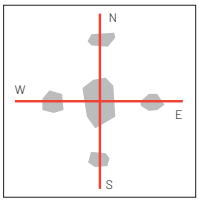
Developing a mesh of soft-infrastructures

Transforming existing open spaces

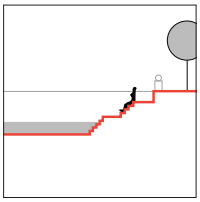
Valorising the rich landscape heritage

FIG. 15.1 Strategic map of the lower mesh (Peter, 2018)

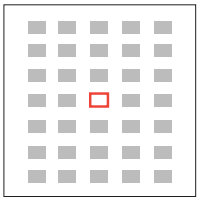
Strategic components



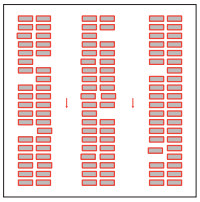
The local roads and pathways



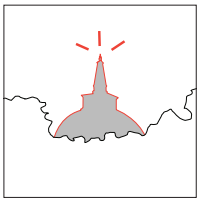
The water features



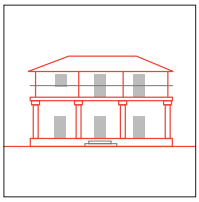
The community places



The parking spaces

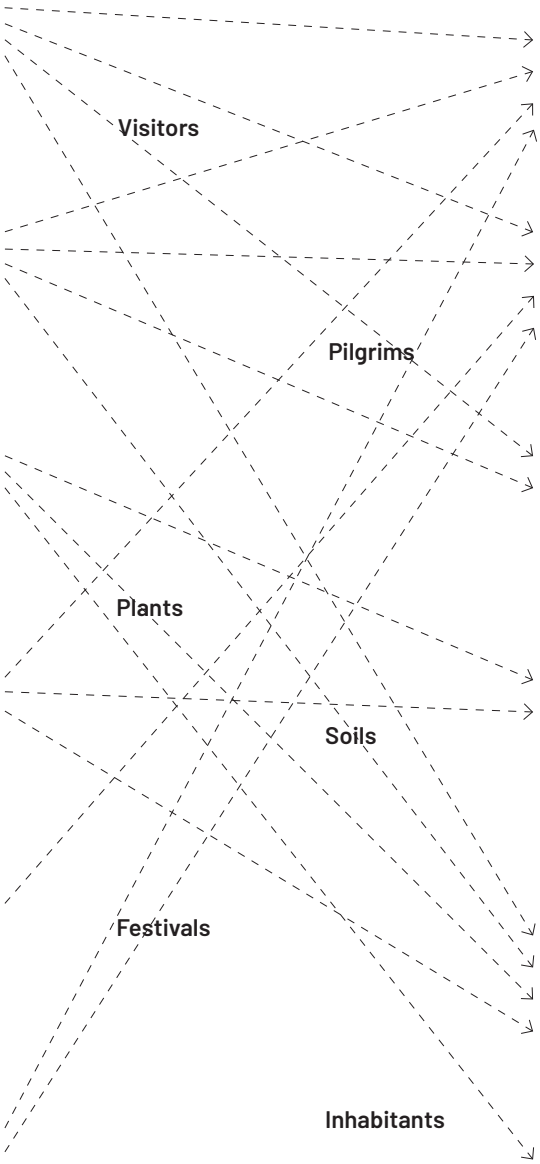


The monumental structures



The architectural ensembles

Actors and processes



Performance objectives

Tourism and recreation

Improve the accessibility of the different attractions of the site for the visitors

Cultural heritage

Valorize the monuments, landscapes, local traditions, practices, etc.

Educational

Enhance the understanding of the unique natural and cultural heritage

Spiritual and religious

Improve the reception of the pilgrims during the religious festivals

Rainwater infiltration

Upgrade the urban drainage system with sustainable measures

Health and well-being

Encourage active modes of transportation, sport activities, etc.

15.3 – **Performance objectives of the lower mesh**

These three strategies assign new functions to the different strategic landscape elements which were identified in the analysis.

Developing a mesh of soft-infrastructures

The aim of this strategy is to transform the existing network of local roads and pathways in order to mesh the territory with soft-infrastructures facilitating the movement of pedestrians and bicycles. In parallel, the goal is also to improve the green and blue networks. This strategy involves requalifying roads by changing the circulation patterns and to improve the landscaping by planting trees, changing surfaces, developing drainage systems, and so forth. This network will have multiple benefits in terms of tourism, recreation, water management, and well-being.

Transforming existing open spaces

Improving existing public spaces aims at valorising the existing open spaces which are scattered all over the territory such as parking spaces, playgrounds, and industrial open spaces. The objective is to transform these spaces in order to integrate them in their environment and to improve the services that they provide. It requires for instance to reduce the size of the parking lots and to improve their landscaping in order to integrate them in the site. The aim is to create a network of flexible public spaces which can support all kinds of human activities.

Valorising the rich landscape heritage

Valorising the cultural heritage aims at showcasing the valuable elements of the landscape of Anuradhapura such as the ancient water features, the monumental structures, and the architectural ensembles. It involves restoring ancient hydraulic systems, to valorise the views on the stupas, and to reutilize colonial buildings which are abandoned.

The different benefits provided by the strategic landscape elements once assigned a new function in the lower mesh are synthesized in the diagram on the left page.

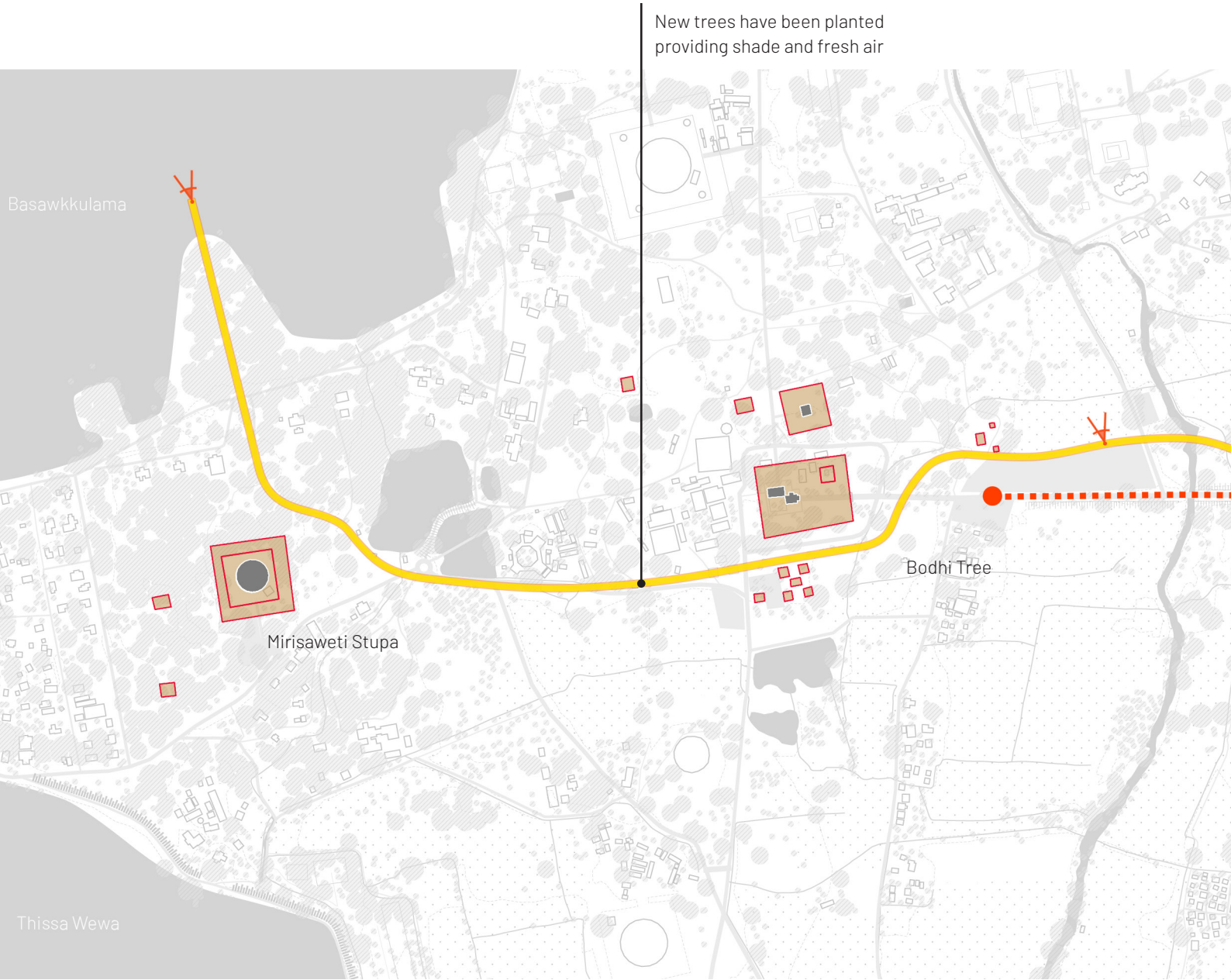
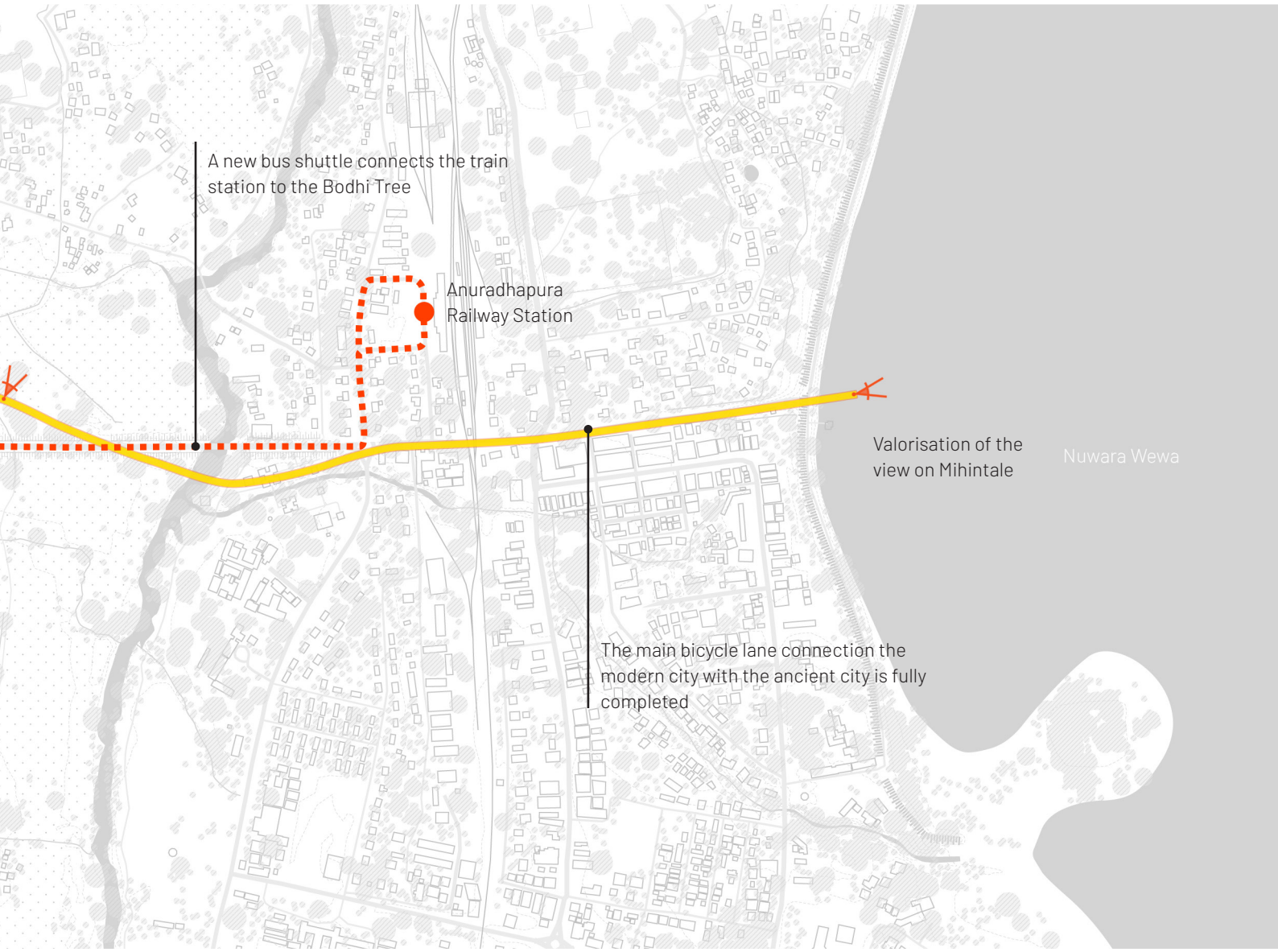


FIG. 15.2 Map of the lower mesh in 5 years (Peter, 2018)

15.4 – **The lower mesh in 5 years**



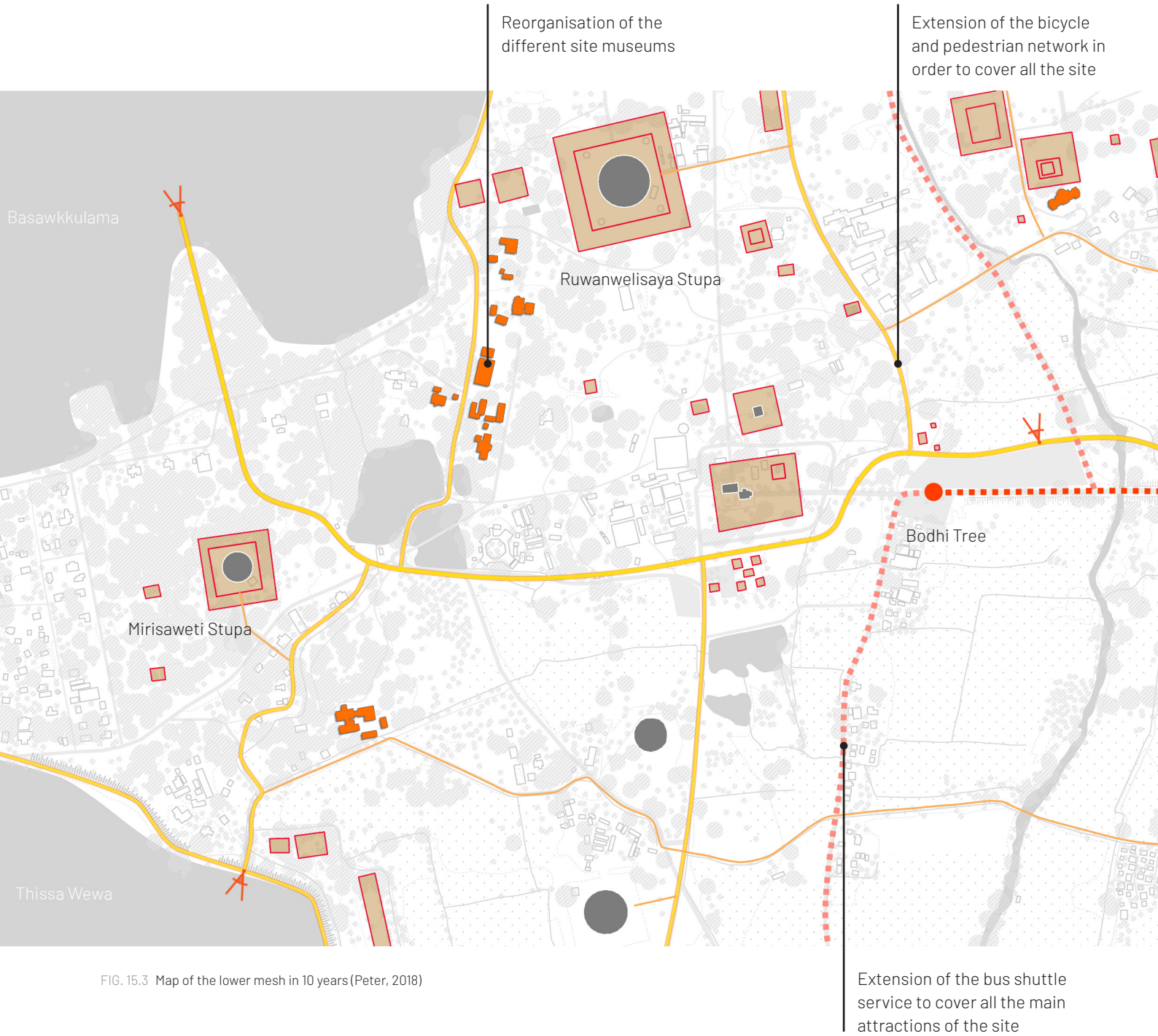
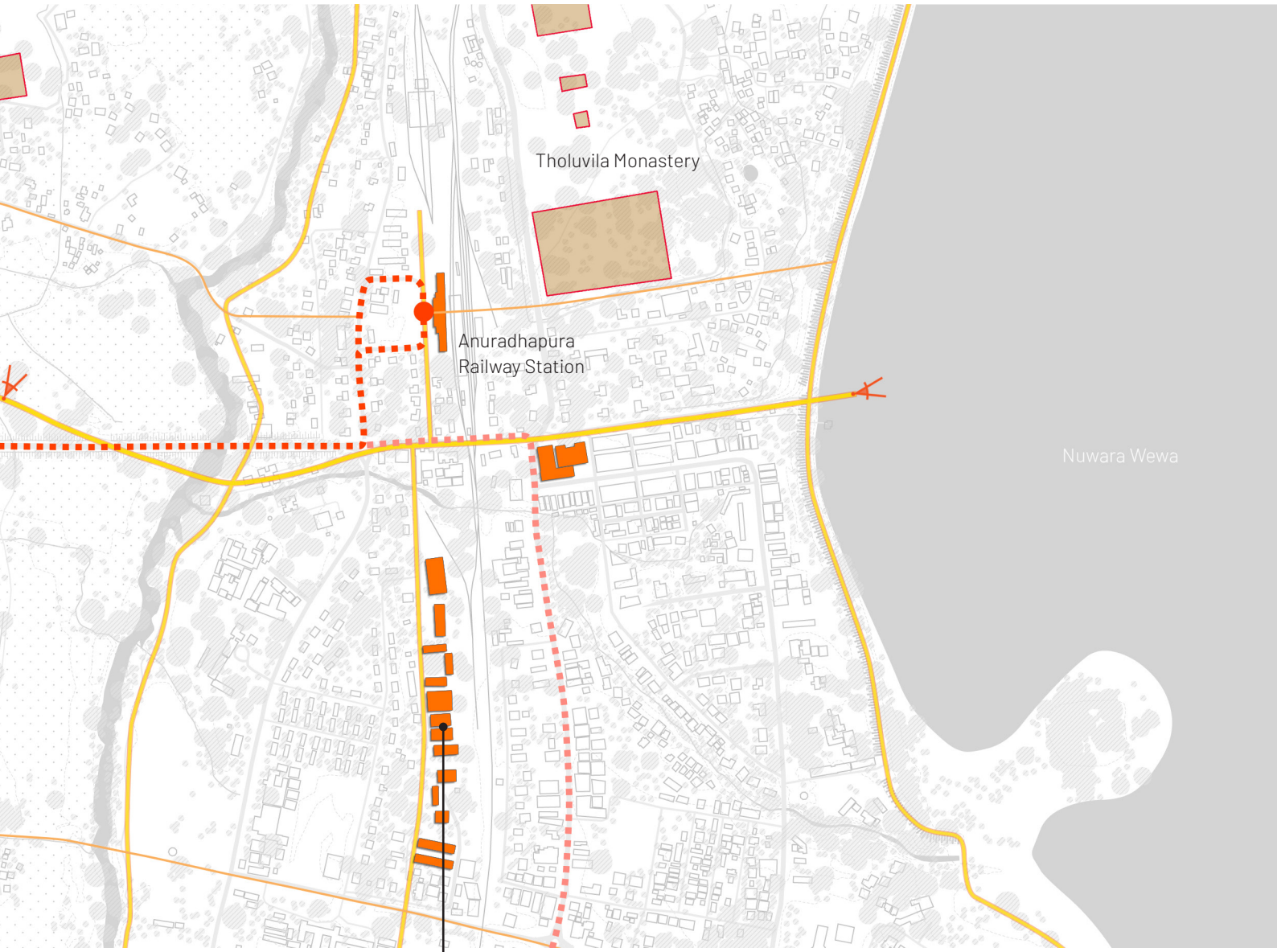


FIG. 15.3 Map of the lower mesh in 10 years (Peter, 2018)

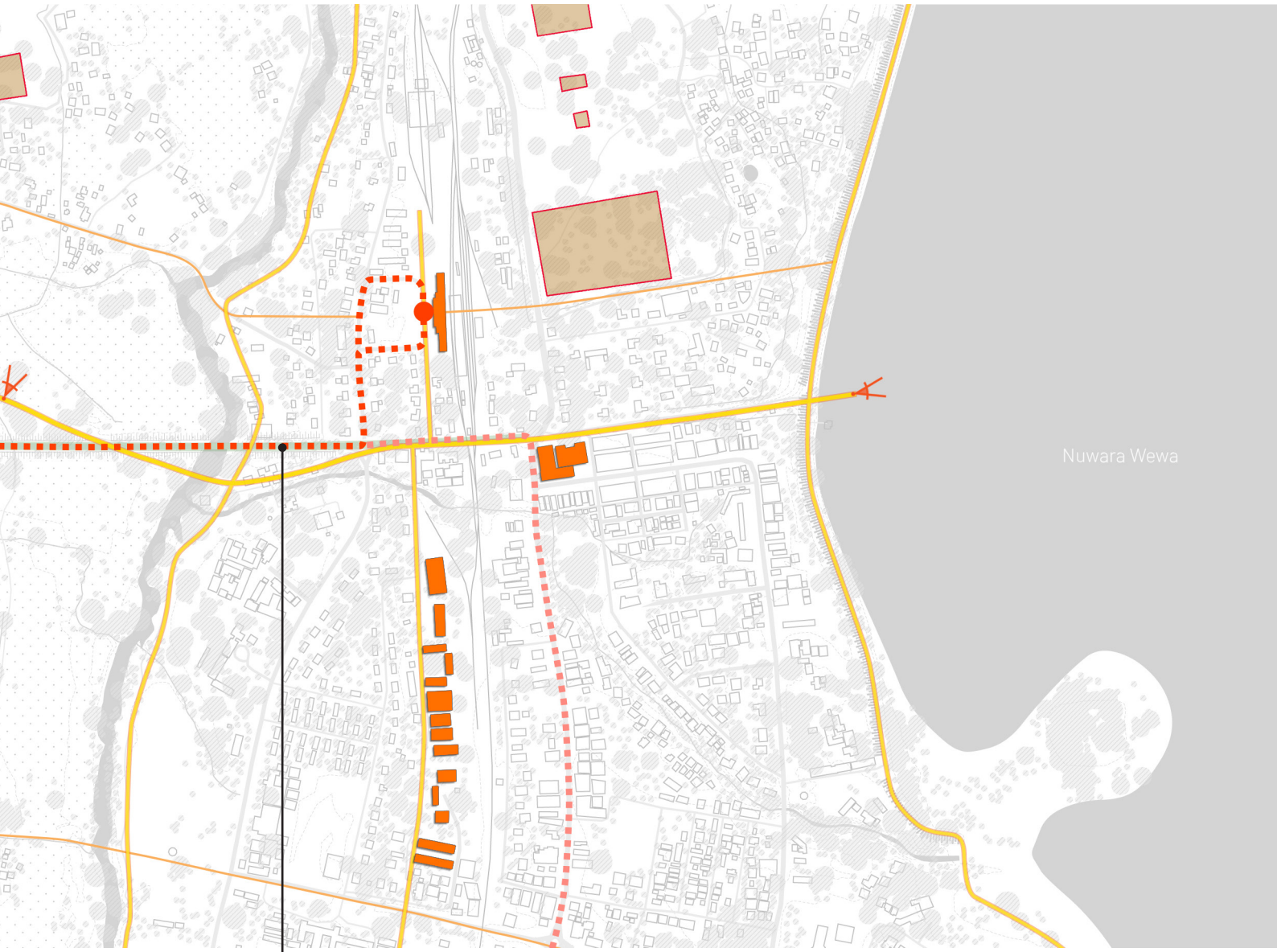
15.5 – **The lower mesh in 10 years**



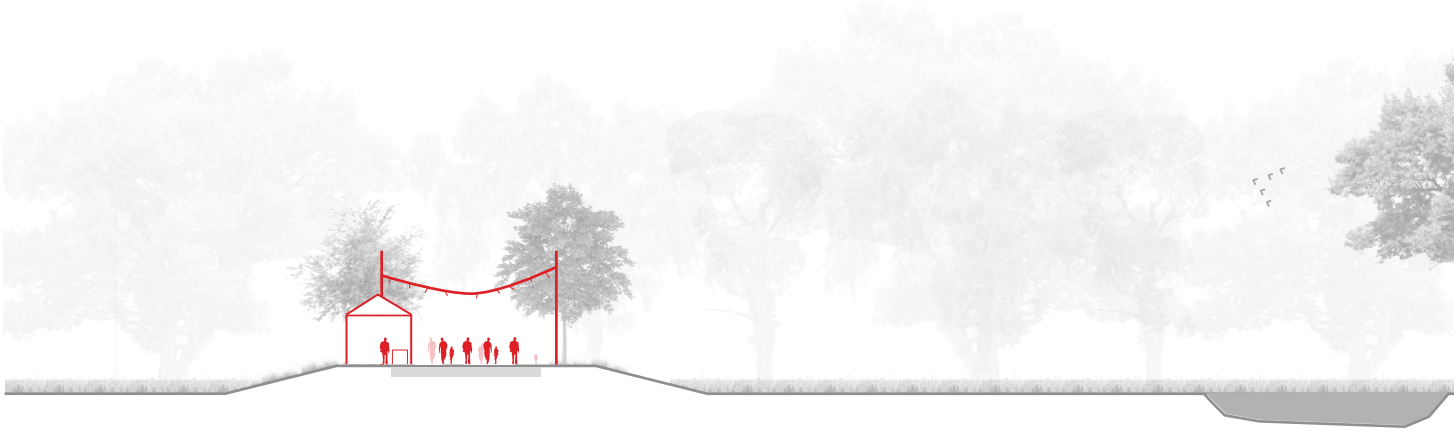
Transformation of the abandoned industrial buildings in order to develop restaurants, handicraft, bars, etc.

FIG. 15.4 Map of the lower mesh in 20 years (Peter, 2018)

15.6 – **The lower mesh in 20 years**



Except for the inhabitants, individual vehicles are not allowed top enter in the Sacred City anymore



15.7 – **Prototype for the lower mesh**

Current situation

Currently, the main access to the heritage site is a 2 km-long "A class" road which connects the modern city to the Bodhi Tree. This road is a 10-meter-wide band of asphalt located on a dike above the rice paddies. At the end of this axis, there is a large 15,000 m2 parking lot which is mostly empty except during festival times. This road infrastructure does not provide any spatial quality and completely neglects the qualities of the surrounding landscape.

Proposed intervention

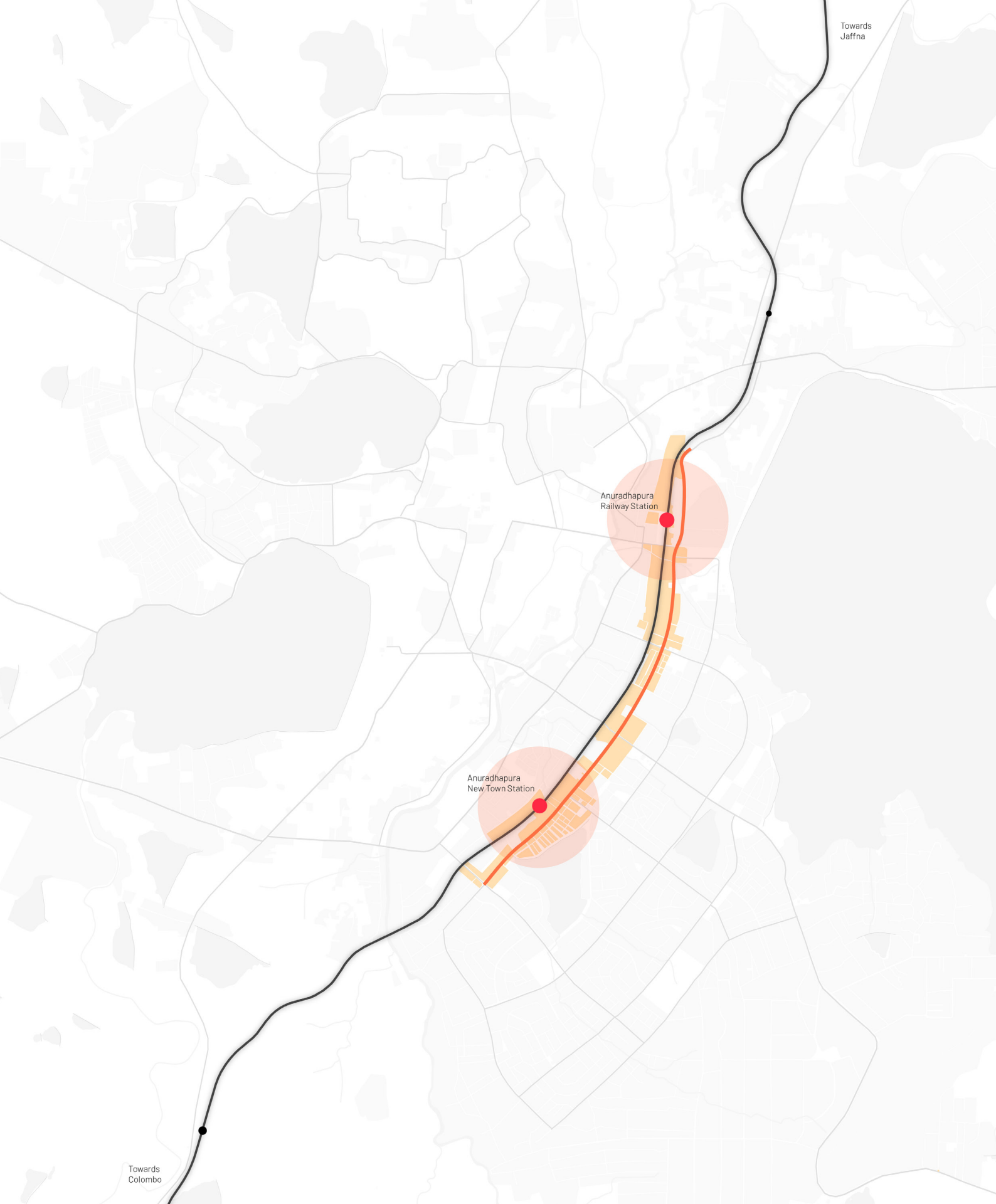
The proposal is to develop alternative modes of transportation such as cycling and walking which are more appropriated to experience the landscape. A bicycle lane is created parallel to the existing dike on the path of the historical road which is still partially existing. New trees are planted along this path and different landscape elements are valorized such as water features, ruins, habitats, and so forth. In parallel, a bus shuttle runs on the dike connecting the train station to the main attractions of the heritage site. The access with individual vehicles is limited to the inhabitants living in the heritage area and to persons with disabilities. This makes it possible to greatly reduce the size of the parking and to requalify the main road into a shared space.

Flexibility of the design

The new design of the main access road is adapted to a large flow of people during festival times. It is now a real public space which valorize traditional processions, give space for food stands and decorations. The remaining parking space is used to provide basic services to the pilgrims such as first aid and mobile toilets.

FIG. 15.5 Proposed transformation of the Bodhi Tree parking area (Peter, 2018)

Top: Current situation
Middle: Proposed intervention
Bottom: During the religious festivities


Towards
Jaffna
Anuradhapura
Railway Station
Anuradhapura
New Town Station
Towards
Colombo

16 – The productive axis

Landscape operative structure

The productive axis is a landscape operative structure which is composed of the main infrastructure lines, the transportation hubs, the main streets, the industrial open spaces, the commercial areas, and so forth. The aim of this strategy is to transform these different spaces in order to create conditions facilitating different flows such as the movement of people, food, recycled materials, and energy.

16.1 – **The challenges and opportunities**

The productive axis addresses three main challenges and opportunities identified during the analysis of the landscape system:

- The traffic congestion and parking. There is a need to reorganize the main flows of vehicles in the city in order to reduce the nuisances caused by heavy traffic.
- The inefficient public transport. Public transport needs to be organized more efficiently in order to be competitive against other modes.
- The low quality of the urban landscape. There is a need to revitalize the main centralities of the city which are currently not attractive.

16.2 – **The strategies of the productive axis**

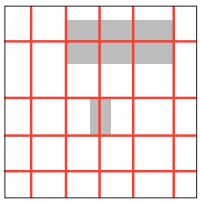
In order to address these challenges and opportunities, two main strategies should guide the development of the productive axis:

Revitalising the main centralities

Developing a public transport corridor

FIG. 16.1 Strategic map of the productive axis (Peter, 2018)

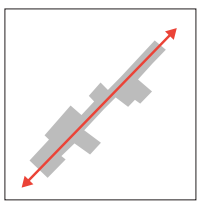
Strategic Components



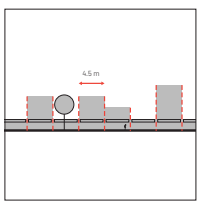
The grid of main streets

The infrastructure skeleton

The transportation hubs

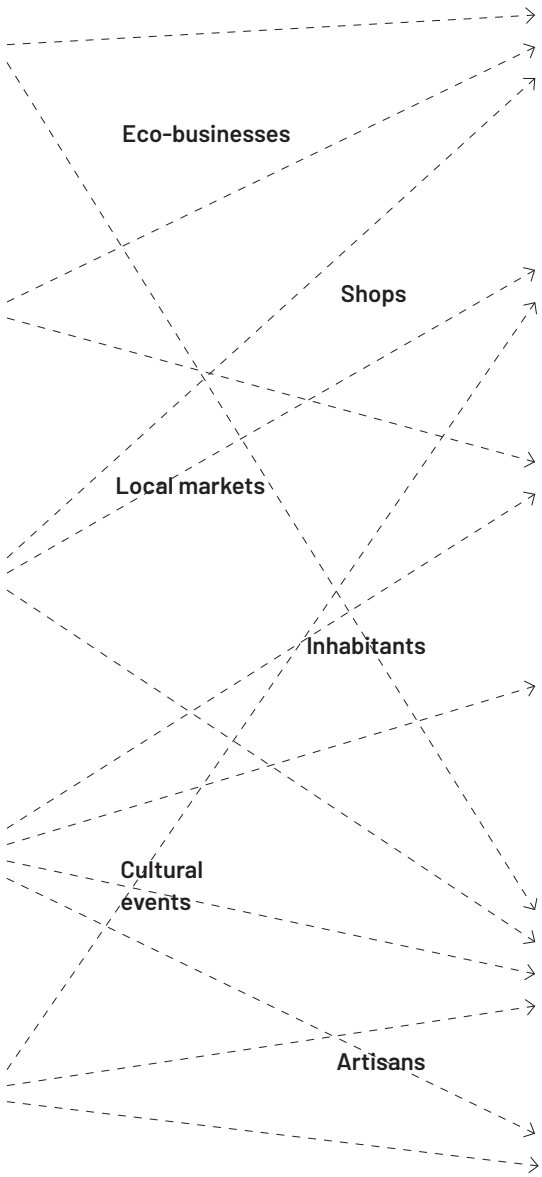


The industrial open spaces



The commercial areas

Actors and processes



Performance objectives

Transportation

Improve the transportation of passengers, freight, electricity, etc.

Recycled materials

Collection, transport, processing, and re-utilisation of urban waste

Energy production

Production of energy from renewable sources such as solar and biomass

Food production

Production of fruits, vegetables, livestock, flowers, etc.

Social interactions

Enable social interactions among different religions, genders, age groups, etc.

Ornamental resources

Support artisanal activities such as handicraft, jewellery, fashion, etc.

16.3 – **Performance objectives of the productive axis**

These two strategies assign new functions to the different strategic landscape elements which were identified in the analysis.

Revitalising the main centralities

The aim of this strategy is to revitalise the main centralities of the city which are currently not very attractive. One way to do this is to relocate the multiple transportation hubs in order to create two multimodal platforms. The industrial open spaces around these hubs could be reactivated and densified in order to relocate the shops to the new location.

Creating a public transport corridor

Creating a public transport corridor aims at improving the efficiency of public transport by transforming the main street of Anuradhapura. This will also provide the opportunity to improve the spatial quality of the main street by planting trees, improving sidewalks, modifying the roundabout intersections, and so forth.

The different benefits provided by the strategic landscape elements once assigned a new function in the lower mesh are synthesized in the diagram on the left page.

FIG. 16.2 Map of the productive axis in 5 years (Peter, 2018)

16.4 – **The productive axis in 5 years**

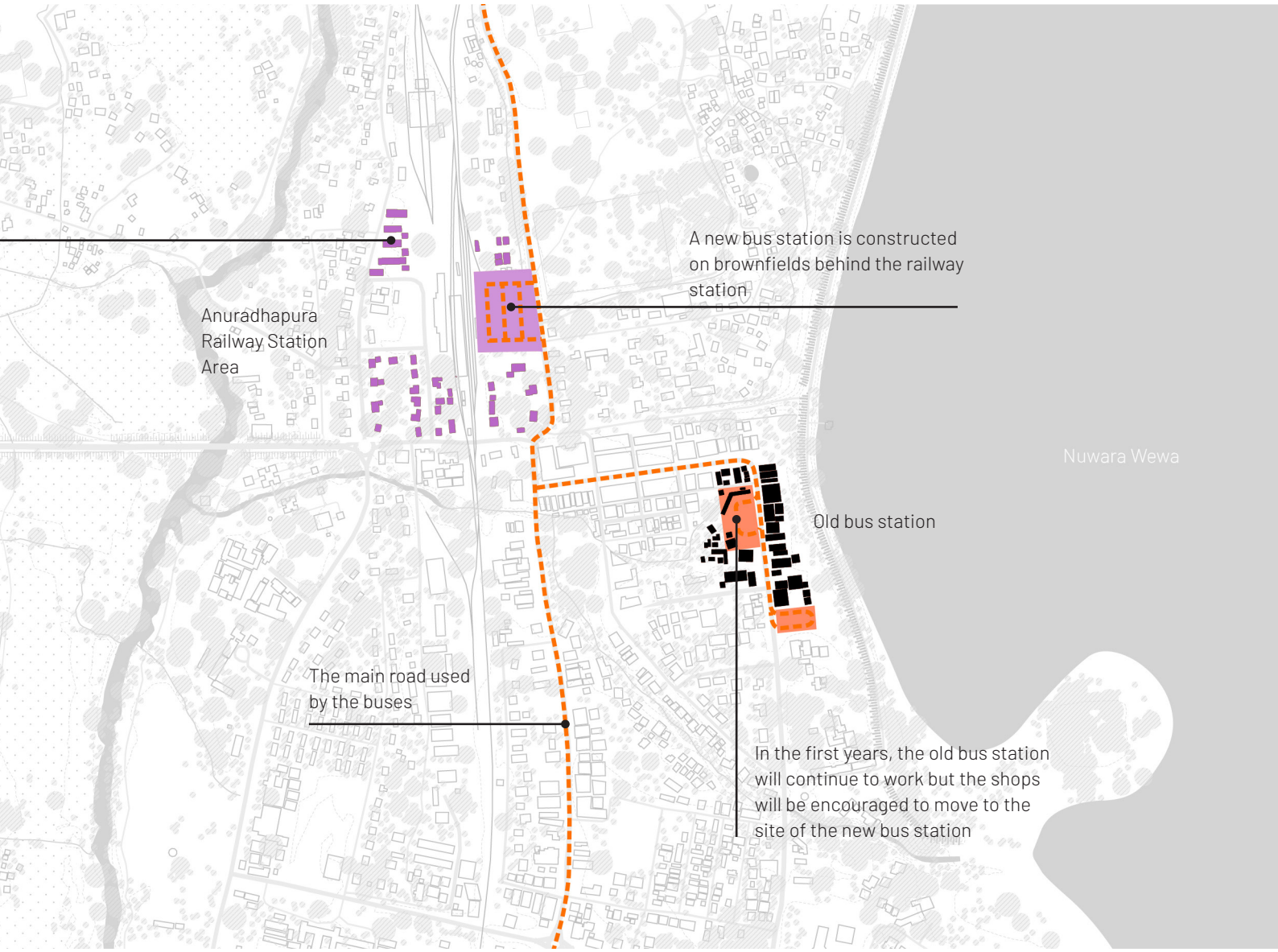


FIG. 16.3 Map of the productive axis in 10 years (Peter, 2018)

16.5 – **The productive axis in 10 years**

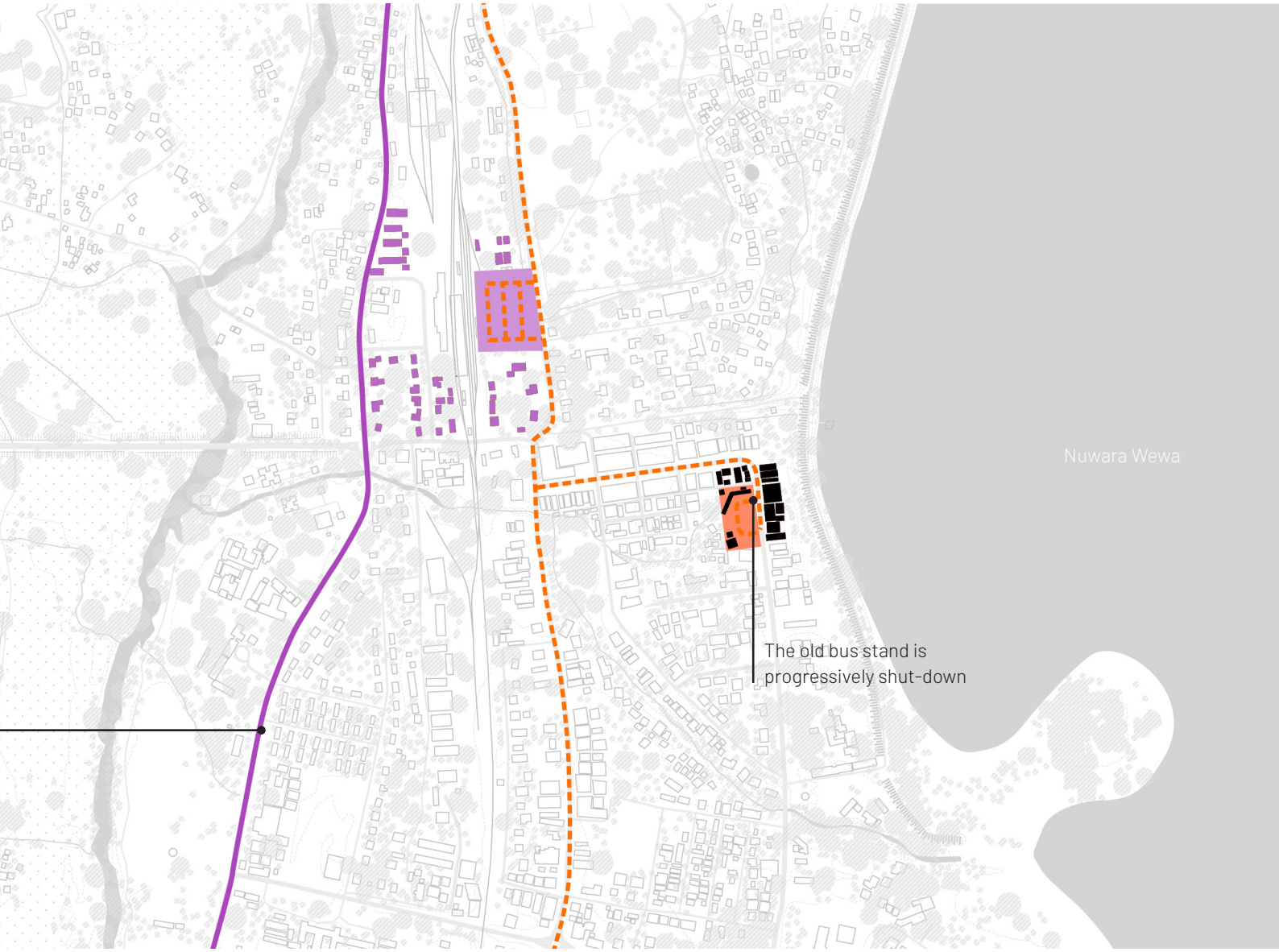
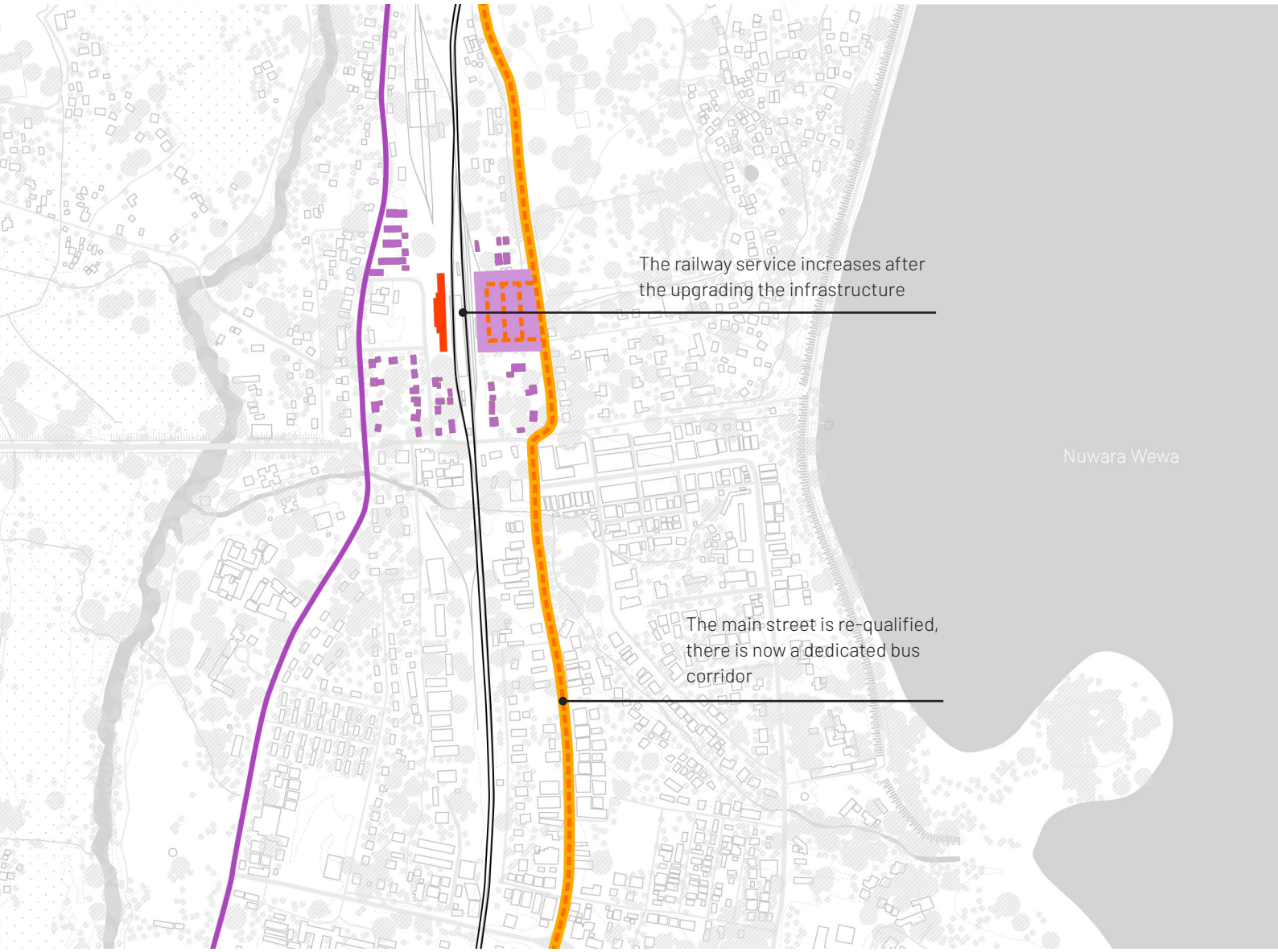
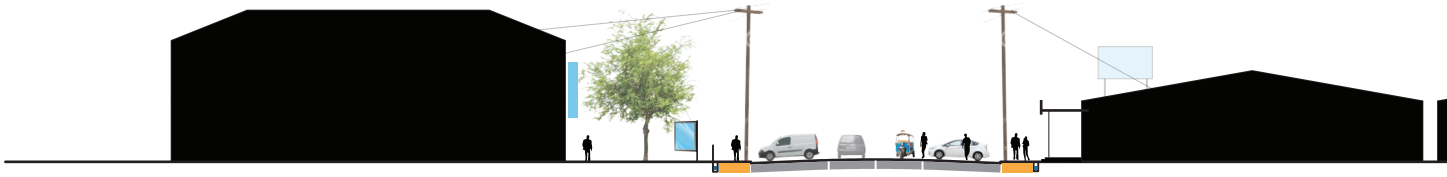


FIG. 16.4 Map of the productive axis in 20 years (Peter, 2018)

16.6 – **The productive axis in 20 years**





16.7 – **Prototype for the productive axis**

Current situation

The main street of Anuradhapura is designed to facilitate the flow of cars. There are large perpendicular parking lanes on both sides of the street and roundabouts at every intersection. The other modes of transport are not taken into account and navigate between individual vehicles. This is quite inefficient as this is the main street for the buses in the city. It is also the main commercial street and nothing is done to facilitate the flow of pedestrians who suffer from the heat, the pollution, the numerous obstacles, and so forth.

Proposed intervention

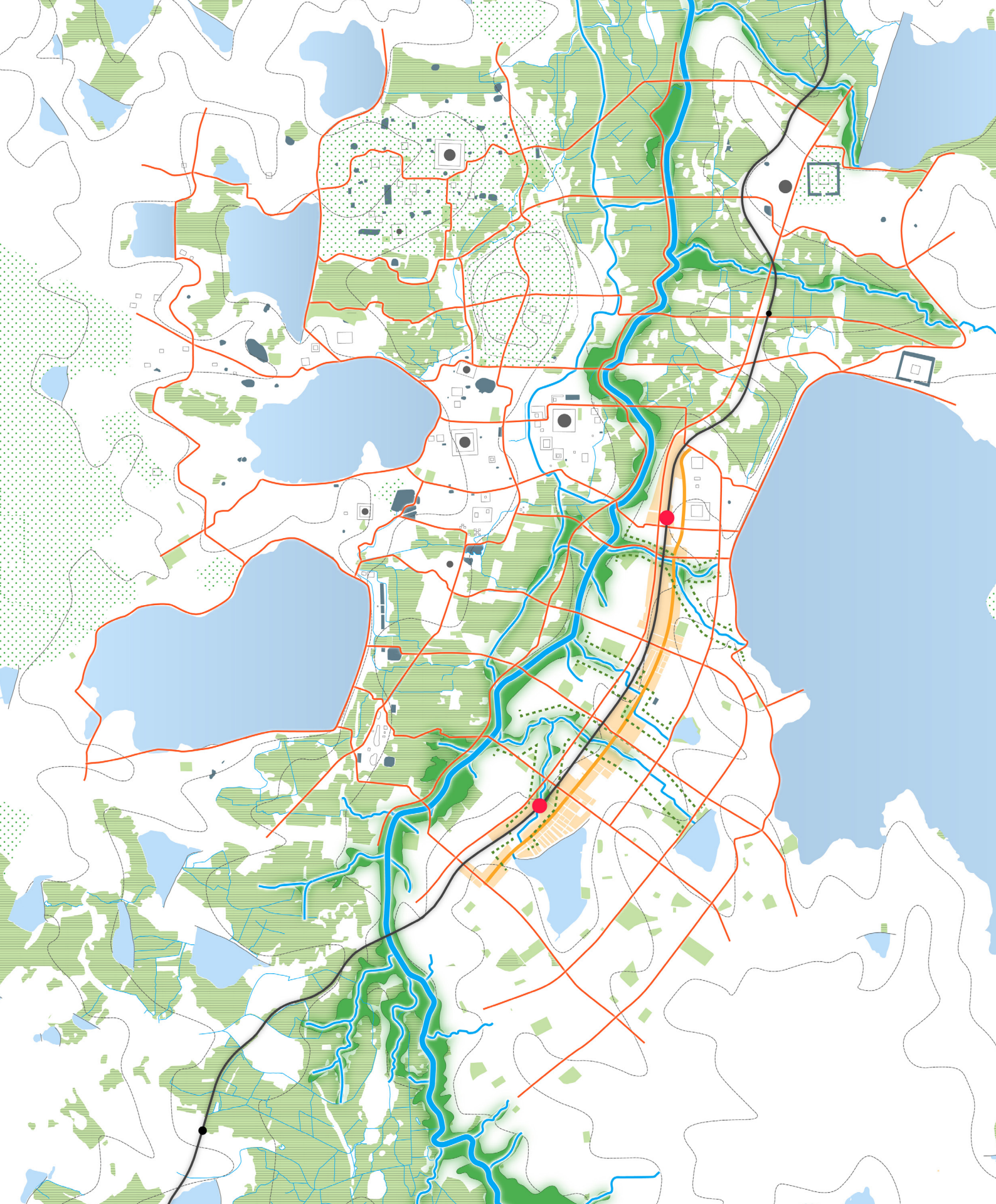
The proposed interventions consist of reallocating the space in a more balanced way in between the different modes of transportation. A dedicated bus corridor is created in the center of the street improving the public transport service. The parking space is reduced and a parking fee is charged in order to discourage people from traveling by car. Trees are planted between parking spaces, providing shade on the sidewalks and improving local climate. The private frontages become an extension of the sidewalks and are fully part of the public domain. The maximum density of the construction along the road is increased, and a value capture mechanism is used to finance the requalification of the street.

Flexibility of the design

The flexibility of the space is given by the appropriation of the private frontages. The shop owners are free to use this space as they want, given that they respect some basic rules such as leaving this space accessible to everyone and not having any permanent construction. This leaves a lot of flexibility for different appropriations of this space during the day and the week at business hours, lunch, dinner, and night time.

FIG. 16.5 Proposed transformation of the Main Street (Peter, 2018)

Top: Current situation
Middle: Proposed intervention
Bottom: At night time



17 – Implications of the design

Adapting the urban planning framework

The proposed strategy is not a blue print for the design of the city but rather a structure which must guide the development of the city on the long-term. The design exercise highlighted different aspects which need to be addressed in terms of planning:

Long-term approach
It is impossible to realize such a large-scale transformation of the landscape in a traditional five years political mandate. The development of the urban landscape infrastructure must be divided into phases which can be achieved in a reasonable amount of time. The environment is changing fast and the strategy should be able to integrate new conditions which can emerge during the process. For instance, this means phasing the transformation of the Malvathu river into different sections.

Participative approach
The cost of the work involved by the strategy cannot be supported by a single stakeholder. There is a need to build partnerships and to find innovative solutions to share the cost of the development of the urban landscape infrastructures. This can be done for instance by involving the shop owners in the development of the productive axis and giving them in exchange the right to increase the density of their plot.

Multiscale approach
There are currently three main plans shaping the development of the city at the national, regional, and local level. However, they are conceived and implemented by different government organisations which do not interact and have a different agenda. This is a challenge for this kind of approach which needs to be consistent through the scales. It is therefore necessary to create specific institutional arrangements in order to avoid conflicts through the scales.

Multifunctional approach
One of the main principles of the urban landscape infrastructures is to create synergies between multiple processes. However, planning is currently very sectorised and the different organisation in charge of water, transport, heritage, and so forth do not interact. Each organisation is following its own standards and do not want to take responsibilities for aspects which are not their core competences. Here again it is necessary to build innovative institutional arrangements in order to progress on a case-by-case basis.

FIG. 17.1 Strategic map of the urban landscape infrastructures (Peter, 2018)

FIG. 17.2 Proposed urban landscape infrastructures (Peter, 2018)


Nuwara Wewa

PART 4

Reflection

Evaluation of the research

The objective of the last part of the research is to reflect on the outcomes of the work and to analyse until which extent the aim of the research was addressed. This part discusses the relevance of the research methodology and potential improvements which could be made. It poses the question of the transferability of the proposed approach to other situations and concludes on the potentials and challenges for an application in practice.

TO DEVELOP AN URBAN REGENERATION STRATEGY EMPLOYING URBAN LANDSCAPE INFRASTRUCTURES AS ARMATURES FOR SUSTAINABLE DEVELOPMENT?

1. THEORY

WHAT COULD BE DONE?

Identify the main theoretical concepts and develop a method to address the reserarch question.

Theoretical tools:

- Literature review
- Case studies

2. ANALYSIS

HOW DOES IT WORK?

Understand how the landscape is structured and highlight the challenges and opportunities.

Analytical tools:

- Landscape perspectives
- Microhistories
- Mapping of systems

3. DESIGN

HOW CAN IT BE APPLIED?

Apply the concept of urban landscape infrastructures to the case of Anuradhapura.

Design tools:

- Landscape operative structures
- Performance objectives
- Design prototypes

4. REFLECTION

WHAT CAN BE LEARNED?

Discuss until which extent the aim of the research was addressed.

Reflection aspects:

- Methodology
- Transferability
- Application

18 – Conclusion of the research

The starting point of this research was an empirical observation: the potential of transforming the landscape in order to support human and ecological activities as been neglected in the past decades. Currently, landscape is perceived as the residual space which is left between the urban infrastructures such as roads, railways, and channels. This led to the hypothesis that an approach through the urban landscape could be used in order to address the challenges of urban decay that the city is facing. Based on this hypothesis, the aim of the thesis was to develop an urban regeneration strategy employing urban landscape infrastructures as armatures for sustainable development.

In the first part of the research, the review of academic literature highlighted a set of interconnected concepts which formed the theoretical framework of the research. While a large amount of literature is available in the field of landscape as infrastructure, it was hard to find concrete applications. Most of the realisations in this field look at the landscape integration of infrastructures. However, the idea that landscape itself can work as an infrastructure remains mostly untested and it is therefore difficult to learn from the practice.

Based on the theoretical framework, the structure and the main elements of the landscape were analysed in a systematic way. The method of landscape perspectives proved to be an efficient way to understand the logic of ecological, social, and economic systems which were later synthetized using the concept of the space of flows. However, this interpretation of the landscape is open to change and could be completed with other perspectives. This part of the research revealed different challenges and potentials which served as a basis for the development of the design.

The design exercise used the learning from the analysis in order develop three urban landscape infrastructures providing conditions for different social, ecological, and economical processes. The specificity of the design comes from the new relationship between the urban form and the local processes. This part showed how urban landscape infrastructures can work as armatures guiding the development of the city and highlighted the numerous economic, social, and environmental benefits that urban landscape infrastructures provide. It also showed the adjustment which needs to be done in terms of planning framework.

In conclusion, the research showed that the approach using urban landscape infrastructures is addressing the main principles of sustainable development due to its capacity to balance social, environmental and economic needs on the long-term. There is a need to further explore the potential of urban landscape infrastructures, and in particular to explore alternative research methods in order to grasp the complexity of the social and ecological systems. This is crucial as the interpretation of the landscape conditions the design of the urban landscape infrastructures.

FIG. 18.1 Research methodology (Peter, 2018)

19 – Reflections on the process

The purpose of this chapter is to look back at the overall research process and to reflect on different aspects related to the choice of the main research fields, the relevance of the research methods, the relationship between research and design, the transferability of the results, and the potential applications in practice. These main aspects have been set in the Graduation Manual - European Post Master in Urbanism Academic Year 2017 – 2018 (TU Delft, 2018).

The relationship between the graduation topic and the main research fields addressed in the EMU.

Most of the theories and methods used in this research were introduced during the EMU Studio – Constructing Sustainable Urban Landscapes at Delft University of Technology. The theory of landscape urbanism, and in particular the approach of the landscape as infrastructure, was used during this studio in order to develop a green-blue infrastructure in the city of Zwolle, The Netherlands. This was for me an opportunity to explore the main principles of urban landscape infrastructures such as interpreting the landscape as a complex system, working through the scales, and taking into account the different temporalities of change.

However, looking back at the final outcome of the studio, more importance was given in my project to the ecological aspects of the urban landscape probably due to the fact that it is more difficult to understand social systems using quantitative research methods. Indeed, there is a lot of data available on landscape elements such as soils, hydrology, climate, and vegetation which makes it relatively easy to analyse ecological systems at different scales. However, data on social processes such as culture, transportation, economy, population, and so forth is still relatively rare and difficult to interpret when it is available.

Elaboration on research method and approach chosen in relation to the methodical line of inquiry of EMU, reflecting thereby upon the scientific relevance of the work.

One of the main methodical lines of inquiry in EMU is to interpret the landscape as a complex system. This is necessary in order to have a grasp on contemporary urban conditions such as climate change and globalization. This way of interpreting the landscape uses specific research methods which makes it possible to break the complexity of the landscape and to understand the underlying structure and elements of the systems. However, it is easy to lose the whole picture and to focus on some aspects of the landscape leaving other apart. This is usually not a good approach as the different systems are interconnected and solving one issue separately can create new ones which are even more complex.

In order to maintain the holistic nature of the landscape, different research methods were combined with the aim to integrate social, ecological, and economical aspects in the analysis. The approach using the landscape perspectives to organize the

research into thematic parts was a very efficient way to look into complex systems such as religious practices, irrigation systems, and transport networks while maintaining a coherent and synthetic research structure. This method is open to change, meaning that the analysis can be completed if some parts were missed by the author which interprets the landscape based on his own experience. It also gives a voice to different actors who can express their contradicting views on the landscape.

In order to limit the effect observed in my previous work of over representation of ecological aspects, different methods of inquiry of the landscape were combined in this research. The microhistories revealed very interesting social processes which would have been very difficult to grasp using geospatial analysis methods. For instance, the microhistory of Poya days gives a good idea of what the important elements for the pilgrims are and how they are interconnected. On the other hand, mapping based on geospatial data is very efficient way to understand ecological processes. The learning here is that it is important to combine multiple methods of inquiry in order to balance the gaps of each method taken apart.

Finally, the concept of space of flows was useful in order to synthesize the learning of the analysis and reconstitute the whole picture of the landscape system. However, the temporal dimension of the landscape is not very strong in this approach and there is a need to explore how to synthesize not only the spatial dimension but also the variation of the landscape systems in time.

Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results.

The challenges encountered in the case of Anuradhapura are global issues which require local solutions. As mentioned earlier, most of the concepts used in this research were initially tested in the Netherlands and it was easy to adapt the approach in order to look at the case of Anuradhapura. The approach of urban landscape infrastructures is not limited to a specific geographical area or context. There are many other places facing similar challenges which could take benefit of urban landscape infrastructures to steer urban development.

However, it is not possible to transfer the design directly from one place to another as urban landscape infrastructures interact with local social, ecological, and economical processes. It is not relevant to transfer some parts of the landscape from one place to another as they are a part of a larger system and will behave differently somewhere else. For instance, the proposed backbone structure is adapted to the specific conditions of Anuradhapura which has a tropical monsoon climate, a hilly terrain, a low population density, and so forth. This structure would be completely irrelevant in another place which will have different landscape characteristics.

Therefore, the relationship between research and design is of utter importance in order to understand how the landscape system works and to adapt the design based on the specific conditions encountered.

The relationship between research and design.

In order to address complex contemporary conditions, it has become necessary to find creative ways to combine the research and design-driven natures of the discipline. Indeed, there are no easy solutions which could be transferred from one place to another. The design assignment is highly context sensitive and requires an excellent understanding of the local processes.

The most common way to acquire this understanding is to use different research methods such as the microhistories, system mappings, literature reviews, and interviews which were critical for this research. These methods produced a lot of knowledge on the landscape of Anuradhapura which was critical for the design of the urban landscape infrastructures.

While it was not the main method of inquiry, design also revealed interesting things about the landscape that the other research methods did not show so clearly. For instance, I initially synthesized the findings of the research using the concept of ecological and social space of flows. However, it appeared very clearly in the design that there is a third structure with distinct qualities which guides the development of the city. This pushed me to distinguish the space of social and economic flows, as they have a very different spatial structure. Therefore, the approach of this research was mostly research for design strategy but ultimately the design did produce new knowledge and influenced my research process.

Discuss the ethical issues and dilemmas you may have encountered in doing the research and potential applications of the results in practice.

One of the dilemmas that I encountered during this research and working as an architect in India before joining the EMU program is the difficulty to if my interpretation of the landscape is influenced by my European origin, educations and experiences. The landscape of Anuradhapura is completely different from what we find in Europe. When I started this research, I did not have any specific knowledge about Buddhist traditions, rice farming methods in tropical climate conditions, ancient Sinhalese civilizations, and so forth. This poses the question of the validity of the research which could be completely biased by my previous experiences especially in a context where data documenting social, economic, and ecological processes is rare. The landscape perspective helped me to overcome this challenge by looking at the landscape from the perspective of the different actors. I created imaginary characters and tried to understand what their claims on the landscape would be. This enabled me to explore aspects of the landscape that I would otherwise leave aside as they are not important in my referential. I think this aspect is crucial in terms of the application of the research as the urban landscape infrastructures must capture the complexity of the local processes.

Bibliography

Abeywardana, N., Bebermeier, W. & Schütt, B., 2017. The Hinterland of Ancient Anuradhapura : Remarks about an Ancient Cultural Landscape. Journal of World Heritage Studies, (Special Issue), pp.37–43. Available at: http://doi.org/10.15068/00148447.`

Agrarian Research & Training Institute, 2007. Anuradhapura District Development Programme Report on Fact Finding/Identification Study, Available at: http://dl.nsf.ac.lk/ohs/harti/14507.pdf.

Antrop, M. & Eetvelde, V. Van, 2017. Landscape perspectives: The Holistic Nature of Landscape 23rd ed., Springer.

Castells, M., 1989. The Informational City: Information Technology, Economic Restructuring, and Urban-Regional Process, Oxford: Blackwell Publishers Inc.

Coningham, R. et al., 2010. The anuradhapura (sri lanka) project: The hinterland (phase ii), preliminary report of the first season 2005. South Asian Studies, 22(1), pp.53–64.

DCS, 2012. Census of Population and Housing, Colombo: Population Cences & Demography Division.
Handawela, J., 1992. Anuradhapura District Environmental Profile.

Hung, Y.-Y. et al., 2011. Landscape Infrastructure: Case Studies by SWA Birkhäuser., Basel.
ICOMOS, 1982. International Council on Monuments and Sites. In Paris, pp. 1–4.

Maitra, A. et al., 2002. Loss of heterozygosity analysis of cutaneous melanoma and benign melanocytic nevi: laser capture microdissection demonstrates clonal genetic changes in acquired nevocellular nevi. Human pathology, 33(2), pp.191–7. Available at: http://www.lavoisier.fr/livre/notice.asp?depuis=e.lavoisier.fr&id=9781405196864.

Motloch, J.L., 1990. Introduction to Landscape Design 2nd ed.,

Nijhuis, S. & Jauslin, D., 2015. Urban landscape infrastructures Designing operative landscape structures for the built environment. Research In Urbanism Series, 3(1).

Nijhuis, S., Jauslin, D.T. & Van der Hoeven, F.D., 2015. Flowscapes: Designing infrastructure as landscape S. Nijhuis, D. Jauslin, & F. van der Hoeven, eds., TU Delft.

North, A., 2012. Operative Landscapes, Birkhaeuser.

Roberts, B.H., 2014. Managing systems of secondary cities: Policy responses in international development J. G. Wood, ed., Brussels: Cities Alliance/UNOPS. Available at: http://www.citiesalliance.org/node/4978.

Rouse, D.C. & Bunster-Ossa, I.F., 2013. Green Infrastructure: A Landscape Approach. , (571).

Shannon, K. & Meulder, B. De, 2008. Water urbanisms 1st ed. F. I. K. Leuven, ed., Amsterdam : SUN, ©2008.

Steiner, F., 2011. Landscape ecological urbanism: Origins and trajectories. Landscape and Urban Planning, 100(4), pp.333–337. Available at: http://dx.doi.org/10.1016/j.landurbplan.2011.01.020.

Swedish University of Agricultural Science, 2016. Beyond-Ism: The Landscape of Landscape Urbanism. In C. Dahl et al., eds. p. 152.

Waldheim, C., 2006. The Landscape Urbanism Reader Princeton. C. Waldheim, ed., New York.

Table of figures


EUROPEAN
POST-MASTER
IN URBANISM
EMU
strategies and design for
cities and territories

TU Delft