The Msimbazi Opportunity

Transforming the Msimbazi Basin into a Beacon of Urban Resilience

Volume A
Strategy and Management Framework
Client:

President’s Office – Regional Administration and Local Government

Financier:

WORLD BANK GROUP

Contractor:

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UKaid

CDR

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Volume A
Strategy and Management Framework
Acknowledgements

Responding to the call of Vice President of Tanzania, Honourable Samia Suluhu Hassan, to pragmatically address the recurrent flood risk in Dar es Salaam, the Msimbazi Opportunity Plan was developed through a participatory design process, known as a ‘Charrette’, that was undertaken from January to August 2018. It is the result of the invaluable time and dedication of more than 200 people, from 59 institutions and communities, across 30 working sessions.

This unprecedented approach benefited from, and was championed by, Selemani S. Jafo (MP) Minister of State, President’s Office Regional Administration and Local Government and January Y. Makamba (MP) Minister of State, Vice President’s Office, Environment and Union Affairs.

The collaboration and consensus building achieved through this process would not have been possible without the sustained efforts of the Dar es Salaam Metropolitan Development Project team within the President's Office for Regional Administration and Local Government, led by Engineer Davis Shemengale.

Through committing to the delivery of a unified solution to one of Dar es Salaam’s most pressing challenges, the Charrette brought together stakeholders from the Dar es Salaam Regional Administrative Secretariat, Dar es Salaam City Council, Ilala Municipal Council, Kinondoni Municipal Council, Ubungo Municipal Council, DART, DAWASA, DAWASCO, Ministry of Lands Housing and Human Settlements Development, Ministry of Water and Irrigation, Ministry of Works, National Environmental Management Council, Wami Ruvu Water Basin Authority, Prime Minister Office – Disaster Management Department, TANESCO, TANROADS, Vice President’s Office, Ardhi University, Korea Eximbank, Department for International Development, National Land Use Planning Commission, Private Sector Representatives, Tanzania Forest Service, National Housing Corporation, Tanzania Meteorological Agency, Non-Government Organizations, and critically Community Representatives from Hanasif, Idrisa, Mchikichini, Kigogo Kati, Kigogo Mkwajuni, Msimbazi Bondeni, Magomenu-Mapipia, Mikumi, and Suna subwards among others. A full list of participants can be found in Volume C.

A flagship of the Tanzania Urban Resilience Program, the Charrette process was coordinated by Nyariri Nanai (Senior Engineer) of the President’s Office for Regional and Local Government, and Eric Dickson (Senior Urban Development & Disaster Risk Management Specialist) and Edward Anderson (Senior Disaster Risk Management & ICT Specialist) of the World Bank.

The Charrette process was facilitated by a consortium of Max van der Sleen (Ecorys), Remco Rolvink (DASUDA), Bas van de Sande (CDR International), and Christina Geoffrey Mandara (WEMA Consult). Detailed review and comments were provided by a World Bank team comprised of Amy Faust (Urban Development & Resilience Consultant), MaryGrace Lugakingira (Urban Planning Consultant), Mussa Natty (Engineer Consultant), Nyambiri Kimacha (Disaster Risk Management Consultant), and Larissa Duma (Urban Ecology, Environment, and Sanitation Consultant).

Special thanks are due to UK aid for their generous funding and support, without which the visionary outcomes of the Charrette process would not have been possible.

Through the collective contributions of such a wide and diverse set of stakeholders, a unique opportunity lies ahead to transform the Msimbazi Basin into a beacon of urban resilience.
Dar es Salaam has lived with the annual flooding of the Msimbazi River for far too long. The people of Dar es Salaam have come to fear the times when dark clouds loom over the city. We have come to expect severe flooding with every rainy season.

Flooding in the Msimbazi destroys infrastructure. It paralyzes our transportation networks. It hinders economic productivity. And most importantly, it threatens the health and safety of Dar es Salaam’s residents.

Action is needed, and it is needed now. We have reached a tipping point: as a result of our city’s rapid expansion, the ecological equilibrium of the Msimbazi has become imbalanced, and this is exacerbated further by frequent and heavier rainfall events as a result of heightened climate variability. Business as usual is no longer a viable option.

With the Msimbazi Strategy and Management Framework and the Detailed Plan for the Lower Basin as our guide, we now have the opportunity to mitigate the chronic issue of flooding in the Msimbazi valley. At the same time, we can breathe new life into the city by restoring the ecological functions of the river basin, and by unlocking development potential by transforming parts of the currently hazardous low lands into safe, buildable space within the core of Dar es Salaam.

The conclusions and recommendations put forward here are the result of an unprecedented process of participation, collaboration, coordination and deep technical analysis.

I am encouraged by the strong commitment and the bottomless effort that I have seen since the beginning of this integrated planning process. A wide range of stakeholders are behind this plan, and both the Government of Tanzania and the residents of the Msimbazi basin feel a strong sense of ownership over the Msimbazi’s future.

We now have a plan for the Msimbazi, and the government of Tanzania is ready to implement, hand in hand with the community and development partners.

Tuanze kazi.

Selemani S. Jafo (MP)
Minister of State
President’s Office Regional Administration and Local Government
Location of the Msimbazi Basin
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<td>ACCA</td>
<td>Awareness, Comprehension, Commitment, Action</td>
</tr>
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<td>ARU</td>
<td>Ardhi University</td>
</tr>
<tr>
<td>BORDA</td>
<td>Bremen Overseas Research and Development Association NGO</td>
</tr>
<tr>
<td>CC</td>
<td>Climate Change</td>
</tr>
<tr>
<td>CCI</td>
<td>Centre for Community Initiatives, NGO in Dar es Salaam</td>
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<td>DART</td>
<td>Dar es Salaam Rapid Transport Company</td>
</tr>
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<td>Dar es Salaam Water and Sewerage Authority</td>
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<td>DAWASCO</td>
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<td>Dar es Salaam City Council</td>
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<td>DMDP</td>
<td>Dar es Salaam Metropolitan Development Program (TURP)</td>
</tr>
<tr>
<td>DFID</td>
<td>Department for International Development, UK Government</td>
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<tr>
<td>DP</td>
<td>Detailed Plan for Msimbazi Lower Basin Area</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System Mapping Technology</td>
</tr>
<tr>
<td>HOT</td>
<td>Humanitarian Open Street Map Team</td>
</tr>
<tr>
<td>IMC</td>
<td>Ilala Municipal Council</td>
</tr>
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<td>Kinondoni Municipal Council</td>
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<td>LRP</td>
<td>Livelihood Restoration Program</td>
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<tr>
<td>MADC</td>
<td>Msimbazi Area Development Corporation</td>
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<td>MLHHSI</td>
<td>Ministry of Land, Housing and Human Settlement Development.</td>
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<tr>
<td>MNRT</td>
<td>Ministry of Natural Resources and Tourism</td>
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<tr>
<td>MOWI</td>
<td>Ministry of Water and Irrigation</td>
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<td>MWTC</td>
<td>Ministry of Works, Transport and Communication</td>
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Volume A: Strategy and Management Framework
Introduction

The Msimbazi Opportunity
“The Msimbazi Basin is a densely populated and environmentally degraded area where the city’s most severe flooding takes place, putting residents and critical infrastructure assets at risk” [1].
The residents of Dar es Salaam are highly familiar with the flooding challenge in the Msimbazi valley; the impacts are easily remembered. Nearly every rainy season brings some degree of flooding. Major events have demonstrable impact - lives are lost, homes are destroyed, and negative health effects of the contaminated flood waters reverberate for months after flood waters subside. Damage is incurred to critical infrastructure and assets, such as the Dar Rapid Transit System depot and bus fleet (DART).

When the many factors that contribute to urban floods are analyzed, it becomes clear that the story of today’s Msimbazi is of a river that has been overwhelmed by the intense pressures that unplanned and unchecked urbanization has put on natural ecosystems over the last decades. Historically a large part of the upper and middle basin was natural forestland and wild bush where flood events and sediment transport contributed to the fertility of the area [2]. Since the 1970’s, rural-urban migration has accelerated, and Dar es Salaam has experienced high growth rates. Over the last fifty years, this urbanization pressure has gradually reduced the water retention capacity in the wider basin and has created various blockages for natural water discharge. As a result, flooding in Dar es Salaam has become more frequent and more severe, with significant flood events in 2009, 2010, 2011, 2014, 2015, 2017, and 2018 [3].

Due to urbanization pressures, flood risk is likely to increase over time in the Msimbazi River Basin if no action is taken. An estimated 1.6 million people currently live in the catchment area, with 250,000 in the lower and middle basin area between Selander Bridge and the Nelson Mandela Road. Some 50,000 people are exposed to flood risks caused by river flooding and rain induced flooding due to poor storm water drainage [4]. It is estimated that 8,000 -10,000 households live in areas exposed to river flooding that is considered unsafe and unsuitable for human settlement.

The Tanzania Urban Resilience Program
Many initiatives have been taken by the Tanzanian authorities over the years to protect their people from flood risks. Notable in this respect is that in 2011 the Ministry of Lands (MLHHSD) gazetted the boundaries of a special planning zone between Selander Bridge and Vingunguti as hazardous (flood prone) lands with the future function as a city park. Nonetheless, these initiatives did not fully resolve the flooding situation on the ground. In response and within the context of the Dar es Salaam Metropolitan Development Program (DMDP), the Government of Tanzania through the President’s Office for Regional and Local Government (PO-RALG), in partnership with the World Bank and the UK Department for International Development’s (DFID), established the Tanzania Urban Resilience Program (TURP)1 which supports “… flood mitigation efforts in the Msimbazi Basin with the goal of taking an integrated approach to rehabilitation in the Msimbazi Basin. This will include flood control measures but also capitalize on the Ministry of Lands, Housing and Human Settlement Development’s (MLHHSD) plan to transform the river into a linear city park that would provide much-needed public space in the city” [5].

1 TURP is a 5-year trust fund with resources from DFID’s International Climate Fund. The main objective of the TURP is to support national and local governments in Tanzania to strengthen the management of climate risk in cities.
Asessing the issues in the Msimbazi Basin

“A number of studies have been undertaken to assess issues in the Msimbazi Basin, which underscore the complexity and interconnected nature of measures needed to improve the situation. As in many rapidly urbanizing cities in developing countries, there are competing priorities for land use in the Msimbazi Basin, evidenced by plans for large-scale infrastructure in the area, pollution, pervasive environmental degradation, and the vulnerable households that have settled in flood prone areas and number in the thousands. Adding to the complexity of the basin, past demolitions in the Lower Basin have served to heighten social tension around resettlement. To date, these issues have not been comprehensively considered in the context of a plan for improving the river valley. A strong participatory process for designing and implementing the investment program is therefore critical”[6].

Design Charrette

Design Charrette: A series of workshops in which the participants are a comprehensive group of stakeholders motivated to finding a solution for a multi-faceted and complex problem that directly influences their day-to-day lives, assets or livelihoods. The stakeholders commit themselves and/or their organizations to the actions designed as part of the solution. The “Charrette team” is provided with all data and available information needed for developing the knowledge and insights required to design the strategies and management framework needed to solve the problem over time.

Figure 2: The ACCA Approach
The participatory design process, which was tailor-made for this project, is based on the “Design Charrette” methodology. PO-RALG and the World Bank have jointly coordinated the Msimbazi Charrette project. The process was set up and facilitated by international and local experts. Through the Charrette process, the Msimbazi Strategy and Management Framework (MSMF) and the Detailed Plan for the Msimbazi Lower Basin were designed by a group of main stakeholders over a six month period.

During the Charrette process, stakeholder participation grew over time from 45 participants in the initial stakeholder workshop in February 2018 to 150 people in the final one in August. The key stakeholders who participated throughout included: Ilala Municipal Council, Kinondoni Municipal Council, Dar es Salaam City Council (DCC), Ministry of Natural Resources and Tourism (MNRT) and Tanzania Forest Services (TFS), Vice Presidents Office - National Environmental Management Council (NEMC), Wami Ruvu Water Basin Office (WRBWO), Prime Minister’s Office (VPO), Prime Minister’s Office (PMO) – Disaster Management Department, President’s Office – Regional Administration and Local Government (PO-RALG), Ministry of Land, Housing and Human Settlement Development (MLHHSD), Ministry of Water and Irrigation (MOWI), Dar es Salaam Rapid Transport Company (DART), Dar es Salaam Water and Sewage Authority (DAWASA), Dar es Salaam Water and Sewerage Corporation (DAWASCO), Tanzania National Roads Agency (TANROADS), the NGOs Bremen Overseas Research and Development Association (BORDA) and Centre for Community Initiatives (CCI), as well as community representatives and the chairmen of the Mitaa, or urban sub-wards that make up the Lower Basin. In addition, meetings were held with the Municipal Directors of Ilala, Kinondoni, Dar es Salaam City Council, Kisarawe and with private sector representatives (Volume C, Appendix A). These stakeholders came together to work on the complex challenge of flood risk reduction and environmental restoration of the Msimbazi Basin.

The initial stakeholder workshop was important for the remainder of the process. The focus was on: (i) Understanding the Charrette approach; (ii) Understanding the concept of complexity and its relevance for the Msimbazi; (iii) Making an inventory of ideas from the stakeholders for possible interventions; and (iv) Visioning Msimbazi futures.

In the subsequent Charrette series, three events were devoted to designing the MSMF and three to the DP. The focus of the Charrettes followed the Awareness – Comprehension – Commitment - Action sequence of the ACCA process (Figure 3).

**ACCA process:** A concept based on group dynamics and change management theory. People can only move one step at a time, from denial to action. In an ACCA process, people are guided systematically through the process of Awareness: Recognizing the existence and multiple dimensions of a problem; Comprehension of alternative approaches and solutions; Commitment to be best available approach/solution; and readiness to take problem solving Action.

**Awareness:**
Situation analysis, exploring the Msimbazi complexities

The Charrette stakeholder team broadened its understanding of the complexities of the causes of the flooding and the negative human impact arising from uncontrolled urbanization on the functions of the river. By combining the findings of scientific research done in the past with their
Figure 3: Stakeholder meetings and Charrette sessions
own professional knowledge and with the historic knowledge and location specific insights of the communities, the Charrette stakeholder team started to comprehend the different elements of an integrated and comprehensive approach.

Comprehension:
Four options and one opportunity
In the Charrettes, four flood protection options for the Msimbazi Lower Basin were reviewed: A) do nothing; B) move people out of harm’s way; C) deepen and/or widen the Msimbazi by removing sedimentation (dredging); and D) extend option C by using the dredged material to create higher ground (terraces) for resettlement and new commercial real estate development, including a city park alongside the river front. Weighing the advantages and disadvantages, the Charrette stakeholder team concluded that doing nothing was not an option in the longer term; options B and C would be difficult to finance as stand-alone options; while the integral option D represented a real opportunity for Dar es Salaam.

Commitment:
Transform the Msimbazi Basin into a model of urban resilience
The MSMF and DP designed by the Charrette stakeholder team provide a way forward to address flood risk in the Msimbazi and transform this challenge into an opportunity. Commitment to these plans were explicitly expressed by the wide group of stakeholders in August 2018 in the presence of, and further echoed by Selemani S. Jafo (MP) Minister of State, President’s Office Regional Administration and Local Government and January Y. Makamba (MP) Minister of State, Vice President’s Office, Environment and Union Affairs.

Action:
Demonstrate the commitment and meet the expectations of the Charrette participants
The Charrette stakeholder team has expressed their support for the MSMF and the DP. Their expectation is that the next phase will see the interventions formulated in the MSMF and DP put into action in 2019. In support of this, PO-RALG has been actively engaging with the Ministry of Finance and Planning and development partners to secure the needed funding to initiate the first set of interventions.
This set of documents comprises an Executive Summary, the Msimbazi Strategy and Management Framework (Volume A), the Detailed Plan for the Msimbazi Lower Basin (Volume B), and the Appendices (Volume C). Volume A sets out the situational analysis and the interventions proposed across the broader Msimbazi Basin. Volume B elaborates on the engineering concepts and urban design principles for starting the prioritized structural works for the Lower Basin. Volume C contains the details and reports from the entire Charrette process, giving insight to the participatory development of the Msimbazi Opportunity Plan.

The information in this Msimbazi Strategy and Management Framework is structured as follows:

1. Introduction
2. Situation analysis
3. Strategy and Management Framework
4. Next steps: The way forward and the PIU Action Plan
Volume A: Strategy and Management Framework
Situation Analysis
Figure 4: Increase in regular flood events follows trend of urban growth of Dar es Salaam (graph) [9] and images of floods in the Msimbazi Basin in 2011, 2016, 2017, 2018.
In the past, a large part of the Msimbazi’s upper and middle catchment was natural forestland. The thick vegetation cover protected the underlying soil from erosion during heavy rains. Although rivers like Msimbazi are never static as they tend to change gradually over years and decades, the absence of severe erosion and extreme sedimentation kept the river in a relatively stable natural state.

During the 1800 and 1900s, flooding was not unusual [7] – in fact, the area owes its fertility to the nutrient-rich deposits that were left behind from past floods. In the late 1980’s and early 1990’s, rural-urban migration gradually began to affect the land use around the river. The city continued to expand, and the area near the middle and lower basins proved attractive for migrants from rural areas [8].

The El Niño rains of 1997-1998 are often regarded as the beginning of extreme flooding in the Msimbazi. Since then, the flooding events have become more frequent and more severe with significant flooding events in 2009, 2010, 2011, 2014, 2015, 2017, and 2018 [9] (Figure 4).

Planning and land administration systems have been unable to keep up with the rapid growth (Box). Although the 1979 Dar es Salaam Master Plan designated the Msimbazi Basin as hazard land, and the Environmental Management Act established a protective zone of 60-meters from a rivers’ high-water marks, land use restrictions have gone largely unenforced. There were no physical demarcations on the ground and the legal process required for officially designating a hazardous area was not followed.

Unplanned development is the norm; on average, unplanned areas are said to account for over 70% of the land in Dar es Salaam. Existing planning systems are applied almost exclusively to surveyed plots or planned areas, which represent only 30% of urban land. Although Local Authorities are technically responsible for the regulation and management of unplanned settlements, the tools and resources available to achieve this are not effective nor sufficient. Development in unplanned and therefore unserviced areas generally occurs without any review or approval by Municipal Urban Planning offices.
<table>
<thead>
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<td>Sub-total 171,356</td>
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Table 1: Population in the Msimbazi Catchment (Source: Ecorys; based on USAID District Map and Bureau of Statistics 2012 Census data)

Figure 5: Map of the Msibazi Lower Basin with buildings falling within either the lower Msibazi flood plain or the 60m buffer (Source: Tanzania Urbanization Review team, based on satellite imagery from 2012, aerial imagery from 1975, 1992 and 2005)
The population growth of Dar es Salaam is one of the highest in the world and for the next decade an average growth rate of 4.3% per year is assumed. Dar es Salaam’s estimated population for the year 2018 is 6 million people [10]. It is expected to reach megacity size, with more than 10 million people, by 2030 [11]. District population data (2011) from the most recent Census (2012) show that 1.2 million people (27% of the city population) lived in the wider Msimbazi catchment (Table 1). Extrapolation of this data with the current 6% growth rate suggests that the catchment’s population is currently close to 1.6 million. Using the population growth projections (3%) of the Bureau of Statistics, the Msimbazi Basin which has a rain catchment area of 271 km2 could become the home of 2.5 million people in 2030. That is twice as many as in 2011.

Analysis using satellite and aerial images from 2005, 2013 and 2015 find the vast majority (78%) of buildings falling within either the lower Msimbazi flood plain or the 60m buffer protected under the Environmental Management Act were built before 2005 (shown in yellow – Figure 5). Observation of location of the buildings constructed from 2005 to 2013 (shown in orange) and 2013 to 2015 (shown in red) suggest a concerning trend toward development on even higher-risk lands. With time, new construction has moved closer to the river and permanent wetlands. While this area has technically been designated as a hazard land as per the 1979 Dar es Salaam Master Plan, past actions by both national and local governments, as well as public utilities, have to some degree tacitly condoned development on this land. This context further demonstrates the complexity and sensitivity of land tenure claims and prospective resettlement efforts.

The encroachment of settlements into the Msimbazi river basin should be understood in the context of the rapid pace of growth in Dar es Salaam, and the country as a whole. Tanzania’s urban transition is at a critical point, and the number of Tanzanians living in urban areas is projected to double in the next 20 years.

Dar es Salaam’s rapid population growth has put intense pressure on land. In the absence of affordable housing options, functioning land markets, and strict enforcement of development regulations, urban dwellers often informally buy land near the urban center.

Household location decisions are shaped by both constraints and benefits. During interviews, area residents stressed that affordability was paramount in household location decisions. Land values are considerably lower in flood areas, and the cost of renting a room is between 20%-40% of the cost of the same room on higher ground in the same Mtaa. In addition, renters in flood prone areas typically pay 1-3 months’ rent in advance, compared to the standard 6-12 months in other areas. There are many renters within the Msimbazi; a Mtaa Chairman estimated that 95 percent of houses in his area had at least one tenant. These renters have few alternatives to living in flood areas if they cannot save for larger down payments [12].

Understanding Locational Tradeoffs
Figure 6: Map of the catchment zones

- Upper Basin
- Upper Middle Basin
- Lower Middle Basin
- Lower Basin
As a megacity Dar es Salaam will need reliable infrastructure to keep the city functional and livable. Improving service delivery, including connectivity and mobility, water supply and sanitation and the development of new urban centers in the areas around the city’s core are all necessary to accommodate city growth. However, more is needed. Open spaces with parks and sport fields are also important to keeping the city livable and providing areas of relief from the stresses of urban life [13].

The lower and middle lower basins are flood risk hotspots (Figure 6). The flood events regularly disrupt the functionality of the vital infrastructure like the bridges and DART service and the bus depot.

Human activity linked to urban development and natural resource exploitation are the main causes for the recurrent disasters in the Msimbazi Basin. A series of flash-floods, together with water pollution from toxic industrial effluents, lack of sanitation and solid waste collection, poor wastewater infrastructure, and water borne illnesses negatively impact on the lives, assets and livelihoods of the people living in these areas. Moreover, the expectation is that the flood risk and health hazards will further increase in the coming decades as a consequence of urban intensification in the Msimbazi Basin. Climate change vulnerability and adaptation studies [14] show that the city is already experiencing heavier rainfall, heavier flooding, and higher mean temperatures than in previous decades. In the period up to 2050 no significant changes in rainfall are expected, but average temperatures will increase further with longer and more frequent heatwaves. Sea level rise is not a significant factor for the Msimbazi Basin[15].

In August 2011, the Ministry of Lands, Housing and Human Settlements Development gazetted the Msimbazi Valley Special Planning Area, and in November 2011, produced a plan for a city park which would stretch from Vingunguti to the Msimbazi River’s outlet at the Indian Ocean, covering the most flood-prone sections of the valley. Implementation has proved to be difficult, due in large part to the need for more precise coordinates for the boundary. Initially, the city park concept did not refer to vulnerability to flooding. However, after a series of severe flooding events, it became evident that the proposed city park should be designed to accommodate flood safety. An important challenge observed by MLHHSMD is the existence of formal property rights (for example Certificate Rights of Occupancy) for land that is within the gazetted boundary. This makes planning of resettlement interventions complex.

People and small businesses continued to settle in the Msimbazi Special Planning Area (MSPA) despite the flood risk. The Lower Basin is close to public transport, markets, and health services and offers relatively cheap accommodation close to income generating opportunities in the city center. These advantages appear to outweigh perceived flood risks at individual household level [16]. Moreover, Dar es Salaam’s land scarcity and dysfunctional land market have led to a limited supply of affordable housing stock for the urban poor, and this also is a driver for building activity in the more vulnerable areas to flooding.

In this setting, it has proved difficult for the Government to protect its people from flood risks. In the immediate aftermath of the 2011 flood, 680 of the most affected households were resettled to Mapwepande, 25 kilometers north of Dar es Salaam, where they were given plots and building materials. Over time, 1,007 plots were allocated, and 3,400 people were moved [17]. This location was prepared as a new area for city development with water access and primary schools. Unfortunately, the area has not been successfully developed due to a lack
Main infrastructure assets of Dar es Salaam cross the Msimbazi River and its tributaries, including the Morogoro Road, Kawawa Road, Nelson Mandela Road and the national railway track. Other main assets in the flood plains are the DART depot, a cement industry depot and a logistics/industrial park adjacent to Nelson Mandela Road. It is difficult to overestimate the negative impact that a further doubling of the population and human activities would have on the river itself, on infrastructure assets and on the flood risk vulnerability of the communities that live in and around the Msimbazi Basin (Figure 7).
of local employment opportunities and a lack of public transport, which is needed to move residents to areas with more active job markets. Many residents ultimately moved back to the Msimbazi Valley in search of economic opportunity and access to services offered by proximity to the city center.

In December 2015, government led evictions and demolitions were undertaken in the Hananasif ward to try and address the challenge of encroachment into flood prone hazard lands. The stated objective of these demolitions was ultimately to include all houses within 60 meters from the highwater mark. Approximately 700 houses were demolished [20] but after considerable public outcry, the initiative was declared illegal and stopped by court order.
Figure 8: The Msimbazi Basin (rain catchment area 271km²)

Figure 9: Rainfall intensity and river discharge during the October 26 2017 flood event

Figure 10: Uncontrolled sedimentation and erosion at the confluence of the Msimbazi and Sinza Rivers.
A history of flood events

The Msimbazi is a natural rain fed river and the morphology of its basin, sub-basins and river plains shows its long history of flooding events. The Tanzania Meteorological Agency started rainfall measurements in 1961 and the heaviest event thus far was recorded in 2011. Heavier than usual precipitation continued in the March-April-May rainy season in the years 2014 to 2016. In 2017 and 2018 the floods occurred in both the long rainy season from March to May, and the short rainy season from October to November. The most recent floods took place in October 2017, January 2018, March 2018, and again in April 2018, resulting in the Regional Commission of Dar es Salaam announcing a state of emergency.

Heavy rainfall events are often characterized by concentrated bursts of downpours. The gauged hourly rainfall intensities show that peaks of more than 50 mm/h are not unusual [21]. Figure 9 shows the development of the October 2017 flood event over a 72-hour period for both rainfall intensity and discharges in the river.

The river system responds very quickly to rain bursts. Within three hours after the rainfall, the river downstream experiences peak discharges causing the system to overflow and become hazardous for the areas around the river. The inundation depths can reach two meters or more with inundation periods which at some locations last for several days.

Flooding occurs as a result of both surface flooding and riverine flooding. Surface flooding occurs when an extremely heavy downpour of rain saturates urban drainage systems and the excess water cannot be absorbed. Riverine flooding occurs when rivers burst their banks after sustained or intense rainfall. In the Msimbazi Basin, surface flooding mainly occurs in the highly densified urban areas at slightly higher grounds relative to the level of the river, whereas riverine flooding mainly occurs in the lower lying areas around the river (such as in the Lower Basin and the Vingunguti area in the Lower Middle Basin).

Floods induce uncontrolled erosion and sedimentation in the river plains. With increased flow velocities of the river, particularly during floods, levees and embankments are susceptible to erosion as the soil particles can get transported more easily. At locations where there is more room for water to flow, as in larger flat flood plains, the flow velocities will reduce and the transported silt and sand particles will settle again. Generally, most erosion is in the upper and middle catchment areas, whereas sedimentation takes place in the lower catchment. It is estimated that about 100,000 m³ of sediment is being transported during an extreme flood event, which is approximately the same amount of sediment being transported annually without flood events [22]. Sedimentation results in a raised level of the riverbed and the floodplains (Figure 10). For most silted areas, this will increase the flood vulnerability because channels, bridges, culverts and other means of water conveyance will have a lower hydraulic capacity, which ultimately results in larger flood extents and flood levels.
Longitudinal profiles of the Msimbazi and Sinza Rivers

Longitudinal profiles of the Msimbazi river are shown in Figure 11. In the last 7 km the river flows from 10 meters above sea level (Vingunguti) to the sea outlet at Selander bridge. The gradient is steeper in the Kawawa Road Bridge–Jangwani Bridge section than in the Jangwani Bridge–Selander Bridge section. These topographical characteristics have important implications for erosion, transport and deposition of sediment (Volume B, Detailed Plan).
River functions

The Charrette stakeholder team, informed by scientific research, professional knowledge and community experience, established that the Msimbazi Basin could perform at least eight vital functions for the city of Dar es Salaam.

i. Discharge stormwater;
ii. Provide drinking and grey water;
iii. Offer space and suitable conditions for biodiversity rich coastal forest and mangrove vegetation;
iv. Provide safe and healthy locations for settlement along the edges of the river plains;
v. Include space for public and private infrastructure assets;
vi. Provide space for serviceable roads and bridges that cross the Msimbazi Basin as essential transport corridors;
vii. Offer lands for growing healthy food in the flood plains for the city population; and
viii. Provide public, open-access, spaces for sports and leisure activities.

Because the ecosystem is out of its natural equilibrium, the performance quality of the Msimbazi Basin on these functions is low. Restoring this equilibrium will significantly benefit the city and especially the vulnerable communities that make up most of the people living in the Msimbazi valleys and lower plains [23].

Seven main challenges

An analysis of the Msimbazi Basin informed by literature research, fieldwork and the Charrette process revealed the causes and effects of the floods and other interrelated challenges:

1. Urbanization and deforestation in the watershed area of the Msimbazi Basin
2. Soil erosion and increased sedimentation
3. Infrastructure barriers
4. Solid waste dumping
5. Inadequate storm water and sanitation infrastructure
6. Climate change effects
7. Vulnerable living environments
Figure 12: Rapid urbanisation in the catchment area and deforestation in the Pugu Hills

Figure 13: Urbanisation diminishes green space, which results in less rain water infiltration

Figure 14: Diminished water retaining vegetation in upstream area

Figure 15: Current condition of the Pugu Forest Reserve
1. **Urbanization pressure and forest exploitation.**

Human activities and especially deforestation and urbanization have diminished the natural water retention capabilities of the land in the Msimbazi Basin and this causes increased stormwater runoff (Figure 12 and Figure 13). This is the main reason why the rivers and streams that make up the river system experience increasingly frequent flooding. Tree cover in and around the Basin has drastically declined. Trees have been cut at alarming rates to clear land for agriculture, urban expansion and provide cooking fuel, leaving bushland which has just 10% of the rainwater infiltration and soil fixing capacity of a forest [24] (Figure 14). One study has found that over a 15-year period, closed forest canopy in Pugu and Kazimzumbwi Forest Reserves decreased by over a quarter (25% and 31%, respectively). Indeed, most of the forest cover in Pugu Forest Reserve has been lost; of the reserve’s 2,180 hectares less than 400 hectares can be considered true forest. Similarly, in the case of Kazimzumbwi Forest Reserve, only 900 hectares out of 4,887 can now be classified as actual forest [24]. Figure 16 illustrate the deforestation and associated land-use changes in the Kazimzumbwi and Pugu Forest Reserves.

![Figure 16: Land use changes in the Kazimzumbwi (top) and Pugu (bottom) Forest Reserves (Source: [25] Tanzania Forest Service)](image-url)
Figure 17: Soil erosion upstream

Figure 18: Increased sedimentation downstream

Figure 19: Sedimentation excavation

Figure 20: Sediment excavated from the river bed is placed on the river banks which is washed back again into the river channel in close distance down stream.
2. Soil erosion and increased sedimentation.
Slope erosion and bank erosion processes are common throughout the Msimbazi Basin. The steep gradient of the upper basin provides a major source of sediment supply and a temporary storage location until the next flood event. Meanwhile, sediment input from basin sides and floodplain areas is strongly influenced by the level of urbanization and land-use type, confining the channel in many parts of the basin.

The siltation of the river channels and floodplains in the lower reaches of the catchment has dramatically reduced the hydraulic capacity of the river. The river channels have become shallower and narrower, and the elevation of the floodplain has risen markedly. The build-up of sediment is particularly extreme underneath the bridges which intersect the valley. This hampers flood waters from discharging into the ocean, which causes serious inundation in the Lower Basin and contributes to increased flooding further upstream.

Erosion and sedimentation are integrally linked with the velocity of water flow. In areas where the flow is fastest (due to a steeper grade of the river bed and the absence of infrastructure such as bridges that might provide a damming effect), levees and embankments are prone to erosion. The sediment that has been eroded upstream is then deposited in locations where the velocity of the water is reduced. This occurs where the river’s gradient becomes less steep, or where there are bridges or other infrastructure, for example as in flat floodplains such as Jangwani or at the confluence of the Sinza and Msimbazi channels.

Sand mining practices aggravate erosion in the upper and middle valleys. This leads to higher sedimentation deposition in the Lower Basin area and contributes to changes in the river course. Increased susceptibility of the soil to erosion due to land use change is inextricably having effect on erosion and sedimentation processes downstream. In the Msimbazi catchment upstream conditions can quickly impact conditions downstream. Torrential downpours upstream cause flash floods downstream within 3 hours. Typically, rivers carry sediment at a moderate pace of a few kilometers per year; sediment travel in the Msimbazi is estimated to be in the order of 30 km per year, which suggests that impacts in the upper catchment can affect the entire river in just one or two years.

Sediment Excavation
TANROADS has led emergency sediment excavation operations near the Jangwani Bridge in advance of both the short rains (October-November) and long rains (March-May) on an annual basis since 2015. Experience has shown that excavated sediment from the river bed which is placed on the river banks is highly vulnerable to erosion; heavy rains have tended to wash it back into the river channel making these repetitive costly dredging works ineffective (Figure 19 and Figure 20).

In addition, the sediment deposits in the estuary affect the mangrove forest, as at high tide the sea cannot reach as far into the lagoon as in the past, and the area covered by mangrove forest (valuable for its water purification and biodiversity functions) has become smaller.
The heavy sedimentation of the Msimbazi river has resulted in burying the air roots of the mangroves and this “asphyxiation” negatively affects the health of the trees. High tide now intrudes only a few hundred meters from the sea (whereas in the past it reportedly reached as far as Jangwani bridge). Sediment has accumulated to a height that is above tidal levels; this means that much of the wetland area that borders the river channel remains dry even at high tide. The effect is that sea water no longer reaches the mangroves that are further inland, and large sections of the mangrove forest have died off (Figure 21 and Figure 22). Information on the health of the mangrove forest reserve is scant. Little is known about the number of species, the number of mangrove trees, and their vitality. Although protected by the 2002 Forest Act and the prohibition on cutting down the mangroves is diligently enforced, the mangrove protected area is not officially physically demarcated [26].

Figure 21: Decrease of mangroves; mapped from satellite data and drone images

Figure 22: Although protected the Mangrove forest is engulfed with sediment and waste
3. Infrastructure barriers

Most of the road crossings over the valley have relatively low and narrow bridge underpasses (e.g. box culverts) (Figure 23). Combined with blockages from solid waste and siltation, this creates insufficient hydraulic capacity during times of peak flow (Figure 24). Some of the crossings cause a damming effect during flood events, delaying water conveyance and sometimes creating backwater that causes a pooling effect and/or the passing of water above the bridge deck (Figure 25).

Infrastructure barriers, such as bridges, and sedimentation are linked in a negative feedback loop in which sedimentation narrows bridge openings, thus reducing the hydraulic capacity of the river. Conversely as this situation worsens, the bridge causes water flows to slow, thus increasing sedimentation.

4. Solid waste management

Solid waste management is a serious challenge throughout Dar es Salaam. Solid waste generation is increasing as the urban population grows. Total generation of solid waste is estimated at 1kg per person per day, which translates into more than 6,000 tons per day in 2015 for the city. That is equivalent to approximately 1.8 million tons per year [27]. Although an estimated 60-70% of waste is composed of organic materials [28] only nominal amounts are currently composted.
The City of Dar es Salaam lacks a waste water treatment plant. This represents an urgent need given the dangers to health and environment associated with inadequate treatment of sanitary waste. The Government of Tanzania has secured financing for the construction of two modern waste water treatment plants, one in Mbezi Beach (financed through the World Bank), and a second that is proposed for a location downstream from Jangwani Bridge and opposite the DART depot (financed through Ko-Exim Bank). The work on the necessary feasibility and design studies is ongoing. Initial plans for the Jangwani facility involve a 180,000 square meter site. The potential flood risk at the proposed site, and the compatibility with other existing and proposed land uses within the basin were intensively discussed during the Charrette process. A number of concerns were raised, including the issues of flood vulnerability and the possibility that additional infrastructure could contribute to even more severe flooding than already exists in the basin. Possible alternatives to this site were discussed and are now under consideration by DAWASA.
In the absence of a comprehensive solid waste management system, the bulk of waste is disposed of illegally. In 2012, only an estimated 37 percent of the total waste generated in Dar es Salaam was systematically collected and disposed of, while the balance was dumped on empty land, along roads, and/or into water bodies [29]. Communities within the Msimbazi Basin rely heavily on informal waste collectors. These individuals charge less than formal solid waste removal service providers, but they often dump waste illegally (Figure 27).

Community Clean Ups
There are grassroots efforts to address the waste problem. The civil society organisation Nipe Fagio has conducted community awareness-raising and cleanup events in various Mitaa within the Msimbazi Basin over the past five years, including various events in 2018 but much more needs to be done.

Flood waters transport the abundant solid waste downstream, where it gets trapped in bridge and culvert openings and mangrove tree roots. This waste accumulates together with sediments, leading to reduced flow capacity and flooding upstream of the roads and bridges and other manmade infrastructure barriers in the Msimbazi Basin (Figure 29).

The first four of the seven main challenges lead to a decreased conveyance capacity of the river, which is a major factor contributing to the intense and widespread flooding in the Lower Basin that affects lives, livelihoods and city assets.

5. Storm water and sanitation infrastructure
Dar es Salaam has a very limited stormwater drainage system. Amongst the roadside drains that do exist, more than 50% are in poor condition, and many are blocked by solid waste and siltation. Infrastructure networks and systems for managing sanitary waste are also extremely limited. Only 13% of the city’s population has access to sewerage services. The remaining 87% use on-site sanitation systems, primarily pit latrines (Dar es Salaam Region Socio-Economic Profile, 2012). Many households in unserved areas connect their toilets to stormwater drains, further exacerbating the area’s drainage problems.

Informal methods for disposal of sanitary waste contribute to the severe contamination of flood waters. Interviews with sanitation-focused NGOs and businesses confirm that illegal discharge into rivers and wetlands is common. Another common emptying method is the intentional flooding or unplugging of latrines during heavy rains, which flushes waste out of the pit and into neighborhoods and water courses.

Decentralized Fecal Sludge Management
The Bremen Overseas Research and Development Association (BORDA) has built a fecal sludge treatment site and is establishing a low cost latrine emptying service with localized wastewater treatment that can manage up to 10 m3 of fecal sludge a day in Mburahati Mtaa. The aim is to provide improved wastewater management and reduce the pollution of illegal pit emptying for Mburahati and surrounding Mitaa.

Especially in dry season, when the Msimbazi has low flows, the water is highly contaminated. “Industrial pollution and wastewater have destroyed a freshwater ecosystem - substantial sections of the river are now incapable of supporting fish populations that had been present until recent years”[30].

Decreased Conveyance
A Dry River

As Dar es Salaam’s urbanization advances and its natural vegetation is converted into impervious surfaces such as roofs and pavement, natural infiltration has diminished and rivers are lacking the water that once recharged them and kept them running year-round. The Msimbazi is reported to be one of seven rivers originating in Pugu and Kazimzumbwi forests which were perennial during 1975 but which have since dried up and become only seasonal. At some points of the year, the only water in the river is industrial discharge and household waste water; upstream sections are completely dry, while downstream sections have low levels of visibly polluted water. Restoration of a continual flow of water is critical to the health of the rivers’ human users and to downstream wetland and mangrove ecosystems. The elimination of pollution will be a long-term effort, and dilution is the only immediate treatment for the river’s high levels of toxicity before wastewater collection and treatment are available.

Urban Heat Stress: A Growing Threat

The average maximum duration of heat waves in Dar es Salaam is predicted to increase from 6 to 16 days by 2050. The events of 5 days of lasting heat could increase from 3 to 24 times in 2050. The amount of 2-week hot weather events will double over the same period. Expert advice is to develop strategies for mitigating heat waves effects to enhance the resilience of the population [36].

Figure 31: Series of sources of river pollution; (left to right) Waste in gutters, open sewerage, chemicals from (textile) factories and polluted residues from flooded stabilization ponds in the area

Figure 32: Community adaptation measures to chronic flooding include construction of retaining walls (Source: TACINE, 2014)

Figure 33: Reinforcing eroded creek banks with sandbags (Source: TACINE, 2014)
Analysis [31] of the river water quality found that the most polluted stretches of the Msimbazi downstream from Vingunguti and its tributaries had:

- pH as high as 12 (compared to the legal standard of 8.5), a level which causes severe burns to skin
- Chromium (VI) at 75 times the legal limit for waste water discharges (chromium VI is very toxic, causing cancer and birth defects with long term exposure)
- Indicators of disease-causing fecal contamination which exceed the World Health Organization limits for safe use of waste-water in agriculture.

The sources of river pollution include municipal wastewater stabilization ponds at Vingunguti, textile and other industries [32], abattoirs, leachate from former dump sites [33], sewers and drainage from houses near the riverbanks which are channeled directly into the river, pit latrines which leach waste or which overflow during rains, transportation runoff (oil and petrol), agricultural runoff (pesticides, fertilizers), and solid waste dumped directly into river (Figure 31). Poor water quality is a health concern all through the year. Hundreds of farmers grow leafy greens and other vegetables in the river basin, and garden plots are irrigated with water from shallow wells. The vegetables are sold in bulk to middle men who distribute the produce throughout Dar es Salaam [34].

6. Climate change effects

Main climate change parameters that have the potential to impact on the living conditions in the Msimbazi Basin are: i) changes in rainfall characteristics and ii) changes in temperature. Changes in sea level rise will have no significant impact for the Msimbazi Basin. The information available on these factors comes from research done in the period 2011-2015 [35]. Generally, it is expected that the extremes will be more extreme and more frequent, which for the Msimbazi catchment area can result in dryer dry periods and wetter rainy seasons (and in particular more intense rainfall events). This in turn results in smaller baseflows of the rivers during the dry seasons and further aggravates the frequency and severity of the water rushes and more floods.

7. Vulnerable living environments

The nature and pattern of flooding has changed dramatically over the past two decades, as has the pattern of human settlement. Development in earlier decades was in more elevated areas which were not so prone to flooding, but construction in recent years is concentrating in areas that are very low-lying, some of which exhibit wetland characteristics year-round. The combination of high-risk settlements with extremely dynamic river morphology puts thousands of lives at immediate risk.

In the face of regular flooding, Msimbazi area residents find household-level solutions to strengthen their own resilience. Residents in flood-prone areas are well-versed in how to live with annual cycles of flooding and have developed their own informal adaptive measures. Examples include physical modifications like retaining walls, raising foundations, or temporarily migrating until floods recede [37]. Generally, evacuation is considered a measure of last resort.
This project utilises the concept of vulnerability as it relates to flooding and uses a multi-layered information approach. A conceptual vulnerability equation, which is generally used in environmental hazard assessments, forms the basis of the information model. Hazards are hazardous hydraulic conditions like inundation depths, inundation periods and increased flow velocities. Exposure can be understood to include people, flora, fauna, and various assets that may be exposed to flooding. The product of hazards and exposure reveals the vulnerability to flooding.
Through the Charrette process, in combination with spatial analysis and numerical flood simulations, it became evident that the main vulnerabilities are:

1) Injuries and loss of lives, damage to houses and personal belongings, and interruptions in income earning activities (livelihood losses) as a result of flooding. The areas are characterized largely by informal, unplanned and informal human settlements and small businesses that dwell in the flood plains or on the slopes of the river valleys;

2) Damage to infrastructure assets and interruptions in urban mobility/connectivity because of flooding of the bridges that cross the river valley and public infrastructure built in the flood plain [38];

3) Damage to ecosystem-services and loss of biodiversity because the sediments transported by the floods deposit in the Lower Basin silt up the mangrove forest and natural wetlands.

Comprehensive information on the cost to society (economic value) of these damages has not been collected for this MSMF. However, studies show that average annual costs of flooding in urban settings can be considerable [39,40]. Recent World Bank studies highlight the economic impact that such events have on the city with a modelled Expected Annual Loss of USD 47.3 million in the Msimbazi Basin alone [41]. A complementary strategic assessment of the climate resilience of the city’s transport infrastructure estimates that reconstruction costs per event are between USD 5.5 to USD 6.1 million. In addition, freight delays are shown to have an estimated financial impact of between USD 200,000 to over USD 400,000 to carriers, depending on the intensity of the rainfall event. Ancillary indirect costs also include a backlog of freight movements affecting marine transport, storage fees, and reliability of inventory.

About 5% of the buildings in the Msimbazi Lower Basin are vulnerable in the sense that they have experienced riverine flooding at least once since 2011. The illustration (Figure 34) shows a maximum flood extent based on surveys conducted by Ramani Huria [42] and flood simulation modelling [43, 44, 45]. The percentage of buildings that are vulnerable to flooding is even higher, up to 10%, when the buildings affected by pluvial flooding are also counted. Jangwani, Mchikichini, Magomeni, Kigogo and Vingunguti wards (respectively labelled 1,2,3,4 and 5 in the figure) have the largest percentages of affected buildings; exceeding 30% of the total number of buildings in the ward.

In the Lower Basin, the bridge most vulnerable to flooding is the Jangwani Bridge on Morogoro Road. During extreme events the bridge and the road are often blocked during and after flash flood events, interrupting transport by cutting the main connection between Dar es Salaam’s City Centre and the city’s outskirts. Other heavily affected bridges are the Kawawa Road Bridge and the Nelson Mandela Road Bridge which both cross the Msimbazi River, and Mkwajuni Bridge which crosses the Sinza River tributary main channel.

**Vulnerable assets**

Constructed assets within and around the valley include the city’s transport network, health facilities, housing and businesses (Figure 35). In the Msimbazi Basin dozens of bridges and culverts cross the river’s main channel and its tributaries. Both of Dar es Salaam’s two ring roads cross the valley in multiple locations. Morogoro Road, one of four trunk roads connecting the city’s Central Business District to its periphery, crosses the river at the Jangwani wetlands. Another of the city’s four main transport arteries, Ali Hassan Mwinyi Road, crosses the
There is evidence that emergency action by the community is triggered when rain water reaches knee-height (50 cm) and it is still raining [46]. Flood depth mapping was done based on household surveys by the urban mapping project, Ramani Huria. Significant parts of the flood prone areas have experienced flood depths of more than 50 cm more than once. This has a significant impact on safety of the community. Generally, evacuation is considered a measure of last resort. Before evacuation is required, residents take precautions to protect their property, for example by tying possessions to the ceiling, putting possessions on the roof, or placing sandbags in front of the doors. Community clean ups and unblocking of drains ahead of the rains are common measures that help to reduce flood impact at the community level. The study shows that the communities are already building up levels of resilience to the circumstances, which does not take away the fact that these circumstances are extremely hazardous.

Community Vulnerability and Resilience

Figure 37: Community vulnerability and resilience map (Source: Ramani Huria project by HOT (Humanitarian OpenStreetMap Team)
Msimbazi. The Dar es Salaam Area Rapid Transit bus depot, which provides parking and maintenance facilities for the fleet of 140 busses, is located just upstream of Morogoro Road. Muhimbili National Hospital is mainly located on high ground which is not within the river’s flood plain, but the property’s steep embankment has experienced severe erosion, which threatens some of the hospital’s facilities.

**Community vulnerability and resilience**

Information on vulnerability and resilience of communities affected by the Msimbazi floods is available from research reports [47], as well as the preliminary results of a household survey. Additional information on community resilience specific to the Lower Basin was collected with a narrative-based survey of 180 community members. The community narratives showed that most people who have experienced flooding would like to relocate but cannot afford to do so. Moreover, 35% would like to stay within their Mtaa neighborhood because they value the Msimbazi Lower Basin location for its proximity to the city center, hospital and other conveniences [48].

Disaster preparedness, early warning and emergency evacuation plans

Flooding in the Msimbazi Basin is characterized by a very short response time between the rainfall event and the subsequent floods, giving affected communities and businesses little response time. Some actions have proven effective to reduce community vulnerability. With support from TURP the Early Warning System is being improved and capacity building has started for disaster risk management, disaster response plans and emergency evacuation plans, with coordination at Mtaa level.
Figure 39: Map of the Special Planning Area (green area) within the Msimbazi catchment (location of M18, map Figure 38, marked in dotted line)
The Msimbazi River serves as, or cuts across, the border of several municipalities and wards, posing cross-boundary governance challenges. In addition, there are numerous institutions with mandates on specific issues in the river valley. The TFS manages the forest reserves and the mangroves but MLHHS D has authority over land and development. WRBWO manages water resources but NEMC and MOWI also have regulatory authority over specific water issues. Still, others, such as TANROADS, TARURA and DART own and/or manage infrastructure within the valley.

The institutional framework for the Msimbazi Basin is complex but uncoordinated. It lacks clear delineations of the responsibilities of each stakeholder and there is no clear authority to coordinate complex issues.

Civil society has been active to some degree, with community clean ups and behavioral change campaigns. Community members have also organized themselves as “M-18”, a federation of eighteen settlements in the Msimbazi Lower Basin that acts as an advocacy group on behalf of communities (Figure 38).

Land ownership in the valley is another complicating factor. Although the Msimbazi floodplain was designated as a hazard land in past master plans (1949, 1968, 1979), land has been purchased both informally and formally. According to MLHHS D, there are also plots within the valley that have been surveyed and allocated to developers.

Figure 38: Administrative boundaries
Figure 40: Map of flood depth at 60 hours of a T10yr event in existing situation

Figure 41: Principle of storm water conveyance and retention areas

Figure 42: Principle of implementing conveyance interventions working from down to upstream
During the Charrette process a hydraulic flood model was used to simulate extreme flood events and to test mitigation measures on effectiveness. This model is elaborated in Volume B.

The flood modeling work gives a clear result:

- It is evident that the hydraulic capacity of the river is not adequate to accommodate the entire water volume during extreme rainfall of a T10yr event (Figure 40) or more extreme. River crossings for rail and road infrastructure have a damming effect for the free flow of river water during extreme events. Most of these crossings are built with closed flood plain crossing bridge approaches (e.g. bunds) and these structures have relatively small bridge underpasses. This results in an insufficient hydraulic capacity for the river, leading to flooding during peak flows.

- Sedimentation of the river channels and floodplains, mainly in the lower reaches of the catchment, reduces the hydraulic capacity underneath the bridges even more and silt deposits in the flood plains between Selander Bridge and Jangwani Bridge hamper the discharge of the flood waters into the ocean. This causes serious inundation in the Lower Basin and backwater effects that contribute to increased flooding further upstream.

Two main principles were established by the Charrette process and the flood modelling work, which shape the interventions defined in the Msimbazi Strategy Development Framework:

- In the Lower Basin and lower tributaries, the focus of the interventions should be on storm water conveyance; whereas in the middle and upper reaches of the catchment the focus should be on (rain) water retention. (Figure 41)

- The interventions to increase the conveyance capacity should be implemented sequentially from downstream to upstream. Here the basic idea is to tackle bottlenecks structurally to have maximum impact and not leave significant bottlenecks untouched downstream. (Figure 42)

A main finding of the flood analysis is that there is a need for a larger main channel and more flow area in the floodplain than the area currently provides. The modelling results show that the optimal combination of structural engineering measures, such as sedimentation removal in river channels and bridge widening, would significantly reduce flood risk. To enable a comparison of the effects of different interventions, simulations were run using rainfall data from the severe flood event of October 2017 (a T10yr event).

The modeling shows through the implementation of the assessed measures, the extent of flooding is reduced and, in areas that still get flooded, inundation depths are significantly reduced below a critical threshold of 50 centimeters in the case of a T10yr rain event. Importantly, however, the modeling also shows that during a heavier T100yr event, the basin will be flooded with inundation depths exceeding the 50 centimeters in most areas even with the interventions.

This demonstrates that the basin still requires sufficient space to flood during severe rainfall events which further emphasizes the relevance of the design concept of a robust floodplain with space for wetlands and constructed terraces to guide the water at peak flow. The Detailed Plan of the Lower Basin further elaborates on this and integrates these findings in the overall design.
Volume A: Strategy and Management Framework
The Strategy and Management Framework
Acceptance
“Focus on getting people out of harm’s way.”

Main theme
Resilient Communities

Protection
“Technical measures to protect people and assets.”

Main themes
Mangrove Forest & Wetlands
Flood Reduction Interventions

Integration
“Reshaping the valley to achieve a place for human activities.”

Main themes
Waste Management
Water & Sanitation
Land Use Planning

Interventions in the valley are limited, only flood prone assets are taken out.
Interventions in the valley concentrate on conveyance of the river, protect all other areas against flood and secure infrastructure.
Interventions in the valley integrate all aspects and make the valley a pleasant place with room for the river, new safe edges and additional uses of the valley space when the river is low.

Figure 43: Diagrams to explore three development directions
The Msimbazi Strategy and Management Framework (MSMF) presented in this chapter was the first main output of the Msimbazi design Charrette process. The Detailed Plan for the Msimbazi Lower Basin is the second output and is presented in Volume B.

The MSMF was designed in a series of meetings or Charrettes. In their first meeting the stakeholder team analyzed the situation and gained an understanding of the complexity of flood protection and environmental restoration challenges. During the second meeting, three development directions were explored: (i) Accepting the situation, moving people out of danger and protecting key infrastructure; (ii) Aiming for optimal flood protection by structural (engineering) and non-structural interventions; and (iii) Integrating flood risk reduction with urban and environmental functions in and around a city park (Figure 43). The insight gained from this exercise was that the Acceptance and Protection development directions offered no real solutions, while an integration approach around a city park concept offered opportunities which seemed attractive from a social, technical, and financial perspective.

This chapter of the MSMF sets out the Msimbazi Opportunity as seen by the stakeholders and describes the four priority strategies: Mitigate, Protect, Transform and Govern. These four priority strategies comprise ten Strategy Components (SCs). Each SC is described in terms of a specific objective and interventions. Together the strategies and interventions make up a road map for the realization of the Msimbazi Opportunity.
The lungs of the city

“The lungs of the city” include:

i. The Pugu and Kazimzumbwi natural forest reserves;
ii. The wooded areas in the upper & middle valleys alongside the riverbanks;
iii. The Mangrove forest and wetlands between Hananasifu and Upanga.

Extending the surface area and quality of these eco-system elements will help Dar es Salaam become a resilient city. These interventions will: (i) improve the water retention capacity in the catchment area and help reduce vulnerability to flooding; (ii) increase carbon capture and mitigate climate change; and (iii) help the city adapt to global warming by developing a cool corridor in the city center.

Opportunities for the Basin

To reduce vulnerability of people and assets, two types of interventions will be needed simultaneously.

Flood hazard reduction interventions: Reducing river hazards such as inundation depth and inundation period by adjusting the river dynamics. For example:

- Removing siltation and creating room for the river;
- Reforesting Pugu hills;
- Constructing large water reservoirs and rain water harvesting systems for buildings;
- Reducing solid waste dumping from households and industries.

Flood protection interventions: Making sure that people and assets are less affected by floods. This could be based on predetermined safety levels. For example:

- Creating protective structures like dikes & flood walls;
- Raising and widening bridges;
- Raising the terrain (terrace building parallel to the river);
- Implementing early warning systems and disaster reduction planning;
- Resettling of people out of harm’s way.
Transforming the Msimbazi Basin into a beacon of urban resilience

- From a hazardous area for people to the green heart and lungs of the city;
- From a flood hazard area to an iconic city park surrounded by prime real estate for urban development;
- From a liability to an asset for Dar es Salaam.

The heart of the city

“The heart of the city” includes:

i. An iconic City Park bordering the business center;
ii. Other parks further upstream.

The Lower Basin between Selander Bridge and Kawawa Road becomes the location of a multi-functional City Park of 400 hectares with three activity zones: (i) The river zone is a flood plain that caters for large volumes of water during peak flows after heavy rainfall events but in a controlled and non-hazardous way; (ii) The river plain is also a natural reserve of wetlands and mangrove forests, rich in biodiversity; and (iii) The terraced zone comprised of a first level used for sports and leisure activities but that can accommodate occasional flooding, and a second terrace and valley edge surrounding Lower Basin that are safe from the riverine flood hazard. This is the location of 57 hectares of real estate for mixed urban functions including social housing, social amenities, offices and commercial real estate.

Main opportunities for the Lower Basin

**Climate Change Adaptation:** The Mangrove and Wetlands Park will provide a green lung for the city of Dar es Salaam and help reduce the heat stress in the surrounding areas by lowering the average temperature.

**City Park Development:** The Lower Basin (4km2) will provide space for leisure, sports, festival areas, and nature trails.

**Urban Development:** 57 hectares of new flood protected land offers sufficient scope for resettlement of vulnerable communities who will have to relocate for flood protection related interventions. With this new urban space, a mix of social and middleclass housing, and commercial activities can provide the business cases to support the feasibility of the program.

**Biodiversity and Ecosystem-services:** The plan envisages an extension of the mangrove forest further inland as well as on the seaside of Selander Bridge. The high carbon capture and storage abilities of growing mangroves will contribute to the resilience of the city. Furthermore, a healthy mangrove environment will attract wildlife, and over time could develop into a visitor attraction.
Strategy № 1: Mitigate

A central challenge facing Dar es Salaam is mitigating the severity of the flood events in the Lower Basin within the context of rapid urbanization and increasing climate variability. The Mitigate Strategy comprises four Strategy Components (SCs) to reduce flood hazards in the long and short term.

SC № 1. Restore the natural ecosystem and make room for the river
SC № 2. Increase water retention and harvest rain water
SC № 3. Control erosion and sedimentation
SC № 4. Enhance water conveyance capacity

Strategy № 2: Protect

To reduce flooding to acceptable levels (inundation <50 cm in T100yr) the Protect Strategy focusses on location-specific protection of people, livelihoods and assets from flood exposure. Where this is not feasible, the affected people and small businesses will be safely relocated. Such processes will be supported by Resettlement Action Plans with Livelihood Restoration Programs in line with international best practices. The Protect Strategy comprises two SC’s to protect against flood and resettle people and businesses to safe locations.

SC № 5. Protect against flooding
SC № 6. Resettle people and businesses
The stakeholders designed four strategies to re-envision the Msimbazi: **Mitigate, Protect, Transform and Govern.** The Mitigate Strategy aims to reduce flood hazard, the Protect Strategy aims to reduce the exposure of people and assets to the flood hazard, these two mutually reinforcing strategies seek to address existing levels of vulnerability to flooding. The Transform Strategy aims to convert the most flood-prone areas of the river valley into a City Park and redevelop surrounding neighborhoods. The Govern Strategy aims to stop the uncontrolled urbanization that results in increased flooding, and to put in place a planned and coordinated process for urban development and eco-system restoration in the Msimbazi catchment.

### Strategy № 3: Transform

The Transform Strategy aims to convert the most flood-prone areas of the river valley into a City Park and redevelop surrounding neighborhoods. This, moreover, involves cleaning up wastewater discharge (household and industrial) and solid waste that currently pollute the river. The Transform Strategy comprises three SCs which collectively will bring important changes to the urban fabric.

- SC № 7: Improve Msimbazi river water quality
- SC № 8: Improve solid waste management
- SC № 9: Develop city parks

### Strategy № 4: Govern

The Govern Strategy seeks to put in place a planned and coordinated process of integrated governance and to stop the uncontrolled urbanization process that is making the river valleys and basin unsafe and unhealthy for human activity. A new authority is needed with a mandate for stakeholder coordination, cooperation and communication to ensure that the program of interventions covered by the MSMF and Detailed Plan for the Lower Basin are aligned and implemented in a planned and synchronized manner. This “Govern Strategy” comprises one SC.

- SC № 10: Good governance for coordination, cooperation, communication and finance

Taken together the ten Strategy Components provide the framework for a multi-annual program and action plan for realizing the Msimbazi Opportunity in a phased implementation process.
Strategy Components for № 1: Mitigate

SC № 1. Restore the natural ecosystem and make room for the river
SC № 2. Increase water retention capacity and harvest rain water
SC № 3. Control erosion and sedimentation
SC № 4. Enhance water conveyance capacity
3.4.1 Strategy № 1: Mitigate

The Mitigate vision

The Msimbazi river system and valleys are the green heart and lungs of Dar es Salaam. The degradation of the water infiltration and retention capacity of the natural ecosystem will be stopped and to some extent reversed in the longer term by: (i) reforestation and rehabilitation of the Pugu-Kazimzumbwi nature reserves; (ii) resilient land use management; and (iii) preservation and extension of the mangrove forest and wetlands in the river plains of the Lower Basin. In the short-term, positive effects on peak flow and flood hazard management will result from the water retention structures, erosion control and sand mining, and engineering works that increase conveyance capacity.
Figure 45: Map with Interventions of Strategy Component №1

Figure 46: SC1.1: Examples of indigenous trees from Pugu Forest Reserve that need to be reintroduced; Pod Mahogany (Afzelia Quanzensis), Sycomore Fig (Ficus sycomorus) and Rock Elm (Milicia excelsa)

Balance Housing and Green space

New housing permits should favor apartments over stand-alone houses to cope with housing demand; each housing development or commercial development should invest in rain water harvesting and green spaces to increase the rain water retention capacity in the area.

“Make it a precondition for land lease and licensing in the upper & middle catchment area that new human activities are only allowed if there is evidence, for example EIAs, that they do not have a negative impact on the retention capacity of the soil and water run-off coefficient” (Charrette participant)
Restore the natural ecosystem and make room for the river

Situation analysis
Forests and wetlands where rainwater infiltrates into the groundwater aquifers have become severely degraded during the urbanization process in the Msimbazi catchment area. Rainwater absorption is now limited and the excess water drains into the Msimbazi river and tributaries, increasing the quantity of water that must be conveyed to the river’s outlet. Flashfloods tend to occur when previous rainfall has saturated the land in the catchment area and new rainfall directly runs off to the river. This results in the water level of the river increasing very rapidly, causing the onset of flooding in the Lower Basin within three hours after upstream rainfall events [49]. To manage the flood inundation areas and inundation depths, peak flows must be reduced.

Objective
The aim of SC1 is to initiate policies, programs and projects which will; (i) stop further degradation of the natural river eco-system; (ii) rehabilitate and enhance the natural qualities of the river, forests, wetlands and landscape in the Msimbazi catchment area; and (iii) strengthen the climate change mitigation dimensions of Dar es Salaam. Four interventions are proposed.

Interventions

SC1.1 Reforestation and rehabilitation
Preserve and grow the natural forests in the upper valleys through: (i) reforestation of the Pugu and Kazimzumbwi Forest Reserves; (ii) rehabilitation and stabilization of forest reserve slopes; and (iii) creating new wooded areas in the valleys of the upper catchment area (Figure 46). The Tanzania Forest Service (TFS) with support from the Program Implementation Unit (PIU) will lead on this intervention. This intervention represents a long-term (10yr) program and will require substantial funding for tree nurseries, research, capacity building of the TFS in reforestation and slope protection against erosion. In addition communication campaigns will be required to reach local populations. As will the introduction of buffer zones around the reserves to protect the trees from being felled to make room for housing developments or charcoal production or the conversion of forested areas into agricultural lands.

SC1.2 Land use planning, communication and enforcement
Reinforce existing regulations and develop new land use management laws/regulations/guidelines which strengthen land use planning as a tool for aligning further urbanization with flood hazard mitigation. The aim is to stop and reverse the loss of the rain water infiltration/retention capacity of the catchment area caused by the unplanned process of urbanization in the upper and middle catchment areas. The task is to mainstream flood resilience through improving rain water retention in: (i) all land use planning decisions – both at master plan level and at operational level of permits for housing developments; and in (ii) the practices in the building sector. To accomplish these outcomes, collaboration between the National Land Use Commission, the Ministry of Land, Housing and Human Settlement Development (MLHHSD) and the Ministry of Water and Irrigation (MOWI) will be required as well as TA support to change current practices.
The mangrove forest and the salt- and freshwater wetlands in the Lower Basin perform essential functions:

- The high vegetation productivity as well as the carbon capture and storage capacity of a growing mangrove forest is an asset for action on climate change mitigation.
- The cooling effect of the tree canopy reduces heat stress (climate change adaptation).
- Mangroves are important feeding grounds and nurseries for ecologically important crab, prawns and other shellfish, and contribute to defending against shoreline erosion.
- Through the action of its roots, the mangrove forest recycles nutrients and traps land-based debris, sediments, and suspended particulate matter carried to the coast by the Msimbazi River.
SC1.3 Wetlands rehabilitation

Make more room for the river. Wetlands are natural areas for groundwater infiltration and water storage for release in the dry season. In the Msimbazi the wetlands are degraded by solid waste dumping from various parts of the city and by sprawling unplanned settlements. This intervention makes room for the river by removing buildings and other structures from the areas prone to inundation from river flooding and seeks to restore saline and fresh water wetland zones in the Msimbazi Special Planning Area (Figure 47). Saline wetlands can cover the major river plain area between Selander bridge and Jangwani bridge. Upstream from Jangwani bridge fresh water wetlands can be developed. This includes the former Vingunguti Wetlands in Ilala, which were gradually filled up with solid waste. The responsible authorities (MOWI, MNRT, WRBWO) will need to develop new expertise including wetlands research and monitoring capacity. The PIU will support this.

SC1.4 Mangrove forest restoration and expansion

Manage, protect and expand the Mangrove forest between Selander Bridge and Jangwani Bridge. To improve the habitat for mangrove pioneers upstream, the natural tidal flows needs to penetrate further into the Lower Basin. This requires dredging works for a wider and deeper channel (see also SC4.1). This dredging will necessitate the removal of certain segments of mangrove trees. Downstream the forest can also expand if the protected area (no tree felling) is extended to the ocean side of Selander Bridge, which is part of the natural habitat for the mangroves. To start this intervention, a mangrove health survey is needed, as well as expert advice on the best possible technology for removing excessive sediment from the aerial roots of the mangroves during the dredging works.

These interventions collectively focus on increasing rain water infiltration and absorption capacity in the watershed area so that more rain can fall before the land is saturated. Important positive side effects are richer biodiversity and a cooling corridor in the heart of Dar es Salaam. As part of the interventions more resources for research and monitoring of the forests and wetlands development will be needed.

• 5% of the catchment area (1400 ha) is replanted and/or rehabilitated with indigenous trees including the forest reserves.
• 1000 ha increase in the Pugu-Kazimzumbwi forest reserves from 1300 hectares today to 2300 ha.
• 400 ha of indigenous trees planted in areas in the middle and Lower Basin where the soils have the potential for infiltration and retaining more water before saturation.
• Building regulations and permits are made “flood resilient” and contain provisions for rain water harvesting, wooded area (the number of trees and species) to be planted, soil erosion control and sanitation and stormwater drainage.
• 100 ha of wetlands are restored with saline wetlands in the Lower Basin (high water line) and freshwater wetlands further upstream including the Vingunguti area.
• The increased forest cover and wetlands in the Lower Basin provides cool areas where people find relief from heat stress.
Outcomes 2019-2030

- Build 1 million m³ storm water storage capacity with ponds and reservoirs.
- Build 0.5 million m³ rain water collection & storage capacity for household level consumption (grey water) as part of the building permits for the house owners in the catchment area.
- Peak flows are reduced by 10% by the combination of reforestation, storm water storage and rain harvesting.

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SC2.1 Stormwater retention ponds and reservoirs
SC2.2 Local rain water harvesting
SC2.3 Local infiltration and retention
Increase water retention capacity and harvest rain water

Situation analysis
Urbanization pressure has overtime reduced water retention capacity of the Msimbazi catchment. There is less infiltration of rainwater and there are very few water retention structures such as lakes, reservoirs, or ponds. Rain water harvesting (roof collector systems) is not yet widespread. Consequently, the water run-off rate is high and this contributes to greater peak flows and flood hazard in the Msimbazi Basin.

Objective
The aim of SC 2 is to reduce peak flows by interventions that increase the direct water storage/retention capacity in the catchment area. The advantage of water retention is two-fold; peak flows are reduced while water availability for household uses will increase. Three interventions are proposed.

Interventions

SC2.1 Stormwater retention ponds and reservoirs
Implement retention schemes in the upper and middle reaches of the Msimbazi River to support peak flow reduction. Rain water retention structures can range from a low dam across the river, which overflows after it has been filled up, to full sized reservoirs with regulating structures in Kinyerezi and Sukita (Figure 50 and Figure 51). As large amounts of sediment are carried by the river, reservoirs in combination with sediment traps/and sand mining can be used.

SC2.2 Local rain water harvesting
Install rainwater collector barrels in the houses and other buildings in the Msimbazi catchment area (Figure 52). Such barrels/water tanks are locally available and could be manufactured from recycled plastic waste material, collected from the river corridor (a small business case option). The provision of barrels in exchange for waste plastic collection if organized at community level could provide a needed incentive for clean-up. This approach would allow households/buildings to use collected water when needed (short-term storage), and to contribute to reducing peak flows.

SC2.3 Local infiltration and retention
Promote local infiltration technologies in the building sector. For example, replacing hard or otherwise impervious surfaces with water permeable surfaces and providing small ponds in the flood plain could provide water for irrigation during the dry season (Figure 54).

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4 The annual rainfall in the Msimbazi averages 1000 mm per year. This amounts to 271 million m3 in the catchment area. During a T10yr rainfall event the amount of rain exceeds 100 mm in 24 hours, which accounts for ten percent of the annual rainfall. This compares with the annual water needs of 0.8 million people.
SC3.1: River monitoring
SC3.2: Sediment traps and controlled sand mining
SC3.3: Maintenance dredging depots
SC3.4: Terrace building with dredged materials
SC3.5: Vegetation for floodplains and river banks
SC3.6: Hazard profiling and zoning

Figure 55: Map with Interventions of Strategy Component №3

Figure 56: SC3.2: Principle for a sediment trap in longitudinal section

Figure 57: Reference images of amphibious excavators and backhoe
Control erosion and sedimentation

Situation analysis
Due to deforestation, mining activities (kaolin and sand) and encroachment on the floodplain, the Msimbazi River carries a huge quantity of sediment which exceeds the natural capacity of the river to deposit the sediment into the sea. This has led to the development of an unbalanced river system in which the sediment deposits in the Lower Basin raises the river bed, reduces the width and height of bridge and culvert openings and thus becomes a major contributing factor to increased flood hazard.

Objective
The aim of SC 3 is to remove sediment by dredging and sand mining. Transport of sediment is highly dependent on flow intensity. By reducing the flow intensity and flow duration through the interventions under SC № 1&2, an improved river equilibrium can be achieved in the long term. For the short-term the removal of sediment is essential. Six interventions are proposed.

Interventions

SC3.1 River monitoring
To address the lack of river specific data, it is recommended that a river monitoring program be established. This program would measure river discharge rates and water levels in combination with rainfall. In addition, monitoring the river bed and flood plain levels and quantifying erosion and sedimentation processes would be important to reveal emerging patterns/trends. The information gained would help establish permissible targets for sand mining. It would also develop new knowledge about the morphology of the river and how to keep the dredged river channels open and stable.

SC3.2 Sediment traps and controlled sand mining
Use sand mining to remove sediment from the river system (Figure 56). From a morphological as well as operational efficiency point of view, the installation of designated sediment traps is recommended in the upper and middle reaches, for example, near Sukita and Vingunguti. It is essential that sand mining is controlled, and the quantities are aligned with the ‘sediment demand’ of the river. Sand mining becomes counterproductive if it is done near river banks, which makes them unstable and can cause further erosion.

SC3.3 Maintenance dredging
Start an annual dredging program to remove the current surplus of sediment in the Msimbazi River. The annual quantities are provisionally estimated at 200,000-300,000 m³ annually. In the longer term (e.g. 10 years) these volumes are expected to decrease as a result of the proposed sediment management interventions. During the 5-year construction period of the Detailed Plan, maintenance dredging will be part of the civil works contract (Figure 57).
Figure 58: SC3.4: At location where currently floods occur (a) cut and fill of dredged (and cleaned) sediment from the river channel capital dredging and maintenance is used to build the terraces (b)

Figure 59: SC3.5: Geotextile reinforcement of the embankment

Figure 60: SC3.5: Vetiver grass; with deep roots and shallow slopes will form a stable environmental condition

Figure 61: SC3.5: Reference to construction of a layered embankment with concrete mattresses, soil and grass, to further enable vegetation growth
**SC3.4 Terrace building with dredged materials**
Reuse the sediment yield from capital and maintenance dredging as material required for the construction of the terraces and landscaping of the City Park and other river training measures, such as streamlining and reinforcing banks in specific areas, or constructing additional levees (Figure 58). The Detailed Plan provides more detail.

**SC3.5 Vegetation for floodplains and river banks**
Plant appropriate vegetation on the river banks and in the flood plains to mitigate erosion and promote a more stable main channel cross section (Figure 59 and Figure 60). This requires lining the banks with trees and sowing grass seeds on the lower and middle level terraces once they have been constructed (Figure 61). The Detailed Plan elaborates further on the types of vegetation suitable for the different terrace levels.

**SC3.6 Hazard profiling and zoning**
Develop flood hazard and erosion hazard profiles and detailed zoning plans to regulate human activities for the Msimbazi Special Planning Area in the upper, middle and lower reaches. The hazards include flood risks, land losses, and risks of collapsing buildings near the valley edge. Such plans can complement existing land use regulations (SC1.2).

- Sand mining operations in silt traps can be developed in Sukita and Vingunguti, as part of the annual dredging contracts.
- Maintenance dredging provides 200,000-300,000 m³ of sand. This is used in the construction of the terraces and for sale to the building industry in Dar es Salaam in later years.
- At least 90% of the sand needed for terrace building in the Msimbazi Lower basin is available from capital dredging, maintenance dredging and sand mining during the five-year construction period of the City Park.
- The annual river erosion monitoring survey shows that the management of sand mining, bank erosion and removal of sediment deposits has the desired effects.
SC4.1: Dredging between Selander Bridge and Jangwani Bridge
SC4.2: Dredging between Jangwani bridge and Kawawa Road
SC4.3: Enlarging of bridge openings
SC4.4: Reconstructing Jangwani Bridge
SC4.5: Removing obstacles from the flood plain
SC4.6: Securing Bus Rapid Transit assets

Figure 62: Map with Interventions of Strategy Component №4

Figure 63: SC4.1: View on existing Msimbazi River channel near Jangwani Bridge
Figure 64: SC4.1: Impression of widening and deepening Msimbazi River channel

Figure 65: SC4.3: References for widened bridge openings for improved conveyance during flood events
Enhancing water conveyance capacity

Situation analysis
The conveyance capacity of the river is too small to accommodate the river discharge rates after extreme rainfall events. The existing river channel in the lower reaches of the Msimbazi is assessed to have a maximum conveyance capacity of 80m³/sec [50]. During extreme rainfall events the peak discharges exceed the capacity of the river with discharges up to 400m³/sec during a T10yr event and 600m³/sec during a T100yr event, causing the river to flood the surrounding areas.

Objective
The aim of SC 4 is to increase the water discharge capacity of the Msimbazi River in its lower and middle reaches, starting from downstream and moving upstream. The increased conveyance is focused on floodwaters, but also improves environmental conditions during low flows in the dry season. Six interventions are proposed.

Interventions

SC4.1 Dredging between Selander Bridge and Jangwani Bridge
Dredge a deeper and wider channel. At present, the conveyance downstream of Selander Bridge is hampered by the recent formation of a delta-like deposit near the confluence with the Sinza River [51], as well as by general sedimentation in the mangrove area. As an adequate short-term intervention, a robust and wide channel is required here (Figure 63 and Figure 64). Because the Msimbazi river is morphologically highly dynamic, it is preferred to keep the river as one channel. Simulations via state-of-the-art hydraulic modelling have indicated a layout that would result in an increased downstream flow profile that would accommodate increasing river discharges towards Selander Bridge. This intervention is elaborated in the Detailed Plan and is a priority for the first year of project implementation.

SC4.2 Dredging between Jangwani Bridge and Kawawa Road
Dredge to widen the floodplain area for wetland creation. In this section the river requires room to overflow during peak flows. The space will be created by widening and deepening floodplains adjacent to the river channel. Deepening of the actual river channel should be limited as much as possible to avoid lowering groundwater tables, which would reduce water availability during dry periods. A smooth transition of the longitudinal river profile is required between the deepened river channel at Jangwani Bridge and the original river bed level at the confluence with the Kibangu River. Therefore, for the river section between Jangwani and the Kibangu, the dredged depth of the channel will gradually decrease.

SC4.3 Enlarging bridge openings
Enlarge the bridge openings at Kawawa Road, Nelson Mandela Road and the railway where they cross the river to improve the conveyance capacity of the river (Figure 65).
Figure 66: SC4.5: Removing of buildings that obstruct river flow. Images of these buildings in Suna, Hananasif and sheds in Msimbazi Bondeni.

Figure 67: Current position of DART bus depot in a T100yr flood event faces 0.9 to 1.8 meter of flood depth.
**SC4.4 Reconstructing Jangwani Bridge**
Reconstruct the Jangwani Bridge to make it wider and higher. The bridge and its dyke obstruct the river flow and contribute to flooding. The Detailed Plan provides the recommended dimensions.

**SC4.5 Removing obstacles from the floodplain**
Remove all buildings that obstruct river flow (Figure 66). Construction materials not reclaimed by the owners can be reused to construct hidden protection in vulnerable sections of the river bank (Detailed Plan).

**SC4.6 Securing Bus Rapid Transit assets**
Study relocation or protection options. The flood model shows that location of the DART bus depot gets flooded during a T10 flood, even when flood mitigation measures are in place (Figure 67). Additionally, because the depot is in the flood plain, it also poses a barrier for the optimal conveyance capacity of the river. Recognizing the importance of keeping the rolling stock of buses near to the BRT corridor, there are several options proposed that would assure effective water conveyance, operational efficiency of the fleet, and secure these vital capital assets from flooding. In the Detailed Plan, the option is explored to shift the facility in due course along Morogoro Road to the proposed new higher terrace.

- River monitoring data from 2019-2023 show that the interventions have gradually increased the conveyance capacity and have reduced inundation duration and depths in the Lower Basin in line with the flood modeling results.
- The civil works in the Lower Basin are completed over a five-year period after awarding of contract.
- The decision on reconstruction of the Jangwani Bridge and the location of the DART Depot will be taken before the end of 2019 and thus not conflict with the civil works contracts.
Strategy Components for № 2: Protect

SC № 5. Protect against flooding
SC № 6. Resettle households, and business to locations safe from flooding
3.4.2 Strategy № 2: Protect

**The Protect vision**

The Mitigate Strategy is effective in reducing the flood hazard in the long term. Nevertheless, the key elements of the Protect Strategy, such as the stabilization of riverbanks, the flow guidance by terraces, and zoning for urban functions at safe and controlled areas will continue to require attention to repair the effects of major flood events. In a phased approach, all families and small businesses, which in 2018 are registered as owners, tenants or other occupants of the buildings in the medium and high flood hazard zones of the MSPA, will have relocated voluntarily or will have been resettled to areas safe from flood hazards. Early flood warning and disaster response management, including improved awareness and emergency planning, will be needed to secure safety levels in all stages of the transformation of the Msimbazi.
To stabilize banks at critical locations, earth will be replenished, adjusted and streamlined (in flow direction) and covered by suitable (flow-resistant) vegetation, such as Vetiver grass. At exposed locations, full stability may not be obtained by such natural protection, but erosion will decrease. To protect important infrastructure assets, such as the Muhimbili National Hospital, from further erosion, a ‘hidden’ barrier can be installed five to ten meters inland from the basin edge. This “hidden protection” is invisible under the sand until the erosion process eventually exposes it.
Protect against flooding

Situation analysis

The flood modeling shows that the cluster of interventions presented under the Mitigate Strategy have the potential to significantly reduce the duration and inundation depths of the floods that are caused by peak rain fall during T10yr and more frequent events. Many areas in the Lower Basin that now experience flooding will remain dry or have short and shallow inundation levels (not exceeding 50 cm). The model, however, also shows that in case of more severe rainfall, as in 2011 (classified as a T100yr event), the proposed flood hazard reduction interventions would not be not adequate. Additional flood protection interventions are needed to ensure that people and assets can be considered safe, given predetermined safety levels. Constructing elevated terraces would minimise the chance of inundation and create a safe zone.

For the MSMF, acceptable flood hazard is defined as an inundation of a maximum of 50 cm during a T100yr flood. Using this definition of acceptable hazardous conditions, the flood model has been used to identify the locations in the Lower Basin where these conditions can occur.

Objective

The aim of SC 5 is to protect people, livelihoods and assets including vital infrastructure from flood exposure. Four interventions are proposed.

Interventions

SC5.1 Reinforcing critical river banks against erosion

Stabilize the riverbanks in the lower and the middle basin at critical locations for example where important infrastructure needs to be protected, where loss of land should be avoided or where buildings are close to the bank line.

SC5.2 Flow guidance by terrace building

Create terraces along the river in locations where the river corridor is sufficiently wide (Figure 70 and Figure 71). Dredging the river channels and flood plains creates more room for the river. Together with the elevated terraces, dredging will divert the intensity of flow away from the retaining banks towards the main channel. The terraces help protect the actual riverbank and provide valuable additional land for housing and activities (see also SC 9).

SC5.3 Early Warning System

Improve flood monitoring and develop an early warning system. Several early warning systems can be piloted for a variety of impacted groups such as community, service providers and facility managers. Such systems should be calibrated for accuracy and improved warning times, and successful systems adopted for broader implementation. A longer-term target could be to develop a real-time prediction system based on short-term rainfall predictions.
Figure 72: SC5.3: Early Warning System based on a network of weather stations that send data to a server that sends out a warning signal by text message to all mobile phones and a signal horn in the Lower and Lower Middle Basin area to announce evacuation.

Figure 73: SC5.5: Relocation of the Wastewater Treatment Plant out of the Msimbazi Basin. A sketch of one of the option explored shows the installation in the shallow bay at the other side of the Ali Hassan Mwinyi Road surrounded by an extension of the mangroves.
**SC5.4 Emergency Response Plans**

Continue emergency preparedness and disaster response capacity building of the communities for full coverage of the MSPA. An important immediate action is to develop community preparedness and response plans and community risk reduction plans. These plans support the development of the ward and Mtaa plans, connecting these communities to the broader citywide emergency management system.

**SC5.5 Relocation Wastewater Treatment Plant**

Currently the Lower Basin adjacent to the Muhimbili National Hospital is identified as a possible location for the new Waste Water Treatment Plant that will be built by DAWASA with South-Korean financing and engineering. The Charrette process underscored that the City Park concept would be incompatible with major infrastructure in the Lower Basin. This was further supported by the flood modelling work done for the Detailed Plan, indicating that flood risk protection of the wastewater treatment plant will be a challenge. In addition, the construction of the proposed plant at the suggested site was shown to contribute to increased upstream flood depths. To align this essential facility with the City Park concept, various alternative options are being assessed.

- All building permits in the Msimbazi Special Planning Area will be based on the zoning plans and flood risk profiles.
- The community members of disaster response teams in the Msimbazi Special Planning Area will have a flood alert application on their mobile phones, with the appropriate disaster response instructions (time window and safe routes) by 2020.
- Key assets will be protected or removed by 2022.
SC6.1 to SC6.4: Resettlement Strategy; Demarcate the flood safe and unsafe zones within the boundaries of the MSPA in each stage and execute SC6.1 to SC6.4 accordingly.

SC6.5: Complete the flood model for the next stage from the Lower Basin up to Vingunguti

Figure 74: Map with Interventions of Strategy Component №6

Insights from Flood Modelling

Analysis of the flood modelling data has demonstrated that within the gazetted Msimbazi Special Planning Area a distinction can be made between areas with high, medium and low susceptibility to flooding. The highly hazardous areas (>50 cm inundation depths) are unsafe and therefore unsuitable for human settlement now and in the future. In the medium hazardous area (30-50 cm), people are advised to temporarily leave their houses when flood warnings are given. In the low hazardous locations, the frequency, duration and inundation depth can become an inconvenience, but lives are not at risk and flood risks (damages) are comparatively limited. This flood modelling insight is a cornerstone for the phased implementation of the resettlement strategy within the boundaries of the MSPA.

Charrette estimates on the population and flood exposed buildings in the Msimbazi Catchment Area for 2012 & 2018

<table>
<thead>
<tr>
<th>Map location</th>
<th>Area in Km²</th>
<th>Population estimates</th>
<th>Density (P/km²)</th>
<th>No. of Buildings</th>
<th>Avg No. of buildings per Ha</th>
<th>Avg No. of flood prone</th>
<th>Avg No. people per Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Catchment</td>
<td>80.17</td>
<td>49,422</td>
<td>70,106</td>
<td>6%</td>
<td>616</td>
<td>874</td>
<td>3,467</td>
</tr>
<tr>
<td>Middle Catchment</td>
<td>142.08</td>
<td>507,202</td>
<td>719,476</td>
<td>6%</td>
<td>5,370</td>
<td>5,064</td>
<td>115,710</td>
</tr>
<tr>
<td>Lower catchment</td>
<td>48.53</td>
<td>644,219</td>
<td>769,231</td>
<td>4.0%</td>
<td>13,275</td>
<td>15,851</td>
<td>145,510</td>
</tr>
<tr>
<td>Total</td>
<td>270.78</td>
<td>1,200,843</td>
<td>1,558,813</td>
<td></td>
<td>4,435</td>
<td>5,757</td>
<td>264,687</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Buildings and flood exposed Buildings within the boundaries of the Special Planning Zone within the Msimbazi Lower Basin Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Basin Area B</td>
</tr>
<tr>
<td>Lower Basin Area A</td>
</tr>
<tr>
<td>Total MLBA</td>
</tr>
</tbody>
</table>

Source: Ecorys, 2018

Table 2: Flood exposed building and population
Resettle households and businesses

**Situation analysis**

Resettlement of people has been identified as one of the means of reducing vulnerability to flooding and improving the value of the various functions which the land inside the MSPA offers to the city of Dar es Salaam. Additional resettlement needs may result from specific interventions in the Upper and Middle valleys such as reforestation, reservoir construction and sedimentation reduction that will help reduce vulnerability to flooding and sedimentation in the Lower Basin [52].

Reliable data on the number of households and businesses that are exposed to the flood hazards in the Wider Msimbazi basin are not available. As a proxy, GIS data was used to count buildings within the new boundaries of the Msimbazi Special Planning Area [53]. This count totals approximately 8,500 buildings. This excludes the remains of the houses of the families displaced by the 2011 flood and resettled in Mapwepande, as well as the remains of the buildings demolished in December 2015/January 2016.

Based on the housing count, approximately 10,000 households and businesses are vulnerable to riverine floods. The number of households that experience water damage from heavy rainfall and inadequate sanitation present a separate category of people who incur damages from floods, but these are not a target group for resettlement action.

During the first year of the Detailed Plan implementation period, the people living in the vulnerable areas between Selander Bridge and Jangwani Bridge would have to resettle (269 buildings). In years 2-5, people living in the area between Jangwani Bridge and the Kawawa Road bridges would be affected (2,338 buildings) (see Table 2). In total some 3,000 households and businesses could be affected (approximately 12,000 people). The provisions of the Resettlement Strategy pertain to the project affected households (PAH) within the boundaries of the Msimbazi Special Planning Area [54]. The exact number of potential PAHs will be determined in due course through surveys by PO-RALG.

**Objective**

The aim of SC 6 is to put in place a socially acceptable system for people and small businesses who have to relocate out of unsafe areas; and to provide, where appropriate, support for Livelihood Restoration. To provide appropriate conditions for successful implementation of the Resettlement Strategy (RS) in the MSPA and in the Lower Basin during the first phase of the Msimbazi Opportunity program, ten interventions are proposed.

**Interventions**

**SC6.1 Resettlement Strategy cost estimates and funding mobilization**

The DCC should be tasked to lead this SC, with support from KMC and IMC and with politicians at the City Council, Ward and Mtaa level as champions. PO-RALG should take the responsibility for defining the Resettlement Strategy Principles and mobilizing the funding. Demarcate the flood safe and unsafe zones within the boundaries of the MSPA. This information is essential for the approval of the Detailed Plan and is the basis for identifying the land and house owners, tenants and small commercial activities that will be impacted by structural engineering works. Start with a screening process to: (i) validate the total number of the affected households and
“Compensation is a very tricky issue and a robust process is needed. There should be rules to govern how households decide on the compensation option and how they receive it. For example, replacement rates need to be established for the construction of new homes, floor price of crops and disturbance allowances in direct consultation with the affected households. In addition, more than just the head of the household should be involved, and multiple family members should be present when cash or other in-kind payment is distributed. The preparation of the RAP will be a consultative process to ensure that the impacted households and businesses are appraised on the compensation reflected in the RAP. The RAP preparation process will involve social workers to sensitize and assist the families to make difficult decisions and possibly lawyers who specialize in family law. It is also important to make sure that people who do resettle elsewhere go to safe and planned locations.” (Participant of the 2nd SHW.)

Resettlement Action Plans (RAP) including Livelihood Restoration Programs (LRP)

“The purpose of the LRP is to restore, as much as possible, livelihoods of the displaced and all those people affected to a level prior to their displacement or the start of the program or even enhance the livelihoods above that level. The LRP is not the same as the compensation for lost properties and assets, but goes well beyond the compensation to support livelihood revival for those that have had this upheaval” [55].
businesses; (ii) document the land ownership; and (iii) value the assets and other elements that will be eligible for compensation. This information is needed to determine the RAPs budget for implementing the resettlement strategy. In addition, the locations, number and timing of the RAPs need to be determined for detailed planning.

**SC6.2 Resettlement Strategy finalization and detailed planning**

Involve the stakeholders in the PO-RALG led process of designing the resettlement strategy, resettlement action plan content and implementation procedures.

Define the compensation options. The RAPs could offer the affected people (heads of household and business owners) different options: (i) replacement housing within the MSPA (high-rise buildings and/or low-rise buildings); (ii) cash; (iii) in-kind compensation of land outside the Msimbazi valley that includes shared community facilities such as water points, playgrounds and public services; and (iv) voluntary relocation with its associated negotiations on replacement rates and quantities of crops, structures, etc.

Tailor the Livelihood Restoration Programs (LRPs) for each affected household and/or business. The aims are to identify to what extent and how the livelihood disrupted by the resettlement can be restored or improved beyond that at the start of the program, and to agree on a LRP support package.

**SC6.3 RAP/LRP preparation and community sensitization**

Create a RAP/LRP development and implementation support team/facility, where the affected households and businesses can get information and the support they are entitled to. The team members should have the skills or have access to surveyors, sociologists, agronomists, appraisers, lawyers, or other relevant specialists. The RAPs themselves should be prepared by a consultant or consortium that could include a company and a local NGO and the work should be overseen by a steering committee that includes the lower levels of government and community members (see also SC10).

Prepare the RAPs based on the socio-economic survey of the affected households and business in each of the areas selected for resettlement. For each area the starting date of the RAP should be established as the cut-off date for identifying and registering the PAHs [56]. The R-day\(^5\) date of the survey should be planned carefully as it starts the resettlement process and RAP, and needs to be accompanied by enforcement measures such as biometric registration\(^6\) to discourage people from returning to hazardous areas. There also needs to be community enforcement at Mtaa level to stop new encroachments. The PIU should ensure continued involvement from community and Mtaa representatives.

Give RAP priority to people whose houses were demolished in 2015/16 and people who are most vulnerable to flood risk in 2019. Involve community leaders in the identification of the affected people for compensation purposes.

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5. The counting, inventory and valuation day that kicks-off the execution of the bespoke resettlement plan.
6. GPS coordinates for the areas compensated should accompany the biometric registration. This will help show exactly who have been resettled from where, as well as act as proof of acquisition of the area.
“No more forced evictions and demolitions.”

“It is important that voluntary relocation follows the basic principles of consent and informed choice and not coercion.”

“Housing should be made available prior to moving people from the flood area.”

Quotes from community members
SC6.4  RAP and LRP implementation
Start in the Lower Basin and align the resettlement implementation stages with the phased development of the terraces. The sequencing of the physical locations for the RAPs is determined by technical factors. The engineering works will start downstream at Selander Bridge and work upstream. Detailed engineering design will have to define the phasing of terrace construction but as a five-year works period is envisioned. The first year of implementation could cover the area between Selander Bridge and Jangwani Bridge, and in the next four years the works would cover the area between Jangwani Bridge and the Kawawa Bridge (See Detailed Plan).

SC6.5  Develop information for Msimbazi Resettlement Strategy stage 2
The next phase of the Msimbazi Opportunity Plan will cover the area between Kawawa Road and the Nelson Mandela Road including Vingunguti. To prepare for this, the flood model used for validating the landscaping and terracing design needs to be extended to cover the stage 2 area.

- By 2019, the owners of the houses demolished by government from 12 December 2015 – 5 January 2016, who have not yet been compensated, will have received their entitlement in accordance with the Msimbazi Resettlement Strategy.
- By 2019, the 1st Resettlement Action Plans for people in the unsafe areas of the lower Msimbazi Basin Area are ready for execution. 35% of the entitled house owners have accepted new housing in new apartments in the neighborhood (in situ) [57]. Others have been resettled ex-situ or have received a cash entitlement.
- As of 2021, there are no longer people at risk from flooding events in the Lower Basin between Selander Bridge and Morogoro Road; As of 2025, there are no longer people exposed to flooding risks in the Lower Basin between Morogoro Road and Kawawa Road.
- By 2028 all families and small business which in 2019 are registered as owners, tenants or other occupants of the buildings in the medium and high flood hazard zones of the MSPA will have relocated voluntarily or have been resettled to areas safe from flood hazards, and their businesses will have been re-established in their new locations.
Strategy Components for № 3: Transform

SC № 7. Improve Msimbazi river water quality
SC № 8. Improve solid waste management
SC № 9. Develop City Parks
3.4.3 Strategy № 3: Transform

The Transform vision

The Msimbazi City Park serves the city as a green lung, garden and public space. The City Park contains green functions and incorporates the principles of room for the river at peak discharges in a safe way, while at dryer times these controlled flood areas can be used for recreation and sports activities for all citizens. The Msimbazi River and its tributaries will become clean and safe for the water functions of the City Park and solid waste will be properly managed in the Msimbazi Basin, preventing infrastructure blockages and making the river basin and valleys a clean place to live, work and recreate.
SC7.1: Inventory of pollution sources and practices
SC7.2: Stakeholder design of a ‘stop the pollution’ program
SC7.3: Improved stormwater drainage for Mitaa bordering MSPA
SC7.4: Improved sanitation facilities for the Mitaa bordering MSPA

Figure 75: Map with Interventions of Strategy Component №7

Figure 76: SC7.3: Example of a stormwater drainage infrastructure planning scheme and references of drainage measures (dry and wet)

Figure 77: SC7.4: Sanitation improvements; an example of public toilet facilities at appropriate level in a chain with a waste to energy biodigester solution. One of the possible options to further elaborate under the Drainage and Sanitation Development Plan (Source: Safi Sana, Accra)

Outcomes 2019-2030

- In the next ten years the waters of the Msimbazi and its tributaries will become clean and safe for the water functions of the City Park and household gardening in designated areas on the lower and higher terraced river bank areas.
- The water standards of the Msimbazi Opportunity Plan are adopted by politicians and industrial leaders. Industry owners have taken measures to stop their pollution.
- The storm water drainage and household sanitation facilities are improved within the boundaries of the MSPA.
Improve Msimbazi river water quality

Situation analysis
Biological and chemical pollution of the water makes the Msimbazi river area unsuitable for agricultural use. Toxic chemicals can infiltrate the aquifers which are important water sources for Dar es Salaam [58]. The chemical components present a health threat. Chemically polluted water used for drinking and cooking can inflict both physical and mental damage on generations to come. Ground water pollution sources include: domestic and industrial waste water, leaching of toxic substances from uncontrolled solid waste dump sites, storm water and poor rural and urban agricultural practices [59], as well as illegal industrial effluent disposal. Other point sources include on site sanitation facilities (septic tanks and pit latrines) and waste from commercial establishments.

Objective
The aim of SC 7 is to stop river pollution and engage the private sector in the polluter pays process. Four interventions are proposed.

Interventions

SC7.1 Inventory of pollution sources and practices
Prepare an inventory of all business licenses and enforce permits. Techniques for waste water treatment solutions are improving. It would therefore be relevant to describe the latest techniques available and their feasibility in various situations (volume of discharge, type of industry, type of pollution). A review of the existing licenses and permits could then be undertaken and advice could be given on how to achieve a higher quality of residue water. The information needs to be communicated and capacity developed among operators and responsible government staff. The next step is ensuring consistency of enforcement.

SC7.2 Stakeholder design of a ‘stop the pollution’ program
Engage with the private sector to develop an industrial clean-up program. Use the Charrette design workshop format to jointly design and implement a voluntary industrial clean-up program for all main point source polluters based on the polluter pays principle. This intervention is essential to overcome the political barriers to enforcing regulations. A wide base of stakeholder commitment will be needed to mobilize the political support that is essential for action on this issue.

SC7.3 Improved stormwater drainage for the Mitaa bordering the MSPA
Design and support the construction of improved stormwater drainage for all Mitaa that share borders with the MSPA. This is a prerequisite for City Park development. Currently heavy rainfall can cause floods in the existing urban areas above the river. The storm water drainage pipe connections between the existing urban areas and the proposed terraces need to be incorporated in civil works specifications for the terrace designs.

SC7.4 Improved sanitation facilities for the Mitaa bordering the MSPA
Support the realization of appropriate sanitation facilities in line with the sewage treatment standards applicable to the City Park ambitions. A range of on- and off-site improved sanitation options are possible in line with the Drainage and Sanitation Development Plan developed by the DMDP and ongoing investment projects in the sector.
SC8.1: Action plan for solid waste management
SC8.3: Unblocking of bridges and culverts
SC8.4: Sanitizing existing illegal dumpsites
SC8.5: Community awareness raising

Figure 78: Map with Interventions of Strategy Component №8

Figure 79: SC8.3: Removal of waste from infrastructure has been done recently mutually by community and organizations during the World Clean-Up day. (Source: Catholic Youth and IPPMedia)
Improve solid waste management

Situation analysis

Solid waste management is a serious challenge in all parts of the city. It is estimated that annually some 180,000 tons of solid waste are dumped illegally in the Msimbazi environment. Currently, private and municipal service providers contracted to collect and transport the solid waste at ward level have limited capacity, and in most of the Mita bordering the Msimbazi, the collection service is poor. Many areas along the Msimbazi River and in the wider catchment area are marred by litter and illegal dumpsites. Existing illegal solid waste dumpsites in Kinondoni and Ilala (Tabata, Vingunguti, Kigogo) are poorly constructed and leach toxic elements into the surface waters. Solid waste piles up at bridges and other obstacles (e.g. mangrove forest). It clogs the river flow and reduces the river’s conveyance capacity. Uncontrolled solid waste disposal is not compatible with the development of a healthy living environment, nor with a flourishing ecosystem and City Park. Improving solid waste management in the Msimbazi Basin is thus essential in the coming years to deliver on the three-fold objective of the MSMF: Flood Protection, Environmental restoration and Green City Park development.

Objective

The aim of SC 8 is to initiate and support measures which will improve the solid waste management systems that impact on the urban environment and communities within the boundaries of the MSPA. Seven interventions are proposed.

Interventions

SC8.1 Action plan for solid waste management for the MSPA
Review the challenges of solid waste management in the Mta bordering the Msimbazi and design feasible approaches for improvement. The PIU can initiate cooperation between the Municipalities to support the development of a feasible community-based approach. It should also aim to mobilize funding for the implementation of an action plan for 2020-2024.

SC8.2 Capacity for local government authorities
Build capacity (manpower and equipment) at LGA level. Prioritize enforcement of laws and by-laws to stop illegal solid waste dumping along riverbanks, and develop the capacity to organize the collection, transport, processing and recycling of solid waste. The program needs to involve the LGA Environment Committees from the Mta level upwards to the wards (Kata) along riverbanks. It is important to continue and expand community participation in the clean-up operations for the Msimbazi City Park to remove solid waste that blocks road culverts, prior to the start of the rainy seasons.

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7 This estimate is derived by making three realistic assumptions: A population of 1.56 million people in the catchment area; an average production of ½ kg per person per day; and a 40% collection and legal disposal rate (Hananasif, 2018) in the Mita.
Figure 80: SC8.4: Sanitizing existing illegal dumpsites by cleaning and/or removing waste and create a clean top soil layer

Figure 81: SC8.5: Community awareness raising (Source: HOT & BORDA)
**SC8.3 Unblocking of bridges and culverts**
Remove solid waste twice annually. The PIU is advised to work with TANROAD, to secure budget allocation.

**SC8.4 Sanitizing existing illegal dumpsites**
Clean and/or remove existing dumpsites, begin at the riverbanks and then extend into the surrounding neighborhoods.

**SC8.5 Community awareness raising**
Initiate an awareness campaign by CBOs, NGOs, in partnership with LGAs on the effects of illegal waste dumping, especially as it relates to flooding. The campaign is to start in the wards and sub-wards along riverbanks and expand upwards into the municipalities.

**SC8.6 Private sector involvement**
Stimulate local entrepreneurship. Promote business opportunities for recycling and sustainable waste processing, such as: (i) refuse derived fuel, based on the high organic contents (around 60%) of solid waste; (ii) bioreactors for abattoir waste; (iii) recycling tires, oil waste, composting and manure; (iv) PET recycling and other production from plastic waste.

- Action plan for solid waste management for the MSPA signed by stakeholders and funded by the end of 2020.
- Illegal dumpsites sanitized by 2022.
- Solid waste is properly managed in the Msimbazi Basin and it has become a clean place to live and work and for recreation by 2030.
- The municipalities have the capacity to keep their respective districts clean by 2025.
- Income and jobs for the communities along the Msimbazi have been created through waste collection and reuse, fee collection, local waste recovery, recycling, composting as well as transportation of waste.
“Between 1982 and 2002, more than 15,500 ha of formerly vacant agricultural lands were converted to urban development.”[61]

The City Park concept involves a redesigning of the river basin plains and valley edges in the MSPA for mixed urban use. Using the interventions proposed under the Mitigate and Protect Strategies as a basis, it offers locations for relaxation and escape from the pressures of a busy city. It provides room for green spaces, trees, biodiversity and ecosystem services at the lower terraces and the flood plain, but also housing and commercial development on the highest terraces, and sports facilities and parks for recreation facilities on the middle level terraces.
Develop City Parks

Situation analysis
The rapid expansion of Dar es Salaam in terms of population growth, extension of built up areas and densification, puts pressure on all aspects of its living conditions. Public spaces in the central areas of the city are becoming scarce, and are largely hard surfaces without green cover or tree canopy. The streets are predominantly devoid of trees and other vegetation, and outside the city center trees are still cut illegally for charcoal or provisional timberworks. The quality of the green spaces in the lagoons, the river basins and brooks that cross the city are degraded because of urban pressure, unplanned building activities, solid waste dumping, toxic industrial effluents and largely untreated sewage. The lack of soft landscaping, green spaces and tree cover is contributing negatively to the microclimate of the city and its potential to absorb peak rainfall.

The areas remaining for public use are thus dwindling and degrading in quality, are often little less than sandy fields in the dry season and stagnant pools in the wet season and offer little value in terms of public recreation. In particular, the more vulnerable members of the city’s population, including the poor, the elderly, women and children, are most affected by the disappearance and degradation of open and green space as the more affluent have means to own a garden or commute to higher quality open spaces in the periphery of the city for recreation and fresh air.

Objective
The aim of SC 9 is to develop a Msimbazi City Park in the heart of Dar es Salaam. Five interventions are proposed.

Interventions

SC9.1 Different parks along the Msimbazi Special Planning Area
Establish a linear river park from the seaside of Selander Bridge all the way to Vingunguti in the MSPA (26.8 km2). In this area the park consists of the flood plain and terraces and caters for public green functions. Extend the green riverbanks further to the middle catchment area to create smaller parks with a smaller number of public functions. Moreover, small local parks can be created in the upper reaches of the MSPA.

SC9.2 An iconic landscape design for a multi-functional City Park
Transform the 400 hectares of the Lower Basin into one City Park. The Detailed Plan presented in Volume B integrates the functions that stakeholders envisioned during the Charrette process of a ‘park for the people’. It should be well landscaped to make the park attractive for the people of Dar es Salaam and for visitors (Figure 84).

Make a refined design of the various terrace levels to shape interesting spaces which allow for various park activities and planting conditions. The detailed landscape design stage should take into account the shape and angle of the terraces and to make sure the shallow green slopes are durable and capable of withstanding the extreme peaks of floods.
The wetlands, and mangrove forest in the river and lower flood plains provide for natural trails. The middle level of the terraces provide space for gardening, shaded parks, playgrounds, sport fields, an amphitheater and lawns/open space for large audience concerts, festivals, gatherings, rallies, religious festivities and celebrations. The highest terraces provide for social housing, commercial real estate, shopping malls, and shaded gardens, as well as a wetland and mangroves information center.

The City Park not only serves as a public space, it preserves the green character of the Msimbazi and the healthy functioning of the river. It offers improved resilience to flooding, with clear demarcations of areas parallel to the river that may be flooded at high peaks of discharge and those that are always safe. The flood plain is accessible to people as a natural asset and recreational space during dry season, but also adaptable to climate change and alterations in weather. The Park, along with the possibilities for new urban activities at its edges, will offer a wide range of economic and social opportunities for investors as well as for local communities and small entrepreneurs.

Figure 85: SC9.2: References of City Park foot paths and wooden pedestrian bridge

Figure 86: References show the prime functions of the City Park

Figure 87: SC9.2: Tree and shrub species growing in Dar es Salaam and proposed for the park areas include: Neem tree (Azandiracta indica), Mango tree (Mangifera indica), Ashoka tree (Polyalthia longifolia) and Hibiscus schizopetalus, amongst others.
Create accessibility in the open park space of the flood plain and first terrace with footpaths, ramps, bridges, boardwalks and steps. These are for recreation purposes and connectivity between the surrounding neighborhoods and the park. This park element should be implemented step by step directly after the capital dredging works and terrace construction have been completed in each location. Accessibility for pedestrians to the park should also be considered in the design of the proposed Hananasif Bridge.

Incorporate tree planting schemes between Selander Bridge and Kawawa Road; wooded areas on the middle and high terraces will add a new livability dimension to the heart of the metropolis. These areas will provide oxygen, capture carbon dioxide, contribute to the ecosystem of the city, and provide for cooler locations when heat waves strike.

Prepare a wetlands restoration plan for the Lower Basin. The City Park concept provides ample space for developing saline wetlands up to the high tide line, and for fresh water wetlands further upstream from Hananasif to Vingunguti. Research and advice will be required from wetland ecologists on how best to restore the natural water cleaning capacity of the wetlands ecosystem and to improve conditions for plants and small wildlife native to wetlands. The wetlands are specified as an integral part of the City Park in the Detailed Plan, and to make the wetlands an attractive area for walkers and nature-lovers, flood-proof trails and bridges will need to be constructed and maintained.

**SC9.3 Terraced lands for new urban development**

Design and develop 57 hectares of high terraced land for new urban development. The City Park offers new urban development space at the highest levels of the terraces. The park development concept aims to be inclusive as well as profitable and should offer new income earning opportunities for the communities in the area. Sustainable, inclusive and economically attractive real estate development is foreseen in a mix of housing categories, large opportunities of commercial development, from small vendors and market places to shops, workshops, offices and malls. The nine planned new urban development areas in the Lower Basin vary in size, density and typology to match the existing neighborhoods in character. Details are provided in the Detailed Plan.

**SC9.4 Urban upgrading linked with the City Park**

Define the edges of the park and make linkages with existing urban development. The zoning of the MSPA covers a wider area than river valley only. The zoning of the Detailed Plan for the Msimbazi Lower Basin Area stretches into some of the existing urban fabric. The MSPA links with existing streets and secures access from all neighborhoods to the park. The areas at the edges of the city park allow for (re)developing areas that overlook the Msimbazi River, the mangrove and the wetlands.
Figure 88: Bird’s eye view impression of the core of the City Park with new urban development at the edges

Figure 89: SC9.3: Example of Mixed Use Higher Density Zone as part of the urban development areas of the Detailed Plan for the Lower Basin
SC9.5 Private investment mobilization
Create profitable opportunities for private sector investment. The potential urban investment on the 57 hectares of new terraces proposed in the Detailed Plan is provisionally estimated as exceeding USD one billion\(^8\). In addition, the investment required for the Mitigate, Protect and Transform strategies is in the range of USD 120 -200 million. This scale of investment offers opportunities to attract private sector investment (see also SC 10.4). This prospect provides a sound financial basis for financing the basic infrastructure for the Msimbazi development program (Stage I) with concessional loans. Increased land available for development that is both safe from flooding and located adjacent to attractive parkland and commercial opportunities near the city center will be a key incentive. On a smaller scale the maintenance dredging could also present opportunities for private sector participation in urban redevelopment if safe and affordable uses for the extracted materials can be found [62].

- The terraces will be shaped, planted and access by footpaths is established. by 2024
- The park will be green and public functions will be established including a sports park with football pitches; an amphitheatre for gatherings and festivals, and children’s playgrounds by 2022.
- 50% of the available area for urban development will be implemented with the intended street layout, housing, commercial and office functions by 2029.

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8 This is estimated using the commercial sales price of 57 hectares of prime real estate (USD 200/m²) and building cost for 14,500 apartments (USD 60,000/unit).
Strategy Component for № 4: Govern

SC № 10: Good governance for coordination, cooperation, communication and finance
3.4.4 Strategy No 4: Govern

The Govern vision

A new Governance body, The Msimbazi Planning Authority, will have the mandate to stop the uncontrolled urbanization process that is making the river basin unsafe and unhealthy for human activity, and to replace this with a planned and coordinated process of development that will improve: (i) the quality of the urban development and ecosystem functions of the Msimbazi valley; and (ii) the living conditions and livelihoods of flood resilient communities in, or adjacent to, the gazetted Msimbazi Special Planning Area.
Key urban governance issues for the MSMF

i. Inter-sectoral coordination between different levels of government;
ii. Overlapping administrative and legislative frameworks and mandates;
iii. Linking the reality of flood risks to urban planning and management practices;
iv. Local government capacity to deliver the proposed interventions;
v. Enforcement of controls on land use development and environmental licenses;
vii. Clarification of land and asset ownership in the proposed Msimbazi Special Planning Area
vii. Specific policies and regulations to address hazards induced by climate change.

Source: Msimbazi Charrette, 1st workshop report, 2018

Figure 90: Short term (2019-2020) at the top and medium and long term (2020-2030) coordination arrangements at the bottom diagram.
From multiple mandates to unity of purpose in coordination

**Situation analysis**
In January 2018 the Vice President of Tanzania, Honourable Samia Suluhu Hassan, convened a meeting on the severe flooding that regularly affects Dar es Salaam. The meeting concluded that a task force was needed to coordinate various government initiatives and provide guidance for the future with respect to flood protection and environmental restoration. The series of Charrettes organized by PO-RALG provided the starting point for this coordination, and focal persons from various government entities.

It is difficult to achieve both inter-governmental coordination and stakeholder engagement in processes of design and decision making. Government entities have sector specific mandates and community interest groups are often topic focused. This makes good cross-sectoral coordination and communication difficult in complex situations. The Msimbazi experience shows that the existing urban governance arrangements are inadequate to cope with the challenges.

**Objective**
The aim of SC 10 is to create a multi-sectoral good governance system for the Msimbazi Basin and the MSPA, and to develop adequate capacity to take responsibility for the implementation of the multi-annual Msimbazi Opportunity Program and Action Plan. For the short term (2019-2020), institutional capacity is needed to initiate the implementation of the project for flood protection and environmental rehabilitation in the Lower Basin, and to prepare the 400 hectares of MSPA land between Selander Bridge and Jangwani Bridge for public and private investments in line with the Detailed Plan specifications. For the longer term (2020-2030), a new authority will be needed with a strong mandate for stakeholder coordination, cooperation, communication and finance to ensure that the program of interventions covered by the MSMF and Detailed Plan for the Lower Basin are aligned and implemented in a coordinated manner.

**Interventions**

SC10.1 Inter-institutional cooperation and community participation
Capitalize on the opportunity to “Transform the Msimbazi Basin into an icon of urban resilience”. Coordinated planning, cooperation and communication are required at three administrative levels: The Msimbazi Basin, the Msimbazi Special Planning Area, and the Detailed Plan for the Lower Basin. It is recommended to create an entity mandated to coordinate at all three levels, with specific responsibility for:
- Championing the Msimbazi Opportunity Plan
- Leading urban development planning of the Msimbazi
- Organizing the Inter-Institutional program review meetings
- Ensuring all stakeholders including lower levels of government and community representatives are, and remain, involved in the planning and preparation of projects that will affect their communities
- Mobilizing the finance needed for implementing a phased improvement program of the Msimbazi Special Planning Area
- Implementing the first stage of the Detailed Plan for the Lower Basin
- Preparing project for the next stages
### Msimbazi Steering Committee

The MSC’s objectives are: (i) to stop the uncontrolled urbanization process that is making the river basin unsafe and unhealthy for human activity; and (ii) to replace this by a planned and coordinated process of development that will improve the quality of the urban development, ecosystem functions, and living conditions. The MSC’s function is to coordinate and oversee the implementation of the ten Strategy Components set out in the MSMF at all three intervention levels. To do this the MSC members should have access to all policy & technical information required. They should also have the decision making power over land use activities in the catchment area that may negatively affect flooding (water retention capacity reduction and conveyance barriers) and water quality.

### Program Implementation Unit

The PIU’s objectives are: (i) to reduce flood hazards and flood risks in the MSPA; (ii) to champion the Msimbazi City Park vision; and (iii) initiate, prepare, implement & monitor all Strategy Components in the MSMF. This will entail the immediate measures identified for flood risk protection in the Lower Basin including: (i) engineering works that enhance the water conveyance capacity in the Lower Basin; (ii) terrace building for landscaping of the City Park; and (iii) relocating people and businesses to safe locations based on RAPs and LRP for the affected households.

### Msimbazi Planning Authority

It is proposed that PO-RALG as the responsible Ministry, after consultations with MLHHS and Local Government, establishes the MPA as an Autonomous Agency to undertake all matters in regard to the Management of Msimbazi Basin and the Msimbazi Opportunity Plan [63]. The objectives are to improve the delivery of public services, create an environment conducive to efficient and effective management, and to promote the potential for continuous improvement of the services provided.

The Order, published in the Gazette, to establish the MPA shall specify the various departments and their functions which the MPA becomes responsible for and in a Framework Document, the functions aims, role, objectives, authority, performance standards and any other particulars of the Agency as approved by the Chief Secretary taking into account any existing laws.

### Msimbazi Area Development Corporation

The Msimbazi Area Development Corporation (MADC) will be established to attract private capital for the development of the City Park in the Lower Basin. The MADC objective is to realize the City Park on behalf of the government. The MADC function is to manage the investment zone in line with the bespoke investment regulations, planning and building guidelines and sustainable building practices established for the investment zone. The MADC will have seven main tasks: (i) to prepare the 400 hectares in the Lower Basin for the City Park functions designated in the Detailed Plan; (ii) to market the “Msimbazi Opportunity” as a unique investment location which offers high returns on prime commercial lands on the edge of the City Park; (iii) to attract real estate investors with appropriate vision for the Lower Basin’s redevelopment; (iv) to prepare the land with basic services; (v) to lease the lands to the investors with the best plans for social and commercial housing, shopping malls, parking, hotels, city park leisure facilities, and nature education; (vi) provide concessions for realization of commercial activities in the area; and (vii) to generate an annual revenue level sufficient to maintain the City Park facilities, including the water infrastructure, and to pay the relevant taxes to the government parties.
The institutional arrangements designed and agreed upon in the Charrette process comprise the establishment of a Steering Committee and Project Implementation Unit for coordination in the short term, and a Msimbazi Planning Authority and Msimbazi Area Development Corporation for the medium and long term. Figures 89 illustrate the short term (2019-2020) and medium and long term (2020-2030) coordination arrangements. To be pragmatic, it was decided that existing institutions should be used as much as possible and that any new institutions should be made financially sustainable.

**SC10.2 Short term coordination: MSC and PIU**

Establish a Msimbazi Steering Committee (MSC) and Program Implementation Unit (PIU). The SC and PIU are needed to maintain stakeholder commitment and to provide sufficient capacity to prepare and implement the Msimbazi transformation program. The MSC can be linked to existing meetings of the stakeholders under RAS. The PIU was established under the Dar es Salaam City Council (DCC) in August 2018.

**SC10.3 Medium term legal instrument: MPA and MADC**

Make the 400 hectares of the Lower Basin a Special Investment Zone. The City Park concept offers significant opportunities for private investment. The participants endorsed “The Msimbazi Opportunity” as a suitable brand name for marketing the Special Investment Zone world-wide. To gain investor confidence and mobilize private investment, investment conditions should be designed together with the private sector representatives who participated in the design charrette process.

Strengthen the PIU mandate so that it evolves into the Msimbazi Planning Authority, a legal instrument for long-term management, coordination and planning in the MSPA. The MPA objectives include those of the PIU as well as the management of Special Investment Zones within the boundaries of the Msimbazi Special Planning Area. Additionally, the MPA is responsible for mobilizing funding for land development and basic infrastructure and supervising the operations of the Msimbazi Area Development Corporation (MADC).

Organically transform the Msimbazi Steering Committee into a Msimbazi Supervisory Board. The MSB would have the same tasks as the MSC, but membership would change with the addition of private sector and community representatives.

**SC10.4 PIU Action Plan**

Implement the PIU Action Plan. The PIU was established by the DCC in August 2018 to mobilize the executive power needed for implementation of the interventions proposed in the MSMF and for delivery on the Detailed Plan for the Lower Basin.

The Action Plan is presented in Chapter Four.

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9 A list of participants is provided in Appendix A.
3.4.5 Matrix: Overview of the interventions designed for the MSMF

### Strategy № 1: Mitigate
Interventions and mandates

<table>
<thead>
<tr>
<th>SC №</th>
<th>Intervention</th>
<th>MRB</th>
<th>UB</th>
<th>MB</th>
<th>LMB</th>
<th>LB</th>
<th>Mandated partner</th>
<th>Other authorities with overlapping mandates</th>
</tr>
</thead>
<tbody>
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<td>Restore the natural ecosystem and make room for the river</td>
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<td>MLHHSD, dep. Phys.plan. MoWI</td>
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<td>Mangrove forest restoration and expansion</td>
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<td>TFS</td>
<td>MNRT, MLHHSD, MoWI</td>
</tr>
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<td>SC № 2</td>
<td>Increase water retention and harvest rain water</td>
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<td>Stormwater retention ponds and reservoirs</td>
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<td>VPO, DAWASA</td>
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<td>2.3</td>
<td>Local infiltration and retention</td>
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<td>KMC, IMC, NGOs, CBOs &amp; community</td>
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<td>Sediment traps and controlled sand mining</td>
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<td>MOWI, WAMI-RUVU</td>
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<tr>
<td>3.3</td>
<td>Maintenance dredging</td>
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<td>MoWI</td>
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<td>MWTC, MLHHSD</td>
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<td>DCC, PIU, PO-RALG, TURP partners</td>
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**Table 3: Intervention Matrix**

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<tbody>
<tr>
<td>MRB: Misimbaiz River Basin</td>
</tr>
<tr>
<td>LMB: Lower Middle Basin</td>
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<tr>
<td>LB: Lower Basin</td>
</tr>
<tr>
<td>UB: Upper Basin</td>
</tr>
<tr>
<td>MB: Middle Basin</td>
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## Strategy № 2: Protect Interventions and mandates

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<tr>
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<th>LMB</th>
<th>LB</th>
<th>Mandated partner</th>
<th>Other authorities with overlapping mandates</th>
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<tr>
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<td>Reinforcing critical river banks against erosion</td>
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<td>☐️</td>
<td>☐️</td>
<td>☐️</td>
<td>MWTC</td>
<td>MoWI, PIU, DCC</td>
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<td>5.2</td>
<td>Flow guidance by terrace building</td>
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<td>☐️</td>
<td>☐️</td>
<td>☐️</td>
<td>☐️</td>
<td>MWTC</td>
<td>MoWI, PIU, DCC</td>
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<td>☐️</td>
<td>☐️</td>
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<td>☐️</td>
<td>VPO, DCC</td>
<td>PO-RALG, IMC, KMC, Kataj &amp; Mitaa</td>
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<tr>
<td>5.5</td>
<td>Relocation Wastewater Treatment Plant</td>
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<td>☐️</td>
<td>☐️</td>
<td>☐️</td>
<td>☐️</td>
<td>PS Tamisemi</td>
<td>PIU, DCC</td>
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</table>

### Table 3: Intervention Matrix (continued)

### Legend
- MRB: Misimbazi River Basin
- UB: Upper Basin
- MB: Middle Basin
- LMB: Lower Middle Basin
- LB: Lower Basin
- PO-RALG: PIU, DCC, TURP partners
- PMO, TURP partners
- DCC-PIU: NGOs, DCOs, NEMC, VPO, PMO
- PO-RALG, communities, Mitaa, MLHHSD, WB
- PIU, DCC, TURP partners
- MLHHSD, PO-RALG
### Strategy № 3: Transform Interventions and mandates

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<td>7.1</td>
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<tr>
<td>7.2</td>
<td>Stakeholder design of a 'stop the pollution' program</td>
</tr>
<tr>
<td>7.3</td>
<td>Improved stormwater drainage for the Mitaa bordering the MSPA</td>
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<td>7.4</td>
<td>Improved sanitation facilities for the Mitaa bordering the MSPA</td>
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<td>8.2</td>
<td>Capacity for Local Government Authorities</td>
</tr>
<tr>
<td>8.3</td>
<td>Unblocking of bridges and culverts</td>
</tr>
<tr>
<td>8.4</td>
<td>Sanitizing existing illegal dumpsites</td>
</tr>
<tr>
<td>8.5</td>
<td>Community awareness raising</td>
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<td>Private sector involvement</td>
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<tr>
<td>9.2</td>
<td>An iconic landscape design for a multi-functional Central City Park</td>
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<tr>
<td>9.3</td>
<td>Terraced lands for new urban functions</td>
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<td>9.4</td>
<td>Urban upgrading linked with the City Park</td>
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<td>Private investment mobilization</td>
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*Table 3: Intervention Matrix (continued)*

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<th>UB</th>
<th>MB</th>
<th>LMB</th>
<th>LB</th>
<th>Mandated partner</th>
<th>Other authorities with overlapping mandates</th>
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<tr>
<td>7.1</td>
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*Legend*

- **MRB**: Misimbazi River Basin
- **UB**: Upper Basin
- **MB**: Middle Basin
- **LMB**: Lower Middle Basin
- **LB**: Lower Basin
- **MOWI**: Municipalities, Mitaa, communities, NF
- **NEMC**: NGOs, CBOs, Communities
- **DAWASA**: DAWASCO, MOWI
- **TANROADS**: Municipalities and Mitaa’s, private sector
- **VPO-NEMC**: Municipalities, NGOs, CBOs, communities
- **PO-RALG**: PO-RALG, MLHHSO
- **MLHHSO**: MLHHSO, KMC, IMC
- **MADC**: MADC, investors
### Strategy № 4: Govern
Interventions and mandates

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</table>

Table 3: Intervention Matrix (continued)

Legend
- MRB: Misimba River Basin
- UB: Upper Basin
- MB: Middle Basin
- LMB: Lower Middle Basin
- LB: Lower Basin

Volume A: Strategy and Management Framework

The Misimba Opportunity
Volume A: Strategy and Management Framework
Next steps:
The Way Forward and the PIU Action Plan Priorities
The short-term time horizon for Stage 1 of the MOP is 2024. Over the five-year period between 2019-2024, the Lower Basin from Selander Bridge to the Kawawa Bridge can be transformed from a degraded area where people’s lives, assets and infrastructure are highly vulnerable to flood risk, to a newly landscaped city park, where infrastructure assets are safeguarded, people are no longer in harm’s way, and new terraced areas provide safe spaces for housing, commercial activities, sports and leisure.

In the medium term, from 2024 to 2031, Stage 2 and Stage 3 of the MOP are planned. Stage 2 covers the Lower Middle Basin between Kawawa Bridge and Nelson Mandela Road; and Stage 3 extends the project into the Middle Basin from Nelson Mandela Road upstream.

Working upwards from Selander Bridge through the Stages 1, 2, and 3 the drainage capacity of the river can be increased by structural engineering works. The three stages all include: sediment removal, deepening and widening the main Msimbazi channel; using the dredged materials for terrace building; removing obstacles from the river plains; and widening bridge openings.

To improve and increase the water infiltration and retention capacity of soils, rehabilitation of the natural ecosystems in the watershed is needed. In combination with a planned and coordinated approach to resilient urban land-use development this will contribute to reducing peak flows and the riverine flood hazards. Essential for this planned outcome are the reforestation and rehabilitation of the Kazimzumbwi and Pugu Forest Reserves, the mangrove forest restoration and expansion, and the rehabilitation and expansion of the fresh and salt water wetlands in the river plains of the Lower Basin.

The long-term time horizon for the Msimbazi Opportunity Plan is 2050. By that time the proposed interventions will have been implemented and their impact fully realize. A new balance in the Msimbazi Basin will have been attained characterized by lower flood risk and effective protection of the urban environment.
The provisional activity planning is provided below (Table 4) which shows eight clusters of proposed interventions over the period 2019-2050.

<table>
<thead>
<tr>
<th>Strategies and key interventions</th>
<th>SC No</th>
<th>Duration (years)</th>
<th>Time horizon</th>
<th>Champion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain the Msimbazi Charrette team cooperation</td>
<td>10</td>
<td>5</td>
<td>Stage 1</td>
<td>PO-RALG and MWTC</td>
</tr>
<tr>
<td>PIU capacity building and TA support</td>
<td>10</td>
<td>2</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>MPA and MADC institution building (Special Investment Zone)</td>
<td>10</td>
<td>3</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>Implement the PIU/MADC Action Plan</td>
<td>10</td>
<td>10</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>RAP for the Households evicted from December 2015 to January 2016</td>
<td>6</td>
<td>1</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>RAP for PAHs and businesses in the Lower Basin - Phase 1</td>
<td>6</td>
<td>2</td>
<td>Stage 1</td>
<td>PO-RALG</td>
</tr>
<tr>
<td>RAP for PAHs and businesses in the Lower Basin - Phase 2</td>
<td>pm</td>
<td>3</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>RAP for PAHs and business in the Lower Middle Basin</td>
<td>pm</td>
<td>3</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>RAP for PAHs and business in the Middle Basin</td>
<td>pm</td>
<td>4</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>Prepare the relevant feasibility studies</td>
<td>10</td>
<td>2</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>Manage the public procurement process - DBFM options for:</td>
<td>10</td>
<td>1</td>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>1 Deepen and widen the Msimbazi in the Lower Basin</td>
<td>4</td>
<td></td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>The channel between Selander Bridge and Jangwani Bridge</td>
<td>4</td>
<td>1</td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>The channel between between Jangwani Bridge and the Kawawa Bridges</td>
<td>4</td>
<td>1</td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>2 Sediment removal in the Lower Basin and terrace building</td>
<td>3</td>
<td></td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>The three terraces in Mkunguni, Hananasif and Suna</td>
<td>3</td>
<td>1</td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>The six terraces in the area between Morogoro Road and Kawawa Road</td>
<td>3</td>
<td>3</td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>3 Reconstructing Jangwani Bridge</td>
<td>4</td>
<td>1</td>
<td>Stage 2</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Implementation planning
## Strategies and Key Interventions

<table>
<thead>
<tr>
<th>Strategies and Key Interventions</th>
<th>SC No</th>
<th>Duration (years)</th>
<th>Time Horizon</th>
<th>Champion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Restore the natural ecosystem and make room for the river</strong></td>
<td></td>
<td></td>
<td>Stage 1</td>
<td>TFS</td>
</tr>
<tr>
<td>Reforestation and rehabilitation</td>
<td>1</td>
<td>10</td>
<td></td>
<td>TFS</td>
</tr>
<tr>
<td>Wetlands rehabilitation</td>
<td>1</td>
<td>10</td>
<td></td>
<td>MOWI</td>
</tr>
<tr>
<td>Mangrove forest restoration and expansion</td>
<td>1</td>
<td>10</td>
<td></td>
<td>TFS</td>
</tr>
<tr>
<td>Vegetation for floodplains and river banks</td>
<td>3</td>
<td>10</td>
<td></td>
<td>MOWI</td>
</tr>
<tr>
<td><strong>Design and Develop the Lower Basin City Park</strong></td>
<td></td>
<td></td>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>Integrate/align the Detailed Plan in the Dar es Salaam Masterplan</td>
<td>10</td>
<td>1</td>
<td></td>
<td>PIU</td>
</tr>
<tr>
<td>Prepare the terraced lands for mixed urban development</td>
<td>9</td>
<td>4</td>
<td></td>
<td>DCC</td>
</tr>
<tr>
<td>Market the Msimbazi Opportunity Park for private investment in real estate development</td>
<td>9</td>
<td>10</td>
<td></td>
<td>MADC</td>
</tr>
<tr>
<td>Invest and build up the first three completed terraces in the Lower Basin</td>
<td>9</td>
<td>3</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td>Invest and build up terraces 4, 5, 6, 7, 8, and 9 in the Lower Basin</td>
<td>9</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td>Sale of apartments and commercial real estate</td>
<td>9</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td><strong>Implement Stage 2: Detailed Plan for Lower Middle Basin</strong></td>
<td></td>
<td></td>
<td>Stage 3</td>
<td></td>
</tr>
<tr>
<td>Design Charrette Detailed Plan for area Kawawa Roads and Nelson Mandela Road</td>
<td>10</td>
<td>1</td>
<td></td>
<td>DCC</td>
</tr>
<tr>
<td>Implement Stage 2 of the Msimbazi Opportunity Plan</td>
<td>10</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td>Sale of apartments and commercial real estate on terraces</td>
<td>10</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td><strong>Implement Stage 3: Detailed plan for Vingunguti upstream</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Charrette Detailed Plan for Vingunguti and the Middle Basin</td>
<td>10</td>
<td>1</td>
<td></td>
<td>DCC</td>
</tr>
<tr>
<td>Implement Stage 3 of the Msimbazi Opportunity Plan</td>
<td>10</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td>Sale of apartments and commercial real estate on terraces</td>
<td>10</td>
<td>4</td>
<td>P</td>
<td>MPA</td>
</tr>
<tr>
<td><strong>Support inter-institutional coordination, cooperation, communication; and funding</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use planning, communication and enforcement</td>
<td>1</td>
<td>33</td>
<td></td>
<td>MLHHSD</td>
</tr>
<tr>
<td>Design and build retention ponds and reservoirs</td>
<td>2</td>
<td>5</td>
<td></td>
<td>MOWI</td>
</tr>
<tr>
<td>Local rain water harvesting</td>
<td>2</td>
<td>30</td>
<td></td>
<td>DCC</td>
</tr>
<tr>
<td>Local infiltration and retention</td>
<td>2</td>
<td>30</td>
<td></td>
<td>DCC</td>
</tr>
<tr>
<td>River monitoring</td>
<td>3</td>
<td>33</td>
<td></td>
<td>MOWI</td>
</tr>
<tr>
<td>Contract for sedimentation traps and controlled sand mining</td>
<td>3</td>
<td>32</td>
<td>P</td>
<td>MADC</td>
</tr>
<tr>
<td>Contract for maintenance dredging</td>
<td>3</td>
<td>26</td>
<td>P</td>
<td>MADC</td>
</tr>
<tr>
<td>Reinforcing critical river banks against erosion</td>
<td>5</td>
<td>33</td>
<td></td>
<td>MOWI</td>
</tr>
<tr>
<td>Relocation Wastewater Treatment Plant</td>
<td>5</td>
<td>3</td>
<td></td>
<td>PO-RALG</td>
</tr>
<tr>
<td>Action Plan to Improve Msimbazi river water quality for the MSPA</td>
<td>7</td>
<td>10</td>
<td></td>
<td>NEMC</td>
</tr>
<tr>
<td>Action Plan to Improve Solid Waste Management for the MSPA</td>
<td>8</td>
<td>10</td>
<td></td>
<td>DCC</td>
</tr>
</tbody>
</table>

Table 4: Implementation planning (continued)

Legend:
- **P**: Private Sector funding - Business case
- Regular operations funded from the annual budget
The PIU action plan is tabulated at the next page. The PIU tasks are listed under five headings:

A. Maintain the momentum created by the charrette process
The commitment of the stakeholders and the support from local and national politicians are an invaluable asset of the project and essential for decision making on the sensitive issues of inter-institutional coordination.

B. Create the planning and management framework
To move beyond Commitment to Action some of the proposed interventions need to be worked out further in terms of institutional feasibility, detailed design and environmental and social impact assessment.

C. Complete the planning process
Formal approval of the Detailed Plan and its alignment with the draft Dar Es Salaam Master-plan is highly desirable to facilitate the proposed institutional arrangements and zoning in the land-use plan for the Lower Basin.

D. Coordinate the implementation of Stage 1 interventions
The four interventions of Strategic Component 1 need to be further developed. Project documents including procurement plans, detailed designs, as well as the finalization of the ESIA and Resettlement Strategy are a priority.

E. Implement the Msimbazi Opportunity Plan
A structured and participatory engagement process with the private sector should be put in place with the objective of clearly defining attractive investment conditions for their involvement.
<table>
<thead>
<tr>
<th>Intervention</th>
<th>MRB</th>
<th>UB</th>
<th>MB</th>
<th>LMB</th>
<th>LB</th>
<th>Mandated partner</th>
<th>Other authorities with overlapping mandates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Maintain the momentum created by the charrette process</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Inform the Msimbazi charrette stakeholder team of the concrete actions that will follow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG</td>
<td>NGOs and TURP partners</td>
</tr>
<tr>
<td>2. Set up a consultation system which will keep the affected communities positively engaged in every phase of the way forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>NGOs and TURP partners</td>
</tr>
<tr>
<td><strong>B. Create the planning and management framework</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Establish the Program Implementation Unit (PIU) and Steering Committee (SC):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC</td>
<td>KMC, IMC,</td>
</tr>
<tr>
<td>4. Establish capacity for Stakeholder communications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td>5. Prepare a multi-annual Msimbazi intervention program and Action Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td>6. Study the technical, institutional, economic and financial feasibility of the Detailed Plan for the Lower Basin; and undertake a Strategic Environmental and Social Impact Assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td><strong>C. Complete the planning process</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Finalize the procedures and ensure that the Msimbazi Special Planning Area and its boundaries are gazetted and demarcated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MLHHSN</td>
<td>DCC-PIU, NEMC</td>
</tr>
<tr>
<td>8. Ensure DP registration and alignment with the Dar es Salaam Master Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG</td>
<td>MLHHSN</td>
</tr>
<tr>
<td>9. Formally adopt the Detailed Plan for the lower basin between Selander bridge and the Kawawa bridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG</td>
<td>PS of Tamisemi, MLHHSN, NEMC, DCC</td>
</tr>
<tr>
<td>10. Finalize the resettlement strategy and prepare the Resettlement Action Plan for the PAHs in the Lower Basin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, NEMC, WB</td>
</tr>
<tr>
<td>11. Start the next Charrette process for the area between Kawawa Road and Nelson Mandela Road</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG</td>
<td>VPO, World Bank</td>
</tr>
<tr>
<td><strong>D. Coordinate the Implementation of the Stage 1 interventions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Design a Msimbazi reforestation and mangrove restoration plan with TFS; Mobilize the financing and support its implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG, PIU</td>
<td>TFS</td>
</tr>
<tr>
<td>13. Prepare the tendering documents and tender for the engineering contracts for dredging and terrace making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td>14. Use the dredged materials to create the terraces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td>15. Implement the RAPs and Livelihood Restoration Programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td><strong>E. Prepare and implement the Msimbazi Opportunity Plan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Establish the Lower Basin as a special investment zone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MLHHSN</td>
<td>DCC</td>
</tr>
<tr>
<td>17. Establish the Msimbazi Planning Authority</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PS Tamisemi</td>
<td>Steering Committee MLHHSN, DCC</td>
</tr>
<tr>
<td>18. Establish the Msimbazi Area Development Corporation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DCC-PIU</td>
<td>PO-RALG, TURP partners</td>
</tr>
<tr>
<td>19. Mobilize the finance and investors for realization of the Msimbazi Opportunity Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG, TURP partners</td>
<td>VPO-DMD, Climate Foundation</td>
</tr>
<tr>
<td>20. Redesign and reconstruct the Jangwani Bridge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO-RALG</td>
<td>MWTC</td>
</tr>
</tbody>
</table>

Table 5: PIU Action Plan
The first steps to move from planning to action were initiated in August 2018, when the DCC PIU was established, and the Detailed Plan for the Lower Basin was publicly presented. Selemani S. Jafo (MP) Minister of State, President’s Office Regional Administration and Local Government and January Y. Makamba (MP) Minister of State, Vice President’s Office, Environment and Union Affairs have pledged their support and PO-RALG is actively engaging with Ministry of Finance to secure initial funding from the World Bank, which has indicated its support for the Msimbazi Opportunity.

The momentum is there. Let’s get to work.
1. Citation from the Terms of Reference (2017); prepared by the World Bank for the Msimbazi Charette Consultants contract ‘A Strategic Development and Management Framework and Detailed Plan for the Msimbazi River Basin through participatory stakeholder engagements’


4. Project calculations based on national statistics and reported population growth rates for Dar es Salaam

5. Information shared within the Msimbazi stakeholder team

6. Citation from the Terms of Reference prepared by the World Bank for the Msimbazi Charette Consultants contract


14. University of Cape Town (September 2017), Dar es Salaam Climate Profile

16. Source: Interview transcriptions from the SenseMaker survey, conducted by the Charrette Consultants and Young Ambassadors of Nipe Fagio – see also the Appendix on the SenseMaker story board.

17. Source: Information received from KMC and validated in site visit during the Msimbazi Charette process


21. TAHMO stands for Trans-African Hydro-Meteorological Observatory. This project aims to create a dense network of 20,000 hydro-meteorological monitoring stations throughout sub-Saharan Africa. It is an initiative of TU Delft.

22. Dr. Kees Sloff (Deltares) and Mr. Adri Verwey (World Bank), (April 30 – May 4, 2018). Aide Memoire - Technical Mission – Role of morphological (sediment deposition and erosion) processes in the Msimbazi River.

23. Not investigated in the Charrette process

24. Tanzania Forest Service, E.M. Nashanda (20 July 2018). Concept note for the proposed PUGU- KAZIMZUMBWI forest landscape and Msimbazi river basin restoration program written for the Msimbazi Opportunity Plan

25. Japhet et al 2013. Integrated assesment of forest cover change in Tanzania


29. Breeze 2012. Municipal Solid Waste Management in Dar es Salaam – Draft Baseline Analysis


31. Based on samples taken at thirteen sites, Joseph and Hepworth, (2014); and Chanzi, (2017)

32. These major polluters are not controlled by discharge permits as required under the Water Resource Management Act 2009, or environmental certification as required under the Environment Management Act 2004.
33. VPO-UNEP (2011), Dar es Salaam city environment outlook 2011, Division of Environment, Vice-President’s Office, United Republic of Tanzania


35-36 CLUVA (2013). Nyed, P.K. Herslund, Deliverable 3.4 – Map of high risk areas for selected case areas (Dar es Salaam), Copenhagen University


38. Flood risks, hazards and vulnerability are not quantified in monetary terms in this MSMF.


42. Ramani Huria; www.ramanihuria.org


45. CCI, (2016). Assessment of the impacts of demolition of houses along Msimbazi River

46. CLUVA, (2013). ‘Climate change and vulnerability in Dar es Salaam’. Poster


48. Source: SenseMaker survey results presented in Appendix B in Volume C

51. Locally known as the Ng’ombe River


53. Expected to be gazetted before the end of 2018

54-55-56. PO-RALG, (2018). Concept paper on resettlement prepared in the context of the Msimbazi Charrette project

57. The SenseMaker Survey, (2018). Showed that 35% of the community members would prefer to resettle inside their Mtaa.


62. New soil binding techniques have been developed and tested in various sites worldwide that could transform Msimbazi river sand into stable construction materials of varying strengths, such as blocks for retention walls, and/or bricks for path and building construction. It is recommended to explore the local availability of suitable sediment binding materials, such as fly ash, and establish the feasibility of reuse of Msimbazi sediments for the local construction industry. This should demonstrate that dredged materials can become a local substitute for concrete at competitive prices which could then catalyze additional investment in local urban redevelopment.

63. Where a Minister is of the opinion that, having regard to the provisions of this Act, it is appropriate to establish an Executive Agency for the purpose of carrying out the functions of a department of his Ministry he may, after obtaining appropriate authority, by Order published in the Gazette, establish such an Agency. According to Section 3 of the Executive Agency Act.
The Msimbazi Opportunity