

Business Case for Durban's Transformative Riverine Management Programme

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LIST OF ABBREVIATIONS

100RC	100 Resilient Cities Programme (Rockefeller Foundation)
ARPP	Aller River Pilot Project
BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BMZ	Federal Ministry of Economic Cooperation and Development (Germany)
CAPEX	Capital expenditure
CFF	C40 Cities Finance Facility
COI	Community of Innovators
CSCM	eThekwini Coastal Stormwater & Catchment Management Department
CSI	Corporate Social Investment
CSIR	Council for Scientific and Industrial Research
D'MOSS	Durban Metropolitan Open Space System
DBSA	Development Bank of Southern Africa
DEFRA	Department for Environment, Food and Rural Affairs, United Kingdom
DGC	Durban Green Corridor
DSW	Durban Solid Waste
DUCT	Duzi uMngeni Trust
ECF	eThekwini Conservancies Forum
EI4WS	Ecological Infrastructure for Water Security Fund
EMA	eThekwini Municipal Area
EPCPD	eThekwini Environmental Planning & Climate Protection Department
EPIC-A	Educational Partnership for Innovation in Communities for Africa
EPWP	Expanded Public Works Programme (National Government)
EWS	eThekwini Water and Sanitation Department
GEF	Global Environment Facility
GGP	Gross Geographic Product
GII	Gender Inequality Index
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HDI	Human Development Index
IAPs	Invasive Alien Plants
IDP	Integrated Development Plan
IIPSA	Infrastructure Investment Programme for South Africa (DBSA)
INK	Inanda KwaMashu Ntuzuma
IPCC	Intergovernmental Panel on Climate Change
LIRA	Leading Integrated Research for Agenda 2030 in Africa
MOA	Memorandum of Agreement
NBA	National Biodiversity Assessment
NPC	Non-profit company
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
OPEX	Operational expenditure
PES	Payment for Ecosystem Services
PET	Polyethylene Terephthalate
RSM	eThekwini Roads & Stormwater Management Department
RVBMA	Riverhorse Valley Business Management Association
SANBI	South African National Biodiversity Institute
SES	Social-ecological System
SPV	Special Purpose Vehicle
TRMP	Transformative Riverine Management Programme
TTT	Climate Change Technical Task Team (eThekwini Municipality)
UEIP	uMngeni Ecological Infrastructure Partnership
UKZN	University of KwaZulu-Natal
WWF	Worldwide Fund for Nature

GLOSSARY

Benefit Cost Analysis (BCA): Benefit-cost analysis is an evaluation of the balance between the benefits and costs of policies or projects. It can be used to compare the ratio of benefits to costs of different alternatives, and so inform decision-making processes. Both costs and benefits can be articulated narrowly to reflect only financial or monetary value, or more broadly to capture the full social and economic impact of a policy or project. Financial benefits are usually quantified on the basis of cost-savings or avoided costs. Non-financial benefits may be human, social, economic or ecological/environmental, and cannot always be articulated in financial terms.

Business case: A Business Case provides justification for undertaking a project, programme or portfolio. It evaluates the benefit, cost and risk of proposed or possible options and provides a rationale for the preferred solution.

Carbon sequestration: The process of capturing and storing atmospheric carbon dioxide in plants, soil and the ocean through assimilation by biological organisms. Carbon sequestration is one method of reducing greenhouse gases in the atmosphere with the aim of mitigating climate change.

Climate resilience: Resilience refers to the capacity of a social-ecological system both to withstand perturbations from for instance climate or economic shocks and to rebuild and renew itself afterwards. Loss of resilience can cause loss of valuable ecosystem services, and may even lead to rapid transitions or shifts into qualitatively different situations and configurations, evident in, for instance people, ecosystems, knowledge systems, or whole cultures (Stockholm Resilience Centre).

Ecosystem services: An ecosystem service is any positive benefit that wildlife or ecosystems provide to people.

Gross Geographic Product: A monetary measure of the market value of all final goods and services produced in a region and representing the size of the economy, in this case the eThekweni Municipal Area.

Human Benefit Index: A 'Human Benefit Index' developed by Cartwright *et al.* (2013)¹ is used in this study. This comprises of the product of: (i) the number of people benefiting from a particular intervention and (ii) the importance of the benefit.

iNgonyama Trust: The iNgonyama Trust is a corporate entity established to administer the land traditionally owned by the Zulu people, represented by their king, for the benefit, material welfare and social well-being of the Zulu nation, who continue to occupy the land as they historically have done. The Trust is governed by a Board of Directors (the iNgonyama Trust Board), and the sole Trustee is King Zwelithini Goodwill kaBhekuzulu.

¹ Cartwright, A., Blignaut, J., de Wit, M., Goldberg, K., Mander, M., O'Donoghue, S., and Roberts, D. 2013. Economics of climate change adaptation on a municipal level under conditions of uncertainty and resource constraints: The case of Durban, South Africa. *Environment & urbanization*, 25(1):1-18.

Net Present Value (NPV): The difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

Payment for Ecosystem Services: The name given to a variety of arrangements through which the beneficiaries of ecosystem services, from watershed protection and forest conservation to carbon sequestration and landscape beauty, reward those whose lands provide these services with subsidies or market payments.

Riverine area: A riverine area includes the river and lands immediately surrounding it and may also be referred to as a 'riparian' area.

Social-ecological System: A social-ecological system consists of a 'bio-geo-physical' unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their contextual problems.

Social Discount Rate: Used to put a present value on costs and benefits that will occur at a later date. In the context of climate change policymaking, they are considered very important for working out how much today's society should invest in trying to limit the impacts of climate change in the future.

Special Rating Area: Special Rating Areas (SRAs) (may also be called Urban Improvement Precincts) are established in terms of a municipality's property rates policy and involve an additional rate levied on property, payable by owners in a defined area, to raise funds for the improvement or upgrading of such an area. It is a vehicle created to serve the purposes of upliftment, rejuvenation and sustainability when a collective of landowners are in agreement of such needs.

Traditional Authority: The term 'Traditional Authority', as used in this document, refers to the iNgonyama Trust.

Transformative Climate Action: Transformative climate action or investment seeks to reduce the root causes of vulnerabilities to climate change by transforming social and ecological systems into more just, sustainable, or resilient states.

Vulnerability Assessment: Climate change vulnerability assessments help establish understanding of the extent to which changing climate will affect a defined spatial area, ecological or social system or economy. Vulnerability assessments go beyond the analysis and quantification of the immediate hazards stemming from changes in temperature and rainfall (exposure), assessing also the characteristics of the system itself and how it may respond to such hazards (sensitivity), as well its ability to deal with the anticipated impacts (adaptive capacity).

EXECUTIVE SUMMARY

1. Introduction

eThekweni Municipality's vision is to be Africa's most caring and liveable city by 2030. In support of this vision, it plans to establish a Transformative Riverine Management Programme (TRMP), which works in partnership with all affected stakeholders to collectively rehabilitate and sustainably manage all riverine areas within its boundaries.

The eThekweni Municipal Area² (EMA) is home to approximately 3.9 million people and covers 2,555 square kilometres, two thirds of which is peri-urban / rural. It is drained by over 7,000km of rivers within 18 major catchments, some of which extend far inland of the municipal boundary. These rivers flow into 16 estuaries³ along the city's 98km long coastline before reaching the Indian Ocean.

The TRMP aims to:

- Build resilience through transformative adaptation to climate change,
- Enhance riverine ecosystem functioning,
- Transform riverine corridors into valuable places which are clean, safe, healthy, useful and pleasant open spaces,
- Generate social and economic opportunity,
- Impact positively on the city as a whole,
- Demonstrate the value of community-ecosystem based adaptation as an inclusive, effective climate change response.

This aligns with eThekweni Municipality's overarching vision of being the most livable and caring city in Africa by 2030 and will support both climate change adaptation and mitigation as part of Plan One of the city's nationally legislated Integrated Development Plan. It will also support implementation of the Durban Climate Change Strategy and Climate Action Plan through its focus on ecosystem and community-based adaptation, as well as disaster risk reduction. Furthermore, TRMP is one of the key knowledge-sharing components in the eThekweni Municipality's implementation of the Durban Adaptation Charter Hub and Compact Approach⁴, where city-to-city peer exchange visits help stimulate climate change adaptation action on the continent.

At the essence of this is the concept of transformative climate change adaptation and resilience. Transformative adaptation addresses the root causes of climate change

² The eThekweni Municipal Area is administered by the eThekweni Metropolitan Municipality and contains the city of Durban.

³ The Umlaas River no longer has an estuary as the lower reaches are canalised. Other river systems, such as the Umbilo and uMhlatuzana, are also completely canalised in the lower reaches, but flow into the Durban Bay Estuary, which has been significantly modified for use as Africa's largest shipping port.

⁴http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/Projects/Pages/11.Implementation-of-the-Durban-Adaptation-Charter.aspx

vulnerability, and requires a radical, systems scale, path-shifting, innovative and continuous learning approach.

2. TRMP Business Case

The Business Case presents an evidence-based rationale for investment in transformative riverine management across the approximately 7,000km of watercourses in the EMA.

It motivates that the effective management of these watercourses can alleviate a service delivery backlog and avoid social productivity losses, as well as deliver a basket of valuable financial, socio-economic, human and ecological benefits in line with eThekweni Municipality's mandate to deliver services in a sustainable, cost-efficient and equitable manner. A clear link is made between these benefits and their role in improving the resilience of the municipal administration, citizens and business/industry to escalating climate change risks and impacts.

The Business Case has been prepared through a year-long process of specialist studies, hydrological and ecological systems modelling, Benefit Cost Analysis and stakeholder consultations.

This work represents a key building block in the eThekweni Municipality's climate resilience pathway. It seeks to unlock increased investment from the municipal fiscus in ecological infrastructure as a supplier of vital goods and services, but also from other government actors, non-governmental and private sector stakeholders, and citizens.

3. Why the TRMP is an Investment Priority

Riverine areas are essential providers of life-giving services, such as fresh water and spaces for recreation and spiritual activities.

Riverine areas provide critical ecosystem services, including: surface water supply, flood reduction, regulation of dry season flows, erosion and sedimentation reduction, food production, water quality maintenance, solid waste capture, biodiversity habitats and conservation, maintenance of transport access⁵, carbon capture and storage, bioenergy, visual amenity and elevated property values, and recreation. By providing these services, rivers support human well-being, effective service delivery and a healthy economy. However, there are very few rivers in South Africa that have escaped degradation from human activities and an associated reduced capacity to deliver beneficial services. Climate change is heavily compounding the damages to river ecosystems and escalating the associated human, financial and economic risks.

Climate change impacts on riverine areas could cost the municipality and citizens of the EMA more than R375 million per annum by 2040.

The major proportion of riverine areas in the EMA (51%) fall within largely peri-urban / rural Traditional Authority areas administered by the iNgonyama Trust, many of which

⁵ Naturally functioning rivers provide protection for road / bridge crossing points.

are experiencing rapid rates of settlement densification. eThekweni Municipality owns / is responsible for 23% of riverine areas, and 26% are in private ownership (businesses and individuals).

As a result of urban development, Durban's riverine areas are already degraded and operating on average 42% below their potential⁶ in delivering essential ecosystem services, such as surface water supply, flood reduction, and cultural and recreational amenity, all of which support human well-being, effective service delivery and a healthy economy. Climate change will exacerbate flooding and water quality problems, accelerate erosion and sedimentation impacts, and drive faster growth of invasive alien species, which will further transform and destabilise Durban's riverine ecosystems.

With climate change, riverine ecosystem service levels are predicted to decline on average 11% below current levels by 2040 (Figure 1).

This will translate into an ongoing burden of low-level service delivery and rapidly increasing risks and service delivery costs that will be felt by all citizens in the EMA. The poorest communities are most vulnerable in this context, given their existing service delivery deficit and their limited capacity to cope with risk and loss. The eThekweni Municipality will be directly affected, with annual damages to municipal road culverts alone due to increased climate change related flooding estimated at over R151 million by 2040. Declining river water quality will affect coastal tourism and property values, as well as the ability of riverine communities to access and use rivers for household water provision, crop irrigation, and recreation. The annual cost implications for the well-being of municipal citizens and coastal users is estimated to reach R224 million by 2040.

Evidence from riverine management projects such as eThekweni Municipality's Sihlanzimvelo Stream Cleaning Programme suggests that good condition, well-managed streams and rivers can help buffer the municipality, citizens and businesses from the escalating flood and human health risks associated with climate change. They also contribute positively to societal well-being and cost-efficient municipal service delivery.

Rivers influence and are influenced by the people, land uses and economic activities that surround them. Transforming the human and economic relationship with riverine areas is central to ecosystem-based adaptation to climate change, building resilience and reducing vulnerability.

Modelling of various riverine management scenario's in the Ohlanga River Catchment (Figure 1) demonstrated that investing in "Future Riparian Management" - even with the added pressures brought by climate change - would be almost sufficient to keep ecosystem services at current (baseline) levels.

There are some riverine ecosystem services where riparian management actions alone would not be sufficient to entirely mitigate climate change related losses. A **transformative management** focus on both the riparian zone and the broader

⁶ The theoretical best case assumes all built, agricultural and natural land uses riverine areas are in pristine / best possible condition, sustainably managed, and operating at 100% of potential in producing ecosystem services.

catchment (i.e. “Future Catchment Management” in Figure 1) could improve most ecosystem service levels an average of 10% above current levels, even with the effects of climate change factored in.

A “transformative” approach to riverine management that limits land use impacts on rivers, restores and manages riverine areas, could therefore reduce the city’s exposure to climate change risks and reduce current shortfalls in societal, financial and economic benefits from rivers.



Figure 1: Modelled supply of riverine ecosystem services in the Ohlanga River Catchment under future climate change, riparian and catchment management scenarios⁷.

4. Building on Existing Successes: the potential for Upscaling Sihlanzimvelo

In 2012, eThekweni Municipality’s Roads and Stormwater Management Department initiated the Sihlanzimvelo Stream Cleaning Programme. The focus of the Programme is on reducing recurrent damage costs to road culverts caused by solid waste and invasive alien plant debris build up during flash floods through managing stream areas more effectively. Local community co-operatives are employed to implement the work, resulting in a labor-intensive municipal service delivery model that creates direct socio-economic benefits in vulnerable communities.

The Sihlanzimvelo Programme demonstrates that managing rivers contributes meaningfully to sustainable municipal service delivery, reduced ecological and

⁷ Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

social vulnerability to climate change, enhanced human well-being, and job creation.

The current Sihlanzimvelo Programme covers 450km of rivers on municipal land in upper catchment areas where surrounding settlement densities are high. In the 2020/21 financial year, the Programme created around 600 jobs through 86 community co-operatives, with a high percentage of these being women and youth.

The eThekweni Municipality has recognised the potential job creation, ecological, municipal service delivery and climate adaptation benefits of upscaling the Sihlanzimvelo Programme to other rivers in the EMA. This would involve expanding the current project to all first and second order streams on municipal land in the EMA (1,168km of rivers / streams). The annual cost of implementing an upscaled Sihlanzimvelo Programme is estimated⁸ at R92 million and would result in avoided municipal culvert damage costs⁹ of at least R59 million per annum. By improving the condition of municipal riverine ecosystems, vulnerable riverine communities are estimated to be protected from annual losses of over R90 million, and coastal users by over R87 million each year.

By expanding the Sihlanzimvelo community co-operative model, at least 1,557 permanent jobs could be created through 234 co-operatives.

As a climate change risk response, upscaling Sihlanzimvelo offers fair value to the eThekweni Municipality in avoided infrastructure damages for each Rand spent. It represents an important investment to protect the well-being of vulnerable riverine communities and the coastal economy. The direct job creation and additional green economy enterprise development opportunities (linked to alien plant biomass and riverine solid waste off-take agreements) are important in the context of these being created in some of the most vulnerable riverine communities in the EMA.

A second option that eThekweni Municipality wishes to pursue is the adoption of a more transformative model of riverine management at a city-wide scale (see next section). This includes a greater focus on riverine restoration and social interventions than is currently included in the Sihlanzimvelo programme model. Transformative riverine management is more costly to implement than Sihlanzimvelo, but will yield greater societal benefits in the form of avoided climate change related damage costs. It should be noted, however, that these are not mutually exclusive options. Rather, a blended process is recommended, involving upscaling of Sihlanzimvelo as a known, tested implementation model, with incremental introduction of transformative management in priority locations where the additional investment in a transformative approach will yield greatest benefits.

⁸ Mander, M., Mander, N., Blignaut, J., de Winnaar, G., Butler, A., Graham, M., and Cartwright, A. (2020). Benefit Cost Analysis Technical Report. Report produced for C40 Cities Finance Facility and GIZ.

⁹ Only road culvert damage costs are included in this estimate. It is therefore likely to be a substantial under-estimate given that electrical, sewer, road, water and telecommunications infrastructure are often also affected when road culverts are damaged by flash flooding.

5. City-wide TRMP Investment Case

A city-wide TRMP would not only limit climate change impacts on riverine services, but could lift ecosystem services levels by 10% above the status quo.

Public and private investment of R7.5 billion in transformative riverine management over 20 years could unlock municipal and societal benefits ranging between R13 billion and R26 billion¹⁰.

To address municipal, societal and economic risks associated with climate change effects on Durban's rivers, a systems-scale shift in human and economic interactions with rivers is needed alongside targeted restoration and management of riverine ecological infrastructure. This will enhance river condition and improve ecosystem services as a buffer to climate change impacts. The eThekweni Municipality's vision is to establish a Transformative Riverine Management Programme (TRMP) for this purpose.

An effective TRMP will require mobilisation of a wide range of government actors, private and Traditional Authority landowners, civil society, business and industry, research institutions, and donor funding agencies. A suitable transversal riverine governance mechanism, with associated capacity, is required to create the enabling conditions for effective protection, restoration and management of Durban's rivers, as well as upstream catchment areas falling outside the municipal boundary.

Through implementing transformative riverine governance as mentioned above, eThekweni Municipality could unlock substantial co-investment in the implementation of riverine management actions by private landowners and third parties (including other government and donor funders).

By spending R719 million on transformative riverine governance over 20 years, eThekweni Municipality could enable R4.5 billion in co-investment by private landowners, other government and third parties.

The resulting benefits to society could be substantial, with each R1.00 of investment in transformative riverine management across the EMA (collectively by all stakeholders) potentially yielding between R1.80 and R3.40 in avoided municipal and societal costs¹¹.

Implementation of transformative riverine management assumes a focus on positive social-ecological systems change in relation to rivers. Biophysical riverine management interventions include both ecological restoration and management at a systems scale, aiming to improve the functionality and resilience of rivers to urban impacts and climate change. The condition and/or management of the built / agricultural landscape surrounding rivers would also be improved, such that accelerated stormwater, sediment loads and pollution entering rivers is minimised. Social interventions aim to build human, social and institutional capital in a way that promotes positive behaviour change and active river stewardship in response to a recognition of the value of rivers to people and the economy. Socio-economic and

¹⁰ The lower end of this scale of benefits uses a 6% social discount rate, whereas the higher end of this spectrum assumes a 6% social discount rate on all costs and municipal benefits, and -1% discount rate on private and traditional authority land benefits. The real financial benefit likely lies somewhere between these two values.

¹¹ The range depends on the social discount rate used.

environmental benefits of riverine management are accelerated through green economy initiatives that make productive use of solid waste and alien plant biomass – either arising from riverine management activities or as a means of reducing waste entering rivers. The social / economic use of riverine areas as places of recreation and tourist activities or harvesting of natural resources is assumed to be optimised within sustainable limits. Agriculture / food gardening on river floodplains is supported, where appropriate, to enhance resilience to increased river flooding and sedimentation, and to limit negative impacts on river ecosystems.

The Benefit Cost Ratio (BCR) of municipal transformative riverine management investment does, however, differ between landownership types. For every R1.00 in municipal TRMP investment, R0.30 in damage to municipal road culverts could be avoided on municipal land. However for each R1.00 spent by the municipality on transformative riverine governance targeting private land, R5.20 in avoided municipal culvert damage costs could be achieved; similarly, R1.00 municipal expenditure targeting Traditional Authority land could save R1.70 in avoided municipal culvert damage costs. It is important to emphasise that these numbers are a significant under-representation of the potential avoided infrastructure damage costs, given the exclusion of other potentially affected infrastructure types in these calculations (for example electricity, roads, wastewater, telecommunications and water infrastructure).

The societal co-benefits of this municipal investment are notable, with each Rand spent by the municipality also protecting vulnerable riverine communities from losses linked to damaged infrastructure and increasing exposure to risks associated with declining river conditions, as well as creating local income generating opportunities. Coastal users stand to benefit significantly without incurring additional costs, and it may be prudent to find appropriate cost sharing mechanisms that allow these groups to contribute towards securing coastal benefits from riverine management.

The “societal value” generated by a transformative riverine management investment by the municipality far outweighs the cost, however, this value accrues to a variety of residents in the region (including riverine communities and coastal communities), rather than only to the eThekweni Municipality. This need not be a problem: government departments do not have to return a profit and one of the economic functions of government is to generate the valuable public goods for which a private sector incentive is insufficient to mobilise investment.

The potential exists to create 9,181 jobs through over 1,000 community co-operatives in a city-wide TRMP.

In addition, enterprise development in the green economy is possible through the productive use of organic biomass and litter collected from rivers (as well as solid waste collection in informal settlements to prevent it washing into rivers). The manner in which these new opportunities are created offers important opportunities for gender equity and social inclusivity.

Transformative riverine management offers significant benefits for society, but for individual private landowners, riverine management costs are likely to exceed the

direct benefits from their investment¹². There remains, however, good reason for private investment to avert damage to private property linked to declining river condition, particularly in high flood / erosion risk locations. As private investment would unlock substantial public good (including substantial avoided damage costs to municipal infrastructure), there may be justification for financial or other incentives and cost-sharing that supports or enable private landowners to invest appropriately in priority areas. Mutually beneficial partnerships between private landowners, the municipality and the coastal users may foster enhanced riverine management that benefits broader society. These partnerships may also create opportunities for Corporate Social Investment and Enterprise Development initiatives that create jobs, empower small enterprises, develop skills, and deliver a range of social / environmental benefits through transformative riverine management. This may offer opportunities for funding riverine management, for example on a business's own land or along a local river, with the added benefit of improved amenity and value of the business's own property.

Failure to manage streams in upper catchment areas, a significant proportion of which fall within Traditional Authority areas, will undermine management investment downstream. As in the private landowner scenario, the downstream beneficiaries have an incentive to support upstream management, given the risk of future ecosystem service declines. On this basis, a Payment for Ecosystem Services¹³ approach offers potential. However, this will only function in so far as the desired ecosystem service levels are delivered to the paying users.

6. The case for TRMP Investment on Private Land

The municipality and broader society could avoid over R176 million per annum in losses if the municipality can enable private landowner investment in riverine management.

Private landowners have a critical role to play in investing in ecological infrastructure both as an investor, and as a landowner. There are regulations¹⁴ in South Africa that compel public and private landowners to manage IAPs on their land, but also a number of motivations for private sector investment in ecological infrastructure. One of the main motivators is to manage risk. In some sectors, investing in ecological infrastructure serves as a direct investment in risk reduction to a business, such as in the case of insurance companies playing a collaborative role in reducing their exposure to flood or fire risk. In some cases, a company or entire sector may recognise the importance of the ecosystem services that are critical in their supply chain or the production of their own products, such as clean, readily available water; and invest in the supply of these services. Investing in ecological infrastructure is also an investment in a more stable society, through helping to address poverty and socioeconomic disparities. Much corporate social investment is built on this premise.

¹² This is because rivers are systems and riverine management in one part of the system may generate the create greater benefits downstream than at the site of management.

¹³ Payments for Ecosystem Services is the name given to a variety of arrangements through which the beneficiaries of environmental services, from watershed protection and forest conservation to carbon sequestration and landscape beauty, reward those whose lands provide these services with subsidies or market payments (www.panda.org).

¹⁴ National Environmental Management: Biodiversity Act, Alien and Invasive Species Regulations (2014)

Approximately 26% of rivers in the EMA fall on privately owned land, including individuals and businesses. There are a growing number of riverine management projects and programmes involving partnerships between the eThekweni Municipality and private landowners. This suggests that there is sufficient incentive in key locations – often associated with known / existing riverine risks – for private investment in riverine management. However, to unlock wider investment and participation by private landowners across the EMA, eThekweni Municipality will need to find ways of motivating and supporting action.

For each Rand spent by the municipality on enabling private landowner management of rivers, eThekweni Municipality would benefit between R3.30 (basic management) and R5.20 (transformative management) in avoided culvert damage costs, and coastal users would benefit by between R3.20 and R6.50¹⁵.

To enable a basic level of riverine management by private landowners, eThekweni Municipality would need to spend R8.3 million per annum to enforce legislation and support / partner with riverine landowners and third-party funders. This public investment could unlock R106 million in private funding of riverine management each year and save the municipality at least R27 million in avoided culvert damage costs. Broader benefits to riverine communities and coastal users amount to just over R113 million per annum.

To enable a more transformative model of riverine management on private land, eThekweni Municipality would need to spend R153 million over 20 years to unlock R2.4 billion in investment by private landowners and third-party funders, including businesses. This could save R803 million in avoided damages to municipal road culverts. Avoided losses to vulnerable riverine communities could be between R665 million and R1.4 billion¹⁶. Coastal users could avoid between R8.1 billion and R16.7 billion in losses from declining coastal quality linked to rivers¹⁰⁹.

Private landowner investment in transformative riverine management could create 3,189 job opportunities.

Mobilising private landowners to better manage riverine areas will require mechanisms that facilitate collaboration, sharing of knowledge, and pooling of resources in a way that enhances landowner motivation and capability to engage in river stewardship. These mechanisms should be responsive to variable / context-specific interests, allowing for clustering around common or overlapping interests, which may be spatially defined or linked to specific riverine risks or green economy opportunities.

As the municipal avoided infrastructure damage costs from private riverine management investment are potentially substantial, there is justification for the municipality to contribute financially to the costs of managing private riverine areas in key locations that present best value in terms of infrastructure protection. Alternatively, financial support could be levied through Special Rating Areas in which the municipality jointly contributes towards the cost of managing rivers with private landowners in key areas.

¹⁵ Depending on the social discount rate used in calculating the benefits.

¹⁶ Depending on the social discount rate used in calculating the benefits.

7. The Case for TRMP Investment on Traditional Authority Land

Management of upper catchment areas on Traditional Authority land is a critical strategy to minimise ecosystem service losses with climate change.

Just over half of the rivers within the EMA fall within Traditional Authority areas, mostly within upper catchments. The rural and peri-urban nature of these landscapes is such that streams and rivers are generally less impacted by urban development than elsewhere. Upper catchment areas play a critical role in protecting the condition of the entire downstream riverine ecosystem. Damage costs and management requirements for rivers may escalate disproportionately with declining condition of upper catchment areas. Conversely, management of upper catchment streams and rivers yields notably high ecosystem services benefits to all downstream users.

For each Rand spent on enabling riverine management on Traditional Authority land, eThekweni Municipality could unlock between R1.70 and R3.40 in avoided culvert damage costs, while protecting coastal quality.

To enable a basic level of riverine management on Traditional Authority land, eThekweni Municipality would need to spend R4.8 million per annum to enforce legislation and support / partner with the iNgonyama Trust and third-party funders (i.e. government, donors). This public investment could unlock R102 million in third-party funding of riverine management each year and save the municipality at least R16 million in avoided infrastructure damage costs. Broader benefits to riverine communities and coastal users amount to over R107 million per annum.

The eThekweni Municipality would need to spend R117.7 million over 20 years to unlock R2 billion in transformative riverine management investment by third parties on Traditional Authority land. This could create 3,146 job opportunities and result in nearly R206 million in avoided damages to municipal road culverts. Vulnerable riverine communities could benefit by between R511 million and R1 billion in avoided losses. Coastal users avoid between R7.8 billion and R16 billion in losses from declining coastal quality linked to rivers.

Given that Traditional Authority land is managed for community benefit using government funding, eThekweni Municipality will need to partner with the iNgonyama Trust and local leadership in facilitating large-scale third-party investment in riverine management – for example from other government or donor funders. Co-operative governance needs to be strengthened to ensure that land-use decision making in Traditional Authority areas are consistent with TRMP objectives.

8. Implementation Recommendations

1. Prioritisation & scaling

The Business Case has focused on building an argument for investment in riverine management at systems-scale in the EMA. While this transformative riverine management ambition is important, in real terms implementation will need to be phased in over several years. The achievement of a TRMP at city-scale is therefore likely to follow a long-term a process of scaling-up and

expanding implementation focus over time as capacity is built, stakeholders mobilised, and financing mechanisms developed.

Well-reasoned prioritisation of upscaling and associated TRMP investment is critical to ensure that the desired benefits are achieved, and incremental successes can be used to steadily build a city-wide TRMP. For this purpose, it is recommended that a TRMP implementation plan / strategy be developed that defines riverine management priorities and sets out a clear pathway toward addressing these over a realistic timeframe.

2. Governance & institutional capacity

The Business Case highlights the importance of transformative riverine governance as a mechanism for mobilising multi-actor, transversal, long-term systems-scale restoration and management of rivers in the EMA. This will require dedicated capacity with an appropriate mandate within the eThekweni Municipality administration. Even to facilitate a basic level of riverine management, additional capacity will be required, however a transformative approach will be more intensive.

A TRMP implementation plan needs to be drawn up which sets out an appropriate governance structure and institutional arrangements, including capacity.

3. Partnerships

Partnerships in which respective landowners (including other government) contribute and benefit from riverine management are crucial to the financial viability and implementation of a TRMP. How to convene these partnerships remains a central question for the TRMP ambition. Partnerships will need to be established across a variety of levels. Each level (local, catchment, and city-wide) will require a specific, strategic aim and objectives, a different arrangement of stakeholders, a deliberate governance configuration, and intentional engagement platforms. At each of these levels the city would decide whether it wants to drive the process or be a partner in the process.

4. Financing models

Funding for the TRMP will need to come from multiple sources, including the municipal fiscus, donors, the private sector, riverine landowners, and other spheres of government¹⁷. A funding strategy for the TRMP needs to be developed that details how and when these sources of funding should be accessed. Importantly, mechanisms will be needed for pooling resources to

¹⁷ It will be important to identify which spheres of government may benefit from riverine management investment. This may include Provincial and National Roads departments whose infrastructure may be protected from flood damage by riverine management in the same manner that municipal road culverts have been demonstrated to be. These beneficiaries of riverine management investment should be encouraged to contribute financially towards management that creates cost savings for them. Similarly, where the TRMP aligns with other government objectives and mandates, such as job creation, environmental management and coastal management, funding from these departments could be motivated for.

achieve jointly desired riverine management outcomes in specific regions, and amongst specific groups.

5. Green Economy approach

For riverine management investment to achieve transformative green economy outcomes that go beyond discrete projects and form a central part of the local economy, it should seek to, (i) leverage additional investment from multiple sources, (ii) create new types of work or jobs that contribute positively to the natural environment and social inclusion, (iii) create new value and new partnerships, (iv) improve access to markets and create markets for new goods or services, and (v) facilitate learning and innovation. Importantly, eThekwin Municipality should not seek to establish green economy enterprises or intervene in value chains / markets. Rather, it should support, facilitate and enable enterprise development through making opportunities known, entering into off-take agreements for biomass and solid waste cleared from municipal riverine areas, and offer business skills training and mentorship.

6. Gender sensitivity

Given the disproportionate vulnerability of women to the impacts of climate change, combined with historic gender imbalances, the Business Case includes a set of principles which could support gender-sensitive design of riverine management projects. These principles can be used to support and improve gender-sensitive project development, implementation, and monitoring and evaluation to optimize transformational benefits of riverine corridor management in the eThekwin Municipality Area.

CHAPTER 1: CONTEXT

1.1 Introduction

Riverine areas are essential providers of life-giving services, such as fresh water and spaces for recreation and spiritual activities.

Riverine areas provide critical ecosystem services, including: surface water supply, flood reduction, regulation of dry season flows, erosion and sedimentation reduction, food production, water quality maintenance, solid waste capture, biodiversity habitats and conservation, maintenance of transport access¹⁸, carbon capture and storage, bioenergy, visual amenity and elevated property values, and recreation. By providing these services, rivers support human well-being, effective service delivery and a healthy economy. However, there are very few rivers in South Africa that have escaped degradation from human activities and an associated reduced capacity to deliver beneficial services. Climate change is heavily compounding the damages to river ecosystems and escalating the associated human, financial and economic risks.

Durban's river assets

The eThekweni Municipal Area¹⁹ (EMA) is home to approximately 3.9 million people and covers 2,555 square kilometres, two thirds of which is peri-urban / rural. It is drained by over 7,000km of rivers within 18 major catchments. These rivers flow into 16 estuaries²⁰ along the city's 98km long coastline before reaching the Indian Ocean.

eThekweni Municipality's ecological infrastructure is contained within the 95,000 hectare Durban Metropolitan Open Space System (D'MOSS), which comprises interconnecting open spaces in public, private and Traditional Authority ownership. D'MOSS seeks to protect the biodiversity and associated ecosystem services of Durban for future generations. This includes protecting built infrastructure from natural disasters such as floods and ocean storm surges. Riverine corridors play a key role in the D'MOSS by linking ecosystems in the rural hinterland with the coast. These riverine corridors also contain approximately 7,500 hectares of wetlands including floodplains, swamp forest and reedbeds.

The ecosystem services delivered by ecological infrastructure in the EMA were estimated in 2017²¹ to be worth at least R4.2 billion per year, with the total natural asset value estimated between R48 and R62 billion.

D'MOSS is also central to eThekweni Municipality's status as a global leader on climate change adaptation and mitigation. Ecosystem-based adaptation has become a central approach in the city's response to increased climate change risk, particularly through

¹⁸ Naturally functioning rivers provide protection for road / bridge crossing points.

¹⁹ The eThekweni Municipal Area is administered by the eThekweni Metropolitan Municipality and contains the city of Durban.

²⁰ The Umlaas River no longer has an estuary as the lower reaches are canalised. Other river systems, such as the Umbilo and uMhlathuzana, are also completely canalised in the lower reaches, but flow into the Durban Bay Estuary, which has been significantly modified for use as Africa's largest shipping port.

²¹ Turpie, J., Letley, G., Chyrstal, R., Corbella, S. and Stretch, D. (2017). A Spatial Valuation of the Natural and Semi-Natural Open Space Areas in eThekweni Municipality. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/26765>

the involvement of local communities²² in the restoration and management of ecological infrastructure²³. Wetlands and forest ecosystems have been recognised as particularly valuable for carbon sequestration. The restoration of degraded ecological infrastructure also offers significant opportunities for job creation, whilst providing benefits for biodiversity, people and the climate.

Rivers are functioning sub-optimally

Most of Durban's rivers have been severely modified by human and economic activities within their catchments, some of which extend far inland of the eThekweni Municipality boundary (see Figure 2). The 2018 National Biodiversity Assessment²⁴ suggests that 95% of these rivers suffer a significant level of ecological degradation, with only 5% remaining in "good condition". While roughly 42% of the land in EMA river corridors²⁵ has already been transformed for urban or agricultural land uses²⁶, settlement expansion and densification continue to press steadily into the city's remaining natural riverine corridors.

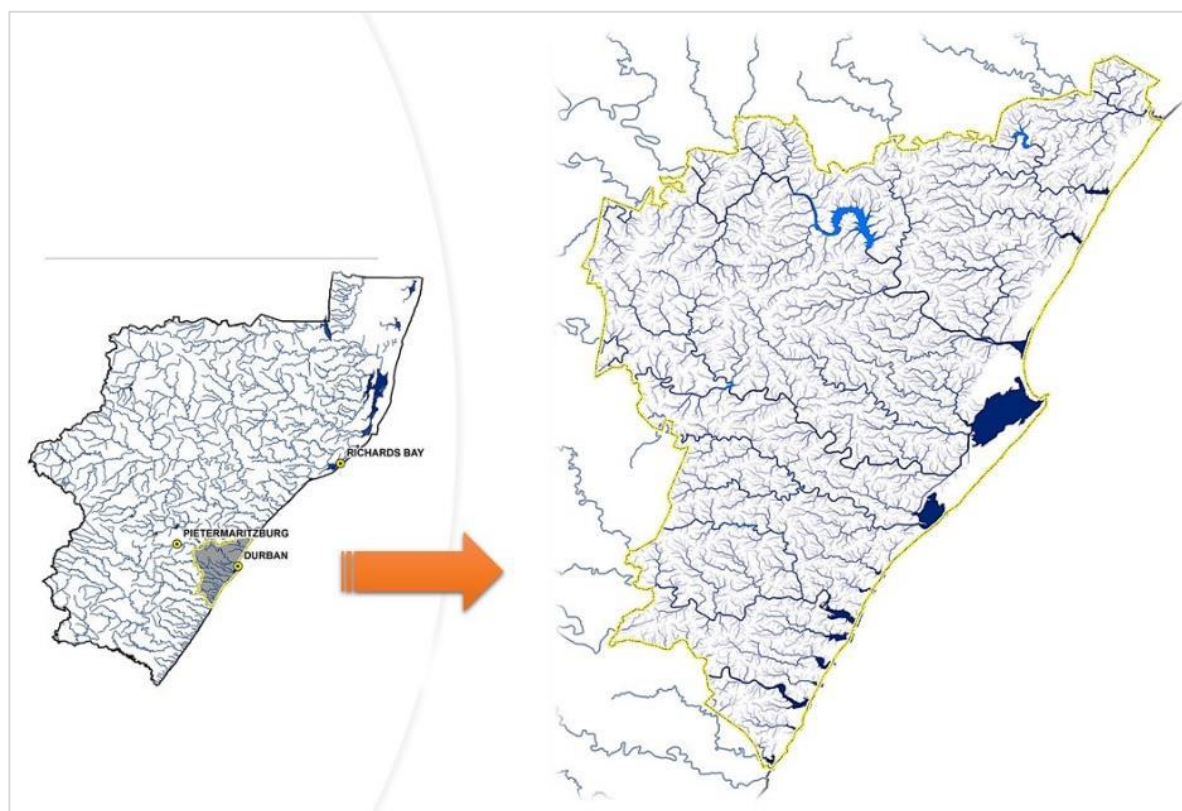


Figure 2: River systems in the eThekweni Municipal Area – several of the major rivers arise far inland of the municipal boundary.

²² Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender, N., McInnes, A., McLean, A., O'Donoghue, S. and Spires, M. (2012). Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by- doing" at the local government coal face. *Environment & Urbanization*, 24(1): 167:195.

²³ When Durban hosted the 2011 17th Conference of the Parties (COP17), eThekweni Municipality defined its Community Ecosystem Based Adaptation (or CEBA) approach to climate change adaptation.

²⁴ <http://bgis.sanbi.org/Projects/Detail/221>

²⁵ Assumed to include river floodplains plus a 100m wide buffer.

²⁶ de Winnaar, G., Louw, A., Graham, M. and Mander, N. (2020). River Vulnerability Assessment for eThekweni Municipality. Report produced for C40 Cities Finance Facility and GIZ.

Water quality in the majority of the city's rivers is now classified as poor or critical²⁷, presenting significant health risks to the many communities using river water for supplementary household consumption or food gardening, and potential for increased cost to purify water for potable use in central water supply systems. This situation also threatens the health of Durban's estuaries, beaches and ocean, with negative implications for Durban's coastal economy. Uncollected solid waste dumped or being swept into rivers with stormwater, combined with accelerated erosion, sediment accumulation and invasive alien plants (IAPs) have also become the source of recurrent road culvert blockages and associated damage to municipal roads, water / sewer pipelines, and electrical infrastructure, as well as private property.

There are multiple human and economic drivers behind this decline in river condition, including²⁸:

- Municipal service delivery deficits that account for open defecation and uncollected solid waste,
- Sewage and industrial pollution,
- Accelerated urban run-off due to increased sealed surfaces in river catchments,
- Alteration of river flows through dams, water abstraction and inter-catchment water transfers (including release of treated wastewater effluent into rivers),
- River habitat destruction for agriculture, urban development and sand mining,
- IAP infestations, and
- Solid waste dumping.

Durban's rivers are bearing the brunt of increasing pollution and catchment-scale hydrological changes caused by growth in urban settlement. Informal settlements (both rural and urban) pose a particular set of problems for rivers, given limited levels of municipal solid waste and sanitation servicing, and a lack of stormwater management systems in these areas. Municipal sewerage systems are straining under growing loads and increasingly pressured maintenance budgets, often resulting in leaks and spills that have a severe impact on rivers, estuaries and the coastal zone.

Climate change

Climate change is compounding existing pressures on Durban's rivers, with associated social, financial and ecological impacts escalating noticeably. The frequency and intensity of floods is growing, costing many lives and millions of Rands²⁹ in damages, as well as displacing thousands of people, and risking tipping river and estuary ecosystems into a downward spiral. Beach closures due to poor quality water are becoming more common, and anecdotal evidence³⁰ suggests people are getting

²⁷ eThekweni Water and Waste Services, Ucity Water Quality Index, 2020.08.19.

²⁸ eThekweni Municipality Integrated Development Plan 2019-2020.

²⁹ Flash floods in 2017 and 2019 each cost the municipality well over half a billion Rands in damages to infrastructure.

³⁰ *Pers comm* Mike Ward (Director: Creating Sustainable Value) (2020).

sick more often when swimming at some of Durban's beaches, especially during the rainy season. Climate change is only likely to increase existing problems such as this.

Global climate models predict up to a 2°C increase in average air temperatures, a 10% increase in average daily rainfall, and a 20% increase in the intensity of rainfall events in the EMA by 2045³¹. This is forecast to further change flooding frequencies and intensities in the city by up to 15%, and increase erosion and sediment yields from rivers by as much as 30%. Climate change is also expected to increase Durban's drought intensity and long-term water scarcity. Increased river water temperatures will exacerbate existing water quality issues, driving up the cost of treating river water to potable standards and amplifying the risk of waterborne diseases.

Ecosystem services modelling recently completed in the Ohlanga River Catchment³² (see Figure 3) demonstrated that riverine ecosystem service levels are already some 40% to 50% lower than their potential level in a theoretical best case³³. With climate change, ecosystem service levels generally decline on average 11% below the baseline (i.e. *status quo*). The most significant ecosystem service declines driven by climate change are seen in the modelling as solid waste capture, dry season flows, water quality maintenance, transport access, visual amenity and biodiversity conservation. Similarly, flood reduction, erosion and sediment reduction, carbon capture and recreation also show the potential for serious declines. On the other hand, bioenergy services grow considerably with sugar cane and IAPs flourishing under a warmer and wetter future climate, with atmospheric carbon fertilisation contributing to more rapid plant growth rates³⁴.

³¹ Davis, N and Schulze, R. 2020. Vulnerability Assessment Report. Report produced for C40 Cities Finance Facility and GIZ.

³² Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

³³ The theoretical best case assumes all built, agricultural and natural land uses riverine areas are in pristine / best possible condition, sustainably managed, and operating at 100% of potential in producing ecosystem services.

³⁴ Note that while this may be seen as a positive outcome for bioenergy production, invasive alien plants create significant disservices that would further degrade the condition of riverine areas, and create declines in other ecosystem services as a result.

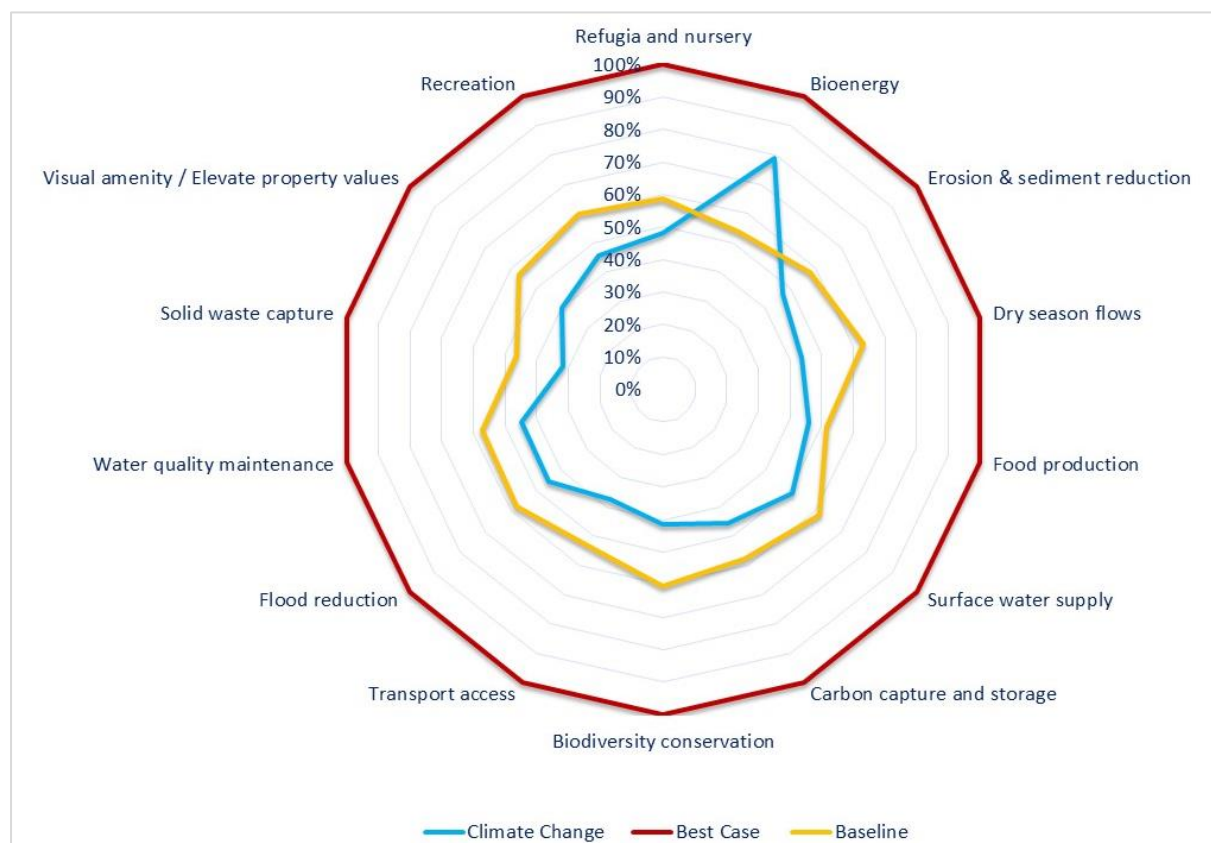


Figure 3: Supply of riverine ecosystem services in the Ohlanga River Catchment under best case, baseline (status quo) and future climate change scenarios³⁵.

Risk-responsive riverine management

Evidence from riverine management projects such as eThekweni Municipality's Sihlanzimvelo Stream Cleaning Programme suggests that good condition, well-managed rivers can help buffer the municipality, citizens and businesses from the escalating flood and human health risks associated with climate change. They also contribute positively to societal well-being and cost-efficient municipal service delivery (e.g. as a sustainable source of water or urban stormwater management services). By contrast, riverine areas in poor condition are associated with negative impacts and costly disbenefits to government and society. Human and economic interactions with riverine areas can play a significant role in intensifying these negative impacts locally or elsewhere in the river catchment system, or conversely – minimising them. For example, canalising rivers or clearing wetlands for agricultural use may generate revenue for farmers, yet create significant risk and cost for people downstream who suffer increased flooding and river sedimentation as a result. Climate change is expected to significantly exacerbate the negative impacts of poor riverine management. By contrast, a well-managed wetland in a commercial area may reduce flood risk in a human settlement area downstream.

Modelling of various riverine management scenario's in the Ohlanga River Catchment (see Figure 4) shows that investing in effective "Future Riparian Management", even

³⁵ Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

with the added pressures brought by climate change, would be almost sufficient to keep ecosystem services at current (baseline) levels. This suggests that a basic level of riverine management is required to limit the social, economic and financial losses associated with declining river condition under climate change.

There are however some riverine ecosystem services where riparian management actions alone would not be sufficient to entirely mitigate climate change related losses. A management focus on both the riparian zone and the broader catchment (Future Catchment Management scenario) was shown to improve most ecosystem service levels an average of 10% above present levels, even with the effects of climate change. This suggests that a “transformative” approach to riverine management, which addresses the sources of negative impacts on rivers with restoration and management of riverine areas, would not only reduce the city’s exposure to future climate change risks, but also help address current shortfalls in societal, financial and economic benefits from rivers.



Figure 4: Supply of riverine ecosystem services in the Ohlanga River Catchment under future riparian and catchment management scenarios³⁶.

Transforming the human and economic relationship with riverine areas clearly needs to be part of a sustainable approach to reducing climate change vulnerability and building resilience in the EMA. As rivers are complex social-ecological systems, addressing riverine condition and associated risk requires a multi-faceted, transversal, long-term process. The opportunity for linking riverine management to a thriving, innovative, inclusive and labour-intensive green economy, and so expanding the

³⁶ Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

positive social and economic benefits of riverine areas is significant when considering the spatial extent of eThekweni Municipality's rivers.

1.2 Transformative Riverine Management Business Case

eThekweni Municipality's vision

eThekweni Municipality's vision is to establish a Transformative Riverine Management Programme (TRMP), which works in partnership with all affected stakeholders to collectively rehabilitate and sustainably manage all riverine areas in the EMA in a manner that:

- Builds resilience through transformative adaptation to climate change,
- Enhances ecosystem functioning,
- Transforms riverine corridors into valuable places which are clean, safe, healthy, useful and pleasant open spaces,
- Is generative of social and economic opportunity,
- Impacts positively on the city as a whole,
- Demonstrates the value of community-ecosystem based adaptation as an inclusive, effective climate change response.

This aligns with the city's overarching vision of being the most livable and caring city in Africa by 2030 and will support both climate change adaptation and mitigation as part of Plan One of the Municipality's nationally legislated Integrated Development Plan (IDP). It will also support implementation of the Durban Climate Change Strategy and Climate Action Plan through its focus on ecosystem and community-based adaptation, as well as disaster risk reduction. Furthermore, TRMP is one of the key knowledge-sharing components in the eThekweni Municipality's implementation of the Durban Adaptation Charter Hub and Compact Approach³⁷, where city-to-city peer exchange visits help stimulate climate change adaptation action on the continent.

The primary aim of the TRMP is to mainstream the protection and sustainable management of rivers based on best available knowledge of climate risks through integrated, inclusive and long-term local adaptation strategies that:

- Recognise the needs of vulnerable communities,
- Ensure sustainable local economic development,
- Prioritise the role of functioning ecosystems as core municipal ecological ('green') infrastructure,

³⁷http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/Projects/Pages/11.Implementation-of-the-Durban-Adaptation-Charter.aspx

- Provide direct access to funding opportunities,
- Build multi-sectoral partnerships at all levels.

At the essence of this is the concept of transformative climate change adaptation and resilience.

Transformative approach

Transformative adaptation addresses the root causes of climate change vulnerability, and requires a radical, systems scale, path-shifting, innovative and continuous learning approach.

People, land uses and economic activities surrounding rivers may both strongly influence and be influenced by rivers. How people interact with riverine areas influences the condition, health and function of riparian ecosystems. This in turn influences the quantity and quality of ecosystem services delivered by rivers, which people may need or benefit from. In acknowledging this cause and effect relationship, researchers and practitioners have increasingly recognised the need to manage riverine areas as socio-ecological systems^{38,39}.

Climate change adaptation has often been implemented as interventions focused on coping through incremental modifications of social and ecological systems without altering the fundamental characteristics of those systems. This approach has led to persistent vulnerabilities and sometimes escalating or shifting climate change impacts. By contrast, transformative climate adaptation fundamentally alters an entire system's ecological and/or social properties and functions^{40,41,42}. It is typically associated with restructuring and path-shifting, and is innovative, multiscale, systemwide, and persistent. It addresses the root causes of vulnerabilities to climate change, such as social, cultural, economic, environmental, and power relations, by transforming social and ecological systems into more just, sustainable, or resilient states⁴³.

However, the complexity introduced by a systems focus and transformational ambition can be overwhelming for decision-makers, especially considering that nobody sees, understands or governs the entire system.

In the context of South Africa, adaptation that is focused exclusively on technological or ecological 'fixes' is unlikely to prove durable. The greater challenge and potential contained in transformative adaptation involves combining improvements in social and

³⁸ Cote, M., and Nightingale, A. J. (2012). Resilience thinking meets social theory Situating social change in socio-ecological systems (SES) research. *Prog. Hum. Geogr.* 36, 475–489. doi:10.1177/0309132511425708

³⁹ Dunham, J., Angermeier, P., Crausbay, S. Cravens, A., Gosnell, H., McEvoy, J., Moritz, M., Raheem, N. and Sanford, T. (2018). Rivers are social-ecological systems: Time to integrate human dimensions into riverscape ecology and management. *Wiley Interdisciplinary Reviews: Water*. 5. e1291. 10.1002/wat2.1291.

⁴⁰ Fedele, G., Donatti, C.I., Corwin, E., Panglinan, M.J., Roberts, K., Lewins, M., Andrade A., Olvera, D., Frazee, S., Grover, M., Lalaina Rakotobe, Z., and Rambeloson, A. (2019), *Nature-based Transformative Adaptation: a practical handbook*, Conservation International, Arlington, VA, USA. <http://doi.org/10.5281/zenodo.3386441>

⁴¹ Adger, W.N. and Jordan, A. (2009). *Governing Sustainability*. Cambridge University Press, Cambridge.

⁴² Pelling, M., O'Brien, K. and Matyas, D. (2015). Adaptation and transformation. *Climatic Change*; 133 (1): 113–127.

⁴³ Kates, R.W., Travis, W.R. and Wilbanks, T.J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*; 109 (19): 7156–7161.

economic equality, participation, enhancement of rights, and environmental sustainability through the same intervention. Appropriate governance structures and processes are needed to secure and sustain these improvements.

Through the *Leading Integrated Research for Agenda 2030 in Africa* (LIRA 2030) project, researchers argue that:

“Transformative adaptation might pragmatically – given “real world” limitations – best be attempted as part of a process of gradual re-imagining and restructuring of incremental adaptation efforts, along a continuum that stretches from initial incremental adaptation efforts that are sequenced and expanded, in scale and ambition, towards transformative adaptation endeavours⁴⁴”.

This rationale, which is based on case studies in Durban and Harare, reiterates that transformative adaptation is part of a process rather than a target. Importantly, it is critical to recognise the value of a process of change, rather than trying to adopt an approach under a rigid framework.

Given the pulsed nature of change processes⁴⁵ and the ever-present risk of unforeseen and unintended consequences, continuous monitoring, learning and re-evaluation are key factors in change management. For transformative adaptation, this includes building an understanding of the complexity of dynamic natural and human system interactions and developing the necessary resource management competence as well as the ability reflect on and learn from experience⁴⁶.

Transformative adaptation investments, as envisaged through the eThekweni Transformative Riverine Management Programme, will therefore focus on:

- Restructuring and shifting social, economic and ecological systems at multiple scales,
- New innovations,
- Radical, large-scale, long-term and sustained positive impact,
- Catalysing replication, multiplication or upscaling of positive impact,
- Addressing the root causes of social and economic inequality, such as participation, rights and environmental sustainability,
- Continuous learning and re-evaluation.

Transformative action should promote greater social and economic equality, participation, rights, and environmental sustainability. This means that transformative action should include a focus on the poor and the natural environment.

⁴⁴ Pasquini et al. (forthcoming). The makings of transformative adaptation in southern African cities: using criteria to explore cases in Harare and Durban. First manuscript produced by the LIRA 2030 Project team.

⁴⁵ Moench, M. (2009). Responding to climate and other change processes in complex contexts: challenges facing development of adaptive policy frameworks in the Ganga Basin. *Technological Forecasting and Social Change*, 77(6): 975–986. DOI: 10.1016/j.techfore.2009.11.006

⁴⁶ Bawden, R. (2007). Messy issues, world views and systemic competencies. *Social Learning Systems and Communities of Practice*, Blackmore, C. (ed). 89–101. DOI: 10.1007/978-1-84996-133-2

Business Case purpose & structure

This Business Case presents an evidence-based rationale for investment in transformative riverine management across the 7,000km of watercourses in the EMA. It motivates that the effective management of these watercourses can alleviate a service delivery backlog and avoid social productivity losses, as well as deliver a basket of valuable financial, socio-economic, human and ecological benefits in line with eThekweni Municipality's mandate to deliver services in a sustainable, cost-efficient and equitable manner. A clear link is made between these benefits and their role in improving the resilience of the municipal administration, citizens and business/industry to escalating climate change risks and impacts.

The Business Case has been prepared through a year-long process of specialist studies, hydrological and ecological systems modelling, economic modelling and stakeholder consultations. Specialist studies (available as separate reports) undertaken which informed the Business Case included:

- Baseline assessment⁴⁷ evaluating existing riverine management programmes and projects in the EMA,
- Gender⁴⁸, green economy⁴⁹ and river vulnerability^{50,51} specialist studies,
- Analysis of the regulatory framework⁵² and implications for partnership-based river management,
- Transformative riverine management proto-masterplan⁵³, including riverine ecosystem services flow modelling under climate change and various riverine management scenarios,
- Ecological infrastructure and socio-ecological toolkit⁵⁴ containing detailed guidance on implementing various transformative riverine management interventions,
- Benefit cost analysis⁵⁵ for nine riverine management scenarios,

⁴⁷ Mander, N., Mander, M., Lamula, K., Graham, M., de Winnaar, G., Cartwright, A., Houghton, J. and Martel, P. (2020) Integrated Baseline Assessment Report. Report produced for C40 Cities Finance Facility and GIZ.

⁴⁸ Houghton, J. (2020) Gender Narrative Report. Report produced for C40 Cities Finance Facility and GIZ.

⁴⁹ Cartwright, A. and Mander, N. (2020). Green Economy Report. Report produced for C40 Cities Finance Facility and GIZ.

⁵⁰ Davis, N and Schulze, R. 2020. Vulnerability Assessment Report. Report produced for C40 Cities Finance Facility and GIZ.

⁵¹ De Winnaar, G., Louw, A., Graham, M. and Mander, N. (2020). River Vulnerability Assessment for the eThekweni Municipality. Report produced for C40 Cities Finance Facility and GIZ.

⁵² Groundtruth (2020). The regulatory framework and implications for partnership-based river management, based on lessons from key river partnership programmes. Report produced for C40 Cities Finance Facility.

⁵³ Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

⁵⁴ <https://www.c40cff.org/knowledge-library/transformative-adaptation-of-rivers-in-an-urban-context-an-ecological-infrastructure-and-socio-ecological-toolkit>

⁵⁵ Mander, M., Mander, N., Blignaut, J., de Winnaar, G., Butler, A., Graham, M., and Cartwright, A. (2020). Benefit Cost Analysis Technical Report. Report produced for C40 Cities Finance Facility and GIZ.

- Riverine management models⁵⁶ report detailing key assumptions used in the benefit cost analysis.

This work represents a key building block in the eThekweni Municipality's climate resilience pathway. It seeks to unlock increased investment from the municipal fiscus in ecological infrastructure as a supplier of vital goods and services, but also from other government actors, non-governmental and private sector stakeholders, and citizens.

Owing to the fact that land ownership along riverine corridors in the eThekweni Municipal Area may be municipal, private or traditional, the Business Case is presented in several parts. The Business Case starts off by presenting the investment case for a municipal-wide TRMP that cuts across all landownership types in river corridors (Chapter 2), then breaks this down into separate cases for each land ownership type along riverine corridors (Chapters 3, 4 and 5). This is followed by an example of how the “transformative” riverine management approach proposed in the Business Case could be implemented across the whole of a river catchment, including the costs of implementation (Chapter 6). The final chapter presents recommendations for progressing the Business Case arguments toward a practical Implementation Plan (Chapter 7).

The Business Case is supported by a Benefit-Cost Analysis (BCA). The BCA and Business Case have been informed by several specialist studies and stakeholder engagements. The technical reports associated with the BCA and specialist studies are available separately and are referenced where appropriate.

A summary of the Chapter contents is presented below:

- **Chapter 1** presents the eThekweni Municipality **context** for TRMP investment.
- **Chapter 2** presents a **city-wide** TRMP Business Case for partnership-based transformative riverine management that cuts across municipal, private and Traditional Authority land ownership along riverine corridors in the EMA.
- **Chapter 3** makes the case for upscaling management investment only on **municipal land** in riverine areas (a) in upper catchment areas through the existing Sihlanzimvelo Stream Cleaning Programme model, and (b) throughout the eThekweni Municipal Area through a range of municipal-led projects or programmes.
- **Chapter 4** makes the case for transformative riverine governance by eThekweni Municipality that enables and unlocks management investment by **private landowners** throughout the EMA through partnerships, incentives and policy enforcement;
- **Chapter 5** makes the case for transformative riverine governance by eThekweni Municipality that enables riverine protection and management on **Traditional Authority** land.

⁵⁶ Mander, N., Mander, M., de Winnaar, G., Graham, M. and Butler, A. (2020) Riverine Management Models Report. Report produced for C40 Cities Finance Facility and GIZ.

- **Chapter 6** presents a prototype TRMP at catchment-scale for the Ohlanga River Catchment. This provides an example of the suite of interventions that could be included and highlights the importance of social and institutional interventions alongside biophysical riverine management if transformative outcomes are to be achieved. It also demonstrates how transformative riverine management interventions have been costed for the relevant BCA scenarios.
- **Chapter 7** presents guidance on the development of an implementation framework for a TRMP within the EMA.
- **Chapter 8** contains the key conclusions and recommendations from the study.

1.3 Learning from Experience

Over the past 10 years, eThekweni Municipality has either implemented or been a partner in numerous projects and programmes focused on improving the condition of rivers, most often with the aim of adapting to climate change risks. While some projects have been entirely funded by the municipality, others are donor funded, or funded from multiple sources.

Demonstrating the social and economic value associated with healthy rivers can help to shift mindsets and grow greater willingness for river stewardship by communities, businesses and government. Highlighting the link between rivers and the green and circular economies is emerging as a key opportunity to expand such benefits from existing riverine management investment. A foundation of this transformative approach is the need to build human, social, ecological and institutional capital that is supportive of riverine protection and management.

Table 1: Examples of riverine management initiatives in the EMA

Project	Key Objectives	Lead Agent
Sihlanzimvelo Stream Cleaning Programme (approved 2009, initiated 2012, ongoing)	To reduce the cost of repairing flood damage to road culverts through better managing rivers on municipal land in upper catchment areas with high settlement densities. In addition to offering cost-effective municipal service delivery, Sihlanzimvelo has been recognised for its ability to provide a range of public and private benefits, including creating employment and income in areas of high socio-economic need within the city, protecting built infrastructure, reducing the extent of flooding, and linkages to green enterprises through recycling of litter collected from rivers.	eThekweni Municipality's Roads and Stormwater Maintenance (RSM) Department funds and implements the programme.
uMngeni Ecological Infrastructure Partnership Project (UEIP) (initiated 2013, ongoing)	In response to growing concerns about water security, the project was established to facilitate investment in ecological infrastructure in the uMngeni River Catchment, the major supplier of water to Durban and several other city regions in the province of KwaZulu-Natal. The project fosters collaboration between eThekweni Municipality and other local	eThekweni Municipality's Water & Sanitation Unit, and Environmental Planning & Climate Protection Department, in partnership with South African National

	governments in the catchment, as well as provincial and national government departments, business and academic institutions, and civil society.	Biodiversity Institute. Funding sourced from donor agencies.
Palmiet Catchment Rehabilitation Project (initiated 2015, ongoing)	Established as a proof of concept pilot project under the UEIP, the project involves an innovative, shared-governance approach to catchment management with a climate change adaptation focus. It addresses the source of river impacts and seeks to enhance ecological infrastructure functions. Partnerships are facilitated through a Community of Innovators (CoI) comprising local conservancies, research institutions, civil society, and various municipal service departments.	Coordinated by eThekweni Environmental Planning and Climate Protection Department. Funding sourced from donor agencies.
Wetland Rehabilitation for Climate Adaptation in the uMhlangane River Catchment Project (2013 to 2016, wetland maintenance ongoing)	An ecosystem-based adaptation project involving wetland restoration and river management with the aim of reducing flood risk and improving river water quality. Wetland restoration and long-term management was implemented in partnership with the management agency of the adjacent Riverhorse Valley Business Park. A continuous water quality monitoring station was also installed to measure long-term impacts of the intervention on water quality downstream.	eThekweni Environmental Planning & Climate Protection Department; Coastal Stormwater & Catchment Management Unit; Economic Development Unit; Water & Sanitation Unit. Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), and co-funded by the Durban-Bremen Climate Partnership
Aller River Project (2016 to 2020)	Community mobilisation and riverine management action along a 5.8km stretch of the Aller River through New Germany and Clermont, incorporating low income and informal housing areas, middle income residential areas, industrial zones and D'MOSS areas. Included participatory video, youth and local leadership education.	eThekweni Conservancies Forum in partnership with eThekweni Municipality, Kloof Conservancy and the Duzi uMngeni Conservation Trust. Funding provided by eThekweni Municipality and donors.
Green Corridors Programme (initiated 2010, ongoing)	Local communities employed to maintain, improve and create new riverine open spaces. Sustainable livelihoods supported through upcycling / recycling waste from rivers and growing food near restored streams. Community-based eco-tourism and nature-based youth development.	Green Corridors NPC, with funding on a 3-year cycle from eThekweni Municipality and donors.
Wise Wayz Water Care Project	Volunteers from the Folweni and Ezimbokodweni communities in the lower Mbokodweni River Catchment adopted a 30km stretch of river upstream of the Umbogintwini Industrial	I4Water non-profit, with corporate social investment funding from AECL. eThekweni

(initiated 2016, ongoing)	Complex to address flooding and water quality impacts caused by illegal solid waste dumping, alien plant infestations, sewage leaks and discharges, potable water pipeline leaks and illegal sand mining. Communities receive training and support in establishing sustainable enterprises that service the project and wider markets.	Municipality contributed towards community training.
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Climate resilience

The Sihlanzimvelo Stream Cleaning Programme has focused on enhancing the resilience of municipal infrastructure to the impact of more frequent and intense flash floods. Sihlanzimvelo has contributed significantly to municipal learning on how climate resilience can be enhanced through shifts in traditional approaches to service delivery. At present, Sihlanzimvelo enhances infrastructure resilience on a localised scale. There is obvious potential for increasing transformative adaptation and climate resilience benefits through upscaling of municipal stream and river management activities at a catchment systems scale.

The uMhlangane Wetland Rehabilitation Project demonstrated the value of restoring ecological infrastructure as part of the municipal stormwater system, particularly in the context of escalating climate change related flooding. Such ecological infrastructure restoration often requires both capital and operational funding, which can be difficult to raise within the boundaries of municipal financial policy given ecological infrastructure is not usually reflected in the municipal asset register. The project highlighted this structural problem and sought to demonstrate the case for functional ecosystems to be recognised in municipal accounting systems as critical infrastructure in need of adequate capital funding and ongoing maintenance, in the same way as engineered infrastructure. This also pointed to a need to unlock current problems associated with raising capital for major ecological infrastructure projects by way of loans. The project also highlighted that when there is shared value in ecological infrastructure between the municipality and private sector actors, co-investment can be leveraged.

The Palmiet Catchment Rehabilitation Project has demonstrated enhanced social resilience to accelerated flooding in exposed settlements through the use of community-initiated flood early warning systems⁵⁷. This highlights that municipal service delivery alone cannot negate climate change risks, and to protect the well-being of citizens, the municipality can proactively enhance community preparedness and social capacity to respond to unavoidable natural disasters. In addition, the project has facilitated community-based hazard mapping, which has built local capacity in understanding of the risks, supporting enhanced capability to respond effectively to these.

⁵⁷ A partnership between academics, local government and civil society with informal settlement leaders helped establish a Whatsapp group, whereby high rainfall recorded in the upper catchment triggered an alert to settlement dwellers near the confluence of the Palmiet with the uMngeni River, affording the dwellers approximately 30 minutes warning time before high river levels reached their settlement. This system is now augmented by the City's Forecast Early Warning System using radar to detect dangerous storm cells, providing an increased warning time.

The Aller River Project, Green Corridors Programme, Wise Ways Water Care Project, UEIP and uMhlangane Wetland Rehabilitation Project demonstrate the value of building human, social and institutional capital as mechanism for supporting enhanced resilience of ecological capital as a buffer for the socio-economic impacts of climate change. As the receiving environment for urban pollution and stormwater, even in peak condition rivers have a finite capacity to cope with the pressures placed on them. The need to transform behaviours and leverage broad-scale stewardship of rivers by communities and businesses will be critical to ensuring the pressures on rivers are minimised so that they can continue to buffer the impacts of climate change on human settlements and economic interests. Similarly, the linking of economic values (for example recycling of solid waste and organic material) to riverine management actions offers potential to develop a “river economy” as part of Durban’s green economy.

Addressing socio-economic needs

The Sihlanzimvelo Stream Cleaning Programme protects drainage infrastructure and supports the effective management of stormwater within the EMA, particularly during floods. It does this in a manner that creates multiple co-benefits and enfranchises local people with socio-economic benefits. In the 2020/21 financial year, the Programme is creating around 600 jobs through 86 community co-operatives that manage some 450km of river in total, with a high percentage of these being women and youth. This is a significantly higher labour intensity than the repairing of flood damage to roads from blocked stormwater culverts. The employing of local community co-operatives has not only overcome the structural barriers of commuting distances and skills levels that prevents many South Africans from accessing work in the mainstream engineering sector, but creates pride and accountability between workers and the local community that the work seeks to protect. The training, business skills and exposure to work is reported by beneficiaries⁵⁸ as having helped them in other areas of their lives, such as growing vegetables, starting small businesses and accessing employment.

Green economy opportunities

The potential is emerging for organic biomass and inorganic material collected from rivers to be sold in off-take agreements and inserted into value chains for items such as compost, biochar and paving stones. Realising this potential can attract increased investment and generate revenue that can help to accelerate job opportunities and the clearing of rivers as part of a green economy system.

Similarly, as the full benefits of rivers and healthy riverine habitats come to be appreciated and valued through initiatives such as Sihlanzimvelo, riverine systems will become valuable components of eThekweni Municipality’s green economy. The ultimate aim should be to have these assets registered in the municipality’s asset registry and maintained alongside other municipal assets. SANBI’s natural capital accounting framework⁵⁹ provides a nationally accepted means for reporting on these assets.

⁵⁸ Lamula, K. *pers comm.* (2020) from a survey of community partners in river corridor management projects conducted as part of the Business Case preparation process.

⁵⁹ <http://biodiversityadvisor.sanbi.org/planning-and-assessment/natural-capital-accounting/>

Delivering societal and ecological value

Once cleared of invasive alien plants and plastic and maintained by local co-operatives, riparian areas offer potential opportunities as places of recreation, farming and ritual ceremonies. Sihlanzimvelo community co-operative members reported reduced crime, increased community use of rivers (including water), reduced odour nuisance and improved community understanding of the value of rivers resulting from the Programme. Those involved in the co-operatives played a role in educating their communities to stop dumping and littering in rivers, which is believed to have supported behavioural shifts and supported social cohesion around rivers as community assets⁶⁰.

The Sihlanzimvelo Stream Cleaning Programme is reportedly having a number of positive ecological impacts, such as cleaner stream banks and improved water quality. The programme has potential to continually reduce problems created by solid waste and alien invasive vegetation in rivers through working in headwater systems. The impact of this programme on ecological systems functionality has significant potential for enhancement through the addition of ecological rehabilitation / restoration actions, such as riparian forest replanting in strategic locations, and wetland rehabilitation.

The Riverhorse Valley Wetland Rehabilitation Project has yielded a number of positive ecological impacts through the rehabilitation of the wetland. Namely, the enhanced functioning and integrity of the large floodplain systems. This improves the ecological status of the area which in turn has positive impacts for the local biodiversity.

The Wise Wayz Water Care Project engages in a number of activities related to addressing the ecological problems in the lower Mbokodweni Catchment, including water quality monitoring using citizen science tools, invasive alien plant removal and solid waste removal from water courses. The Ezimbokodweni wetland has been rehabilitated, improving the provision of ecosystem services.

Growing human and social capital for river stewardship

As a collective, these riverine management projects have begun to demonstrate the role and value of community (and business) stewardship of rivers. Given that government will likely never have the resources to manage all rivers alone, stewardship by local communities and businesses is essential. In urban areas, the value created for people and businesses by functional, healthy riverine areas is demonstrated by projects such as Wise Wayz Water Care and the uMhlangane Wetland Restoration Project as sufficient incentive for communities and businesses to contribute to river restoration and/or maintenance, including reporting pollution events to support a faster municipal response. Given that rivers are a repository for unmanaged by-products of urban settlements, community and business river stewardship is also key to ensuring behaviour that limits polluting impacts on rivers. This was a critical element of Wise Wayz Water Care, in which water abstraction for industrial use was threatened by declining river water quality.

⁶⁰ Lamula, K. *pers comm.* (2020) from a survey of community partners in river corridor management projects conducted as part of the Business Case preparation process.

The Aller River Project provided a broad base of training to their Eco-Champs, who used their new skills to build awareness and capacity in surrounding communities. A similar approach is being applied in the Palmiet Catchment Rehabilitation Project and Wise Wayz. This focus on building human and social capital is likely to yield notable community mobilization impact in active stewardship of rivers.

The Aller River Project included community-based monitoring and reporting of river health. Specifically, a system was developed to monitor water quality, invasive alien plant infestations, dumping, liquid effluent, untreated sewage spillages, as well as other biophysical issues such as blocked water courses. The project reportedly resulted in an improvement in river health, namely an improvement in the microbiological water quality. However, the ecological improvements noted in the area have been largely dependent upon reporting of incidents, such as sewage leaks, by the Eco-Champs and it is unclear whether in the absence of this programme the ecological benefits will be sustained.

Securing and scaling benefits

A key constraint to riverine management projects and unlocking the opportunities that riverine management presents is the intermittency of funding for this task. With few exceptions, the jobs created have been short term contracts, often with lengthy gaps between contracting opportunities as project funding cycles renewed, new funding was found, or procurement processes undertaken. Given the majority of job beneficiaries have no other source of income and limited opportunities for alternative employment, the need to improve the continuity of funding and efficient supply chain management processes are critical to ensuring that the socio-economic benefits of these investments are optimized (including sustainable reductions in vulnerability).

1.4 Estimating Benefits & Costs of Transformative Riverine Management

Riverine areas provide significant public and private good in the form of ecosystem services. However, their true value to society is often poorly understood and investment is often constrained by ‘free-rider’ or ‘collective action’ problems.

As with all forms of infrastructure, ecological infrastructure, such as rivers, comprises assets that need to be maintained and, in some cases, restored. Rivers in the EMA produce significant public and private good. As they degrade, they are becoming associated with increasing public and private costs and disbenefits.

Under-investment in rivers has occurred because of a failure to recognise the societal value of riverine ecosystem services. It is often only as these services begin to decline and create definable costs and risks that cogent arguments for management investment begin to emerge. Furthermore, because rivers are landscape-scale systems, landowners may not receive the full benefit of their river management efforts, and so tend to under-invest. Those that receive the benefits from others’ investment may become ‘free-riders’ by failing to contribute towards the costs. In these cases, where the market is unable to capture such externalities, the public sector often has a

role to play in ensuring optimal investment in ecological infrastructure at systems-scale.

Climate change is expected to drive increasing risks and costs associated with rivers in Durban. As a proactive approach, eThekweni Municipality is seeking to invest in restoring and managing rivers throughout the municipal area as a risk-prevention measure to (i) address current societal and municipal costs associated with declining river condition, and (ii) avoid future escalations of these costs with climate change.

To support the motivation for transformative riverine management investment in the eThekweni Municipal Area, a Benefit Cost Analysis was undertaken for a range of future scenarios. These scenarios included the costs to society and the municipality of not managing rivers as climate change continues to drive flooding and water quality risks, and a comparison of the financial costs of a range of riverine management models against associated financial and societal benefits of these interventions. Climate change was included in all scenarios as a driver of increased ecological, social, economic and financial risk.

BCA methodology

Benefit Cost Analyses (BCA) were undertaken for three landownership categories (i.e. municipal, private and Traditional Authority land in riverine areas), under three separate riverine management scenarios (i.e. do nothing, basic and transformative riverine management) (see Figure 5). In total, nine BCA scenarios were modelled to understand the implications of different riverine management models in relation to landownership types. As a foundation or baseline for all scenarios, a BCA of the eThekweni Municipality's Sihlanzimvelo Stream Cleaning Programme was initially undertaken. A detailed report on the costs and benefits was developed for this and is available separately⁶¹.

As the management of the rivers involves natural capital or ecological infrastructure (as well as built infrastructure), it was also necessary to develop an understanding of the management implications for ecological functions and associated supply of and demand for ecosystem services from rivers in the EMA. For this purpose, a social-ecological systems model was developed for the Ohlangua River Catchment⁶² (which has all three types of landownership) as representative for all other catchments in the municipal area. This process was used to model the changes in riverine ecosystem services that would occur with climate change, as well as how basic and transformative management interventions would affect ecosystem services delivery (see Figure 4). The results were used to inform the likely changes to human well-being associated with each of the BCA scenarios.

A summary of the three-step analytical process, method and key assumptions used in the BCA is outlined below. The BCA process is summarised in Figure 6, while the origins and use of key BCA assumptions is shown in Figure 7.

⁶¹ Mander, M., Mander, N., Blignaut, J., de Winnaar, G., Butler, A., Graham, M., and Cartwright, A. (2020). Benefit Cost Analysis Technical Report. Report produced for C40 Cities Finance Facility and GIZ.

⁶² Mander, M., Mander N., de Winnaar, G. and Graham, M. (2020). Ohlangua Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

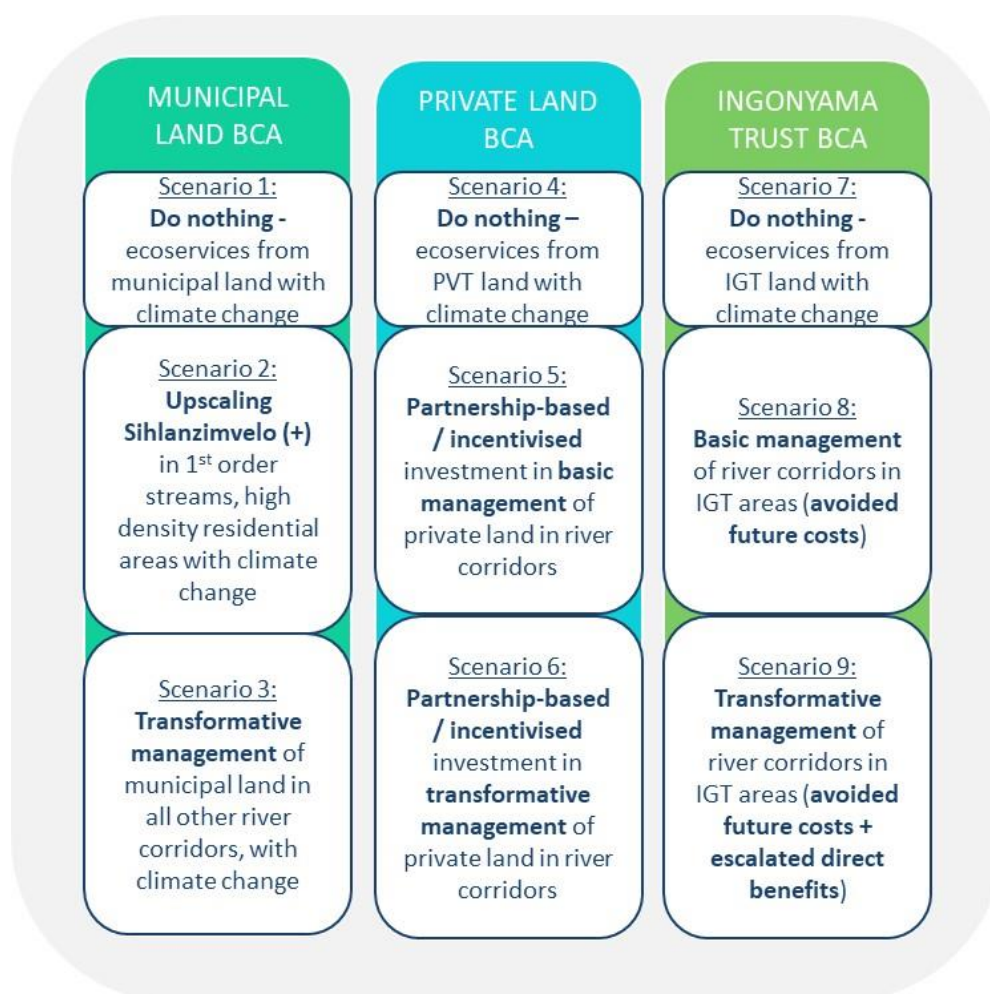


Figure 5: Summary of BCA scenarios

Step 1: Current Sihlanzimvelo Programme BCA

- (i) **Financial baseline:** A baseline for all the analyses was established by firstly developing the costs and benefits of the eThekweni Municipality's Sihlanzimvelo Stream Cleaning Programme using current implementation data – i.e. this represented the known context.

Current municipal budgets were assessed to identify total implementation costs for the 450km of river currently managed under the Programme. From this, the implementation costs per kilometre of river managed were determined (Table 2).

Table 2: Current Sihlanzimvelo Stream Cleaning Programme implementation costs

Annual operational costs – Sihlanzimvelo Stream Cleaning Programme		
Total annualised cost per co-operative (each managing 5km of river)	R	392 280
Total annualised cost to municipality of managing 1km of river	R	78 456
Total annualised operational costs (over 450km of river) including annualised start up	R	35 305 160
Jobs Created by the Programme		
Average number of jobs per co-operative (each managing 5km of river)		6.7
Jobs per 1km section of river		1.3
Annual cost to the municipality per job created (wages plus oversight costs)	R	58 842
Direct income to household per job	R	54 000

The financial benefits of Sihlanzimvelo were estimated by modelling the avoided damage costs to a range of culvert types and sizes (Table 3). The analysis was based on the known damage frequency and the repair and reconstruction costs in the uMhlangane and other catchments where Sihlanzimvelo is being implemented⁶³.

To account for predicted climate change, the frequency of damage events for the different culverts was escalated using assumptions provided by detailed eco-hydrological modelling (2020 Agricultural Catchments Research Unit – ACRU - modelling⁶⁴).

⁶³ Note that as data were not available for damages to other types of municipal infrastructure, such as roads, electrical cables, water and sewer pipelines and pump stations, the damage costs for these are not included. This indicates that the avoided damage costs reported in the BCA are a significant under-representation.

⁶⁴ Davis, N and Schulze, R. 2020. Vulnerability Assessment Report. Report produced for C40 Cities Finance Facility and GIZ.

Table 3: Annual culvert damage costs in two scenarios

Do nothing scenario (with climate change)				
Annual damage costs per culvert	High risk		Low risk	
Single cell – individual damage costs	R	382 080	R	166 773
Multi cell - individual damage costs	R	853 891	R	395 745
Annual damage costs per culvert type	High risk		Low risk	
Single cell damage costs ⁶⁵	R	8 023 680	R	9 339 307
Multi cell damage costs ⁶⁶	R	9 392 796	R	1 187 236
Total damage costs – all 4 categories for 91 culverts				R 27 943 018
Sihlanzimvelo management scenario (with climate change)				
Annual damage costs per culvert	High risk		Low risk	
Single cell individual damage costs	R	58 817	R	32 268
Multi cell individual damage costs	R	177 125	R	92 856
Annual damage costs per culvert type	High risk		Low risk	
Single cell damage costs	R	1 235 153	R	1 807 030
Multi cell damage costs	R	1 948 373	R	278 569
Total damage costs				R 5 269 125
Annual damage avoidance with Sihlanzimvelo				R 22 673 893

The benefits had to be modelled as explained above, because the damages to culverts before and after implementation of Sihlanzimvelo had not been explicitly recorded by eThekweni Municipality. An average benefit value per kilometre of river managed was estimated and adopted as an average value for all municipal catchments.

These financial costs and benefits were used and/or adapted for the other BCA scenarios to provide a 'strictly' financial BCA of each management scenario. Note that as data were not available for damages to other types of municipal infrastructure, such as roads, electrical cables, water and sewer pipelines and pump stations, the damage costs for these are not included. See more in Section 8.2.

⁶⁵ In terms of single cell culverts, 21 high risk and 56 low risk culverts were present within the Sihlanzimvelo project area.

⁶⁶ In terms of multi cell culverts, 11 high risk and 3 low risk culverts were present in the project area.

- (ii) **Ecosystem services & user number assumptions:** The Ohlanga River Catchment was modelled using the Eco-Futures⁶⁷ tool to develop an understanding of the supply of riverine ecosystem services under current land uses and ecological conditions, and under various future scenarios, and to determine who would be affected by changes in the delivery of these services. The Ohlanga Catchment was selected as a representative catchment in the eThekweni Municipal Area for this modelling because, i) the whole catchment is contained within the municipal boundary, ii) it contains municipal, private and Traditional Authority land, and iii) the catchment morphology and land uses are broadly representative of catchments within the eThekweni Municipal Area.

Using assumptions provided by Davis and Schulze⁶⁸ (2020), the impacts of climate change on river condition and ecosystem services supply were modelled (see Figure 3). Following this, two management responses were modelled, i.e. i) basic riverine / riverine management; and ii) transformative riverine management. For the climate change scenario and the two riverine management scenarios, the likely changes to ecosystems were workshopped and the consequent changes in ecosystem services modelled (see Figure 4).

The number of ecosystem service users alongside rivers was estimated by counting households near streams and rivers. Coastal user numbers were estimated using published literature and Umhlanga Tourism estimates. The numbers of users of ecosystem services were moderated using a weighting index that recognised levels of dependence on the ecosystem services. The weightings allow for a comparison between ‘full-time’ users and ‘part-time’ users. For example, 2.2 million part-time⁶⁹ users of the Durban beachfront per annum, when weighted, become equivalent to 131 000 full-time users, which can then be used in calculating benefit values (see Table 4).

⁶⁷ Eco-Futures is an ecosystem services supply and demand assessment process developed by FutureWorks that enables stakeholders to quantify changes to ecosystem services in alternative land use and management scenarios.

⁶⁸ Davis, N and Schulze, R. 2020. Vulnerability Assessment Report. Report produced for C40 Cities Finance Facility and GIZ.

⁶⁹ In other words, people that use the beachfront intermittently for recreation or tourism.

Table 4: Human Benefit Index calculation for the uMhlangane River Catchment that produced key assumptions for BCA scenarios

	Total number of beneficiaries				Dependence				Weighted Human Benefit Score
	Upper catchment	Middle catchment	Coastal	Sub-total	% Very high dependence	% High dependence	% Moderate dependence	% Low dependence	
Ecosystems Services	70 290	51 480	2 247 000		1	0.5	0.1	0.05	
Surface water supply	45%	35%		49 649	3%	10%	87%		8 291
Dry season flows	45%	35%		49 649	5%	20%	75%		11 171
Water quality maintenance	45%	35%	50%	1 173 149	2%	4%	50%	44%	131 393
Erosion & sediment reduction	10%	15%	20%	464 151	2%	4%	50%	44%	51 985
Flood reduction	100%	100%		121 770	25%	25%	25%	25%	50 230
Transport access	100%	100%		121 770	5%	10%	30%	55%	19 179
Food production	2%	3%		2 950	80%	20%			2 655
Bioenergy	1%	1%		1 218	100%				1 218
Solid waste capture	100%	100%	50%	1 245 270	2%	4%	8%	86%	113 320
Carbon capture and storage	100%	100%		121 770				100%	6 089
Refugia and nursery	0.5%	0.5%		609			100%		61
Recreation	30%	30%		36 531	2%	4%	8%	86%	3 324
Visual amenity / Elevated property values	100%	100%	30%	795 870	2%	4%	8%	86%	72 424
Biodiversity conservation	100%	100%		121 770	1%	2%	4%	93%	8 585

Based on the Eco-Futures modelling, changes in each ecosystem service under each of the future scenarios were estimated based on projected changes in ecosystem condition and associated productivity. An average change in all ecosystem services was then estimated for each scenario, which could then be used to understand changes in societal well-being.

(iii) **Proxy for societal costs / benefits:** A proxy value for riverine management impacts on individual productivity and well-being was developed, using a Human Capital Approach^{70,71,72,73,74}. This approach puts an economic value on the productivity or well-being of affected catchment users and provides an indicator of the economic benefits of the riverine management actions to the catchment community. In this case, three variables were considered:

- The level of income: the gross geographic product, or income, per capita of the municipality was used as a reasonable proxy for the income of the residents, although personal disposable income could also have been used. This was kept constant for all BCA scenarios.
- Term or duration: The period of inconvenience avoided that could be attributed to the investment in ecosystem services was used as the duration of the benefit.
- Number of beneficiaries: The number of beneficiaries of the intervention was used as the quantum of the number of people positively impacted.

The modelled percentage change in ecosystem service levels with management of rivers was combined with a proxy annual value of human well-being or productivity, and a one month period of time (or duration of impact), to estimate an annual value to ecosystem users living near rivers, and downstream users (including coastal users).

(iv) **Sihlancimvelo BCA:** A BCA was prepared for the current Sihlancimvelo Programme.

Step 2: Basic Riverine Management BCA

- Upscaling Sihlancimvelo:** Once the benefits and costs of the existing Sihlancimvelo Programme had been established (i.e. the financial and economic baseline), the benefits and costs were then upscaled to all first and second order streams on municipal land in the EMA by combining the associated river length with the average benefit and cost values per kilometre. A benefit cost ratio was calculated.
- Basic Riverine Management on private and Traditional Authority land:** The Sihlancimvelo benefits and costs were then adapted for the private landownership and Traditional Authority ownership contexts, such as lower populations densities per kilometre, lower management costs (in the case of Traditional Authority rivers)

⁷⁰ An approach often used with respect to the economic valuation of investments in ecosystem and public benefit services. (Blignaut and Lumby 2004, Beli *et al.* 2001, Tietenberg 1996, and Mooney 1977).

⁷¹ Beli, P., Anderson, J.R., Barnum, H.N., Dixon, J.A. and Tan, J-P. 2001. Economic Analysis of Investment Operations. Washington D.C.: World Bank

⁷² Blignaut, J.N. and Lumby, A. 2004. Economic valuation. In Blignaut, J.N. and De Wit., M.P. *Sustainable options*. UCT Press.

⁷³ Mooney G.H. 1977. The Accounting or Human Capital Approach to Life Valuation. In: The Valuation of Human Life. Palgrave, London. https://doi.org/10.1007/978-1-349-03193-1_5.

⁷⁴ Tietenberg, T. 1996. Environmental and Natural Resource Economics. New York: Harper Collins.

and the respective estimated river lengths. This analysis generated the respective costs, benefits and benefit cost ratios.

Note that all the preceding basic management estimates were based on annual costs and benefits as only annual maintenance costs are incurred.

Step 3: Transformative Riverine Management BCA

- (i) **Defining transformative management:** The transformative riverine management approach was developed by estimating the capital and management costs of a suite of management and social interventions⁷⁵ for the Ohlanga Catchment⁷⁶ (Table 5). The costs include basic management costs, ecological restoration costs, social development costs and a **Transformative River Management Programme Management Unit**⁷⁷ cost. The benefits included both avoided damage costs to municipal culverts and societal benefits through access to ecosystem services. Note that in the transformative management scenarios, the avoided damages to culverts remains the same as for basic river management scenarios, but the human benefits double in comparison.

The capital costs were assumed to be incurred over a 10-year period, and all the costs and benefits were modelled over a 20-year period. The net present value (NPV) of the costs and benefits were estimated for the catchment, and a benefit cost ratio calculated. Furthermore, the average NPV for costs and benefits per kilometre of river was calculated, and then upscaled for the municipal-owned river length.

Note that in the transformative management models, the avoided costs to municipal culvert damage is kept the same as for the basic management as no additional infrastructure protection gains are anticipated over and above basic management or Sihlanzimvelo management interventions embedded in the transformative management scenario⁷⁸. However, the societal benefits associated with avoided service losses doubles in response to the transformative ecological and social investments.

⁷⁵ Identified by the eThekweni Municipality, workshopped with riverine stakeholders, and costed by the report authors.

⁷⁶ See Chapter 6.

⁷⁷ The TRMP Programme Management Unit is assumed for BCA purposes to consist of 14 staff, including a strategic policy coordinator, a programme implementation manager, a programme ecohydrologist / engineer, 10 catchment project managers, and a programme monitoring and evaluation specialist.

⁷⁸ The majority of the avoided damage costs to culverts is experienced in upper catchment areas where the rivers are narrower and culverts are small enough to be blocked by waste and vegetation during flash floods. Lower down in the river system, road crossings tend to be larger bridges that are not damaged by regular flash floods in the same way.

Table 5: Representative costs of transformative riverine management interventions in the Ohlanga River Catchment

Summary of Biophysical Interventions	Capital costs	
Invasive Alien Plant control programme	R	18 200 000
Revegetation – indigenous vegetation restoration	R	7 000 000
Riverbank stabilisation - Gabions	R	10 000 000
River channel and bank stabilisation - riprap	R	6 300 000
Debris walls	R	3 240 000
Wetland rehabilitation	R	83 900 000
Wetland creation - stormwater ponds	R	4 125 000
Litter Booms	R	280 000
Litter Socks - Drains and Culverts	R	1 265 000
Groynes	R	1 170 000
Pocket Parks	R	13 000 000
Biophysical Interventions	Annual costs	
River maintenance (294km)	R	3 066 038
Summary of Social Interventions	Annual costs	
School Programmes adopting up to 30 km of river each	R	480 000
EnviroChamps for 25 informal settlements	R	1 800 000
Training and awareness raising	R	300 000
Treepreneurs	R	500 000
Municipal TRMP coordination and management unit (1/3 of total unit cost)	R	7 215 437

- (ii) **BCA:** The transformative management analysis model for the municipal land was then adapted for privately owned and Traditional Authority owned land, assuming fewer riverine management actions, lower riverine population densities, different river lengths (for small and large rivers), and importantly different municipal facilitation / governance costs (see above, and last row of Table 5). Note that the downstream coastal user numbers were kept constant at 2.2 million per year for the Durban beachfront (Table 4).

Unlike the basic management model, which only operates on annual costs and benefits, the transformative model includes capital investments over 10 years, and is therefore modelled over a 20-year period. The net present value (NPV) of management costs and municipal benefits are discounted by 6% (social discount rate). However, the NPV of societal benefits accruing from river management are

modelled using a two social discount rates, i.e. 6% and a negative discount rate of -1%, to provide two perspectives on societal benefits.

Conventional economic analysis would usually employ a social discount rate of 6% in South Africa. However, investing in natural capital, which does not necessarily depreciate with use as built infrastructure does, can escalate in value with population growth and increased demand for ecosystem services over time (i.e. scarcity of supply of ecosystem services drives up the value of the natural capital that produces it). To reflect this, a -1% discount rate is employed, accounting for a 1% to 2% annual increase in population in the EMA, and associated increase in demand for ecosystem services (with associated increase in value of natural capital). This is done to demonstrate an alternative perspective on societal value of natural capital. The real value is likely to lie somewhere between the traditional and alternative values in the NPV and BCR calculations.

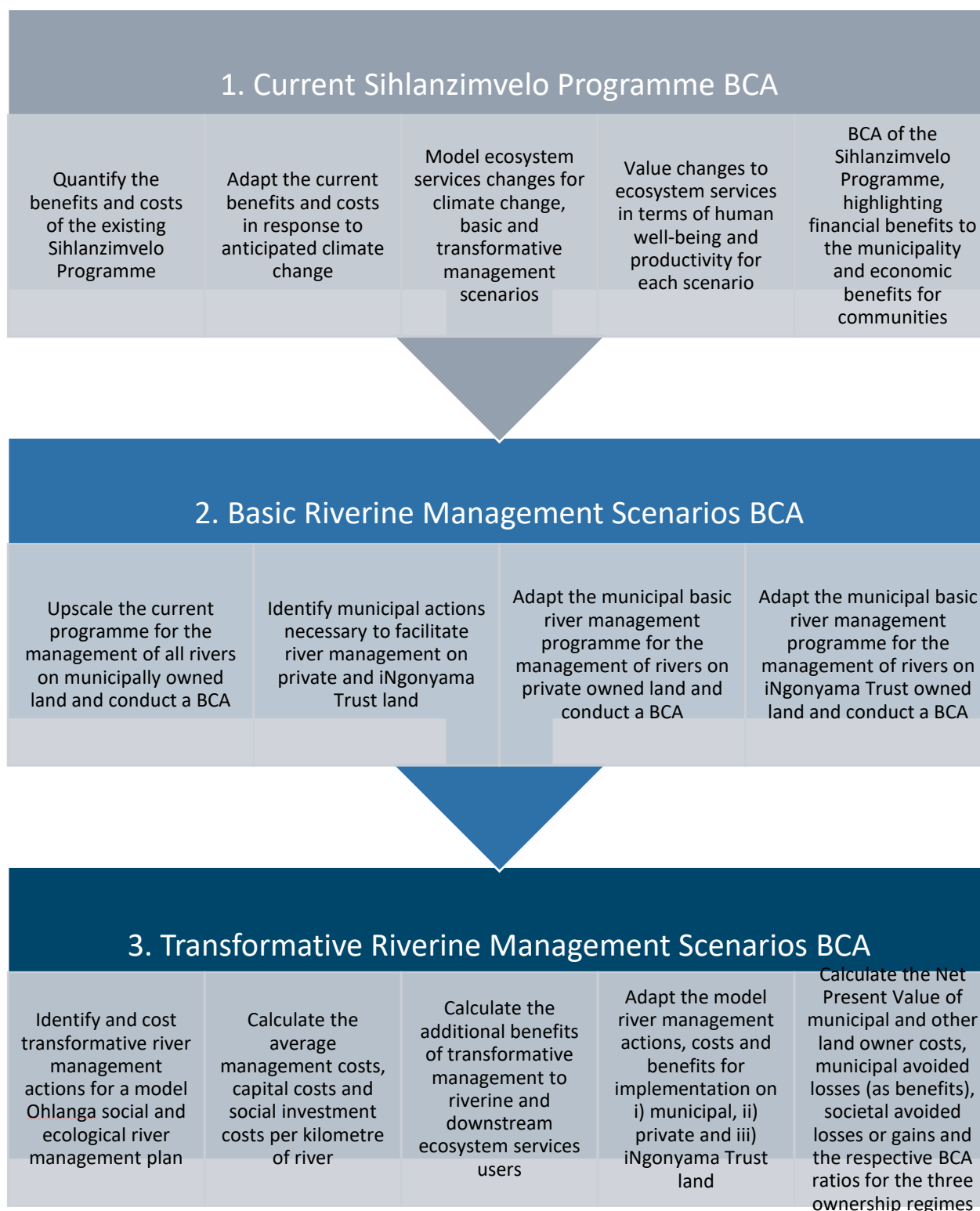


Figure 6: Summary of the three-step Benefit Cost Analysis process.

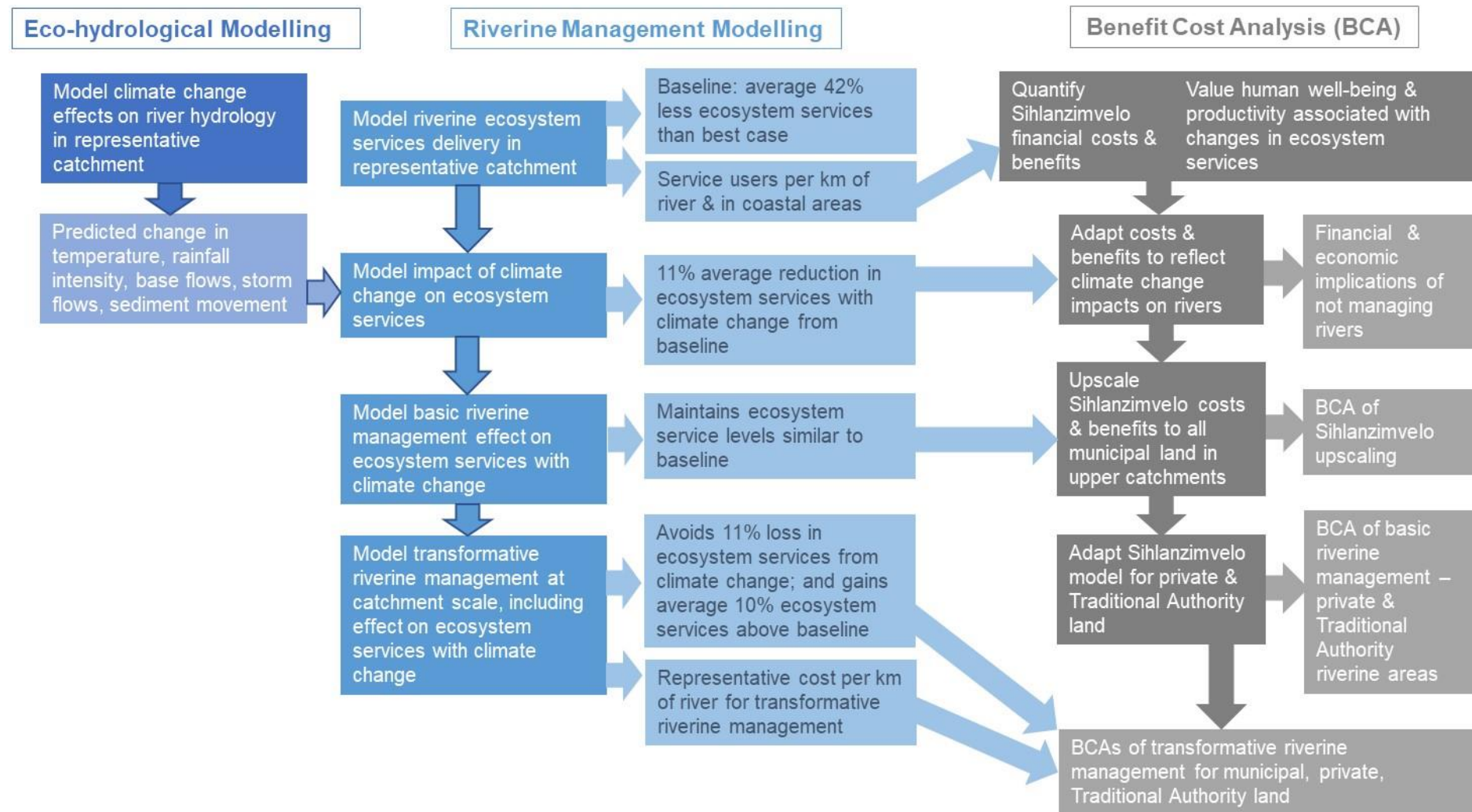


Figure 7: Origins and use of key assumptions for the BCA .

1.5 Study Limitations & Gaps

The Business Case and associated Benefit Cost Analysis (BCA) have been prepared between April and November 2020, the entire duration of fell within the COVID 19 national lockdown. This has meant that stakeholder engagements were severely constrained, both in scope and depth. Although virtual stakeholder consultations were possible, the project team (comprising the consultant group, eThekweni Municipality officials, GIZ and CFF project managers) have needed to provide the perspectives that would ordinarily have come directly from stakeholders. This has likely meant that the study results are more conservative than would otherwise have been the case.

Access to data has also been a significant constraint. The study team needed to fill critical data gaps for the BCA with assumptions and modelled data. In this regard, the key data gaps were:

- Data on culvert damage repair costs before and after implementation of Sihlanzimvelo's implementation had not been collected and had to be constructed using systems and financial modelling.
- No data were available on damage costs for other types of municipal infrastructure associated with rivers, including sewers and sewage pumpstations, water pipelines, roads, electrical and telecoms cables.
- No data were available on the costs of flood damage to private properties.
- Limited data were available on private landowner costs to manage rivers, although these could not reliably be linked to benefits or avoided damage costs due to a lack of associated monitoring data.
- No data were available on the benefits / disbenefits to riverine communities for flood damage, health impacts, loss of visual and recreational amenity, and water use. This information had to be modelled in the study.
- No data were available on riverine management costs or benefits in Traditional Authority areas.
- Limited anecdotal information was available on impacts of river water quality on coastal recreational users. Proxy information had to be developed for the study.

BCA modelling of the Sihlanzimvelo Programme is the most credible aspect of the work conducted, as it was based on actual costs and to some extent known benefits. All other scenarios were evaluated as adaptations of the Sihlanzimvelo information and therefore include many more assumptions.

The study also did not quantify the job creation or economic potential associated with green economy enterprises that may be established to utilise the organic or inorganic material removed from rivers as part of the TRMP.

The above limitations suggest that the avoided costs and societal benefits estimated for the eThekweni TRMP in this study are a significant under-estimate. These estimates may be improved through additional data and stakeholder consultation.

To improve the rigour of the BCA calculations in future updates, the following information should be collected where possible:

- Frequency, intensity and costs of flood and other damages to municipal infrastructure and private property in riverine areas, including changes to property values where applicable.
- Benefits / avoided costs of riverine management to all types of municipal infrastructure and private / Traditional Authority landowners.
- Numbers of riverine beneficiaries / users affected by flood damage, health impacts, loss of visual and recreational amenity, and declining water quality.
- Quantification of enterprise development / job creation potential associated with recycling of biomass and inorganic materials removed from riverine areas.

In exploring possible market-based mechanisms for riverine management investment, the following information / studies should be considered:

- Quantification of the relationship between upstream riverine management and downstream ecosystem services supply levels.
- Quantification of the numbers of users of riverine ecosystem services, and coastal users of ecosystem services.
- Quantification of biomass and inorganic material removed from rivers and relating this to relevant green or circular economy value chain potential, as well as jobs.

In addition to the above, it was noted that there is a significant amount of data being collected on effluent discharges to rivers, spills, water quality, and river health. This data is collected by different departments within the municipality, as well as by a range of other actors (including the private sector). It would be useful to establish a central platform for reporting this data so that it can be consolidated and analysed, allowing better tracking of river impacts and health status over time.

CHAPTER 2: THE CASE FOR CITY-WIDE TRANSFORMATIVE RIVERINE MANAGEMENT INVESTMENT

2.1 Introduction

Rivers influence and are influenced by the people, land uses and economic activities that surround them. Transforming the human and economic relationship with riverine areas is central to ecosystem-based adaptation to climate change, building resilience and reducing vulnerability.

There are over 7,000 kilometers of rivers in the EMA. Figure 8 shows that the major proportion of these (51%) fall within peri-urban / rural Traditional Authority areas administered by the iNgonyama Trust. eThekweni Municipality owns / is responsible for 23% of riverine areas, and 26% are in private ownership (businesses and individuals).

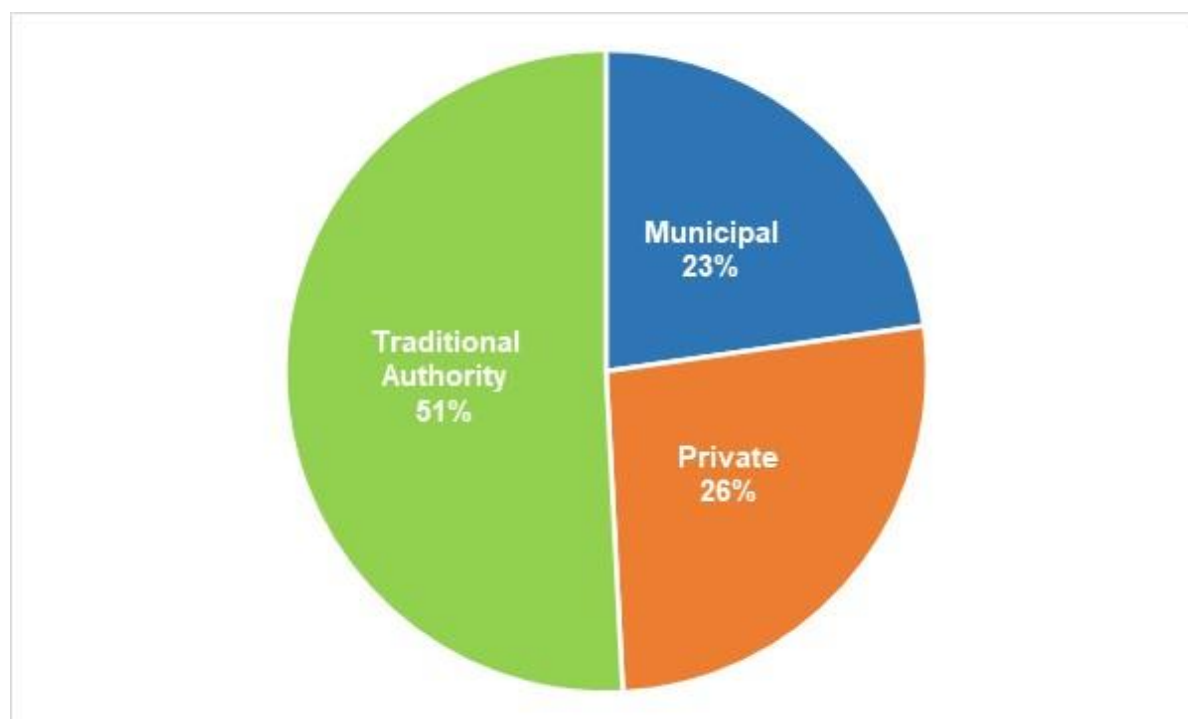


Figure 8: Percentage of riverine areas under different land ownership in the eThekweni Municipal Area

Being landscape-scale systems, rivers cut across a mosaic of land uses and land ownership types. Activities in upper catchment areas can have major impacts on the whole downstream system, creating distinct dependencies between communities in different parts of a river catchment.

As rivers are complex social-ecological systems, improving the state of rivers requires multi-faceted, transversal, multi-stakeholder, long-term processes. To progress from an incremental climate adaptation to a transformative approach in riverine management, a focus on structural and systems changes that address the root causes of negative river impacts is required.

The implication is that for transformative outcomes to be achieved, riverine management needs to be coordinated at systems-scale. This requires a system of governance that identifies and responds to catchment-scale priorities, incentivizes and enables riverine restoration / management investment, strategically aligns available resources and capacity, proactively seeks to close capacity gaps, connects stakeholders, builds partnerships and facilitates learning.

2.2 Costs of Climate Change

Climate change impacts on rivers could impose a cost on society in the EMA exceeding R375 million per annum by 2040 (Table 6).

As a result of urban development, Durban's rivers are already degraded and operating well below their potential. Riverine ecosystem services are currently supplied on average 42% below the best case. Climate change will exacerbate flooding and water quality problems, accelerate erosion and sedimentation impacts, and drive faster growth of invasive alien species which transform and destabilise riverine ecosystems. These pressures are expected to further reduce riverine ecosystem services delivery by at least 11% by 2040.

This climate change driven decline in riverine ecosystem services will translate into a continued burden of low-level service delivery and rapidly increasing risks and service delivery costs that will be felt by all citizens in the EMA. The poorest communities are most vulnerable in this context, given their existing service delivery deficit and their limited capacity to cope with risk and loss. The eThekweni Municipality will be directly affected, with annual damage to municipal road culverts alone due to increased climate change related flooding estimated at over R151 million by 2040 (Table 6). Declining river water quality will affect coastal tourism and property values, as well as the ability of riverine communities to access and use rivers for water provision, crop irrigation, and recreation. The annual implications of this on the well-being of municipal citizens and coastal users is estimated to reach R224 million by 2040 (Table 6).

Table 6: The “do-nothing” scenarios for rivers on municipal, private and Traditional Authority land, demonstrating the cost of climate change in the absence of increased investment in riverine management

DO NOTHING SCENARIO	Municipal owned land	Privately owned land	Traditional Authority land	Total for eThekweni
River management distance (in km) ⁷⁹	1 168	1 350	2 611	5 129
Riverine management costs to residents ⁸⁰		R10 591 548		
Cost of damage to municipal infrastructure (culverts only)⁸¹	R72 527 656	R62 871 791	R16 213 160	R151 612 607
Decline in ecosystem services (average of all ecosystem services)	11%	11%	11%	11%
Number of people impacted in riverine communities ⁸²	130 375	37 673	29 145	197 193
Proxy wellbeing and productivity losses amongst riverine communities⁸³	R90 286 365	R26 088 740	R20 183 072	R136 558 177
Total losses - municipality & riverine communities	R149 137 714	R88 960 531	R36 396 233	R274 494 478
Number of people impacted on the coast ⁸⁴	125 832	125 832	125 832	125 832
Proxy wellbeing and productivity losses amongst coastal users⁸⁵	R87 140 226	R87 140 226	R 87 140 226	R87 140 226
Total losses – municipality, riverine communities & coastal users	R249 954 247	R176 100 757	R123 536 459	R375 311 010⁸⁶

2.3 Responding to Climate Risk through Transformative Riverine Management

The TRMP represents an effective climate change risk-reduction measure that can mitigate substantial losses to the local economy and to citizens and businesses across the whole EMA.

⁷⁹ 1st and 2nd order streams only.

⁸⁰ It is assumed that 10% of private landowners currently comply with legal requirements (especially alien plant management) and these existing efforts are therefore not excluded from the “do nothing” scenario.

⁸¹ The average culvert damage costs per kilometre were calculated for the uMhlangane catchment and assumed as representative for all municipal rivers. Private land and Traditional Authority areas were assumed to have 75% and 10% respectively, of municipal owned land culvert damage costs per kilometre of river.

⁸² Municipal rivers were assumed to have 112 users per km (based on uMhlangane catchment estimates), private rivers some 28 users per km and Traditional Authority rivers some 11 users per km.

⁸³ The number of users multiplied by the R693 productivity loss per person residing adjacent to the river.

⁸⁴ The coastal users are kept constant at 125 832 (the weighted 2.2 million beach front users).

⁸⁵ The number of users multiplied by the R693 productivity loss per river user.

⁸⁶ Note that this total is a sum of the total cost of damage to municipal infrastructure, total proxy wellbeing and productivity loss of riverine communities and coastal users, with the coastal user costs remaining at a constant value (i.e. not added across each landownership type column).

To address municipal, societal and economic risks associated with climate change effects on Durban's rivers, a systems-scale shift in human and economic interactions with rivers is needed alongside targeted restoration and management of riverine ecological infrastructure. This will enhance river condition and improve ecosystem services as a buffer to climate change impacts. The eThekweni Municipality's vision is to establish a Transformative Riverine Management Programme (TRMP) for this purpose.

An effective TRMP will require mobilisation of a wide range of government actors, private and Traditional Authority landowners, civil society, business and industry, research institutions, and donor funding agencies. A suitable transversal governance mechanism, with associated capacity, is required to create the enabling conditions for effective protection, restoration and management of Durban's rivers, as well as upstream catchment areas falling outside the municipal boundary. This includes:

- Planning and prioritising riverine management interventions
- Facilitating transversal collaboration
- Facilitating vertical and horizontal alignment
- Establishing supportive policy and standards
- Facilitating partnerships
- Raising strategic funding to close implementation gaps
- Facilitating learning and knowledge sharing

Figure 9 suggests how a TRMP may be structured, with eThekweni Municipality playing a transformative riverine governance role which enables, supports and facilitates riverine systems restoration and management, appropriate social interventions, and green economy opportunities associated with rivers and riverine management.

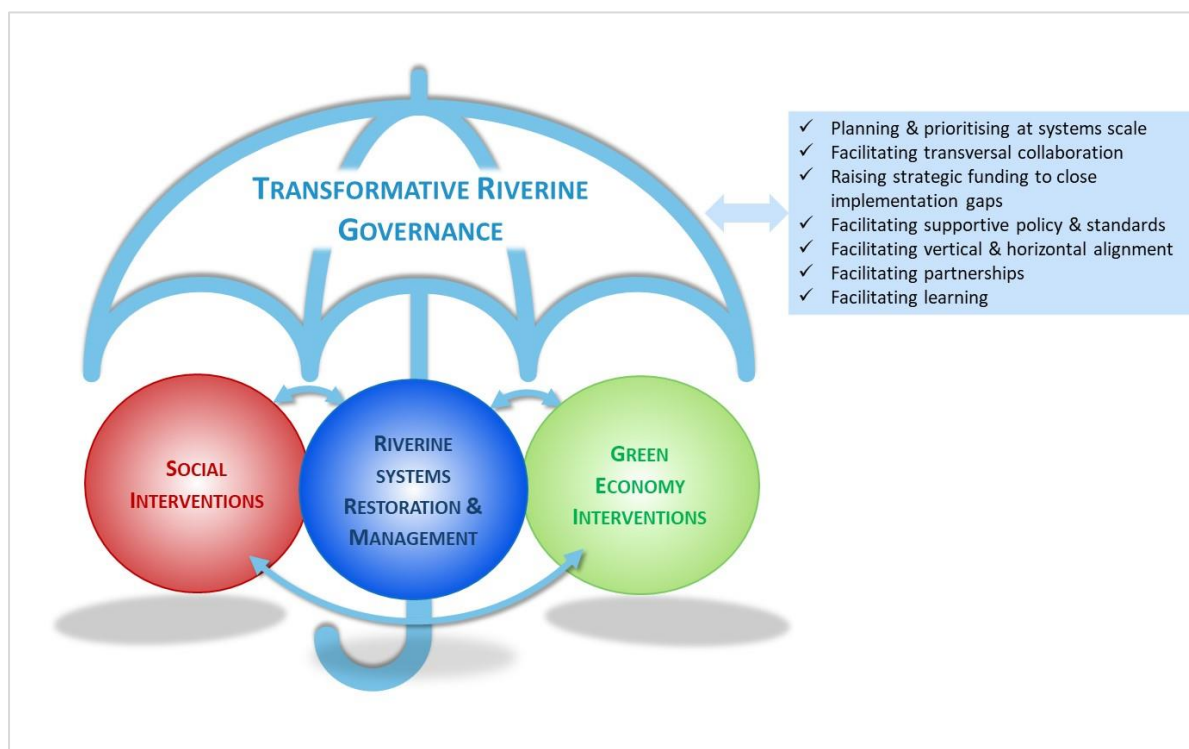


Figure 9: Theoretical structuring of a Transformative Riverine Management Programme

Implementation of transformative riverine management assumes a focus on positive social-ecological systems change in relation to rivers. Biophysical riverine management interventions include both ecological restoration and management at a systems scale, aiming to improve the functionality and resilience of rivers to urban impacts and climate change. The condition and/or management of the built / agricultural landscape surrounding rivers would also be improved, such that accelerated stormwater, sediment loads and pollution entering rivers is minimised.

Social interventions aim to build human, social and institutional capital in a way that promotes positive behaviour change and active river stewardship in response to a recognition of the value of rivers to people and the economy. Socio-economic and environmental benefits of riverine management are accelerated through green economy initiatives that make productive use of solid waste and alien plant biomass – either arising from riverine management activities or as a means of reducing waste entering rivers. The social / economic use of riverine areas as places of recreation and tourist activities or harvesting of natural resources is assumed to be optimised within sustainable limits. Agriculture / food gardening on river floodplains is supported, where appropriate, to enhance resilience to increased river flooding and sedimentation, and to limit negative impacts on river ecosystems.

2.4 TRMP Investment Case

A city-wide TRMP would not only limit climate change impacts on riverine services, but could lift ecosystem services levels by 10% above the status quo. This investment could unlock municipal and societal benefits ranging between R13 billion and R26 billion⁸⁷, and create over 9,000 job opportunities (Table 7).

Service delivery deficits constrain productivity

Service delivery deficits place a notable burden on human productivity, often despite incredible efforts to transcend circumstances and remain productive. Where people are unable to cross rivers, avoid flood damage to their property or are exposed to contaminated water, their ability to access economic opportunities and make an economic contribution is curtailed.

Under the “do nothing” riverine management scenario (Table 6), damage of over R151 million is done to municipal culvert infrastructure each year. An estimated 200,000 people living near rivers experience the burden of declining ecosystem services, imposing a burden on their productivity of over R136 million each year. As estimated 126,000 coastal users experience over R87 million in losses from a decline in coastal amenity each year. Conversely, as ecosystem services are restored through riverine management, human productivity is greatly enhanced in ways that buoy the entire economy.

How service delivery deficits are addressed matters

The great advantage of the Sihlancimvelo Stream Cleaning Programme is that 90% of the allocated budget is spent on wages for the local residents doing the work. It is highly likely that most of this investment will re-enter the local economy in the short-term as expenditure on food, clothing and building material increases. In this way, Sihlancimvelo not only addresses services deficits, but does so in a manner that generates local work opportunities, a sense of place and the potential for high economic multipliers.

Municipal & societal benefits

The total estimated cost of implementing a city-wide TRMP is R7.5 billion over 20 years (Table 7). Through implementing transformative riverine governance, eThekweni Municipality could unlock substantial co-investment in the implementation of riverine management actions by private landowners and third parties (e.g. other government and donor funders).

By spending R719 million on transformative riverine governance over 20 years, eThekweni Municipality could unlock a potential R4.5 billion in co-investment by private landowners, other government and third parties (Table 7).

⁸⁷ The lower end of this range assumes a discount rate on ecological capital of 6%, while the higher end assumes -1%. Conventional discounting would employ the 6% in South Africa. However, investing in natural capital, which does not depreciate with use as with built infrastructure, escalates in value as population grows and demand greater levels of services.

The resulting benefits to society could be substantial, with each R1.00 of investment potentially yielding between R1.80 and R3.40 in avoided municipal and societal costs⁸⁸ (Table 8).

The Benefit Cost Ratio (BCR) of transformative riverine management investment does, however, differ between landowners (Table 8). For every R1.00 in municipal TRMP investment, R0.30 in damage to municipal road culverts could be avoided on municipal land. However for each R1.00 spent by the municipality on TRMP for private land, R5.20 in avoided municipal culvert damage costs could be achieved; whereas R1.00 municipal spend on TRMP for Traditional Authority land would save R1.70 in avoided municipal culvert damage costs. These numbers are a significant under-representation of the potential avoided infrastructure damage costs, given the exclusion of other potentially affected infrastructure types in these calculations.

However, the societal co-benefits are notable, with each Rand spent by the municipality also protecting vulnerable riverine communities from losses linked to damaged infrastructure and increasing exposure to risks associated with declining river conditions. Coastal users stand to benefit significantly without incurring additional costs, and it may be prudent to find appropriate cost sharing mechanisms that allow these groups to contribute towards securing coastal benefits from riverine management. This could, for example, be achieved through a special coastal hotel bed levy, or through coastal Special Rating Areas that contribute funding towards transformative riverine management.

While the modelling undertaken is clear that the “societal value” generated by a transformative riverine management approach outweighs the cost, this value accrues to a variety of residents in the region (including riverine communities and coastal communities), rather than only to the eThekweni Municipality. This need not be a problem: government departments do not have to return a profit and one of the economic functions of government is precisely to generate the valuable public goods for which a private sector incentive is insufficient to mobilise investment. Indeed, it costs the municipality less than R1 million to sustain a transformative riverine management “job” for 20 years, which is reasonable even without other benefits. However, in the South Africa context of highly constrained fiscal resources, budget requests will be strengthened where the benefits can be clearly articulated.

⁸⁸ The range depends on the social discount rate used.

Table 7: Benefits and costs of city-wide transformative riverine management

TRANSFORMATIVE RIVERINE MANAGEMENT: Discounted costs and benefits over 20 years	Municipal land	Private land	Traditional Authority land	Total for eThekwin
River management distance - in kilometres	1 592	1 852	3 560	7 004
Net Present Value (NPV) Costs - social discount rate 6%:				
<i>Municipal costs for TRMP programme management / governance for private & TA land</i>	<i>R448 million</i>	<i>R153 million</i>	<i>R118 million</i>	<i>R719 million</i>
Capital costs – ecological infrastructure restoration	R622 million	R525 million	R251 million	R1.4 billion
Capital costs – pocket parks	R52 million	R0	R0	R52 million
Riverine management costs	R1.4 billion	R1.7 billion	R1.6 billion	R4.7 billion
Social interventions	R191 million	R223 million	R201 million	R615 million
Total NPV Costs (6% discount rate)	R2.7 billion	R2.6 billion	R2.2 billion	R7.5 billion
Net Present Value (NPV) Benefits – social discount rate 6%:				
Benefits to municipality (discount rate 6%)	R920 million	R803 million	R206 million	R1.9 billion
Proxy benefits to riverine communities (discount rate 6%)	R2.3 billion	R665 million	R511 million	R3.5 billion
Proxy benefits to coastal users (discount rate 6%)	R7 billion	R8.1 billion	R7.8 billion	R8.1 billion ⁸⁹
Total NPV Benefits to Municipality & Society (6% discount rate)				R13.5 billion
Net Present Value (NPV) Benefits - social discount rate minus 1% for users:				
Benefits to municipality (discount rate 6%)	R920 million	R803 million	R206 million	R1.9 billion
Proxy benefits to riverine communities (discount rate -1%)	R4.7 billion	R1.4 billion	R1 billion	R7.1 billion
Proxy benefits to coastal users (discount rate -1%)	R14.3 billion	R16.7 billion	R16 billion	R16.7 billion ⁸⁹
Total NPV Benefits to Municipality & Society (6% and -1% discount rates)				R25.7 billion
Job creation benefits:				
Jobs – construction for 10 years	723	720	773	2 216
Jobs – annual maintenance	2 123	2 469	2 373	6 965
Number of potential cooperatives	318	370	356	1 044

⁸⁹ Note that the coastal user numbers remain constant across land ownership categories and across the municipality as a whole, given that all coastal users are deemed to benefit similarly across different landownership investments.

Table 8: Comparison of Benefit Cost ratios for municipal, private and Traditional Authority landowners in a city-wide TRMP implementation model

TRANSFORMATIVE RIVERINE MANAGEMENT Benefit Cost Ratios	Municipal Land	Private Land	Traditional Authority Land	Implications
BCR for municipal benefits and costs (SDR ⁹⁰ 6%)	0.3	5.2	1.7	Private land performs best as municipal actions leverage large scale management. Justifies facilitation and developing incentives.
BCR for societal benefits and costs to riverine community users (SDR 6%)	0.8	0.3	0.2	Municipal land performs best for riverine users as relatively greater numbers of vulnerable people benefit from management. Justifies preventative expenditure as coastal users would improve this ratio without additional costs. The weak performance of private and Traditional Authority land may justify some form of cost sharing facility.
BCR for societal benefits and costs to coastal users (SDR 6%)	2.5	3.2	3.6	Traditional Authority land performs best as large numbers of coastal (and downstream users) benefit from the relatively lower management costs per km (as the rivers are already in good condition). The good returns and lower costs justify maintenance management.
BCR for municipal and societal benefits and costs (SDR 6%)	1.8			
BCR for municipal benefits and costs (SDR 6%)	0.3	5.2	1.7	Private land performs best as municipal actions leverage large scale management. Justifies facilitation and developing incentives.
BCR for riverine community benefits and costs (benefits SDR -1%)	1.71	0.53	0.48	Even with escalated service values, the weak performance of private and Traditional Authority land indicates unfavourable returns to landowners or third-party management costs due to low riverine user numbers. The actions' objectives need to focus on broader societal benefits and may necessitate a cost sharing facility such as payment for ecosystem services.
BCR for coastal users benefits and costs (benefits SDR -1%)	5.23	6.50	7.38	When all catchment and coastal beneficiaries are included, with escalated service values, all landownership types perform similarly well. A growing population with a growing demand for ecosystem services, justifies preventative investment into management.
BCR for municipal and societal benefits and costs (SDR 6% for costs and municipal benefits, and SDR -1% for benefits to riverine communities and coastal users)	3.4			

⁹⁰ Social Discount Rate.

Jobs & enterprise benefits

The job creation and enterprise development benefits from a city-wide TRMP are substantial.

The potential exists to create 9,181 jobs through over 1,000 community co-operatives in a city-wide TRMP (Table 7). In addition, enterprise development in the green economy is possible through the productive use of organic biomass and litter collected from rivers (as well as solid waste collection in informal settlements to prevent it washing into rivers). The way these new opportunities are created offers important opportunities for gender equity and social inclusivity.

Cost sharing through partnerships

Transformative riverine management offers significant benefits for society, but for individual private landowners, riverine management costs are likely to exceed the direct benefits from their investment⁹¹. There remains, however, good reason for private investment to avert damage to private property linked to declining river condition, particularly in high flood / erosion risk locations. As private investment would unlock substantial public good (including substantial avoided damage costs to municipal infrastructure), there may be justification for financial or other incentives and cost-sharing that supports or enable private landowners to invest appropriately in priority areas. Mutually beneficial partnerships between private landowners, the municipality and the coastal users may foster enhanced riverine management that benefits broader society.

Failure to manage streams in upper catchment areas, a significant proportion of which fall within Traditional Authority areas, will undermine management investment downstream. As in the private landowner scenario, the downstream beneficiaries have an incentive to support upstream management, given the risk of future ecosystem service declines. On this basis, a Payment for Ecosystem Services⁹² approach offers potential. However, this will only function in so far as the desired ecosystem service levels are delivered to the paying users.

2.5 Harnessing Opportunities in the Green Economy

Modelling and observations undertaken by eThekweni Municipality suggest that 70% of the debris causing blockages in riverine systems in the eThekweni Municipal Area is made up of alien vegetation, while 30% is solid waste. In a TRMP, this material would not only be removed from watercourses and riparian areas, but also repurposed and reused, challenging the whole notion of “waste”. The eThekweni Municipality is unlikely to be the agent of every innovation required to make this a reality and will need operational green economy enterprises to play this role. Instead, it could allow local enterprises rights over the collected material and provide a market

⁹¹ This is because rivers are systems and riverine management in one part of the system may generate the create greater benefits downstream than at the site of management.

⁹² Payments for Ecosystem Services is the name given to a variety of arrangements through which the beneficiaries of environmental services, from watershed protection and forest conservation to carbon sequestration and landscape beauty, reward those whose lands provide these services with subsidies or market payments (www.panda.org).

for the beneficiated compost and Bokashi at the city's parks and similar markets for the "pavers" used on the city walkways and bicycle paths. In this way the municipality will not risk pre-empting the technologies and ideas available to green economy entrepreneurs and will not take direct responsibility for the success of green economy enterprises. The eThekweni Municipality can crowd-in private sector investment to the riverine stewardship process by allowing green economy entrepreneurs access to recovered material that could then be used to start new private enterprises.

Organic Material

Invasive alien plants removed from riverine areas usually include Water Hyacinth, Spanish Reed, *Chromolaena odorata* and fast-growing woody species such as Syringa and Black Wattle. Most organic material removed from South Africa's rivers ends up on the banks of the river or in municipal landfills where it composts and ferments releasing a combination of CO₂ and methane. The nationally run Expanded Public Works Programmes that set up furniture-making cooperatives made from wood removed in water catchments have experienced mixed results, often struggling to find markets for their furniture and becoming dependent on government support. It is therefore proposed that the eThekweni Municipality does not take responsibility for end products or new industries that utilise the organic invasive alien plant material removed from riverine areas, but rather enable the creation of businesses that utilise this resource through offtake agreements.

Green Corridors already pioneers "manufacturing units" that seek to add value to the biomass removed from eThekweni Municipality's rivers. Efforts include:

- Bokashi manufacturing through combining micro-organisms, biomass from invasive alien plants or cleared from rivers, manure and spent brewery grain. Bokashi composts anaerobically in polybags and without the need for turning and produces a growing medium that is more fertile than most composts. Companies such as Earth Probiotics in South Africa have already established commercially successful Bokashi enterprises and demonstrated its value.
- A prototype for a "green concrete" retaining wall block in which sand is displaced by up-cycled plant fibre (cleared "Spanish Reed" is ideal). The resulting block is lighter than conventional concrete blocks and its production has the potential to reduce damaging sand mining. Where successful, up-cycled biomass has the potential to be used in various green composites as a substitute for heavier material that rely on extractive industries.
- Green Corridors is also experimenting with the use of up-cycled Syringa wood chips as a feedstock in a 5KVA generator which, if successful, could be scaled to larger generators.

In addition to those enterprises being trialled and pioneered by Green Corridors, South Africa has enterprises that upcycle biomass and could utilise the types of organic material removed from rivers under the TRMP. These include:

Composting:

- Woody and non-woody invasive alien plant material that has been chipped provides an excellent source of compost that can be used to support local agriculture, landscaping and the rehabilitation of degraded soils, or as a mulch in City parks. Effective composting depends on keeping organic material aerated, and as such is well suited to manual labour that turns compost regularly. It can also, however, be conducted at scale, as illustrated by Reliance Compost, one of South Africa's leading composting companies, employing over 200 people and deploying a combination of labour intensive and mechanised technologies.

Commercial composting depends on a steady supply of green waste, but Reliance generates revenue by both collecting green waste and selling a variety of composts that range in value from R150/m³ to R800/m³.

Composting green waste is safe but requires open land.

The environmental value of compost is contained in its ability to:

- (i) Reduce the pressure on expensive municipal landfills. Reliance Compost claims to have kept 20 million m³ out of the City of Cape Town's landfills.
- (ii) Enhance soil organic carbon, which in turn improves water infiltration and soil fertility and can counter soil erosion. The addition of woodchips sourced from AIPs in the Western Cape's LandCare project is known to have protected farmers from the impact of the recent drought, due to the ability of soil organic carbon to retain soil moisture⁹³.
- (iii) Reduction of greenhouse gases from municipal landfills, generated when organic material decays anaerobically. Reliance has received money for its "carbon credits" that it used to supplement revenue from waste collection and the sale of compost.

Biochar production:

- Biochar is made through the process of pyrolysis – the burning of biomass under conditions of low or little oxygen. The result is a product that absorbs CO₂ and other chemicals. When placed in the soil, biochar can enhance soil organic carbon and soil fertility. There is also evidence that biochar, when added to manure lagoons at stock farms, traps ammonia and methane⁹⁴. Once it has trapped ammonia, methane and other nitrogen run-off the same biochar can be added to soil as a source of nutrients, and to reduce nutrient leaching⁹⁵. The making and application of biochar qualifies for carbon credits (using the Clean Development Mechanism Methodology AMS III.D and AMS III.L) due to the reduction of methane from animal husbandry and the securing of stable soil carbon instead of decaying

⁹³ In line with the Conservation of Agricultural Resources Act (1983), South Africa has been able to spend public funds to support farmers in soil conservation projects.

⁹⁴ Dougherty, B; Gray, M; Johnson, M and Kleber M (2017) Can Biochar Covers Reduce Emissions from Manure Lagoons While Capturing Nutrients? *Journal of Environment Quality*, 2017; 46 (3): 659 DOI: 10.2134/jeq2016.12.0478

⁹⁵ Wang, B; Xinqing Lee, Benny K. G. Theng, Like Zhang, Hongguang Cheng, Jianzhong Cheng & Wenqiang Lyu (2019) Biochar addition can reduce NO_x gas emissions from a calcareous soil, *Environmental Pollutants and Bioavailability*, 31:1, 38-48, DOI: 10.1080/09542299.2018.1544035

organic matter (effective pyrolysis preserves 22-25% of the original biomass; this is biomass that would have otherwise decayed releasing carbon dioxide and methane).

A study commissioned by the South African Department of Environmental Affairs identified “pros, cons and uncertainties” around biochar potential, but also noted the opportunities for private enterprise particularly where a mobile kiln was available⁹⁶.

Organisations such as Living Lands and Biogrow are already making and using biochar in South Africa.

Activated Carbon:

- Activated carbon is made when natural, carbon rich material (charcoal, wood, or nut shells) is exposed to steam or chemicals that opens the pores of the charred material. The porosity and adsorptive properties of the activated carbon material is used to remove pollution from liquid or air. As such activated carbon is applied in the purification of water and air, extraction of minerals from mine tailings and in a range of cosmetic and colour removal products.

Rotocarb, a South Africa leader in the production of activated carbon currently produces 100 tons a month, and sells this carbon at over R20,000 per ton. The same company estimates that South Africa currently imports 700 tons of activated carbon a month. This amounts to an import value of R200 million per annum.

Inorganic Material

The removal of inorganic material such as plastics, glass and metal from rivers provides both an ecological benefit for the riverine area and, once sorted, a feedstock for a range of activities.

More than 270 million tons of waste are recycled around the world annually, supporting a \$200bn industry. Almost certainly a much greater amount is repurposed or reused. South Africa has a small but growing plastics and metal recycling industry that has proven useful in creating local work that does not require specialist skills.

The prices offered for recyclable plastic material have proven volatile (loosely linked to the oil price). The global recycling market suffered in December 2017, when China and Hong Kong who had previously purchased 60% of the world’s recyclable material, cut their purchases to 10% citing concerns over dirty and hazardous material.

The removal of plastic, glass and metal from rivers is unequivocally good for river health, but the material itself can be sold, as can the carbon credits that arise from the avoided emissions associated with the mining and production of virgin material: a ton of recycled aluminium avoids the release of 9.8tCO₂e, while a ton of recycled PET avoids 0.855tCO₂e, and a ton of “mixed plastics” avoids 0.805tCO₂e according to the

⁹⁶ http://tgh.co.za/case_studies/biochar-potential-in-south-africa/

United Kingdom's Department of Environment, Food and Rural Affairs (DEFRA) lifecycle analyses⁹⁷.

Typically, plastic recycling requires scaled industrial plants capable of turning recovered material into plastic flakes that can be used in everything from shoe soles to a bitumen replacement in the construction of roads and the making of paving stones and eco-planks. The use of recycled plastic in making bricks and paving stones is becoming commonplace in many countries and is being pioneered in South Africa by the Centre for Regenerative Design and Collaboration (CRDC), which claims to make bricks that are 10% stronger, 8-16% lighter and much lower in CO₂ emissions than cement bricks.

The collection and sorting of plastic material opens opportunities for micro-enterprises, as has been demonstrated by the Wildlands Conservation Trust's "wastepreneur" programme, which is implemented in parts of the EMA. It also creates the scope for "reverse vending" whereby people that deposit plastic or cans in a designated repository are rewarded with cash, airtime or food and travel vouchers, effectively crowd-sourcing plastic recycling.

Productive use of Riverine Areas

Protecting land adjacent to streams and rivers from urban transformation secures a flood buffer and allows riparian ecosystems to thrive. It promotes access to these restored areas for various productive uses, including recreation, eco-tourism and agriculture. In some regions of South Africa, the upkeep of municipal commonage is supported by a range of line departments, creating a combination of work and commercial opportunities for users of the commonage⁹⁸.

Degraded riverine areas that have been cleaned of invasive alien plants and litter (for example through the various Case Example projects studied in the baseline assessment) are often reported to become used by local communities for vegetable farming and recreation⁹⁹. These areas could be demarcated as municipal commonage and be managed by common-resource collectives to lease the land for activities such as vegetable farming and grazing, indigenous vegetation pollination sites and honey farming, ceremonies and sporting events, eco-tourism and environmental education activities. Ensuring that these activities comply with environmental legislation is key protecting the health of the adjacent riverine ecosystems and ensuring the safety of the enterprises. For example, adoption of conservation agriculture and establishment of recreational parks or environmental education facilities will have to be designed to withstand natural flooding and drought cycles. Green Corridors already has an experimental agroecology project that treats stormwater run-off by filtering it through reedbeds and sand and gravel filters before using it as irrigation water in agricultural projects. Using riparian spaces to create 'resilience' value in this way will help to

⁹⁷ Credible Carbon, *pers. comm*, 2020

⁹⁸ Anderson, M and Pienaar, K. (2003) Evaluating Land and Agrarian Reform in South Africa: Municipal Commonage. <https://www.africaportal.org/publications/evaluating-land-and-agrarian-reform-in-south-africa-municipal-commonage/>

⁹⁹ Taylor, A *et al.* (2020) Lessons about fundamental changes and demonstrable aspects of transformative adaptation in Durban and Harare. LIRA Technical Report.

ensure sustained interest and investment in their management by local communities and landowners.

Riverine Areas as Infrastructural Assets in their own right

Once the multitude of goods and services produced by rivers is documented and valued, a case emerges for them as pieces of valuable ecological infrastructure. Ecological infrastructure is akin to conventional municipal infrastructure, being critical for the provision of municipal services, and requiring maintenance in ways that generates employment. Where this is the case, eThekweni Municipality would be able to record their ecological assets on the municipal asset inventory, making use of tools such as the natural capital accounting system that is being advanced in South Africa by StatsSA¹⁰⁰ and SANBI. This in turn could enable the use of infrastructure grants for the creation and upkeep of riverine areas, where this activity can be shown to yield a municipal service.

Viewing rivers and other types of natural capital as assets is an essential part of the green economy. However, efforts to advance this approach need to be cognisant that rivers and streams may have intrinsic value that is worth protecting in its own right, even when that value is difficult to commodify and record alongside other infrastructure assets¹⁰¹. The complex and highly connected role that rivers and streams play in supporting the ecological stability and functioning of the natural environment on which all life depends, will never be fully captured by economic models. In this sense, investing in functional rivers and streams (and other aspects of the natural environment) not only generates goods, services and employment opportunities, but is an essential component of supporting life.

Given that markets are not yet capable of imputing all of this value, the responsibility falls to public entities; by the time the next flood (or drought) arrives in Durban it will be too late to invest in healthy streams and rivers capable of absorbing the worst impacts of a flood and saving damage to livelihoods and infrastructure. It is the same complex but intrinsic role of rivers that tends to lead to un-anticipated benefits (sometimes called “co-benefits”) when well-planned investments are made in their restoration, and the connections between healthy and productive people and a healthy and productive natural environment are unlocked¹⁰².

TRMP as part of a Post-COVID Economy

In economic terms, the COVID-19 crisis has enforced a supply-side shock that precipitated a dramatic decline in demand through retrenchments, bankruptcies and loss of savings. Unlike a conventional recession emanating from weak demand, the economic fall-out from COVID-19 was induced in order to save lives. Knowing this, national governments everywhere began thinking about stimulus packages as soon as they began enforcing lock-downs, borrowing concessionary finance where this is available. The sustainability of this debt will be enhanced where borrowed money can

¹⁰⁰ <http://www.statssa.gov.za/wp-content/uploads/2019/02/Natural-Capital-Accounting-Assessment-Report.pdf>

¹⁰¹ Vatn, A and Bromley, D. (1994) Choices without prices without apologies. *Journal of Environmental and Economic Management*, 26, pp.129-148.

¹⁰² Boltz, F., LeRoy Poff, N., Folke, C., Kete, N., Brown, C. M., St. George Freeman, S., *et al.* (2019). Water is a master variable: Solving for resilience in the modern era. *Water Secur.* 8. doi:10.1016/j.wasec.2019.100048.

be used to create assets. The focus during the stimulus phase will be on growth, but it cannot be the same mode of growth that has created the systemic social and environmental risks we are now facing.

The design of stimulus packages offers a rare chance to restructure the economy. Effective stimuli will: (i) be able to be mobilised quickly (ii) keep money circulating in the real and local economy in the short term, (iii) not hand money to sectors in lockdown that cannot absorb the stimulus, (iv) not hand money to sectors at risk of spreading the disease through unavoidable proximity in working quarters (v) not support sectors, such as coal, that have been identified as unsustainable and in a process of phased decline (vi) generate high economic multipliers and co-benefits (vii) not easily be off-shored resulting in a loss of local impact. In its discussion document prepared by the ANC's Economic Transformation Committee, South Africa's ruling party called for the Covid-19 response to, "*Aim at strengthening the resilience of the water sector.... in order to protect lives and livelihoods.*" Providing stimulus money to people working on the restoration of rivers and the reduction of flood risks meets all of the requirements for an effective COVID-recovery initiative and represents a sure way of ensuring that stimulus money re-enters the economy immediately and systemically – poor households supplying labour restoration schemes have a higher propensity to consume, rather than save and money in their hands will immediately support the producers of food and essential materials in the real economy.

From early in the response strategy it became clear that fund disbursements that relied on existing programmes, such as Sihlanzimvelo and others studied in this Baseline Assessment, were able to disburse money quite quickly. In contrast, when disbursements required new systems to identify and appraise applicants, relatively few applicants have received any support. The important point, that should not be lost, is that labour intensive public investment in projects such as the TRMP, should form a priority in the wake of COVID-19.

CHAPTER 3: THE CASE FOR TRANSFORMATIVE RIVERINE MANAGEMENT INVESTMENT ON MUNICIPAL LAND

3.1 Context

Municipal riverine management mandate and interests

The mandate for the protection and management all riverine areas is shared between all three spheres of government in South Africa. For example, land use decisions made by municipalities affect the state of rivers, such as the maintenance of healthy wetlands that provide a disaster risk reduction role for human settlements; while the enforcement of agricultural buffers along rivers by Provincial Government has a direct impact on river health and water quality; and National Government controls the water resources within rivers through pricing water and issuing Water Use Licenses for developments that may impact rivers.

eThekweni Municipality is responsible for the implementation and maintenance of roads, stormwater, water, sewerage and electrical infrastructure in riverine areas. In recognising the risk of damage to this infrastructure posed by rivers in poor condition, including flood damage due to culvert blockages, eroding river banks, sediment and solid waste build up, and invasive alien plants, eThekweni Municipality has a direct interest in ensuring that risks are minimised through effective riverine management.

eThekweni Municipality is also mandated to ensure healthy, quality living environments for its citizens. This includes addressing climate change as a driver of negative impacts on society and natural ecosystems. Where citizens and businesses are impacted negatively by degraded rivers, including through flooding and waterborne disease risk, the municipality has a duty to work towards resolving the problems, even if this means lobbying other spheres of government to exercise their mandates more effectively in key hotspot areas.

Track history

In 2012, eThekweni Municipality's Roads and Stormwater Management Department initiated the Sihlanzimvelo Stream Cleaning Programme. The focus of the Programme is on reducing recurrent damage costs to road culverts caused by solid waste and invasive alien plant debris build up during flash floods through managing stream areas more effectively. Local community co-operatives are employed to implement the work, resulting in a labor-intensive municipal service delivery model that creates direct socio-economic benefits in vulnerable communities.

The Sihlanzimvelo Programme demonstrates the value of managing or restoring rivers as supportive to sustainable municipal service delivery, reduced vulnerability to climate change related risks, enhanced human well-being, and job creation. The current Programme covers 450km of rivers on municipal land in upper catchment areas where surrounding settlement densities are high. In the 2020/21 financial year, the Programme has created around 600 jobs through 86 community co-operatives, with a high percentage of these being women and youth.

Options for municipal riverine management

eThekwini Municipality has recognised the potential job creation, ecological, municipal service delivery and climate adaptation benefits of upscaling the Sihlanzimvelo Programme to other rivers in the EMA. Given that the Programme model is well established, the costs and benefits of doing so can be estimated.

A second option that eThekwini Municipality wishes to pursue is the adoption of a more transformative model of riverine management, which includes a greater focus on riverine restoration and social interventions. This model is expected to be more costly to implement than Sihlanzimvelo but is anticipated to yield greater societal benefits in the form of avoided climate change related damage costs.

These two options for riverine management have been evaluated on the basis of potential benefits and costs of implementation, and the results of this evaluation are presented in Section 3.2 and 3.3. It should be noted, however, that these are not mutually exclusive options, as it is assumed that transformative riverine management interventions could be included with the Sihlanzimvelo implementation model over time as funding allows. This is explained further in Section 3.4, which presents the investment case for riverine management on municipal land.

3.2 Upscaling Sihlanzimvelo

Riverine management model

The upscaling of the Sihlanzimvelo Stream Cleaning Programme involves expanding the current project model (which is being implemented on 450km of rivers / streams in upper catchment areas) to all first and second order streams on municipal land in the EMA (1,168km of rivers / streams).

The implementation model (see Figure 10) involves community co-operatives being hired directly by eThekwini Municipality, trained in a variety of skills, and implementing a range of riverine management activities in a 3m wide strip along each side of specified sections of river / stream¹⁰³. Projects are managed by dedicated eThekwini Municipal staff, with the management of co-operatives outsourced to a third party.

¹⁰³ This is the model currently used by eThekwini Municipality, and which would also be used in the upscaled programme.

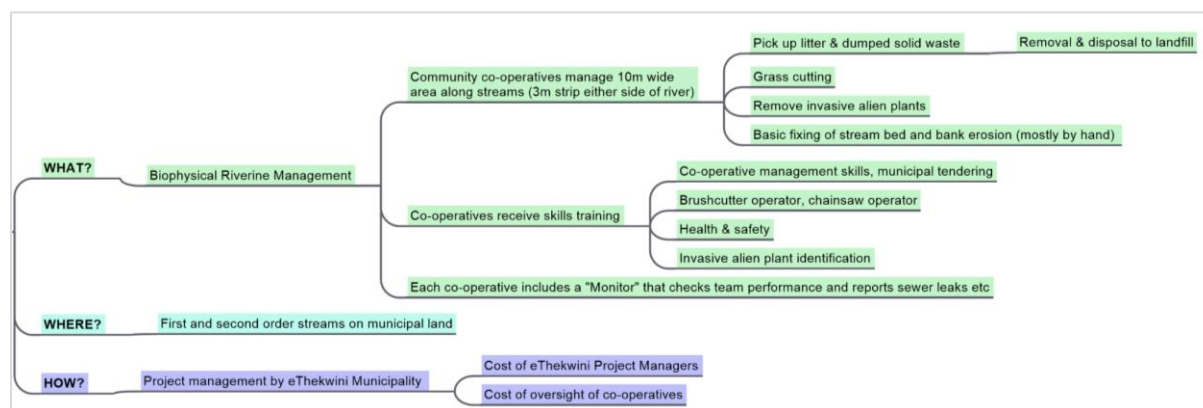


Figure 10: Sihlanzimvelo Upscaling Riverine Management Model.

Summary of benefits & costs

The known operational costs of implementing the existing Sihlanzimvelo Programme through community co-operatives on 450km of first and second order rivers / streams in the EMA (Table 2) were used to generate a cost estimate for upscaling across all first and second order streams on municipal land in the EMA (Table 9).

Table 9 shows that the annual cost of implementing an upscaled Sihlanzimvelo Programme across 1,168km of rivers / streams in upper catchment areas is estimated¹⁰⁴ at R92 million, and would result in avoided municipal infrastructure damage costs¹⁰⁵ of R59 million per annum. By expanding the community co-operative model, 1,557 permanent jobs could be created through 234 co-operatives. Vulnerable riverine communities are estimated to be protected from annual losses of over R90 million, and coastal users by over R87 million each year.

¹⁰⁴ Mander, M., Mander, N., Blignaut, J., de Winnaar, G., Butler, A., Graham, M., and Cartwright, A. (2020). Benefit Cost Analysis Technical Report. Report produced for C40 Cities Finance Facility and GIZ.

¹⁰⁵ Only road culvert damage costs are included in this estimate. It is therefore likely to be a substantial underestimate given that electrical, sewer, road, water and telecommunications infrastructure are often also affected when road culverts are damaged by flash flooding.

Table 9: Benefits and costs of upscaling Sihlanzimvelo on municipal land

Annual costs and benefits	Upscaling Sihlanzimvelo
River management distance – 1 st and 2 nd order rivers / streams, municipal land (in km)	1 168
Riverine management costs to municipality	R92 million
Avoided damage costs to municipal infrastructure (partial value – only for culverts)	R59 million
Benefit cost ratio - municipality (partial value – only for culverts)	0.6
Avoided decline in ecosystem services ⁵³	11%
Proxy wellbeing and avoided productivity losses ¹⁰⁶ to riverine communities	R90 million
Total avoided losses to municipality & riverine communities combined	R149 million
Benefit cost ratio – municipality & riverine communities	1.6
Proxy wellbeing and avoided productivity losses to coastal users	R87 million
Total avoided losses to municipality, riverine communities & coastal users	R236 million
Benefit cost ratio – municipality, riverine communities & coastal users	2.6
Number of jobs created	1 557
Number of cooperatives created	234

3.3 Transformative Riverine Management

Riverine management model

The implementation of transformative riverine management on municipal land includes biophysical restoration and management interventions, social interventions and green economy interventions.

The biophysical interventions are assumed to include restoration of wetlands and replanting of appropriate riparian vegetation on floodplains. Riverine management is implemented through community co-operatives which are upskilled in a range of technical and sustainable livelihood subject areas. Additional solid waste and debris trapping interventions are implemented in key locations. In lower catchment areas (stream orders 3 and greater), biophysical interventions include improving the condition / management of built and agricultural landscapes in riverine zones with a view to reducing negative impacts on the river from urban and agricultural run-off.

Social interventions include building awareness and skills amongst community leaders of the value of rivers, changing behaviour to protect rivers and encouraging positive river stewardship amongst riverine communities. Through an Enviro-Champs

¹⁰⁶ See Section 1.4 of this report for the methodology used to calculate proxy wellbeing and avoided productivity losses.

approach, social capital is developed amongst riverine communities to value and take care of rivers. Schools programmes and citizen science are used to activate inclusive, participatory engagement in river stewardship, while building the skills and capacity necessary for communities to respond to river issues.

eThekweni Municipality enables green economy initiatives to develop using solid waste and invasive alien plant biomass by issuing offtake agreements and partnering with non-profits, community organisations and businesses.

Summary of benefits & costs of implementation

Table 10 shows that the estimated cost of implementing transformative riverine management on municipal land is R2.75 billion over 20 years, creating 2,846 job opportunities and resulting in avoided damage costs to municipal culverts of R920 million. Societal benefits to vulnerable riverine communities are estimated at between R2.3 billion and R4.7 billion, and coastal users will benefit by between R7 billion and R14.3 billion.

Table 10: Benefits and costs of transformative riverine management on municipal land

Discounted costs and benefits over 20 years	Transformative Riverine Management: Municipal land
River management distance – all rivers, municipal land, whole EMA (in km)	1 592
Net Present Value (NPV) Costs - social discount rate 6%	
Capital costs	R673 million
Management and social costs	R2 billion
Total costs	R2.7 billion
Net Present Value (NPV) Benefits - social discount rate 6%	
Benefits to municipality (discount rate 6%)	R920 million
Proxy benefits to riverine communities (discount rate 6%)	R2.3 billion
Proxy benefits to coastal users (discount rate 6%)	R7 billion
Total benefits (discount rate 6%)	R10.2 billion
Net Present Value (NPV) Benefits - social discount rate of -1% for users	
Benefits to municipality (discount rate 6%)	R920 million
Proxy benefits to riverine communities (discount rate -1%)	R4.7 billion
Proxy benefits to coastal users (discount rate -1%)	R14.3 billion
Total benefits (discount rates of 6% and -1%)	R20 billion
Job creation benefits	
Jobs - construction for 10 years	723
Jobs - maintenance yearly	2 123
Number of potential cooperatives	318

3.4 Investment Case

Failure to manage riverine areas on municipal land will cost the city close to R59 million per annum in damage costs to road culverts by 2040, with losses to societal well-being and coastal users adding a further R177 million (Table 6).

Upscaling Sihlanzimvelo

The BCA has shown that each R1.00 invested in an upscaled Sihlanzimvelo Programme would generate R0.60 in avoided damages to municipal infrastructure¹⁰⁷ (Table 9). This is a significant under-representation of avoided infrastructure damage costs, given the exclusion of other potentially affected infrastructure types in these calculations. When including the benefits to vulnerable riverine communities, a R1.00 municipal spend generates R1.60 in benefits. Without incurring additional management or capital costs, coastal users also benefit, resulting in a total of R2.60 societal benefits for every R1.00 spent.

Expanding the community co-operative model, 1,557 permanent jobs could be created through 234 co-operatives in an upscaled Sihlanzimvelo Programme.

This suggests that as a climate change risk response, upscaling Sihlanzimvelo offers fair value to eThekweni Municipality in avoided infrastructure damages for each Rand spent. It represents an important investment to protect the well-being of vulnerable riverine communities and the coastal economy. The direct job creation and green economy enterprise development opportunities (linked to alien plant biomass and riverine solid waste off-take agreements) are important in the context of these being created in some of the most vulnerable riverine communities in the EMA.

Transformative riverine management

For every R1.00 in municipal TRMP investment, R0.30 in damage to municipal road culverts could be avoided (Table 8). However, the societal co-benefits from this investment are notable, with a significant number of vulnerable riverine communities being protected from losses linked to damaged infrastructure and increasing exposure to risks associated with declining river conditions. Each R1.00 municipal spend benefits these groups by R0.80, more than double the benefit created from management of private or Traditional Authority riverine areas. Coastal users stand to benefit by a further R2.50 without the municipality incurring additional costs. It may therefore be prudent to find appropriate cost sharing mechanisms that allow these groups to contribute towards securing the coastal benefits from riverine management. This could, for example, be achieved through a special coastal hotel bed levy, or through coastal Special Rating Areas that contribute funding towards transformative riverine management.

Overall, each R1.00 spent by the municipality on transformative riverine management on its own land could generate up to R5.23 in municipal and societal benefits.

¹⁰⁷ Recognising that Sihlanzimvelo alone cannot prevent all flood damage to municipal infrastructure, residual damage costs of one fifth of the predicted annual total will remain.

Incremental approach

It is suggested that eThekweni Municipality does not choose between the option of upscaling Sihlanzimvelo or implementing a transformative riverine management approach. Rather, a blended process is recommended, involving upscaling of Sihlanzimvelo as a known, tested implementation model, with incremental introduction of transformative management in priority locations where the additional investment will yield greatest benefits.

CHAPTER 4: THE CASE FOR TRANSFORMATIVE RIVERINE MANAGEMENT INVESTMENT ON PRIVATE LAND

4.1 Context

The municipality and broader society could avoid over R176 million per annum in losses if the municipality can enable private landowner investment in riverine management (Table 6).

Private landowners have a critical role to play in investing in ecological infrastructure both as an investor, and as a landowner. There are regulations¹⁰⁸ in South Africa that compel public and private landowners to manage IAPs on their land, but also a number of motivations for private sector investment in ecological infrastructure. One of the main motivators is to manage risk. In some sectors, investing in ecological infrastructure serves as a direct investment in risk reduction to a business, such as in the case of insurance companies playing a collaborative role in reducing their exposure to flood or fire risk. In some cases, a company or entire sector may recognise the importance of the ecosystem services that are critical in their supply chain or the production of their own products, such as clean, readily available water; and invest in the supply of these services. Investing in ecological infrastructure is also an investment in a more stable society, through helping to address poverty and socioeconomic disparities. Much corporate social investment is built on this premise.

Businesses also have a key role in managing their operations, product life cycles, waste outputs and business premises responsibly. Such practices support reduced impacts on rivers.

Approximately 26% of rivers in the EMA fall on privately owned land, including individuals and businesses. There are a growing number of riverine management projects and programmes involving partnerships between the eThekweni Municipality and private landowners, including the Wise Wayz Water Care Project, uMhlangane Wetland Rehabilitation Project, Green Corridors, Aller River Project and Palmiet Catchment Rehabilitation Project (see Table 1). This track history suggests that there is sufficient incentive in key locations – often associated with known / existing riverine risks – for private investment in riverine management. However, to unlock wider investment and participation by private landowners across the EMA, eThekweni Municipality will need to find ways of motivating and supporting action.

4.2 Basic / Transformative Riverine Management on Private Land

Basic riverine management model

Biophysical riverine management on private land is enabled, incentivised and supported through a municipal transformative riverine governance approach. Laws and policies are enforced in such a way that landowners keep riverine areas clear of invasive alien plants and do not undertake activities which degrade riverine

¹⁰⁸ National Environmental Management: Biodiversity Act, Alien and Invasive Species Regulations (2014)

ecosystems. eThekweni Municipality uses its existing mandates and functions to ensure that development nearby rivers does not discharge unattenuated stormwater, pollution or solid waste into rivers. eThekweni Municipality works proactively with other spheres of government to activate support from those whose mandates can support the municipality in enabling improved protection / management of rivers.

Transformative riverine management model

Transformative riverine governance by the eThekweni Municipality can enable and leverage biophysical restoration and management interventions, social interventions and green economy interventions on private land.

Like in the basic riverine management model for private land, laws and policies are enforced in such a way that landowners keep riverine areas clear of invasive alien plants and do not undertake activities which degrade riverine ecosystems. eThekweni Municipality uses its existing mandates and functions to ensure that development nearby rivers does not discharge unattenuated stormwater, pollution or solid waste into rivers. eThekweni Municipality engages other spheres of government with mandates relating to riverine protection / management to play a supporting role.

eThekweni Municipality develops supportive policy and by-laws and enters into partnership arrangements that leverage enhanced protection and management of riverine areas on private land at no additional cost the municipality. In lower catchment areas, eThekweni Municipality applies a requirement for “flood negative” development designs which add to flood reduction services delivered by the built landscape in river catchments.

Social interventions include supporting community-based organisations, businesses and agricultural landowners to value rivers and become proactive riverine stewards. Schools programmes and citizen science are used to activate inclusive, participatory engagement in river stewardship, while building the skills and capacity necessary for communities and businesses to respond to river issues.

eThekweni Municipality supports green economy initiatives and the sustainable economic use of riverine areas for recreation, tourism and conservation agricultural activities.

Summary of benefits & costs of implementation

Table 11 shows that to enable a basic level of riverine management by private landowners, eThekweni Municipality would need to spend R8.3 million per annum to enforce legislation and support / partner with riverine landowners and third-party funders. This public investment could unlock R106 million in private funding of riverine management each year and save the municipality at least R27 million in avoided infrastructure damage costs. Broader benefits to riverine communities and coastal users amount to just over R113 million per annum.

Table 11: Benefits and costs of basic riverine management on private land

Annual costs and benefits	Basic Riverine Management – Private land
River management distance – 1 st and 2 nd order rivers / streams, private land (in km)	1 350
Riverine management costs to municipality	R8 million
Riverine management costs to private landowners / third parties	R106 million
Avoided damage costs to municipal infrastructure (partial value – only culverts)	R27 million
Benefit cost ratio – municipality (partial value – only for culverts)	3.3
Avoided decline in ecosystem services	11%
Proxy wellbeing and avoided productivity losses to riverine communities	R26 million
Total avoided losses to municipality & riverine communities combined	R53 million
Benefit cost ratio – municipality & riverine communities	0.5
Proxy wellbeing and avoided productivity losses to coastal users	R87 million
Total avoided losses to municipality, riverine communities & coastal users	R140 million
Benefit cost ratio – municipality, riverine communities & coastal users	1.2
Number of jobs created	1 800
Potential number of cooperatives created	270

Table 12 shows that eThekweni Municipality would need to spend R153 million over 20 years to unlock R2.4 billion in transformative riverine management investment by private landowners, including businesses. This could create 3,189 job opportunities and result in R803 million in avoided damages to municipal road culverts. Vulnerable riverine communities could benefit between R665 million and R1.4 billion in avoided losses¹⁰⁹. Coastal users avoid between R8.1 billion and R16.7 billion in losses from declining coastal quality linked to rivers¹⁰⁹.

¹⁰⁹ Depending on the social discount rate used.

Table 12: Benefits and costs of transformative riverine management on private land

Discounted costs and benefits over 20 years	Transformative Riverine Management - Private land
River management distance – all rivers, private land, whole EMA (in km)	1 852
Net Present Value (NPV) Costs - social discount rate 6%	
Municipal costs of transformative riverine governance	R153 million
Capital costs - Municipality	R0
Capital costs - Private landowners & third parties	R525 million
Management and social intervention costs - landowners & third parties	R1.9 billion
Total costs	R2.6 billion
Net Present Value (NPV) Benefits - social discount rate 6%	
Benefits to municipality (discount rate 6%)	R803 million
Proxy benefits to riverine communities (discount rate 6%)	R665 million
Proxy benefits to coastal users (discount rate 6%)	R8.1 billion
Total benefits (discount rate 6%)	R9.6 billion
Net Present Value (NPV) Benefits - social discount rate of -1% for users	
Benefits to municipality (discount rate 6%)	R803 million
Proxy benefits to riverine communities (discount rate -1%)	R1.4 billion
Proxy benefits to coastal users (discount rate -1%)	R16.7 billion
Total benefits (discount rates of 6% and -1%)	R18.9 billion
Job benefits	
Jobs - construction for 10 years	720
Jobs - maintenance yearly	2 469
Number of potential cooperatives	370

4.3 Investment Case

For each Rand spent on private landowner management of rivers, eThekweni Municipality would benefit between R3.30 (basic management) and R5.20 (transformative management) in avoided culvert damage costs, and coastal users would benefit by between R3.20 and R6.50 (Table 8).

Financial motivation

A lack of management of streams and rivers on private land could cost the city more than R63 million per annum in damage costs to road culverts by 2040 (Table 6). Including the social costs of these damages and loss of amenity to coastal users, the total annual cost of not managing private riverine areas in the EMA is estimated to reach R176 million by 2040.

The financial case for private landowner investment in riverine management is weak. The direct avoided losses to private landowners generally do not offset their management costs. For example, a private landowner spend of R1.00 could produce as little as R0.25 in benefits to themselves, yet creates substantial benefits to the municipality and coastal users. This is a reflection of the current situation, in which the benefits are not sufficient for widespread voluntary private investment in riverine management. The exceptions are where the direct risks of increased flooding or river erosion / sedimentation to private property warrant intervention by those affected.

Incentives & support

Given the potentially significant costs of poor management to the municipality and broader society, a combination of legislative enforcement, incentives and technical support will be needed to unlock the public good associated with well-managed rivers on private land. Applied effectively in a transformative riverine management model, this could create 3,189 job opportunities and play a key role in supporting a vibrant coastal economy.

Given that the benefits of private riverine management often accrue significantly to downstream communities and the municipality, there may be justification for cost sharing, for example through a Payment for Ecosystem Services approach, between the municipality, private landowners, and coastal users (such as property and tourism sectors). For example, a coastal hotel bed levy could co-finance upstream management by a cost-effective non-profit management agency or cooperative.

In accordance with South Africa's Broad-based Black Economic Empowerment regulatory framework¹¹⁰, many private companies budget for Corporate Social Investment and Enterprise Development initiatives that create jobs, empower small enterprises, develop skills, and deliver a range of social / environmental benefits. This can offer opportunities for funding riverine management, for example on a business's own land or along a local river.

¹¹⁰ See <http://www.thedtic.gov.za/financial-and-non-financial-support/b-bbee/b-bbee-codes-b-bbee-acts-strategies-policies/>

The municipal cost of facilitating basic riverine management by private landowners is R8.3 million per annum, and for each Rand spent, R3.30 in avoided infrastructure damage costs is achieved. In a transformative riverine governance model, eThekweni Municipality would need to spend R153 million over 20 years to facilitate private investment, and for each Rand spent R5.20 in avoided infrastructure damages would be achieved.

As the municipal avoided infrastructure damage costs from private riverine management investment are potentially substantial, there is justification for the municipality to contribute financially to the costs of managing private riverine areas in key locations that present best value in terms of infrastructure protection. Alternatively, financial support could be levied through Special Rating Areas in which the municipality jointly contributes towards the cost of managing rivers with private landowners in key areas.

To achieve transformative outcomes, the eThekweni Municipality will need to partner with businesses and private riverine landowners to facilitate joint riverine management investment and action. Given the extent of private landownership, prioritisation will be key.

A stewardship approach

Mobilising private landowners to better manage riverine areas will require mechanisms that facilitate collaboration, sharing of knowledge, and pooling of resources in a way that enhances landowner motivation and capability to engage in river stewardship. These mechanisms should be responsive to variable / context-specific interests, allowing for clustering around common or overlapping interests, which may be spatially defined or linked to specific riverine risks or green economy opportunities. One example is the Community of Innovators established within the Palmiet River Catchment Rehabilitation Project, which comprises catchment stakeholders with a shared interest in addressing sources of river degradation, including mobilising other actors within the catchment as necessary.

CHAPTER 5: THE CASE FOR TRANSFORMATIVE RIVERINE MANAGEMENT INVESTMENT ON TRADITIONAL AUTHORITY LAND

5.1 Context

Management of upper catchment areas on Traditional Authority land is a critical strategy to minimise ecosystem service losses with climate change.

Just over half of the rivers within the EMA fall within Traditional Authority areas, mostly within upper catchments. The rural and peri-urban nature of these landscapes is such that streams and rivers are generally less impacted by urban development than elsewhere. Upper catchment areas play a critical role in protecting the condition of the entire downstream riverine ecosystem. Damage costs and management requirements for rivers may escalate disproportionately with declining condition of upper catchment areas. Conversely, management of upper catchment streams and rivers yields notably high ecosystem services benefits to all downstream users.

The iNgonyama Trust administers approximately 2.8 million hectares of land in KwaZulu-Natal. Of this, 79 913 hectares fall within the eThekweni Municipality. The trust is mandated to hold land for “the benefit, material welfare and social well-being of the members of the tribes and communities” living on the land. According to the Traditional Leadership and Governance Framework Act (Act No. 41 of 2003) a traditional leader performs the functions provided for in terms of customary law and customs of the traditional community concerned, and in applicable legislation. Although the iNgonyama Trust has certain rights related to land tenure, it is not exempt from adhering to the National, Provincial and Local Government policies and regulations pertaining to land, environmental affairs, water and conservation. These provincial, national and local level regulations, along with the rights enshrined in the Constitution, and the customary laws, thus provide the framework in which to ensure the management of riverine corridors on iNgonyama Trust land in the eThekweni Municipality.

5.2 Basic / Transformative Riverine Management on Traditional Authority Land

Basic riverine management model

Biophysical riverine management on Traditional Authority land is enabled, incentivised and supported through a municipal transformative riverine governance approach. Laws and policies are enforced in such a way that riverine areas are kept clear of invasive alien plants and are not the subject of activities which degrade riverine ecosystems. eThekweni Municipality uses its existing mandates and functions to ensure that development nearby rivers does not discharge unattenuated stormwater, pollution or solid waste into rivers. eThekweni Municipality works proactively with other spheres of government to activate support from those whose mandates can support the municipality in enabling improved protection / management of rivers.

Transformative riverine management model

The transformative riverine management model for Traditional Authority land involves implementation of transformative riverine governance by eThekweni Municipality that enables and leverages biophysical restoration and management interventions, social interventions and green economy interventions.

Like in the basic riverine management model, laws and policies are enforced in such a way that riverine areas are kept clear of invasive alien plants and are not subject to activities which degrade riverine ecosystems. eThekweni Municipality uses its existing mandates and functions to ensure that development nearby rivers does not discharge unattenuated stormwater, pollution or solid waste into rivers. eThekweni Municipality engages other spheres of government with mandates relating to riverine protection / management to play a supporting role.

eThekweni Municipality develops supportive policy and by-laws and enters into partnership arrangements that leverage enhanced protection and management of riverine areas. In lower catchment areas, eThekweni Municipality supports floodplain restoration to improve stormwater attenuation and filtration, as well as litter trapping services.

Social interventions include building awareness and skills amongst community leaders of the value of rivers, how to change behaviour to protect rivers and to encourage positive river stewardship amongst riverine communities. In addition, eThekweni Municipality supports community-based organisations to value rivers and become proactive riverine stewards. Schools programmes, citizen science and education campaigns are used to activate inclusive, participatory engagement in river stewardship, while building the skills and capacity necessary for communities to respond to river issues.

eThekweni Municipality supports green economy initiatives associated with alien plant biomass cleared from riverine areas and the sustainable economic use of riverine areas for recreation and tourism activities. It also supports resilient floodplain food gardening and sustainable natural resources usage (e.g. river sand, natural fibre harvesting and processing etc.).

Summary of benefits & costs of implementation

Table 13 shows that to enable a basic level of riverine management on Traditional Authority land, eThekweni Municipality would need to spend R4.8 million per annum to enforce legislation and support / partner with the iNgonyama Trust and third-party funders (i.e. government, donors). This public investment could unlock R102 million in third-party funding of riverine management each year and save the municipality at least R16 million in avoided infrastructure damage costs. Broader benefits to riverine communities and coastal users amount to over R107 million per annum.

Table 13: Benefits and costs of basic riverine management on Traditional Authority land

Annual costs and benefits	Basic Riverine Management - Traditional Authority land
River management distance – 1 st and 2 nd order streams (in km)	2 611
Municipal costs of riverine governance, including enforcement	R4.8 million
Riverine management costs to third parties	R102 million
Avoided damage costs to municipal infrastructure (partial value – only culverts)	R16 million
Benefit cost ratio – municipality (partial value – only for culverts)	3.4
Avoided decline in ecosystem services	11%
Proxy wellbeing and avoided productivity losses to riverine communities	R20 million
Total avoided losses to municipality & riverine communities combined	R36 million
Benefit cost ratio – municipality & riverine communities	0.3
Proxy wellbeing and avoided productivity losses to coastal users	R87 million
Total avoided losses to municipality, riverine communities & coastal users	R124 million
Benefit cost ratio – municipality, riverine communities & coastal users	1.2
Number of jobs created	1 741
Potential number of cooperatives created	261

Table 14 shows that eThekweni Municipality would need to spend R117.7 million over 20 years to unlock R2 billion in transformative riverine management investment by third parties on Traditional Authority land. This could create 3,146 job opportunities and result in nearly R206 million in avoided damages to municipal road culverts. Vulnerable riverine communities could benefit by between R511 million and R1 billion in avoided losses. Coastal users avoid between R7.8 billion and R16 billion in losses from declining coastal quality linked to rivers.

Table 14: Benefits and costs of transformative riverine management on Traditional Authority land

Discounted costs and benefits over 20 years	Transformative Riverine Management - Traditional Authority land
River management distance – all rivers, Traditional Authority land, whole EMA (in km)	3 560
Net Present Value (NPV) Costs - social discount rate 6%	
Municipal costs of transformative riverine governance	R118 million
Capital costs - Municipality	R0
Capital costs - Traditional Authorities & third parties	R251 million
Management and social intervention costs – Traditional Authorities & third parties	R1.8 billion
Total costs	R2.2 billion
Net Present Value (NPV) Benefits - social discount rate 6%	
Benefits to municipality (discount rate 6%)	R206 million
Proxy benefits to riverine communities (discount rate 6%)	R511 million
Proxy benefits to coastal users (discount rate 6%)	R7.8 billion
Total benefits (discount rate 6%)	R8.5 billion
Net Present Value (NPV) Benefits - social discount rate of -1% for users	
Benefits to municipality (discount rate 6%)	R206 million
Proxy benefits to riverine communities (discount rate -1%)	R1.1 billion
Proxy benefits to coastal users (discount rate -1%)	R16 billion
Total benefits (discount rates of 6% and -1%)	R17.3 billion
Job benefits	
Jobs - construction for 10 years	773
Jobs – annual maintenance	2 373
Number of potential cooperatives	356

5.3 Investment Case

For each Rand spent on enabling riverine management on Traditional Authority land, eThekweni Municipality could unlock between R1.70 and R3.40 in avoided infrastructure damage costs, while protecting coastal quality¹¹¹.

Prevention is better than cure

The streams and rivers on Traditional Authority land in the EMA are generally in a better ecological state than elsewhere in the city. Modelling suggests that neglect of these upstream rural rivers could result in significant declines in downstream ecosystem services¹¹², with associated productivity and well-being losses to downstream users. Preventing the decline of these areas – caused either through settlement expansion, inappropriate agricultural use, unsustainable natural resource harvesting, or invasive alien plants – offers a low-cost option for maintaining riverine ecosystem services delivery.

Table 6 shows that failure to protect and manage streams and rivers on Traditional Authority land could cost the city more than R16.2 million per annum in additional damage costs by 2040. Including the social costs of these damages and loss of amenity to coastal users, the total annual cost of not managing these riverine areas in the EMA is estimated to reach R123.5 million by 2040.

System-scale benefits

The benefits of riverine management to communities living on Traditional Authority land are relatively low compared to other land ownership regimes due to the small, dispersed resident populations. For example, a R1.00 spend may only yield as little as R0.20 in riverine community well-being benefits. However, the municipal and coastal benefits are substantial, as the relatively low management costs per kilometre of river benefit a large number of ecosystem service users, with R3.60 in avoided societal and municipal losses being achieved through each R1.00 spent.

As in the private land business case where benefits of riverine management investment accrue mostly downstream, there may be justification for cost sharing, for example through a Payment for Ecosystem Services approach, between the municipality, iNgonyama Trust, traditional leaders, and coastal users (such as property and tourism sectors). There is justification for the municipality to consider contributing financially to the costs of managing Traditional Authority riverine areas, particularly in upper catchment areas.

Co-operative governance

Given that Traditional Authority land is managed for community benefit using government funding, eThekweni Municipality will need to partner with the iNgonyama Trust and local leadership in facilitating large-scale third-party investment in riverine

¹¹¹ See Table 8 and Table 13.

¹¹² An additional 'upper catchment neglected' scenario was modelled for the Ohlanga River Catchment using the Eco-Futures process, which showed that the 11% avoided loss associated with river management, could be curtailed to only a 3% avoided loss, implying that the upper catchment plays a critical role in downstream river functionality and ecosystem services supply.

management – for example from other government or donor funders. Co-operative governance needs to be strengthened to ensure that land-use decision making in Traditional Authority areas are consistent with TRMP objectives.

CHAPTER 6: PROTOTYPE CATCHMENT-SCALE TRMP

6.1 Overview

To better understand how a TRMP could be implemented at catchment-scale, including the costs and benefits thereof, an indicative Prototype Catchment-scale TRMP was prepared for the Ohlanga River Catchment¹¹³. This entailed:

1. Determining the current delivery of riverine ecosystem services (based on current state of rivers) in the catchment and associated infrastructure and social vulnerabilities,
2. Modelling how riverine ecosystem services delivery in the catchment could be affected by climate change,
3. Identifying biophysical, social and institutional riverine management interventions that would address key risks and vulnerabilities in the system.

The above information was used to inform assumptions in the BCA on the cost per kilometer of river to implement a TRMP. In addition, this information is useful as a demonstrated example of the scale and nature of interventions that could be implemented to achieve transformative riverine management objectives.

6.2 Ohlanga River Catchment

The Ohlanga River Catchment occurs to the north of Durban and covers an area of around 8 200 ha. It includes various urban and rural land uses and natural ecosystems, ranging from grasslands and wetlands to sugarcane agriculture and subsistence food gardens, to informal settlement and high-income development. As a relatively small catchment, it provides a reasonable representation of land uses that typically characterise river catchments in the EMA.

The Ohlanga River Catchment can be divided into upper, middle and lower sub-catchments, based on topography and associated clustering of land uses (Figure 11). The upper sub-catchment includes a mix of land uses dominated by formal and informal residential in the southern part, with sugarcane agriculture and natural vegetation as a mosaic of grassland, thicket and forest in the northern part. The middle sub-catchment comprises formal residential development with some informal settlement, while the lower sub-catchment is dominated by sugarcane.

¹¹³ Mander, M., Mander, N., de Winnaar, G. and Graham, M. (2020). Ohlanga Proto-Masterplan for Transformative Riverine Management. Report produced for C40 Cities Finance Facility and GIZ.

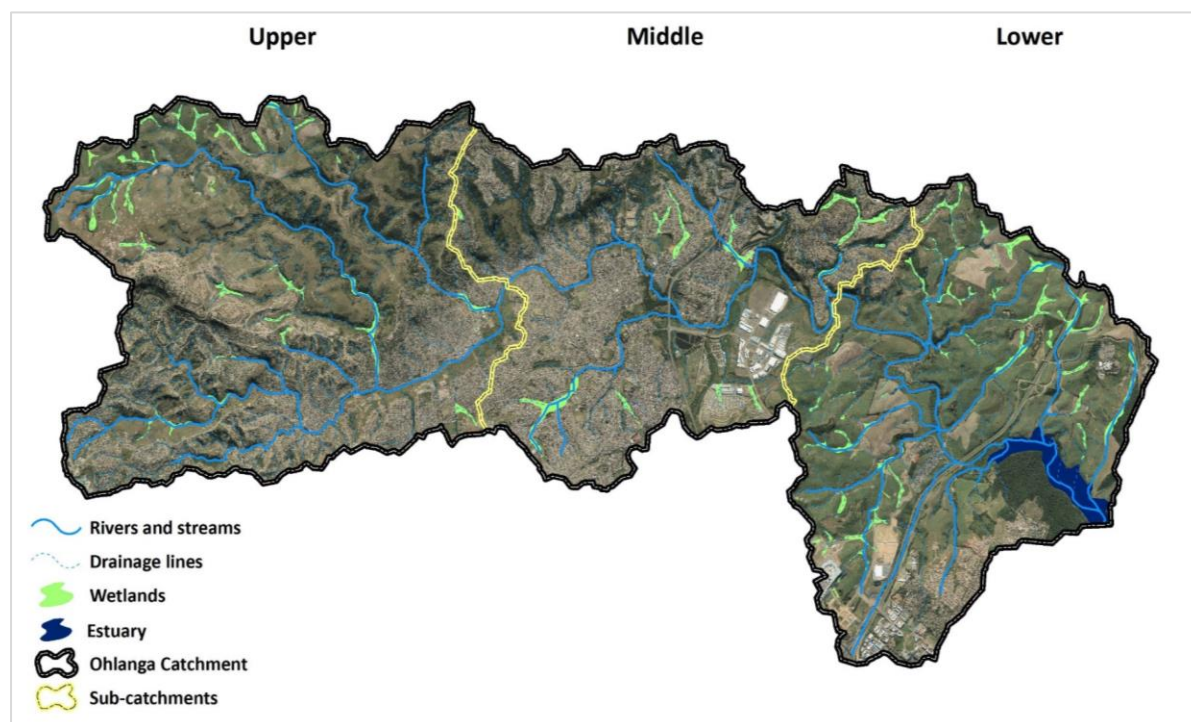


Figure 11: Overview of the Ohlanga River Catchment and its associated aquatic habitats.

There are over 100 wetlands scattered throughout the catchment, mostly concentrated in the lower sub-catchment and northern half of the upper sub-catchment. Few of the wetlands are in good condition, which presents opportunities for wetland rehabilitation. There are roughly 230 km of small rivers (of orders 1 and 2), which flow into the larger rivers (of orders 3 and greater) that extend for another 64 km before reaching the uMhlanga Estuary. The rivers are generally in the poor condition. It is only some rivers and streams in the less developed upper reaches that are in a relatively good condition.

Riverine Vulnerability Assessment findings¹¹⁴ for the Ohlanga River system are summarised as follows:

- The middle and lower sections of the Ohlanga River mainstem are at the highest risk from flooding resulting largely from the dense urbanisation. There is evidence of severe bank erosion/collapse along the mainstem as observed from aerial imagery.
- Flood impacts to infrastructure are exacerbated by debris (mainly invasive trees) and solid waste entering the river channel. The risk from debris and solid waste is greatest along the Ohlanga River mainstem, particularly in the middle sub-catchment.
- The greatest potential for attenuating floodwaters exists in the lower sub-catchment, with some capacity along the Ohlanga mainstem within the middle sub-catchment.

¹¹⁴ De Winnaar, G., Louw, A., Graham, M. and Mander, N. (2020). River Vulnerability Assessment for the eThekweni Municipality. Report produced for GIZ and CFF.

- The headwaters of the Ohlanga River in the upper sub-catchment, and the Canehaven tributary in the middle sub-catchment, present the greatest risk for solid waste pollution, which is transported downstream.
- Pollution from failing sewer systems appears to be associated with the middle sub-catchment and parts of the lower sub-catchment.
- Additional pollution sources include industries and wastewater treatment works in the lower sub-catchment.
- Most of the adaptive capacity is centred in the lower sub-catchment, but there is some capacity in the middle sub-catchment.
- Open spaces are threatened by invasive alien plants (IAPs), and infestations appear to be problematic along rivers, particularly in the more urbanised areas of the catchment.

6.3 Prototype TRMP

A TRMP for the Ohlanga River system would require biophysical, social and institutional interventions. It should also include all stakeholders at various levels (or spheres) of influence.

Further details and information on specific interventions is provided in the specification sheets prepared as part of the ecological infrastructure and socio-ecological toolkit for transformative adaptation of rivers¹¹⁵. Each specification sheet provides a description of each type of intervention with additional information on capital and maintenance costs, approaches, methods, constraints, risks, benefits, etc.

Biophysical interventions

Biophysical interventions involve both natural systems (e.g. restoration and management of floodplains, riparian vegetation, etc.), and engineered interventions (e.g. gabions, reshaped floodplains, groynes, litter or trash booms, etc.). They often help to address “symptoms” of concern (e.g. flooding and solid waste) rather than targeting the issue at source (e.g. stormwater controls on-site, improved awareness of solid waste impacts to communities, maintenance of sewer systems). Since these interventions are closely aligned with the active river channel, they need to be correctly sited and managed to account for variable flow conditions.

¹¹⁵ Prepared by Groundtruth Consulting for C40 Cities Finance Facility. (2020).

Invasive alien plant control and revegetation



To correctly establish requirements and costs of an **IAP Control Programme** requires understanding of the extent and severity of infestations. This should preferably be supported by a IAP baseline study with mapping and assessment of IAP infestations to measure the degree of infestation. Areas, preferably defined as sub-catchments, need to be assigned as management units, each with a plan and defined targets to clear and control IAPs.

The Ohlanga Catchment supports up to around 1 100 ha of riverine area, just over half of this area falls within the 1 in 100 year floodplain. It has been assumed, based on transformation levels and inspection of aerial imagery, that approximately 25% would be targeted for clearing IAPs with moderate to high infestations. The IAP Control Plan should target smaller river systems as a priority to control downstream dispersal in future. The IAP Control Plan should also consider all the risks and opportunities that may affect the overall success of the programme. For, example, consideration should be given to areas infested with IAPs that are adjacent to river management areas, as these present a risk of reinfestation. This would significantly increase costs required to implement a catchment-wide IAP Control Plan.

Estimated cost = R 18 200 000 to clear up to 280 ha that is moderately to highly infested by IAPs

Revegetation of areas that have been cleared of IAPs is an essential intervention that should accompany all IAP Control Plans, especially in areas with problematic infestations. Although this adds significant cost, it will reduce the long-term costs for repeated follow-ups required to continually manage IAPs. The simplest and most practical approach is to establish cover with indigenous grasses, which is often done using grass seed mixes or hydroseeding. The type of revegetation should, however, also try to be orientated according to the size river to avoid knock-on effects such as blockage and damage caused to infrastructure due to debris being washed down

ivers during floods. The desired approach should be to establish woody riparian vegetation (comprising suitable riparian trees and shrubs) along smaller rivers, which will also help to regulate and control flood pulses along these smaller systems as a means to reduce the cumulative flooding effects downstream. Sites on larger rivers, should however be planted with herbaceous vegetation using various indigenous grasses, sedges and reeds that typically grow along rivers.

Tree planting can be done through a “treeprenuers” programme (as an added social intervention). The initial focus should be on establishing small islands of trees to create stabilizing features at strategic positions along rivers (e.g. upstream of road crossings). These islands will help reduce flood velocity by increasing resistance (from riparian trees with stabilizing root systems) across the channel.

Estimated cost = R 7 200 000 to revegetate heavily infested areas by creating an indigenous grass cover that will help to reduce IAP regrowth

Bank and channel stabilization



Gabions are generally installed as retaining walls along riverbanks, particularly in cases where banks are collapsing near roads, bridges and buildings. They help to stabilize banks and reduce further erosion during high flows and floods. A geofabric must be installed at the interface between the earthen bank and gabion structure to limit sediment moving through the gabion structure. This not only ensures that sediment is retained behind the structure and prevented from entering the watercourse, but also prevents the gabions from collapsing due to cavities developing behind the structure.

Several sites were identified within the Ohlanga Catchment using aerial imagery. These sites appear to be concentrated in the lower parts of the upper sub-catchment, as well as the middle sub-catchment (including the Canehaven tributary). These sites

also fall within the areas that were modelled in the Vulnerability Assessment as having the highest risk from flooding.

Estimated cost = R 10 000 000 to install gabions covering up to 1 000 m² on the Ohlanga River mainstem within the Upper and Middle sub-catchments and up to 250 m² on the Canehaven tributary

Riprap involves installing rock-packs along the edge of riverbanks to protect the toe of a bank from being eroded and undercut. Riprap is often accompanied by bank re-shaping and revegetation above the riprap that help to stabilize the entire bank.

It is likely that there are limited opportunities for using riprap (and bank reshaping) due to the highly developed nature of the urban areas within the Ohlanga. Thus, it is assumed that 5 000 m², 3 000 m² and 1 000 m² of riprap may be required in the upper, middle and lower sub-catchments respectively.

Estimated cost = R 6 300 000 to install up to one hectare of riprap (or interlocking blocks) along small rivers within urbanized areas throughout the Ohlanga Catchment

Solid waste and debris traps

Debris walls are concrete pillars constructed within a river channel upstream of culverts and bridges to help trap debris and solid waste before it enters the culvert, further reducing debris blockages and lowering the risk of debris blockages damaging the culvert/bridge. They are relatively expensive to install and will require ongoing maintenance to remove build-up of debris and solid waste.

Estimated cost = R 3 240 000 to install up to nine debris walls (three in the upper, four in the middle and two in the lower sub-catchments) at road crossings in urbanized areas, targeting sites downstream of informal settlements

Litter socks are relatively novel structures that can be fitted onto culverts and stormwater drains on outflow points. They are relatively specialized and may need to be imported, unless they can be made up locally. Waste will need to be cleared out from socks regularly, especially during the summer/rainfall season. Otherwise, excessive build-up of waste within the socks will result in them being damaged.

Estimated cost = R 1 265 000 to install up to eleven litter socks (eight in the upper and three in the middle sub-catchments) at road crossings in urbanized areas, targeting sites downstream of informal settlements (this cost could be reduced through local construction)



Litter booms (or trash booms) are installed diagonally across waterways to catch and direct floating material (debris or solid waste) towards the banks, thus preventing this material from travelling further downstream. Floating debris and waste can then be easily removed from the watercourse, and certain wastes recycled (as an added economic benefit). Booms will need to be serviced regularly (preferably daily), and they are ineffective during high flows.

The Integrated Green Spaces Partnership Management Plans¹¹⁶ developed for the Ohlanga Catchment identified fourteen sites for litter booms, which were verified using aerial imagery and aligned with the solid waste modelling from the Vulnerability Assessment. A smaller subset of these were selected as the most viable sites from installing litter booms.

Estimated cost = R 280 000 to install and service up to six litter booms (eight in the upper and three in the middle sub-catchments) at road crossings in urbanized areas, targeting sites downstream of informal settlements

¹¹⁶ eThekweni Municipality and Green Corridors (2020). Ohlanga Integrated Green Spaces Partnership Management Plans. eThekweni Municipality Report.

Wetland rehabilitation and creation



There are 110 non-riverine wetlands within the Ohlanga Catchment based on the National Wetland Map 5 (NWM5), which includes inland wetlands and estuaries within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018¹¹⁷. All floodplain and channeled valley-bottom wetlands were excluded on the basis that they are represented as part of riverine ecosystems in the TRMP. Selected wetlands occur mainly in the lower sub-catchment (61 wetlands covering approximately 100 ha), followed by the upper sub-catchment (34 wetlands covering approximately 75 ha). The middle sub-catchment has the least number of wetlands (14 wetlands covering approximately 55 ha). Over 80% of these wetlands are in a poor to seriously modified state.

The objective of **wetland rehabilitation** is to restore wetland ecosystem functionality by improving the condition of existing, impacted wetlands. It can be an expensive process, particularly for highly degraded systems, and requires specialist input from wetland specialist and design engineers. However, the benefits are substantial. Rehabilitation of wetlands within the Ohlanga Catchment will help to enhance water quality, improve flood attenuation, increase water supply (i.e. baseflows and low flows), assist groundwater recharge and improve biodiversity. They will increase carbon storage, reduce erosion and sedimentation, trap litter, as well as provide numerous resources and materials (e.g. woven baskets and sleeping mats, reeds for building, grazing for livestock, etc.) to local communities.

Estimated cost = R 44 025 000 to rehabilitate up to 110 wetlands within the Ohlanga Catchment

¹¹⁷ Van Deventer H, Smith-Adao L, Mbona N, Petersen C, Skowno A, Collins NB, Grenfell M, Job N, Lötter M, Ollis D, Scherman P, Sieben E and Snaddon K (2018). South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A).

Stormwater controls

The Integrated Green Spaces Partnership Management Plans¹¹⁸ developed for the Ohlanga identified 45 sites for **stormwater treatment wetlands**. A number of these correspond with existing wetlands and were thus excluded on the basis that they will be catered for under the wetland rehabilitation component of the TRMP. Created wetlands should be located within urban areas associated with the upper and middle sub-catchments to maximize opportunities for attenuating stormwater runoff / floods, and to increase trapping of waste and assimilation of pollutants.

Estimated cost = R 4 125 000 to create up to 25 stormwater treatment wetlands within the upper and middle sub-catchments of the Ohlanga Catchment

Groynes are structures that protrude from a bank into a river. They are constructed using reinforced concrete, gabions or soil berms and are generally used on floodplains and in lower-energy river systems. The purpose of a groyne is to direct high energy flows away from the bank to protect it from erosion, as well as enhancing energy flow to promote the scouring of accumulated sediment and sludge in streams that are heavily polluted by raw sewage. Groynes also influence the hydraulics of a river by creating an eddy, which lowers the flow and energy of the water and encourages sediment and solid waste deposition.

Estimated cost = R 1 170 000 to create two pocket groynes, one in the lower parts of the Middle sub-catchment and one in the upper parts of the lower sub-catchment



¹¹⁸ eThekwin Municipality and Green Corridors (2020). Ohlanga Integrated Green Spaces Partnership Management Plans. eThekwin Municipality Report.



Pocket parks are relatively expensive features that cost in the region of R 6.5 million for a 1 ha pocket park. They provide an attractive space for recreation and exercise by the general public, but are also cleverly designed to incorporate flood attenuation capacity, as well as providing some green open space within highly urbanized areas.

Estimated cost = R 13 000 000 to create two pocket parks, one in the Upper sub-catchment and one in the Middle sub-catchment (each covering one hectare)

Social interventions

Social interventions involve training of local communities and municipality officials in resource management practices, improved supply chains, access to markets, new infrastructure, peer learning and user groups, financial investments, etc. Empowering people to take ownership and responsibility of their surroundings and to make them more in control of their own lives is an effective way instilling behavioral changes and encouraging people to take action as river stewards.

Enviro Champs (training and monitoring)



The **Enviro Champs** programme has had great success in the community of Mpophomeni (in the KZN Midlands) and in the Aller River Project (in the EMA) and has massive potential for upscaling throughout the EMA. Enviro Champs are essentially on-the-ground monitors that provide education and training to local communities on riverine protection (e.g. proper disposal of refuse, reporting of sewerage spills, proper sanitation and no illegal dumping of waste). They are trained to use citizen science tools to monitor water quality, and report issues to responsible authorities.

Enviro Champs can be selected from up to 25 informal settlements located within the Ohlanga Catchment, which will help to uplift social well-being while helping improve river health through water quality monitoring, reporting leakages, burst pipes and discharging sewers, and engaging in door-to-door initiatives to raise awareness about water and sanitation issues. Enviro Champs should prioritize working within informal settlements (e.g. Goqokazi and Amawoti informal settlements) and suburbs with known sewer failures (e.g. Waterloo, Caneside, Forest Haven, Woodview and Shastri Park).

Estimated cost = R 1 800 000 to train and employ up to 30 Enviro Champs to monitor and report problems such as sewer leaks/failures, and to remove solid waste for the rivers

School environmental programmes



Building awareness around river ecosystems through school environmental programmes is a good way to get local schools to become involved in the ongoing monitoring of river health. A practical example is to provide support to multiple schools that can “Adopt-a-River” reach and undertake monitoring using various citizen science tools. School groups could even provide outreach around issues such as solid waste and sewerage pollution within respective reaches.

There are several primary and secondary/high schools within the catchment that could be approached to develop a school Adopt-a-River programme. Together, these schools can cover up to 75% of the rivers within the Ohlanga Catchment simply by virtue of them being within close proximity (i.e. within one kilometre radius).

Estimated cost = R 480 000 to develop and run a school programme (including up to 10 secondary and 15 primary schools), which can be staggered over a few years

River awareness and training

Stakeholders that can significantly influence how the Ohlanga Catchment is managed and coordinated include municipal officials, ward councilors and private businesses. Key members from these groups should be trained to improve understanding of ecological infrastructure. Improved awareness of riverine ecosystems by key individuals will help improve the sustainability of the TRMP.

Estimated cost = R 300 000 to train 10 councilors/officials and 10 business members

Tree prenuers



The concept of treepreneurs was originally established in KwaZulu-Natal by the NGO, Wildlands Conservation Trust. It has now been expanded to many more communities throughout South Africa. Treepreneurs are taught how to grow and care for indigenous trees and shrubs that can then be used in active rehabilitation/restoration projects. Support is given to treepreneurs by providing seeds and growing medium. Once seedlings have grown to a sufficient size, they can be exchanged for food vouchers, clothing, bicycles, educational support and other essentials. The indigenous plants/trees can then be planted to assist with bank stabilisation, improve biodiversity, be used in stormwater management or to revegetate areas cleared of alien vegetation.

Estimated cost = R 500 000 to develop and support for 10 treepreneurs

Institutional interventions

Critical issues affecting river systems linked to governance need to be identified and prioritised, with steps put in place to address shortfalls in institutional roles. Ultimately, civil society, business and government must work together to create meaningful social, environmental and economic change for the whole of society to benefit from transformative riverine management. The following suggestions will serve to improve overall governance:

- Various municipal departments need to strive for improvements in service delivery that address current impacts on rivers, particular in terms of sanitation and waste.
- Departments should provide support and/or facilitate programmes to improve use of services/infrastructure by citizens. For example, educating communities on litter prevention, proper management of solid waste, and proper use of waterborne sewerage systems to reduce pipeline blockages.

- Departments need to collaborate with NGOs and other organisations to expand interventions that improve awareness around threats to river ecosystems and promote community and business stewardship of rivers.
- Initiate measures to evaluate the state of systems. River health monitoring should form an important foundation to understand where problems are occurring in the system and define appropriate steps to pinpoint and fix problems.
- Develop incentives that will help local communities and industries give more consideration to their impacts in the catchment, and how they can influence others to act against factors causing degradation of rivers.
- Determine meaningful and practical ways for businesses to invest in river ecosystem restoration, either through Corporate Social Investments (CSI) or Corporate Social Responsibility (CSR).
- Identify priority areas and actions for government intervention and obtain support from National Government Departments (e.g. Water and Sanitation, Environmental Affairs, etc.) and external (local and international) funding agents.

6.4 Implementation Guidance

The following interventions and approaches are suggested to guide the establishment of a sustainable TRMP for the Ohlanga River Catchment:

- Establish a platform of all relevant stakeholders (i.e. primary, target, enabling, supporting, and external stakeholders) who can act as partners in implementing the Ohlanga TRMP to bring about positive change in the system.
- Set up a steering committee to drive the Ohlanga TRMP. The committee should develop a constitution and meet at regular intervals, as well as organise public engagements.
- Develop an Implementation Action Plan to be managed by the steering committee to guide ongoing activities of the TRMP according to respective interventions and institutional roles. This Implementation Action Plan should be a living document that guides information, governance, actions and responsibilities. It must describe the various tasks/activities, monitoring and evaluation requirements, priorities and set targets for each intervention. It should also put in place stakeholder/s that are principally responsible/accountable and define sources of budget. It will be important to include mechanisms to adapt and re-prioritise over time based on feedback from systems monitoring and performance evaluations.
- Fund raising will be required as an ongoing task to ensure that interventions are continuously and effectively implemented and maintained so that the Ohlanga TRMP does not lose momentum.

- Interventions that have the greatest potential to restore river health must be given the highest priority. For the Ohlanga this should be those tasks/activities for addressing water quality impacts, followed by measures for reducing flood risk.
- The Ohlanga TRMP should be systematically implemented. For biophysical interventions this should be progressive in a downstream direction by targeting the upper sub-catchment first, then the middle sub-catchment. Trade-offs will need to be made where there is infrastructure or communities at risk in the middle and lower catchment, such that these may be first order priorities for interventions that directly ameliorate the levels of direct risk.
- The Ohlanga TRMP should adopt a catchment-wide approach and not focus only on the riverine areas. It should seek to include innovative ways target drivers of riverine degradation at “source”, rather than tackling the symptoms. Some innovative measures that can be considered include:
 - Retrospectively installing **rainwater harvesting systems** that can supply clean water to households and/or urban gardens, prioritising dense, urban areas to cumulatively reduce accelerated stormwater runoff, and ultimately reduce downstream flood risk,
 - Develop **sustainable urban drainage systems** to attenuate and control stormwater runoff by installing swales, berms, over-sized stormwater infrastructure (e.g. bigger diameter pipes with energy dissipating chambers installed in-line),
 - Develop **best practice guidelines for future development** to ensure all new development is flood negative and designed according to “green” industry standards.
- Ultimately, there is need for river stewardship whereby citizens of the Ohlanga Catchment realise the role that each person can play in ensuring the overall well-being of river systems. People must be encouraged by the potential value, importance and buffering of climate change risks provided by healthy river systems.

CHAPTER 7: IMPLEMENTATION RECOMMENDATIONS

7.1 Prioritisation & Scaling

As rivers are complex social-ecological systems, addressing riverine condition and associated risk requires a multi-faceted, transversal, long-term process – as well as a high level of context specificity in the response. Leveraging existing riverine interests (and investment) of municipal and external actors and building on already successful initiatives offer ‘low hanging fruit’ for the TRMP. Capitalising on synergies through strengthening partnerships and creating mechanisms for collaboration will be an important approach.

The Business Case has focused on building an argument for investment in riverine management at systems-scale in the EMA. While this transformative riverine management ambition is important, in real terms implementation will need to be phased in over several years. The achievement of a TRMP at city-scale is therefore likely to follow a long-term process of scaling-up and expanding implementation focus over time as capacity is built, stakeholders mobilised, and financing mechanisms developed.

eThekweni Municipality is already implementing the Sihlanzimvelo Programme across 450km of rivers on municipal land, as well as several other projects and programmes focused on rivers (see Table 1). The opportunity exists to upscale these existing initiatives in working towards a city-wide TRMP. This could include:

- Expanding the **range of actors** involved, with a view to more inclusive participation and greater benefits achieved,
- Expanding the **spatial scale** of the initiatives,
- Expanding the **depth and scope** of activities within each initiative to better address transformative riverine management opportunities and objectives.

In many instances, upscaling existing initiatives will involve more than one of the above.

Well-reasoned prioritisation of upscaling and associated TRMP investment is critical to ensure that the desired benefits are achieved, and incremental successes can be used to steadily build a city-wide TRMP. For this purpose, it is recommended that a TRMP implementation plan / strategy be developed that defines riverine management priorities and sets out a clear pathway toward addressing these over a realistic timeframe.

There are multiple criteria that could be used to inform the prioritisation process, including:

- Where to invest in riverine management, based on levels of existing and climate change related **risks and associated vulnerabilities** (including social, ecological, economic and financial).

- Where to invest based on **cost efficiencies**, for example managing upper catchment areas benefits the whole river system and all users of riverine ecosystem services.
- **What actions** will have the greatest effect in reducing negative impacts on rivers, or that reduce riverine vulnerability and costs.
- Where there are **willing, active stakeholders** with direct interests in riverine management and that can be mobilised.
- Where there are **existing initiatives** that can be upscaled.

7.2 Governance & Institutional Capacity

The Business Case has highlighted the importance of transformative riverine governance as a mechanism for mobilising multi-actor, transversal, long-term systems-scale restoration and management of rivers in the EMA. This will require dedicated capacity and an appropriate mandate within the eThekweni Municipality administration. Even to facilitate a basic level of riverine management, additional capacity will be required, however a transformative approach will be more intensive.

A key challenge in establishing this institutional capacity is its required role in facilitating transversal commitment and action across multiple municipal functions. Careful consideration will need to be given to where in the municipal organogram this capacity is placed / drawn from, and how transversal working and accountability can be facilitated.

There is precedent in the Climate Change Technical Task Team (TTT), which was established to coordinate implementation of the Durban Climate Change Strategy and address the risk of silo-isation specifically within the climate change space, given that climate change is a cross-sectoral issue. As riverine management similarly requires a cross-sectoral response, much could be drawn from the TTT experience in responding to the institutional requirements for the TRMP.

A TRMP implementation plan needs to be drawn up which sets out an appropriate governance structure and institutional arrangements, including capacity. According to the CFF, the following five core functions require organisational resourcing in the TRMP:

1. Programme management:
 - Programme design
 - Cost benefit analysis / cost effectiveness analysis
 - Transversal facilitation across municipal departments
 - Vertical alignment with other spheres of government
 - Fund raising
 - Research
 - River management partnerships (including with upstream municipalities, business, citizen groups etc.) & institution building
 - Monitoring & evaluation

2. Riverine infrastructure:

- Grey infrastructure (canals, culverts, gabions, sand and silt removal)
- Ecological infrastructure (riparian tree planting, agro-ecology and food gardens, artificial wetlands, weirs, clean ups)
- Recreational infrastructure (pocket parks, pedestrian bridges, outdoor gyms and play equipment, lighting, pathways and benches)

3. Sewerage infrastructure:

- Wastewater Treatment Works
- Linear sewerage infrastructure including sewers, pipes, manholes and pumping stations

4. River management services:

- Sihlanzimvelo Programme
- Water quality monitoring
- Sewerage system fault reporting & response
- Environmental health
- Pollution control

5. Socio-economic capital:

- Leadership development
- Community education and capacity building
- Enterprise development
- Green economy
- Green economy & recycling
- Learnerships, skills development & job placement.

7.3 Partnerships

The BCA shows that partnerships in which respective landowners contribute and benefit from riverine management are crucial to the financial viability and implementation of a TRMP. How to convene these partnerships remains a central question for the TRMP ambition. Groundtruth¹¹⁹ suggests these partnerships will need to be established across a variety of levels. Each level (local, catchment, and city-wide) will require a specific, strategic aim and objectives, a different arrangement of stakeholders, a deliberate governance configuration, and intentional engagement platforms. At each of these levels the city would decide whether it wants to drive the process or be a partner in the process.

Partnerships at a local level

There are already a variety of existing riverine management initiatives and some fledgling partnerships which can be used as examples of what is achievable in which

¹¹⁹ Groundtruth (2020). The Regulatory Framework and Implications for Partnership-Based River Management, based on lessons from key river partnership programmes. Report produced for CFF and GIZ.

contexts. Most of these programmes and partnerships are detached (or semi-detached) from each other and are largely decentralised partnership networks. Clearly identifiable intermediary or representative structures are usually present, which is partly responsible for the successes of these interventions. While in the Sihlanzimvelo Programme, hierarchical, operations-driven, municipal interventions are demonstrated to be highly successful on municipal land, interventions on land not owned by the city will require network-style partnerships with good support, high levels of capacity and commitment to working together.

A significant issue is the cost to develop and sustain such partnerships. In an emerging, context-specific, small partnership which developed between a number of SRA's, the Sibaya Coastal Precinct Conservation Trust and the eThekweni Water and Sanitation Unit related to the sewer crisis in the Ohlanga, significant successes were achieved. However, the transaction costs (building trust, getting meetings with key people, sharing data, taking collective action) were effectively too high to sustain. A clear and efficient contact point within the city would go a long way to enabling and sustaining this partnership.

Understanding clearly who the role-players are, what type of collaboration would be required, and how to build capable partnerships to sustain interventions is important.

Partnerships at a catchment level

At a catchment level, multiple actors need to be involved that deal with a diversity of issues across different contexts. These would most probably be highly decentralised partnerships that may include SRAs, Water User Associations, multiple city departments, community-based organisations, non-profits, Traditional Authorities etc. One option would be to create opportunities for these decentralised groups to build their individual capacity and to strengthen the interconnections between them. One example of this under development elsewhere is 'course supported learning networks'.

Another option would be a joint management structure (e.g. through a super-Water User Association or a Catchment Management Forum) that would play a coordinating role while allowing diverse partners with a shared interest in the catchment to collaborate as peers in terms of capacity and power. This coordination would require significant capacity and resources.

Although more diffuse than at the local level, there is still a direct shared interest and impact down a catchment. This shared interest creates incentives for partnerships to develop.

Partnerships at a city level

One option is for eThekweni Municipality to play a convening role that brings together key partners such as city-wide business interests, non-profits and traditional leaders to develop shared approaches and projects. This is likely to require substantial central coordination to build alignment between the priorities and activities of all of the partners.

Alternatively, eThekweni Municipality could work together with a wide range of partners to build the capacity for partnership-based riverine management. This would include

the identification of key areas that require strengthening such as: regulatory support; collaborative fundraising; capacity development; knowledge sharing and tools development; open repositories for and access to data; communication and profiling the work; monitoring, evaluation and research.

A combination of both convening and supporting capacity building for partnership-based riverine management suggests a high-level role for the eThekweni Municipality. This would, however, require a dedicated institution to support and raise funding for this work. A re-imagined and expanded Green Corridors non-profit or similar institution could potentially fulfil this role.

Across all levels

As partnerships are scaled up across larger geographical areas and multiple catchments, issues of shared interest become far more diffuse, and thus needs to be approached and managed strategically. There are already many examples of individual and collaborative initiatives between peers and in clusters, and many organisations working at multiple levels. There is thus significant value in sharing and learning across organisations and initiatives locally, nationally, and even further afield in via global cities networks.

There are significant opportunities (and perhaps a real need) for city level institutions to act as intermediary and strategic support across scales. Rather than seeking to control the activities across complex networks it may be more useful, particularly at the catchment, city and beyond city levels, to link broader catchment, national and international networks to the shared opportunities for building capacity and collaboration mentioned above and addressing the key success factors identified in the review of current projects. Different provincial, national and global stakeholders will have different interests and thus different needs from and contributions to partnerships for riverine management. Mobilising and connecting these resources and interests to City level riverine work and through this into catchment and local networks is a key role that the City plays and needs to continue to play.

7.4 Financing Models

Sustained, adequate funding required

In all existing riverine management programmes and projects reviewed during the study, intermittent or constrained funding was cited as a major constraint or risk. This is because the benefits of riverine management require sustained investment in management action. Many of the jobs created were short term contracts, often with lengthy gaps between contracting opportunities. For example, the job beneficiaries in projects like Sihlancimvelo are needy and have few alternatives. The gains created through removing invasive alien plants on riverbanks are quickly undone if follow-up treatments are not sustained.

Funding for the TRMP will need to come from multiple sources, including the municipal fiscus, donors, the private sector, riverine landowners, and other spheres of

government¹²⁰. A funding strategy for the TRMP needs to be developed that details how and when these sources of funding should be accessed. Importantly, mechanisms will be needed for pooling resources to achieve jointly desired riverine management outcomes in specific regions, and amongst specific groups.

Market-based mechanisms

Financing mechanisms for riverine management need therefore to be structured to ensure long-term, sustained availability of funding that is adequate for the management interventions required to achieve the desired outcomes. The BCA has shown that there is potential for market-based financing instruments such as Payment for Ecosystem Services and Special Rating Areas, which can leverage co-funding from those with a direct interest in effective riverine management (including coastal users which stand to be heavily impacted by declining river condition). These options require further exploration in the context of the proposed TRMP.

There are many opportunities emerging to link green economy enterprises to riverine management investments. This is based on the premise that riverine management produces outputs in the form of organic biomass and inorganic waste materials that have value as inputs to other value chains (such as compost production, bioenergy, and manufacture of recycled plastic pavers). However, these value-adding activities may also present opportunities to recycle funding back into riverine management. For example, enterprises that require collected litter from streams as input, may be prepared to fund the cost of litter boom installation and management in order to “harvest” the litter. These types of opportunities for funding riverine management interventions may operate at the micro-scale (e.g. funding of litter booms) or at larger scales (for river recreation areas / enterprises may need to manage whole sections of river to secure the quality of environment required for their business). Creating a supportive environment for these investments will be a key role that eThekweni Municipality can play. For example, eThekweni Municipality could assist in developing riverine management plans and obtaining legal authorisations for restoration / riverine management activities in partnership with private / community actors.

Ecological asset class

Work being done by SANBI¹²¹ on the establishment of an Ecological Infrastructure for Water Security Fund (EI4WS) needs to be closely watched for its relevance to the TRMP. According to Cartwright¹²² (2020), the proposal is to link the holding of ecological assets to the draw-down of money from a national EI4WS fund that is formed as a sub-component of South Africa’s proposed Infrastructure Fund. State-owned entities, provincial and local governments and companies that take

¹²⁰ It will be important identify which spheres of government may benefit from riverine management investment. This may include Provincial and National Roads departments whose infrastructure may be protected from flood damage by riverine management in the same manner that municipal road culverts have been demonstrated to be. These beneficiaries of riverine management investment should be encouraged to contribute financially towards management that creates cost savings for them. Similarly, where the TRMP aligns with other government objectives and mandates, such as job creation, environmental management and coastal management, funding from these departments could be motivated for.

¹²¹ <https://www.sanbi.org/news/new-partnership-project-for-water-security-launched/>

¹²² Cartwright, A. 2020. Mobilising Investment for Ecological Infrastructure and Water Security. A roadmap for the Western Cape and uMngeni Catchment in South Africa. Report produced for the SANBI GEF6 project.

responsibility for these assets, hold them on their balance sheet and report their value¹²³ using SANBI's natural capital accounting framework, in order to qualify for money held in a national water fund. The money would be dispersed through subsidiary funds at Provincial or Regional Office level. It would be the role of the respective the Provincial or Regional Office's to ensure that the state of ecological assets were enhanced in accordance with the relevant catchment management strategies, and that was produced to enable the calculation of a return on investment.

Cartwright¹²² suggests that to avoid the capitalist default in the demarcation of new asset classes in a manner that increases socio-economic inequality¹²⁴, the recognition of ecological assets should be linked to new ownership structures. Communities and people doing the manual labour required to create and maintain ecological assets, should share in the benefits that accrue from the enhanced value of these assets. Such custodianship would not only increase their incentive to enhance asset value, but also enfranchise them with ownership of what is likely to be seen as an increasingly valuable form of capital. There are different means of achieving this, including the granting of any carbon sequestration rights to the people who work on this asset class.

Municipal finance

eThekweni Municipality has funded the Sihlanzimvelo Programme through the Roads and Stormwater Maintenance Department's budget. This has been a point of contention because the stream cleaning programme benefits the service delivery objectives of multiple municipal departments, including solid waste, parks and recreation, environmental management and others. The preference would have been that each department benefitting from the programme contributed fairly towards the cost from their own budget allocations. However, this was institutionally difficult, given each department's budgets are linked to their own key performance indicators, which includes capacity to perform mandated functions. Instead, some departments have provided support "in-kind" to the Programme by, for example, running training courses for community co-operative members using their own budgets. Budget sharing at the departmental level for riverine management is unlikely to be practical under the current model of performance management within local government.

Given that riverine management investments can play an important municipal service delivery function across multiple service delivery mandates, there is a need to consider how budgets can be allocated at a strategic level, where fair contributions towards the funding of riverine management projects are allocated by the Municipal Treasury from different line function budget streams before departmental allocations are made.

A further issue that requires investigation is the need to expand the municipality's recognition of ecological infrastructure as essential to the provision of municipal services, and therefore requiring adequate annual capital and operating budgets, including recognising ecological infrastructure in municipal asset registers. The

¹²³ The Natural Capital Accounts framework provides a measurable and defensible account of the current state of Ecological Infrastructure linked to water security for example the condition of rivers and wetlands. A disbursement would be linked to maintaining or achieving a desired state which is associated with improved water security.

¹²⁴ Piketty, T., (2014) Capital in the Twenty First Century, Tr. Arthur Goldhammer, Belknap Press of Harvard University Press

Natural Capital Accounting Framework under development nationally by SANBI may offer solutions for this challenge.

Corporate Social Investment & Enterprise Development

South Africa's Broad-based Black Economic Empowerment (BBBEE) regulatory framework¹²⁵ sets out the requirements for businesses to invest in marginalised individuals and communities and to grow small enterprises outside of their profit-making focus. These contributions are made through Corporate Social Investment (CSI) or Enterprise Development initiatives, in return for which businesses receive BBBEE points that count towards compliance with the BBBEE regulations for their sector. These BBBEE points may also help businesses by improving their "preferential procurement" status, making them more attractive suppliers to government and other businesses that also receive BBBEE points for interacting with companies that have good BBBEE status.

CSI and Enterprise Development funding presents a significant opportunity for leveraging investment in riverine management. The Wise Wayz Water Care Programme (see Table 1) is an important example of long-term corporate support for riverine management investment that focuses on community skills development and green enterprise development.

7.5 Green Economy Approach

For riverine management investment to achieve transformative green economy outcomes that go beyond discrete projects and form a central part of the local economy, it should seek to, (i) leverage additional investment from multiple sources, (ii) create new types of work or jobs that contribute positively to the natural environment and social inclusion, (iii) create new value and new partnerships, (iv) improve access to markets and create markets for new goods or services, and (v) facilitate learning and innovation. Importantly, eThekweni Municipality should not seek to establish green economy enterprises or intervene in value chains / markets. Rather, it should support, facilitate and enable enterprise development through making opportunities known, entering into off-take agreements for biomass and solid waste cleared from municipal riverine areas, and offer business skills training and mentorship.

Attracts public & private investment

Sihlanzimvelo was initiated with public investment from the eThekweni Roads and Stormwater Management Department. In a future TRMP focused on green economic transformation, public finance will remain an ongoing requirement for riverine management, given the catalogue of public benefits these areas generate, but will also crowd-in private and donor resources. This investment may include volunteered time or financial resources spent in establishing new collaborations, clearing privately

¹²⁵ See <http://www.thedtic.gov.za/financial-and-non-financial-support/b-bbee/b-bbee-codes-b-bbee-acts-strategies-policies/>

owned land, the acquisition of material and equipment, bank loans or new donor support.

Creates new types of work or jobs

Access to work imparts income and social identity. As such it is a key component of social inclusion. One of the cited benefits of the green economy relative to an extractive economy is that the jobs it generates tend to be location specific and “more reliant on local content”¹²⁶. The same jobs tend to be relatively low-skilled and foster a “sense of place” all of which are important in addressing South Africa’s unemployment crisis^{127,128}. Moreover, these jobs cannot be easily destroyed by trade wars or similar geo-political shifts in trade policy. A 2011 report by South Africa’s Industrial Development Corporation identified the potential for 462,567 jobs to be created through the green economy over 8 years, with natural resource management (of the type involved in Sihlanzimvelo) the highest contributor to this number at 232,926. Where the TRMP generates the type of work or jobs mentioned above, it will be unlocking this potential and contributing to a transformative green economy in eThekweni. The Programme already creates work for over 600 people and saves the department R22 million in damage to culverts annually. On municipal and alone, this could become 2,846 jobs if the Programme were extended to other municipal land in upper catchment areas.

Creates new value & new partnerships

Economic systems generate and circulate value an extension of Sihlanzimvelo on municipal land has the potential to generate a Net Present value (NPV) of over R920 million over 20 years¹²⁹. This value can include, for example, risk reduction to households and their possessions, risk reduction to public infrastructure linked to lower management costs insurance costs, and lower depreciation rates on built infrastructure due to reduced damage during floods. The Disaster Management Amendment Act (Act no. 16 of 2015) places ecosystem and community-based adaptation at the centre of resilience and risk reduction. Section 53 of the Act provides a strong mandate to municipalities to conduct risk and vulnerability assessments, develop adaptation plans and allocate budget for adaptation programs. A green economy approach within the TRMP will build on this responsibility to create a low risk economy, not only at the project or individual scale, but across the social system. Unlike much conventional economic activity and disaster management, a green economy does not simply shift or reallocate risk within the system, but rather reduces total risk. The value created by the green economy may accrue outside of formal markets and be difficult to quantify. This includes enhanced tenure security and a sense of place for example, as well as new partnerships between municipal, private and non-governmental projects and programmes as a function of increasing trust generated through the TRMP. It seems important then, that Sihlanzimvelo

¹²⁶ Borel-Saladin, J. M., and Turok, I. N. (2013). The impact of the green economy on jobs in South Africa. *S. Afr. J. Sci.* 109, 1–4. doi:10.1590/sajs.2013/a0033.

¹²⁷ Ward, M and Mudombi, S (2018) Protecting And Unlocking Jobs Through Water Stewardship: A Case Study Linked To The Umbogintwini Industrial Complex, Ethekeeni. TIPS Technical Report.

¹²⁸ Taylor, A et al. (2020) Lessons about fundamental changes and demonstrable aspects of transformative adaptation in Durban and Harare. LIRA Technical Report.

¹²⁹ 6% discount rate.

collaborates with the Igagasi Hotshots for example, to share experiences and innovations.

The ultimate aim should include new forms of capital that can be included in asset inventories; the “ecological infrastructure” referred to in eThekweni’s 2020/21 IDP and in South Africa’s National Strategy for Sustainable Development 2011-2014. Crucially, where new capital or asset classes are created, the ownership of these assets should be more diverse than current asset ownership in the South African economy. The shift to a green economy affords the rare opportunity to create new forms of capital, as well as the opportunity to be intentional about who owns that capital.

Access to markets & the creation of markets for new goods & services

The trading of goods and services in existing and new markets, is one of the features that defines a socio-economic system. For example, the TRMP could attract established markets to key areas where it operates, including the ability to offer riverside tours to visitors or host public recreation events in riparian spaces. It includes ‘offtake agreements’ with enterprises that trade recycled plastic, timber and other biomass sold as an energy feedstock or as a carbon-rich mulch for enhancing soil fertility or for food grown in local community agricultural projects. In other instances, the TRMP may have to create markets, such as ‘carbon markets’ or ‘reverse vending markets’, that reward the reduction of plastic to landfill where it would have emitted methane and carbon dioxide¹³⁰, or enable the reduction of insurance premiums on municipal infrastructure in exchange for river cleaning. As far as possible the TRMP should support a green economy; at its best the green economy mimics nature in repurposing and recycling material and nutrients, internalising negative externalities (there is no “waste” in nature) and externalising positive externalities that support and enhance the system that underpins transactions. A green economy is not as dependent on extracting virgin resources, and better at avoiding the types of economic dead-ends in which plastic collected from water resources is sent to landfills, for example. Precedents for this type of economy already exist in South Africa’s sanitation sector, for example, and in eThekweni Municipality’s Resilience Strategy.

Learning & innovation

eThekweni Municipality’s IDP 2020/21 is explicit in connecting the green economy with the knowledge economy. If the TRMP is to contribute to this economy, then it will incorporate learning. This learning will include the transfer of indigenous knowledge regarding rivers, places, place names and customs to the manner in which rivers are managed, and the upskilling of local river custodians with more conventional river engineering and stewardship capacity. It will also incorporate mission-oriented experimentation and innovation¹³¹ of the type that will enhance the benefits that it generates. The “Hole in the Wall” project piloted by eThekweni Municipality as part of its knowledge economy, is one such linkage that could be made by the TRMP, but there are other linkages and scopes for innovation in the solid waste sector, the

¹³⁰ See www.crediblecarbon.com

¹³¹ Mazzucato, M and Penna, C (2015). Mission-Oriented Finance for Innovation: New Ideas for Investment. Policy Network, London.

Human Settlements programme and through WWF's Green Outcomes Fund, for example.

7.6 Gender Sensitivity

Context

It is generally accepted that women are more vulnerable than men in terms of bearing the impacts of climate change¹³². Thomas¹³³ argues that socio-economic and cultural factors such as “age, levels of poverty, ethnicity and marginalisation” combine with gender to increase the vulnerability of women to climate change^{134,135}. Women, particularly poor women, are less likely to be informed about the environment and about climate change, and they are typically less involved in making decisions that ultimately affect their degree of vulnerability¹³⁶. Furthermore, “in the aftermath of disasters [which are occurring with increased frequency due to global environmental change], women are more likely than men to be displaced, to be sexually assaulted, to be victims of violence and to face other human rights violations”¹³³. These general trends in the unequal vulnerability to impacts of climate change in accordance with gender are true for South Africa^{134,135,136}.

Furthermore, inequality is a predominant feature of the South African population and gender inequality impacts on the everyday lives of women in many ways and across the country. South Africa's Human Development Index (HDI) for 2018 is 0.705— which puts the country in the high human development category (113 out of 189 countries and territories)¹³⁷. However, when the standard HDI value is adjusted in relation to inequality, the HDI drops to 0.463, largely due to the Gross National Income *per capita* for females being approximately 38% lower than that of men, indicating that men typically have a greater income than women in South Africa. According to the Women's Empowerment Dashboard for South Africa¹³⁷, women in South Africa measure in the middle third of indicators for women's empowerment, covering indicators which measure reproductive health and family planning, violence against girls and women, and socio-economic empowerment. Thus, in terms of the Gender Inequality Index (GII) in 2018, South Africa placed 97th out of 162 countries with a GI value of 0.422. This mid-range of gender inequality at the national scale is evidenced by approximately 42% of parliamentary seats being held by women, and 75% of adult women having reached at least a secondary level of education as compared to 78.2%

¹³² Global Climate Fund. (2017). Mainstreaming Gender in Green Climate Fund Projects, Korea.

¹³³ Thomas, A. (8 March 2020). Power structures over gender make women more vulnerable to climate change, *Climate Change News*, <https://www.climatechangenews.com/2020/03/08/power-structures-ge>. Accessed 15 May 2020.

¹³⁴ Chersich, M. F., Wright, C. Y., Venter, F., Rees, H., Scorgie, F., & Erasmus, B. (2018). Impacts of Climate Change on Health and Wellbeing in South Africa. *International journal of environmental research and public health*, 15(9), 1884. <https://doi.org/10.3390/ijerph15091884>

¹³⁵ Flatø, M., Muttarak, R. and Pelsler, A. (2016). Women, Weather, and Woes: The Triangular Dynamics of Female-Headed Households, Economic Vulnerability, and Climate Variability in South Africa, *World Development* 90, 41–62.

¹³⁶ Shackleton, S., Cobban, L., and Cundill, G. (2014). A gendered perspective of vulnerability to multiple stressors including climate change, in the rural Eastern Cape, South Africa. *Agenda*, 28, 73–89. <http://dx.doi.org/10.1080/10130950.2014.932560>.

¹³⁷ UNDP (2019). Human Development Report 2019: Inequalities in Human Development in the 21st Century. Briefing note for countries on the 2019 Human Development Report: South Africa. <http://hdr.undp.org/en/countries/profiles/ZAF>, accessed 30 May 2020.

of men. Female participation in the South African labour market is almost 49% of total participation¹³⁷. While these indicators provide an aggregated perspective, there is obviously much variation across the spaces and communities of South Africa, therefore the following discussion is focused on the eThekweni Municipal Area.

The population of eThekweni Municipality is estimated to be 51% female^{138,139}. In eThekweni, women have a longer life expectancy than men, a trend which follows the national pattern. The sex ratio for the eThekweni population is 96 males per 100 females.

As with many contexts within South Africa, women in eThekweni are vulnerable. Some indicators of their vulnerability relate to head of household, health, and safety. In terms of HIV/AIDS infection rates, a high number of infections in adolescent girls and young women outstrips that of adolescent young men, with an estimated 2 363 new infections weekly in females aged 15 to 24 years. Females are estimated to be the head of 42% of the households in the Municipal Area. Furthermore, within the vulnerable population of child headed households, 44.8% have women as the head of the household (approximately 1350 households), which is approximately 20% higher than the provincial and national average. Safety is an important consideration in relation to a gendered understanding of eThekweni and is evidence of further vulnerabilities of women. In line with other large cities in South Africa, gender-based violence and femicide feature regularly in crime statistics.

In terms of governance, of the 219 councilors currently in office (elected in 2017), 86 are females and 133 are males. Women account for 37% of top management employees within the municipality during 2017/2018¹³⁹. This unequal division of local political leadership and municipal management has implications for the prioritisation of women's concerns and reduction of their vulnerabilities through the leadership of female councilors and the leveraging of city resources to address these concerns. There is evidence of support for women within the city region through, for example, local government policy. The 2019 IDP Review notes the 'strengthening gender equality and youth empowerment' as one of the nine levers of change identified in the United Nations' New Urban Agenda. This lever is, however, noted as a priority for improving social cohesion in the city and is not directly linked to environment sustainability goals of the Municipality.

Based within the IDP and responsive to the National Policy Framework for Women's Empowerment and Gender Equity, the eThekweni Municipality has a programme focused on the support and upliftment of women within the city. The gender programme states that the municipal government's vision in relation to gender is "working towards the attainment of gender equality so that all men and women have equal opportunities to participate and benefit in all development processes. The city focuses on the empowerment of women and the involvement of men". This policy does not, however, mention climate change impacts and instead offers a broad platform for improved gender equality and the empowerment of women.

¹³⁸ Community Survey 2016: Statistics South Africa (2016) South African Community Survey 2016. Indicators derived from the full population Community Survey. <https://wazimap.co.za/profiles/municipality-ETH-ethekweni/> accessed 23 May 2020

¹³⁹ eThekweni Municipality (2019). Draft Integrated Development Plan 5 Year Plan: 2017/18 to 2021/22. 2019/2020 Review, Durban.

Little analysis of the direct relationship between climate change and gender-sensitive impacts is available for South Africa and for the eThekweni Municipal Area responses. Neither is there particular focus on reporting gender disaggregated benefits of climate change responsive projects or of the ways in which these projects foster gender equity within specific communities of the city. However, co-benefits such as the reduction of poverty within the city are evident within eThekweni Municipal projects that are responsive to the risks and impacts associated with climate change¹⁴⁰. Furthermore, these projects offer sources of livelihood to the beneficiaries of projects. It can be reasonably anticipated that where beneficiaries of projects are women, these projects would be likely to decrease both their vulnerability to climate risks and increase overall quality of life for women.

Within the wider context of the eThekweni Municipality, several projects have recently involved riverine corridor management activities through community-partnership approaches. These projects are largely focused on services provision and management but are also responsive to climate change and foster adaptation to anticipated effects of climate change within the Municipal Area. The following section presents an assessment of a selection of these projects through a gender-sensitive lens.

Gender Sensitivity in the TRMP

A set of principles which could support gender-sensitive design of riverine management projects are listed below. These principles can be used to support and improve gender-sensitive project development, implementation, and monitoring and evaluation to optimize transformational benefits of riverine corridor management in the eThekweni Municipal Area.

Principles for project development and implementation:

- Initiatives should promote poverty reduction and the empowerment of women in their design and implementation.
- Ensure that any climate adaptive actions undertaken in the programme support, sustain or enhance the asset base of women.
- Specify targets for participation and benefits of the programme which support gender equity so that women are not disadvantaged in gaining access to participatory processes or project benefits.
- Actively prioritise women's access to job opportunities created by the programme since they are more marginalised within many communities in the eThekweni Municipal Area.
- Actively ensure that women and men can actively and equally participate in project activities, decision-making and management.

¹⁴⁰ Okem, A.E. (2017). An Investigation into the Poverty Reduction Co-Benefits of Climate Change-Related Projects in eThekweni Municipality, South Africa, Technical Research Report 2017 No. 11.

- Ensure that women and men can equally benefit from training, capacity-building and technical assistance offered by the programme.
- Schedule community information sharing, awareness raising or training activities when women have access to childcare or offer safe, reliable childcare during these activities.
- Ensure equitable representation of women and men on project committees and within project leadership and management teams, and in planning and conducting project activities and meetings.

Principles for project monitoring and evaluation:

- The project team is alert to, and considerate of, gender differentiated impacts of the project.
- Incorporation of gender considerations within the monitoring and evaluation of the programme.
- Establish gender-specific targets for women and men in terms of benefits and participation in the programme.
- Data collected as part of monitoring and evaluation is able to be disaggregated by sex to facilitate a gendered analysis of the benefits and challenges of a project and to assist in identifying gender-specific concerns related to project processes and/or outcomes.

Principles relating to project beneficiaries:

- Project outputs contribute to women's empowerment.
- Benefits of the programme are equally shared between women and men employees.
- The approach incorporates consideration of the anticipated benefits/impacts for women, men, girls and boys.
- Anticipated project outcomes contribute to improving equality between women and men.

CHAPTER 8: CONCLUSIONS

Durban's riverine areas provide critical, life-giving services to all residents of the municipal area. They are an essential component of the city's ecological infrastructure asset base, which collectively has an estimated worth of between R48 and R62 billion and delivers R4.2 billion in ecosystem services annually. However, urban development and an associated historic failure to invest in the protection and management of rivers has resulted in a significant decline in the condition and functionality of most of the city's rivers. Riverine ecosystem service levels are already on average 42% lower than potential. Climate change is predicted to substantially impact rivers, further decreasing riverine ecosystem services delivery by 11%.

This decline in riverine ecosystem services will create significant risk to the municipality, to society and to the local economy. The estimated total societal cost of failing to address the issue has been estimated at R375 million per annum by 2040. eThekweni Municipality will suffer escalating damage costs to its infrastructure in riverine areas. The average annual cost of damage to culverts alone is expected to exceed R152 million by 2040. The productivity and well-being of riverine communities will be impacted by more frequent disruptions to services and increasing riverine disbenefits, such as flooding and declining water quality. Coastal recreational users and property owners will also be affected by changes in water quality and condition of estuaries and beaches. These are expected to drive significant negative impacts on Durban's local economy, particularly in relation to coastal tourism.

Investing in riverine management is motivated in this Business Case as an effective response to the above risks and costs. Benefit Cost Analysis was used to demonstrate that managing rivers effectively can help reduce or avoid municipal infrastructure damage costs, while creating substantial societal value. Importantly, investing in rivers is an effective risk mitigation measure that will help protect the most vulnerable communities in the city from the effects of climate change.

Riverine management also offers significant opportunities to create jobs and new enterprises in the green economy. However, as rivers are complex social-ecological systems, addressing riverine condition and associated risk requires a multi-faceted, transversal, multi-actor, long-term process. A wide range of stakeholders will need to be mobilised through incentivisation and partnerships. eThekweni Municipality has a central role to play in championing and coordinating a transformative riverine governance approach as a mechanism for unlocking and leveraging the required systems-scale response.

The current study has built a compelling, evidence-based argument for transformative riverine management investment in the eThekweni Municipal Area. The next step will be to progress these arguments into implementation planning. This will need to consider prioritisation of riverine management investment as part of a process of incremental upscaling, governance and institutional capacity requirements, financing, unlocking green economy opportunities, and the adoption of inclusive, gender sensitive approaches.

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