ECOLOGICAL INFRASTRUCTURE

Water factories: The intrinsic value of a critical resource in water-scarce cities

The effective functioning of ecological infrastructure (EI) is essential for providing a wide range of ecosystem services crucial to human well-being, optimal environmental functioning and economic development. These services offer both direct and indirect benefits, such as water regulation, climate moderation, water purification, biodiversity protection, and soil formation (Rasmussen et al. 2021; Sokolova et al. 2024). Article by Nkosingithandile Sithole.

Riverhorse Valley Business Estate Management Association, 13 June 2018

Cooperative rehabilitation and management of the Riverhorse Valley Wetland involving investment by the public and private sector.

With the rise in climate change impacts and a rapidly expanding population, the significance of water-related EI is anticipated to grow, especially in ensuring the supply of drinking water (Chapagain et al. 2020). Furthermore, the rehabilitation, restoration, and upkeep of EI can boost the resilience of these ecosystems, enhancing their capacity to endure and recover from extreme weather events linked to climate change. Despite the increased awareness of the critical role of EI, water-related ecological systems continue to degrade mainly due to anthropogenically driven activities including inter alia, urbanisation, deforestation, poor farming practices, mining, and pollution (Ziervogel et al. 2022).

With South Africa characterised as a water-scarce country, climate change impacts are expected to increase water demand, both in cities and rural areas. Thus, there is an urgent need to prioritise and increase investment in EI. There are several methods to implement EI interventions, such as restoring or rehabilitating degraded ecosystems that can offer the needed ecosystem services. These actions can help to strengthen the resilience of these ecosystems against human activities and, more significantly, the impacts of climate change (Rebelo et al. 2021). According to the Organisation for Economic Cooperation and Development (OECD) (2022), investment in EI involves maintaining naturally functioning ecosystems by allocating resources like time, funding, or strategic decision-making to protect or restore them.

To encourage investment in EI, it is essential to provide quantifiable, user-friendly information that clearly demonstrates

the tangible and intangible benefits of EI. These advantages should be presented in an engaging and comprehensive manner and may be tailored to development finance institutions (DFIs) and the private sector. Additionally, the benefits of EI investment should draw on insights and outcomes from existing EI projects.

Showcasing the advantages of EI can play a pivotal role in integrating it into water resource management, and subsequently encourage investment in EI from public and private sector users. However, this lack of information has led to the limited support for EI investment. A new project funded by the Water Research Commission (led by GroundTruth sought to address these challenges by developing a user-friendly EI framework to encourage investment in EI by private sector and DFIs. The framework development process was informed by a range of data collection activities, including, an in-depth literature review, stakeholder engagement, and the evaluation of four South African EI initiatives. The case studies formed the backbone of this research, guiding the literature review, stakeholder engagement, and framework development process.

The review of the four selected EI initiatives was to develop an understanding of the factors driving investment, challenges faced, enabling partnerships and the funding mechanisms in place enabling investment in EI. The evaluation of the four selected EI initiatives aimed to provide evidence-based insights into effective EI initiatives and management in South Africa, highlighting both tangible and intangible benefits of EI investment. The diverse nature of these initiatives offered a comprehensive overview of how EI management impacts water users in specific catchments and the mechanisms that spurred investment in these projects. The EI initiatives associated with this study included two sites in the Western Cape namely 1) the Wolseley Water User Association (WWUA) EI Coordinator Initiative, and 2) the Klein Swartberg Initiative; and two sites in KwaZulu-Natal namely 1) the Mpophomeni-uMthinzima (Upper uMngeni) Initiative and 2) the uMhlangane Initiative. These initiatives were selected based on their varied management contexts, intervention types, funding sources, land use settings, and the availability and accessibility of information. This diversity allowed for rich stakeholder engagement, showcasing different forms of EI investment across various catchment areas. These initiatives underscore successful collaborations in addressing the challenges of implementing EI interventions, showcasing the effectiveness of diverse partnerships in achieving sustainable outcomes. The case study analysis was informed by a set of guiding questions which aimed to understand (1) what the quantifiable outcomes (including ecosystem services linked to water security) of the interventions linked to the EI initiatives are (2) the role players and funding mechanisms applied to implement EI investment (3) and how relevant the outcomes of the interventions were to the role players involved. A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was also applied to each case study to further distil key lessons from the EI initiatives, and the associated enablers and inhibitors to investment in EI.

GroundTruth, June 2019

Concrete butress weir built during phase 1 of Working for Wetlands construction cycle.

R Pienaar

Clearing underway of a riparian zone in the Wolseley area which is infested with Acacia saligna, Acacia mearnsii and other invasive alien plants.

Local temporary farmworkers and a member of the Mountain Club of South Africa involved in hakea clearing in the Klein Swartberg.

Following this, a brief review of five other EI initiatives in South Africa was conducted. These initiatives include the 1) uMhlathuze Water Stewardship Programme, 2) the Nature Conservancy (TNC) Greater Cape Town Water Fund (GCWF), 3) the Program Skoon Veld-Ceres, 4) the Upland River Conservation, and 5) the Endangered Wildlife Trust Carbon for Conservation Project. Each of these cases demonstrate different EI investment scenarios varying both in scale and partnership complexity. This brief review provided further valuable evidence-based information supporting the framework's development. The nine (9) reviewed EI initiatives are described in more detail below (Table 1)

Table 1: Examples showing the diversity of types, financing arrangements, and scales of EI investment initiatives in South Africa

Factors	uMhlatuze Water Stewardship Programme	The Nature Conservancy (TNC) Greater Cape Town Water Fund (GCTWF)	Program Skoon Veld - Ceres	Upland River Conservation	The Endangered Wildlife Trust Carbon for Conservation Project	Sihlanzimvelo / TRMP (eThekwini)	uMhlangane /Riverhorse Valley	Mpophomeni	Klein Swartberg	Wolseley Water Users Association EI coordinator initiative
Type of investment	This case exemplifies public and private sector collaboration in catchment management. It aims to improve freshwater coastal lakes and surface water dams, promote efficient water use, support agricultural water stewardship, secure ecological infrastructure, and develop community water champions.	This case aims to enhance water security for catchments serving the Greater Cape Town area through EI interventions, such as nature-based solutions and the management and removal of invasive alien plants (IAPs).	Situated in the Western Cape, the Program Skoon Veld-Ceres case is primarily funded by the private sector, with additional support from non-profit organizations. The initiative focuses on controlling invasive species to ensure water supply and biodiversity. Funding comes from local businesses, municipal sources, and WWF's Green Trust.	Funded by the private sector, this initiative targets riparian rehabilitation in the upper uMngeni catchment. The project aims to improve water quality, boost recreational fishing opportunities, and enhance land productivity. Efforts include removing invasive alien plants (IAPs), replanting vegetation, and monitoring water quality.	The Endangered Wildlife Trust's Carbon for Conservation Project showcases private-private partnerships focused on rehabilitating grasslands and wetlands to enhance water quality and quantity in Strategic Water Source Areas (SWSAs). It leverages a sustainable financing mechanism, carbon offsetting, to fund these improvements.	The initiative began with public funding from the municipal Opex budget and later expanded through grants from Development Finance Institutions (DFIs).	Showcases EI investment in an urban environment. It focuses on rehabilitating and managing urban freshwater ecosystems to enhance flood attenuation and water quality. Since the early 2000s, projects like the Riverhorse Wetland Management Initiative, Green Corridors Green Spaces project, Sihlanzimvelo Programme, and eThekwini's Transformative River Management Programme (TRMP) have emerged. These initiatives involve diverse stakeholders, including private businesses, NGOs, civil society, local authorities, and community groups.	Highlights EI investment in urban settings. It aims to rehabilitate and manage freshwater ecosystems to enhance flood control and water quality. Since the early 2000s, projects like the Riverhorse Wetland Management Initiative, Green Corridors Green Spaces project, Sihlanzimvelo Programme, and eThekwini's Transformative River Management Programme (TRMP) have emerged, involving private businesses, NGOs, civil society, local authorities, and community groups.	In Ladismith, Western Cape, a small EI initiative focuses on water security through invasive alien plant (IAP) removal. Local businesses like Ladismith Cheese and Lactalis fund this effort. SAEON's application estimates annual water savings from IAP clearing, providing data to sustain funding. Key supporters include the Mountain Club of South Africa, local farmers, Kannaland Municipality, Cape Nature, and Gourtiz Cluster Biosphere Reserve.	A small-scale initiative in Wolseley, Western Cape, tackles the issue of invasive alien plants (IAPs) threatening water security for the Breede River. Local businesses like Woolworths and Marks & Spencer depend on these water resources. Funded by sources such as Coca-Cola, the Western Cape Government, and others, the project has consistently controlled IAPs. Its success is largely due to Ryno Pienaar, the local EI coordinator since 2017, who manages rehabilitation efforts and multiple funding sources.
Catchment	uMhlatuze Catchment	Multiple catchments supplying the Greater Cape Town area	The catchment supplying Ceres Town	The Upper uMngeni catchment (highland areas), expanded into the broader eastern Drakensberg drainage region	Multiple strategic water source areas	uMhlangane catchment, located in the Lower uMngeni catchment	uMhlangane catchment, located in the Lower uMngeni catchment	uMngeni	Gouritz	Breede

Some of the outcomes from the case studies included the identification of key enablers for the investment in EI, which include:

- **Capitalising on existing partnerships (particularly between funders), can significantly enhance investment in EI**. The WWUA EI coordinator initiative, funded by Woolworths, exemplifies this approach. The EI coordinator-maintained project continuity despite changes in primary funding sources and built trust within the community, encouraging local ownership. Additionally, the coordinator responded to tenders and collaborated on funding proposals. However, appointing an EI coordinator alone doesn't solve all challenges. Certain prerequisites are necessary to ensure their effectiveness.

- **Leveraging on compliance and regulatory frameworks can enable investment in EI.** Strong environmental legislation and its effective implementation serve as crucial "push factors" that encourage EI investment through development authorisations. For example, developers required to mitigate environmental impacts might invest in EI to comply with regulations. An example of this approach is Mpophomeni-uMthinzima initiative, in which the requirement for upstream wetland rehabilitation as a condition for the environmental authorisation of the wastewater treatment works (WWTW) motivated uMngeni-uThukela Water to support downstream wetland rehabilitation.

- **Articulate the benefits of EI investment and how they align with funders' objectives clearly.** This involves creating a compelling value proposition and business case, supported by scientific data and catchment-specific monitoring. It should also include a systematic evaluation of the expected benefits, costs, and potential risks to the long-term sustainability of the investment.

- **To attract private sector investment in EI, managers need to develop a compelling business case showcasing the socio-economic benefits of the EI intervention**. This business case must be supported by a strong evidence base, which clearly demonstrates the impact on EI and related ecosystem services. Examples of evidence include before and after pictures of project area post interventions, project outcome descriptions, and quantifiable indicators, like the amount of water saved attributed to invasive alien plants (IAPs) clearing.

- **EI managers and funding recipients should seek multiple, diverse funding sources rather than relying on one**. EI initiatives often face short-term private sector funding, which is insufficient for long-term projects that require extended monitoring and evaluation. Multiple funding sources can ensure sustained support over a longer timeframe. The Mpophomeni-uMthinzima initiative is a prime example, with various stakeholders funding different aspects of wetland rehabilitation.

- **Identify opportunities to integrate green and grey infrastructure, which can yield various co-benefits, especially for the private and public sectors.** These benefits include job creation, social equity, specialized expertise for technical EI projects, and increased funding and resources. For instance, in the Mpophomeni-uMthinzima initiative, the restoration of the uMthinzima wetland complex was driven by the importance of the Midmar Dam, a key regional water supply. Additionally, the downstream rehabilitation of the uMthinzima wetland was motivated by uMngeni-uThukela Water (UUW) to meet environmental authorization requirements for the wastewater treatment works (WWTW).

- **To establish effective social processes with key stakeholders—such as funders, implementing agencies, the community, and local authorities—it is crucial to build and maintain strong relationships.** This can be achieved through transparent, upfront, and honest communication about what can realistically be accomplished within the agreed timeframe, including budget constraints, expected outcomes, and potential risks. Additionally, maintaining a good funding relationship is essential for initiatives that have developed organically, like the Klein Swartberg initiative, which evolved through a series of small-scale interventions.

In conclusion, the case study review was instrumental in shaping the framework, offering a comprehensive analysis of how EI management affects water users within specific catchments. It highlighted the mechanisms that facilitated investment in these initiatives and provided valuable insights into the tangible and intangible returns from EI interventions, relevant to both private and public stakeholders. The review also shed light on the factors that hinder EI investment, providing a solid foundation and real-world perspective on EI investment in South Africa.

References

- Chapagain D, Baarsch F, Schaeffer M and D'haen S (2020) Climate change adaptation costs in developing countries: insights from existing estimates. ***Climate and Development***, ***12***(10), 934–942.

- OECD (2022) ***Financing a Water Secure Future, OECD Studies on Water***. OECD Publishing, Paris, https://doi.org/10.1787/a2ecb261-en.

- Rasmussen LV, Fold N, Olesen RS and Shackleton S (2021) Socio-economic outcomes of ecological infrastructure investments. ***Ecosystem Services*** 47 101242.

- Sokolova MV, Fath BD, Grande U, Buonocore E and Franzese PP (2024). The Role of Green Infrastructure in Providing Urban Ecosystem Services: Insights from a Bibliometric Perspective. ***Land*** 13(10), 1664.

- Ziervogel G, Lennard C, Midgley G, New M, Simpson NP, Trisos CH, et al. Climate change in South Africa: Risks and opportunities for climate-resilient development in the IPCC Sixth Assessment WGII Report.