



Kruger to Canyons

Catchment Investment Programme

Updated Business Case
December 2025

Acknowledgements

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01|



Executive Summary

The Business Case demonstrates that investing in nature, through an innovative mechanism such as a **Catchment Investment Programme (CIP)** improves water security, protects biodiversity and supports resilient livelihoods in the Kruger to Canyons Biosphere Region (K2C).

Kruger to Canyons Biosphere Region

In 2001, the Kruger to Canyons Biosphere Region was officially ratified by UNESCO as part of the Man and the Biosphere Programme. The Kruger to Canyons Biosphere Region Non-Profit Company was established in 2011 to act as the vehicle for coordinating the implementation of Biosphere activities. The work of K2C includes a focus on protected area expansion, ecological restoration and improved management of important ecosystems, job creation and support for small, medium and micro enterprises.



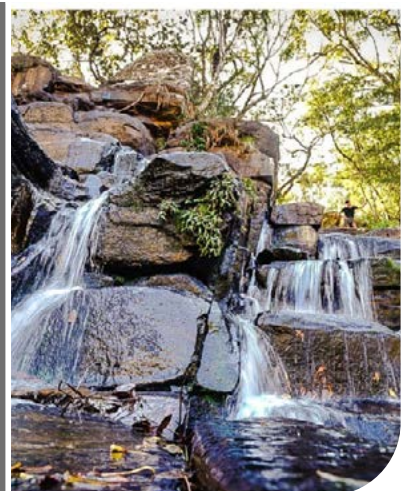
Biodiversity

Spreading over 2.5 million ha, the Kruger to Canyons Biosphere Region is home to a high level of biodiversity. The Afromontane, forest, and grassland biomes are home to a wide diversity of South African plant, bird, and mammal species. The core areas include a large portion of the Kruger National Park, home to many iconic savanna species, including the Big 5. The Kruger to Canyons Biosphere Region also forms part of the Great Limpopo Transfrontier Conservation Area, a conservation area linking South Africa, Mozambique and Zimbabwe, covering approximately 3.5 million ha.



Source Water

The Blyde River Catchment is part of the Mpumalanga Drakensberg Strategic Water Source Area. The source of the Blyde is in the Mount Anderson catchment and Hartebeesvlakte Nature Reserve. The river flows northwards forming the iconic Blyde River Canyon, including other impressive geological features. The Blyde River then flows into the Olifants River which enters the Kruger National Park, eventually crossing into Mozambique. Good quality water from the Blyde River is crucial for the Olifants, one of the important rivers maintaining the ecology of Kruger National Park.

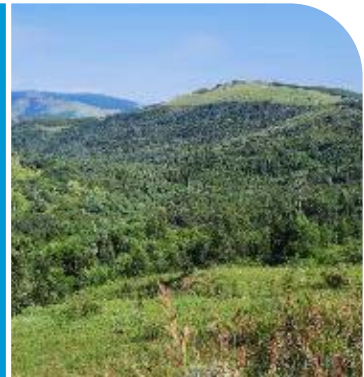


The Challenge

The Blyde River Catchment is part of the Mpumalanga Drakensberg Strategic Water Source Area. It is a complex and ecologically and socio-economically diverse area facing multiple threats including from Invasive Alien Plants (IAPs), illegal mining and land-use change. These threats, along with increasing water demand from population growth and economic activities, result in water insecurity and biodiversity loss. This directly impacts critical natural assets, causes financial losses and economic uncertainty, and limits people's ability to adapt to ever-changing climatic conditions. Despite these threats, there are opportunities to improve water security through strategic investment in Nature-based Solutions (NbS) in the Blyde catchment.

Threats to Water

Key threats are linked to the spread of IAPs, poor land-use management practices, inadequate wastewater treatment and illegal mining. These threats degrade water quality and the reliability of water supply. IAPs use far more water than indigenous species. South Africa loses the equivalent of R6.5 billion worth of ecosystem services annually to the rapid expansion of these plant invaders¹.



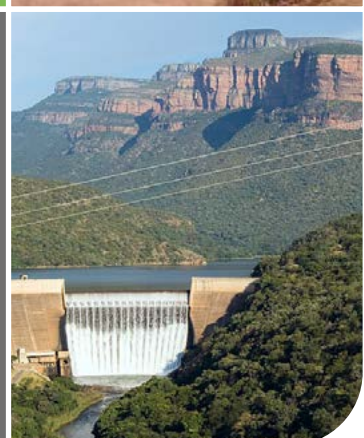
Threats to Land

Poor land-use practices lead to increased erosion and reduced infiltration capacity, negatively impacting groundwater replenishment. This has caused more than 60% of the world's original dam water storage to be lost in 30 years.² Due to the Blyderiverspoort Dam's small size it is not able to contain all the run-off during the summer rainy season and relies on slow groundwater infiltration to maintain levels during the dry winter months.



The Blyderiverspoort Dam

Downstream water users depend on the Blyderiverspoort Dam for domestic, agricultural and industrial water supply. These include commercial and community farmers, the residents of Hoedspruit town, as well as users further downstream like Phalaborwa (an extensive mining town) and the Kruger National Park. Several times over the past 20 years, the dam level dropped, and water shortage concerns arose.³ These events directly threaten economic activity and domestic water security, highlighting that a water supply challenge already exists.



1. Dini et al (2015)

2. WRI (2021)

3. The pipeline that supplies water from Blyderiverspoort Dam is pressure driven, meaning that when the levels drop below a certain level, water conservation or water usage limits are applied, impacting on water supply.

The Solution

Nature-based Solutions are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature. In 2020, K2C and Conservation South Africa came together with the Nature for Water Facility to explore the feasibility of developing a Catchment Investment Programme (CIP) for the Biosphere Region. The K2C CIP will aim to enhance water security through the control of IAPs, improved Grazing Best Management Practices (GBMPs) and an increase in the land area under protection. Benefits include the delivery of additional water which would contribute to protecting agricultural yields and benefiting larger towns and industries further downstream. Other benefits include the creation and protection of jobs, additional household income for upstream communities, restoration of biodiverse ecosystems and the potential carbon offset value of restoration and grazing management interventions.

The CIP will serve as a long-term and inclusive collective action platform for convening diverse public, private and community stakeholders together in the landscape to collaborate effectively, mobilize and align resources for greater impact, and ensure continuity of investment for sustained impact over the long-term. Initial efforts will focus on the Blyde River Catchment as a demonstration catchment, with the potential to scale throughout the K2C Biosphere.



The objectives of the Catchment Investment Programme (CIP) include:

-  To create a collective action platform, with a common vision, to address water security challenges in the Kruger to Canyons Biosphere Region.
-  To source and manage long-term financing solutions to implement Nature-based Solutions (NbS) at scale.
-  To support existing initiatives and catalyse systemic change in catchment management.

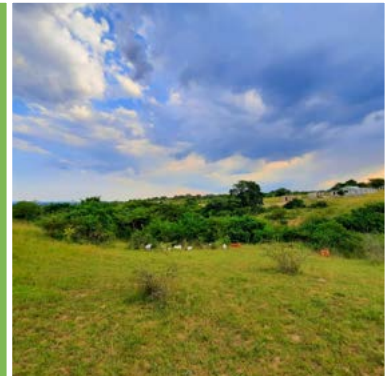
Controlling Invasive Alien Plants

Controlling IAPs on 63,206 ha decreases run-off, improves water infiltration and reduces water losses associated with IAP-invaded catchments. In addition, terrestrial and freshwater biodiversity is protected, and ecosystem functioning is improved. The IAP clearing activity contains two phases: (1) An initial High Impact Phase involving intensive clearing in the short-term. (2) A Maintenance Phase follows to prevent regrowth in cleared areas.



Grazing Management

Restoring 10,559 ha of degraded grasslands through changing grazing practices addresses erosion, reduces sedimentation and delivers benefits to 200 communal herders. This activity will increase the value of their livestock and improve their resilience to climate impacts through the restoration and maintenance of productive grasslands.



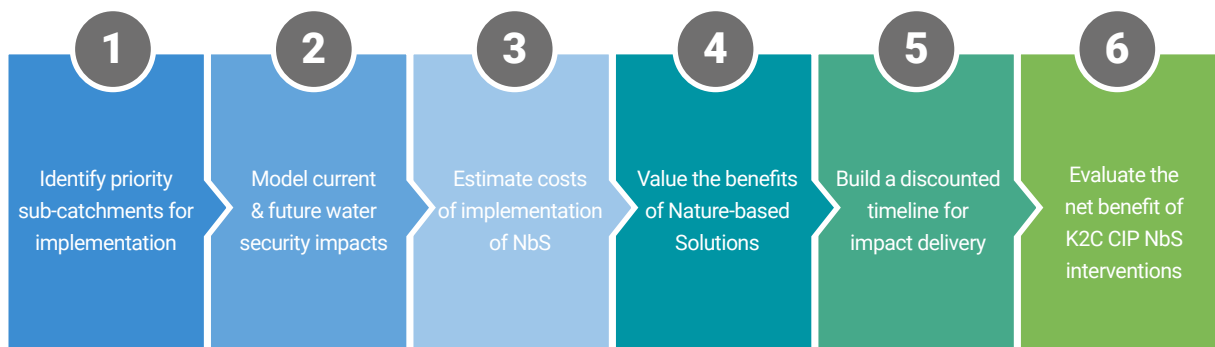
Area Protection

To secure the investment in nature, the CIP will seek to formally protect the areas where solutions are implemented. This maintains the impacts of the CIP's activities and secures the long-term success of the programme. This will see the protection of diverse ecosystems via biodiversity stewardship, driven by a landowner stewardship approach for protected areas expansion.



Building the Business Case for investment in NbS

The development of the Business Case **follows six steps** as shown below:



This Business Case demonstrates that investing in nature, through an innovative mechanism such as a Catchment Investment Programme improves water security, protects biodiversity and supports resilient livelihoods in the Kruger to Canyons Biosphere Region.

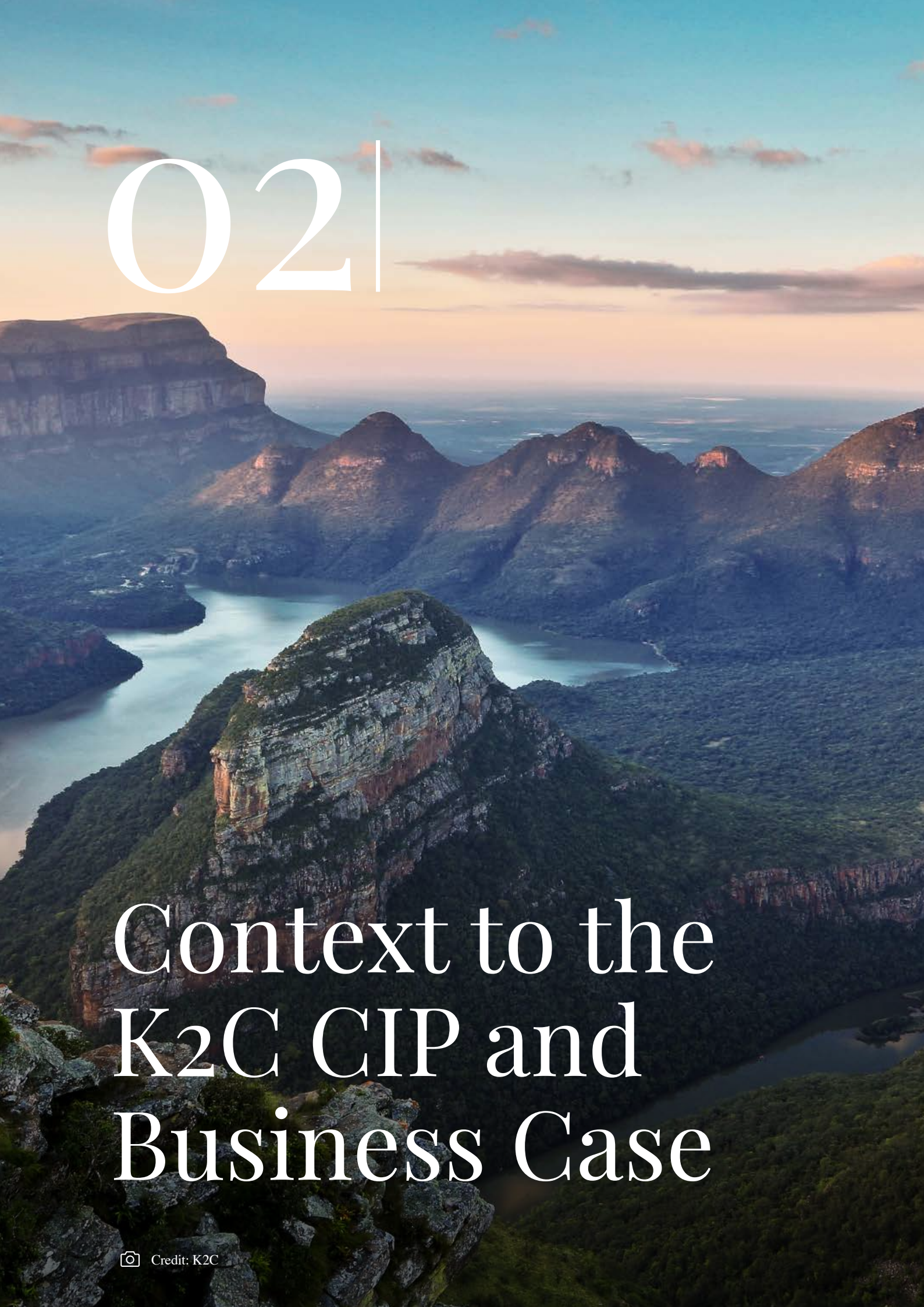
Over a 30-year period, results show that a lifetime investment of ZAR 554.9 million (USD 33.1 million) in Nature-based Solutions unlocks benefits worth between ZAR 2.7 billion (USD 157 million) and ZAR 7.4 billion (USD 441 million)⁴.

The benefits are unlocked in several categories. The primary benefit is the avoided loss of an estimated 700 million m³ of irrigation water to the agricultural sector over the 30-year period of the programme as a result of the additional water storage of, on average, 13.7 million m³ each year. This helps to protect between ZAR 2.7 billion (USD 160.9 million)⁵ and ZAR 7.3⁶ billion (USD 435 million) worth of agricultural yield in the mango and citrus farms downstream of the Blyderivierspoort Dam. Additional streamflow at the catchment outlet also benefits large towns and industries further downstream, predominantly the Phalaborwa Mining Complex. Other benefits include poverty alleviation worth ZAR11.7 million (USD 697k) in additional household income to upstream communities involved in improved Grazing BMPs, the restoration of over 74,000 ha of biodiverse ecosystems, and over ZAR 43.8 million (USD 2.6 million) in carbon offset value⁷ at current prices.

The financial and economic appraisal presented in this updated Business Case for the K2C CIP shows that, for every South African Rand invested in NbS, a return of between ZAR 4.91 and ZAR 13.33 is generated, depending on how the relationship between irrigation reduction and the impact on agricultural yield is defined. Cumulatively, the interventions create and protect almost 29,000 full-time equivalent (FTE)⁸ job-years over the lifetime of the CIP. On average, this results in impacts on approximately 960 workers per year over the 30-year lifespan of the CIP, with an average of 160⁹ jobs created per year, and an average of 800 jobs protected.

Critical next steps for the K2C CIP include the need to secure investments for the high-impact phase of the programme over the next 5-7 years, and to explore relevant governance, sustainable funding and monitoring and evaluation mechanisms for the CIP over the next 30 years.

-
4. Figures are quoted in present value terms, discounted over 30 years at a social discount rate of 3.66%. It should be noted that the water benefit is the most significant, and therefore the additional poverty alleviation and carbon benefits do not change the returns significantly.
 5. Based on a ZAR:USD ratio of 16.78:1 (estimated on 19/12/2025)
 6. All figures quoted in the report summary section are expressed in present value terms, discounted over 30 years at a social discount rate of 3.66%. Discount values are used to put a present value on costs and benefits that will occur at a later date.
 7. The carbon market is readily accepting offsets from Grazing BMPs. There is a programme registered with the Gold Standard in the market that will issue its first credit within the next 6 months.
 8. A full-time equivalent (FTE) job is a measure that converts the hours of part-time and full-time employees into a single unit of a standard full-time position. It is calculated by dividing the total hours or days worked by an employee (or group of employees) by the standard number of hours or days for a full-time job.
 9. It is important to note that the number of jobs created through the IAP programme will be significantly higher during the high impact phase of the work (an estimated 265 FTE jobs per year).

A scenic landscape of a mountain valley. In the foreground, a large, craggy rock formation with some greenery sits on a rocky outcrop. Below it, a winding river flows through a lush green valley. In the background, several mountain peaks are visible, some with flat tops, under a sky with soft, colorful clouds from a low sun, creating a warm, golden light.

02|

Context to the K2C CIP and Business Case

2.1. The Blyde River Catchment System

The Blyde River is an iconic landscape and cultural resource in South Africa, with its headwaters located in the Hartebeesvlakte Nature Reserve. It is located within the broader Kruger to Canyons Biosphere Region, which was ratified by UNESCO in 2001 (**Figure 1**). The Kruger to Canyons (K2C) Non-profit company (NPC) was established in 2011 to act as the vehicle for coordinating the implementation of Biosphere activities. The Blyde River Catchment (**Figure 2**) spans various important ecosystems, with the river flowing through iconic landscapes, including the Blyde River Canyon and the Blyde River Canyon Nature Reserve, the latter of which also includes the Blyderivierspoort Dam.

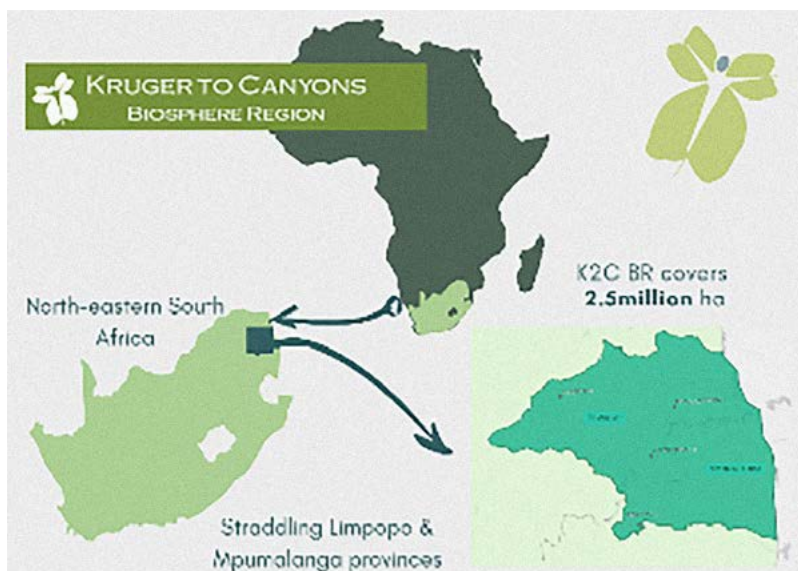
Blyde River Catchment

Mean Annual Runoff:
385.7 million m³

Size of the sub-catchment:
2 000 km²

Total Length of Blyde river:
>135 km

Drop in elevation:
ca. 1 600 metres



Strategic Water Source

Areas are those that supply a disproportionate amount of mean annual runoff to a geographical region of interest. In South Africa only 8% of the land area produces the runoff (water that drains from the surface of an area of land into the river systems) that generates 50% of the volume of water in our river systems.

Figure 1. Location of the Kruger to Canyons Biosphere Region (K2C BR)

The upper reaches of the river are located within the Mpumalanga Drakensberg **Strategic Water Source Area** for South Africa. These areas provide numerous important ecosystem services to downstream areas and must be protected for current and future generations. Key ecosystem services include flood attenuation, water purification, erosion control, water provision and habitat for species.

In addition to serving direct downstream users, the Blyde River serves as a lifeline to the Olifants River, supporting water users further downstream including the town of Phalaborwa and multiple surrounding industrial and mining areas. The Olifants River also forms part of a transnational catchment in South Africa and Mozambique, supporting more than 5 million people. The Olifants River is significantly contaminated from upstream activities, such as mining and agriculture, but the provision of good quality water annually from the Blyde River helps to dilute the pollutants. This ensures that the water quality remains acceptable for users downstream of the confluence, such as tourism and wildlife within the Kruger National Park.

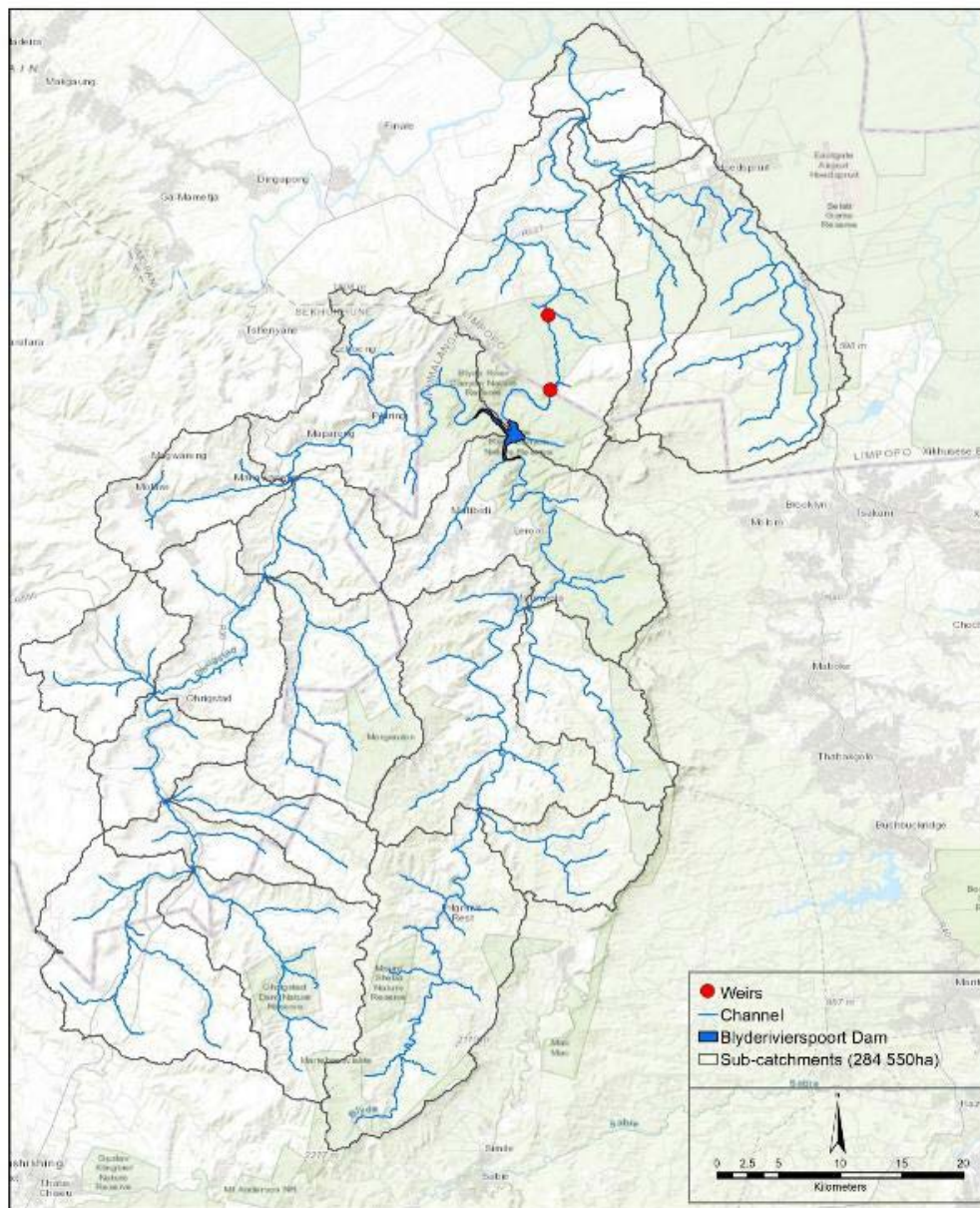


Figure 2. The Blyde primary river catchments, river network and key runoff stations



2.2. The Challenge

The Blyde River catchment is a complex and ecologically and socio-economically diverse area facing multiple threats from alien plant invasions, illegal mining and land-use changes from natural to degraded. Unsustainable land-use activities upstream (e.g. IAP spread, poor grazing practices) and increasing water demand from population growth and economic activities, in the context of an increasingly variable climate, result in water insecurity and biodiversity loss. This directly impacts critical natural assets, causes financial losses and economic uncertainty, and limits people's ability to adapt to ever-changing climatic conditions. The upper Blyde River Catchment provides important ecosystem services to downstream areas in the form of water provision, flood attenuation, erosion control, and habitat for wildlife. If these threats are not addressed, the Blyde River Catchment's important ecosystem services will diminish, with significant consequences for livelihoods, climate resilience and economic prosperity.

Key threats in the upper catchment are summarised in **Table 1**. All these threats impact ecosystem functions and the provision of ecosystem goods and services. Importantly, the K2C CIP specifically addresses the spread of IAPs (linked to resource constraints), overgrazing and inappropriate burning practices.

Table 1. Land-use drivers threatening water security in the Blyde River Catchment.

Land-use management drivers	Threats	Impacts
Resource constraints affecting historical state-owned forestry areas	• Spread of Invasive Alien Plants	• Water quantity and quality are reduced • Indigenous biodiversity is crowded out
Mining (including the rapidly expanding illegal mining on the Blyde)	• Loss of biodiversity • Heavy metal pollutants • Sedimentation	• Poor water quality • Reduced health of aquatic ecosystems • Increased water treatment costs
Unsustainable farming practices, such as monoculture, excessive fertilization and over-tilling	• Increased run-off leading to erosion, nutrient leaching and sedimentation • Pollution from chemicals • Reduced infiltration	• Poor water quality • Reduced groundwater recharge • Threat to Blyderivierspoort Dam's storage capacity
Overgrazing	• Increased run-off leading to erosion and sedimentation • Reduced infiltration	• Biodiversity loss and reduced health of aquatic ecosystems • Increased water treatment costs
Too frequent burning and poor burning practices	• Loss of biodiversity • Increased run-off and erosion	• Increased erosion – poor water quality • Threat to Blyderivierspoort Dam's storage capacity
Land-use change (e.g. urban sprawl) and encroachment into natural areas	• Loss of indigenous ecosystems	• Loss of biodiversity and ecosystem services

2.3. The K2C Catchment Investment Programme

In 2020, K2C, Conservation South Africa, The Nature Conservancy and the Nature for Water Facility came together to explore the feasibility of developing a Catchment Investment Programme (CIP) for the Biosphere Region. The CIP capitalises on a globally proven governance and funding model, typically known as a ‘Water Fund’. Water Funds enable downstream water users – such as businesses, utilities and urban and agricultural users – to invest in upstream land management to improve water quality and quantity and generate long-term downstream benefits, such as biodiversity conservation, climate resilience, and improved livelihoods.

The K2C CIP will aim to enhance water security through the control of IAPs, the introduction of GBMPs and an increase in the land area under protection. Benefits include the delivery of additional water which would contribute to protecting agricultural yields and benefiting larger towns and industries further downstream. Other benefits include the creation and protection of jobs, additional household income for upstream communities, restoration of biodiverse ecosystems and the potential carbon offset value of restoration and grazing management interventions.

The CIP will serve as a long-term and inclusive collective action platform for convening diverse public, private and community stakeholders together in the landscape to collaborate effectively, mobilize and align resources for greater impact, and ensure continuity of investment for sustained impact over the long-term. Initial efforts will focus on the Blyde River Catchment as a demonstration catchment.



📷 Credit: Simon Attwood_K2C

03 |

Nature as the solution

Without large-scale investment in NbS, it is likely that land degradation will increase, leading to increased sediment loads, reduced resilience for the catchment to cope with extreme events (e.g. floods, droughts, fire), loss of biodiversity and key habitats, continued spread of IAPs, and a reduction in livelihoods reliant on the landscape, all of which impact on water security and regional stability. Degradation in the upper catchment will have a direct impact on downstream water users, through reduced reliability of water supply (quantity) and quality.

Nature-based Solutions are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature (IUCN).

The K2C CIP Feasibility Report undertaken in 2023¹⁰ identified IAP clearing and Grazing BMPs as being the most suitable and effective NbS to generate hydrological and ecological returns. These solutions also have several co-benefits, including carbon sequestration and the creation of sustainable employment opportunities.

3.1. Invasive Alien Plant Clearing

Although IAPs are a problem throughout the landscape, the most significant impacts are felt in the escarpment and upper catchment, with IAPs being one of the greatest threats to the Strategic Water Source Area and to biodiversity. IAPs are more resilient and spread more quickly than local indigenous species, taking over large expanses, and requiring much more water than local species. IAP clearing will target 63,206 ha of the Blyde Catchment area (40% of the total 155,489 ha catchment area) that is invaded mainly by acacia, pine and eucalyptus species (**Figure 3**). IAP control will be undertaken in two phases:

- **Phase 1:** An initial High Impact Phase involving intensive clearing in the short-term.
- **Phase 2:** A Maintenance Phase to follow, preventing regrowth in cleared areas.

Large-scale IAP infestations significantly alter the hydrological processes of a catchment. Invasive species such as pines and wattles consume substantially more water than native vegetation due to their deep root systems and high transpiration rates. They intercept rainfall in their dense canopies, reduce groundwater recharge, and lower baseflow to rivers, ultimately decreasing streamflow and overall water yield. These changes lead to considerable water losses, impacting both ecosystem health and downstream water availability.

10. <https://tnc.box.com/s/ff8oav8ege3yzcjh4gwdvxze8m340pyz>

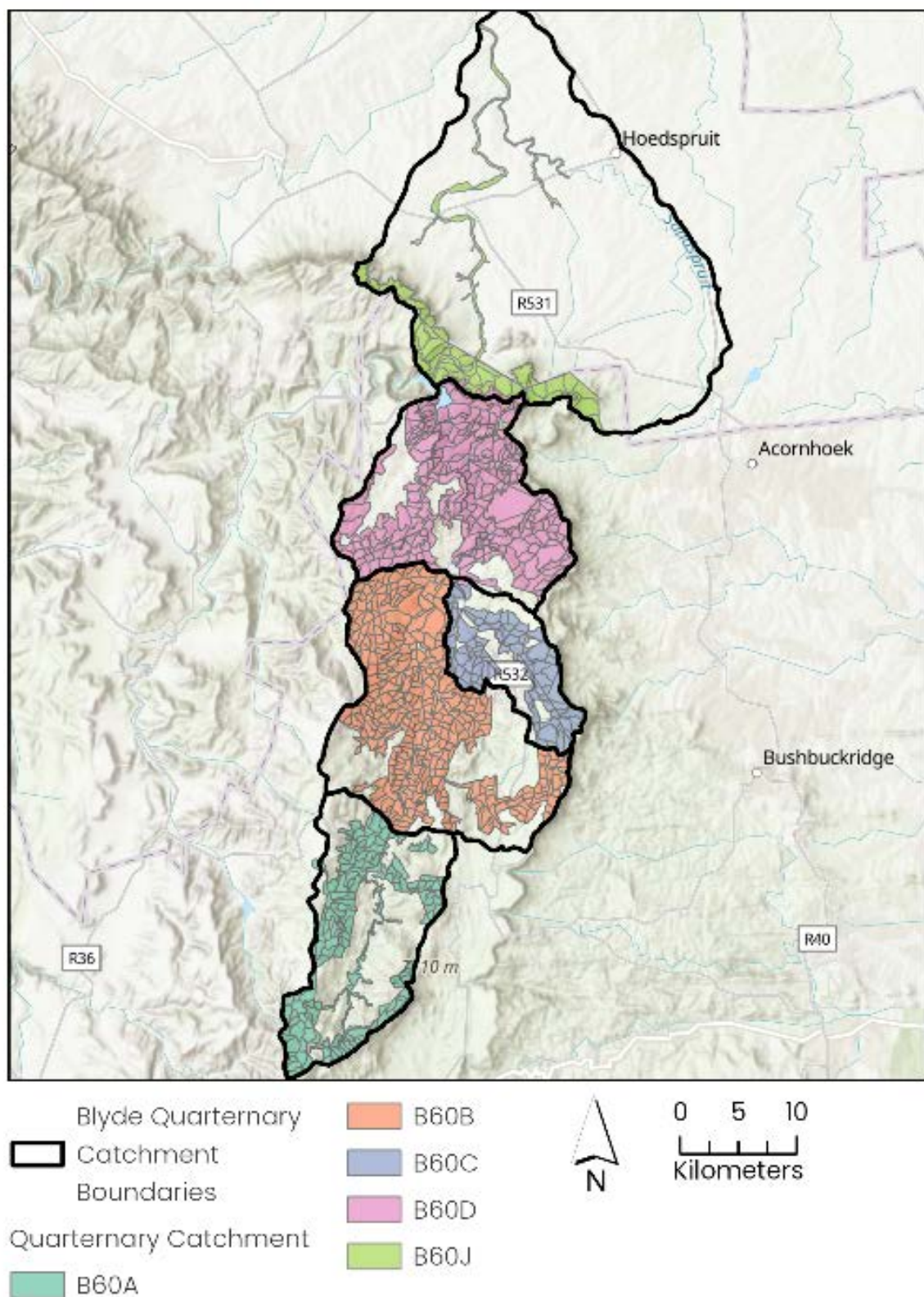


Figure 3: Implementation areas for Invasive Alien Plant Clearing in the Blyde Catchment (each of the numbers represents a quarternary catchment for planning and modelling purposes)

3.2. Grazing Best Management Practices

Over-grazing results in a loss of vegetation cover, soil compaction and a deterioration in the biodiversity value of the land, as well as increased erosion rates. This has a direct impact on the health of cattle, which in turn reduces the livelihood opportunities for communal farmers. Community engagement and knowledge sharing plays a crucial role in this NbS. Eco-rangers from beneficiary communities will be trained to work with communal farmers and monitor implementation. The primary incentive for uptake is facilitating improved access to livestock markets through mobile auctions, access to livestock medicine and services like sheep shearing. GBMPs will be implemented predominantly on land owned by Communal Property Associations and will involve the co-development of grazing management solutions to address issues of overgrazing. It includes evidence-based practices for improved animal and ecosystem health outcomes¹¹ and will target an estimated 200 communal herders, increasing the value of their livestock and improving their resilience to climate impacts in the Blyde Catchment. The area that will be targeted by the K2C CIP for improved GBMPs is 10,559 ha (**Figure 4**).

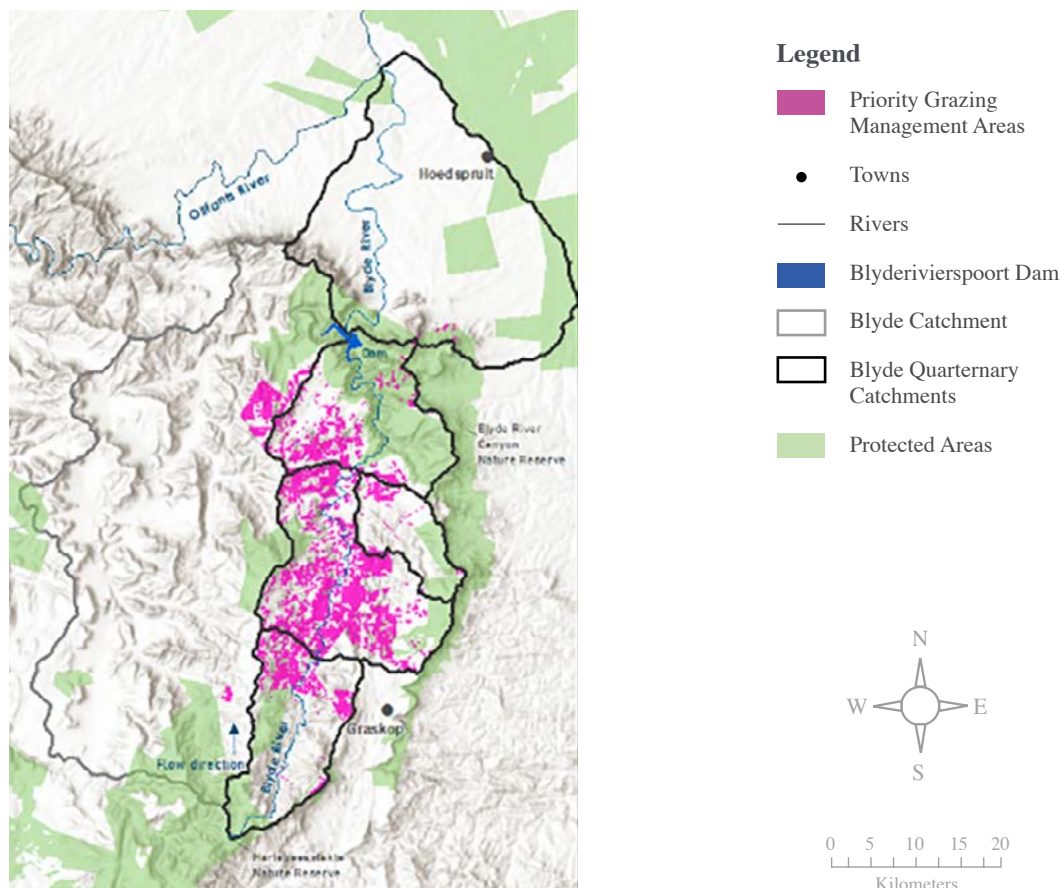
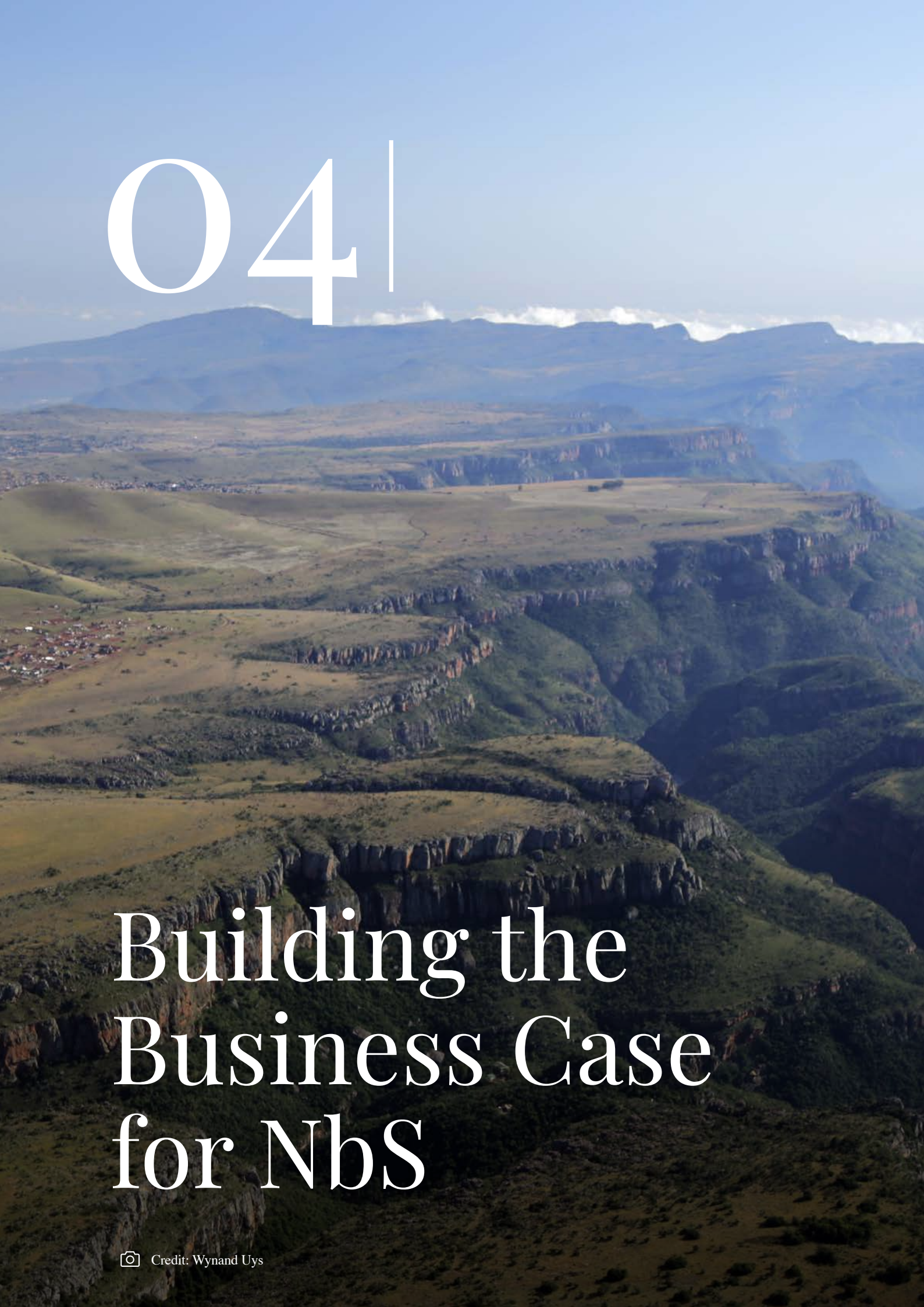


Figure 4: Implementation areas for Grazing BMPs

11. Developed, for example, through programmes like 'Herding for Health' (www.herding4health.net) and Meat Naturally (www.meatnaturallyafrica.com)



04 |

Building the Business Case for NbS

The Business Case aims to outline the relevant benefits that can be generated (e.g. improved water security and livelihoods) through investment in NbS. The development of the Business Case **follows six steps** as shown in **Figure 5** and described in the subsequent sections.

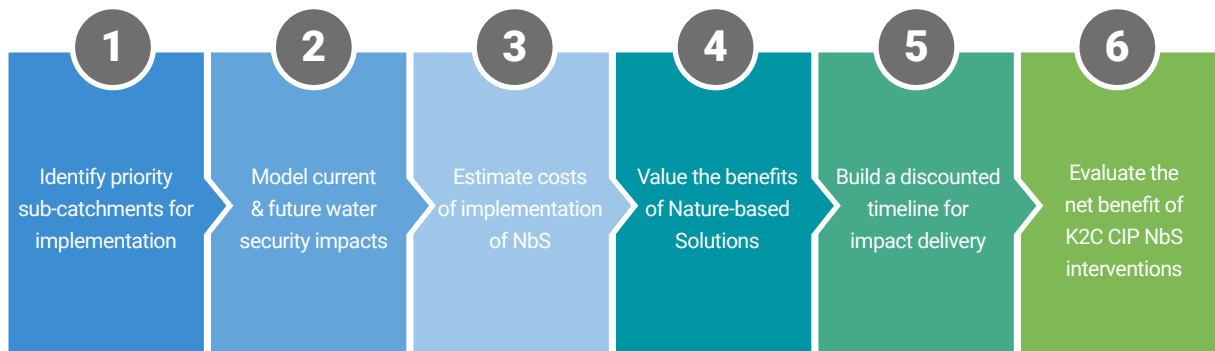


Figure 5: An overview of the process followed to develop the K2C CIP Business Case



4.1. Identifying priority sub-catchments for implementation

A key input to the updated Business Case, was an updated spatial layer with more accurate mapping of the distribution and density of IAPs in the landscape. K2C's Medium-Term Restoration Plan for IAP clearing¹² used this layer to help prioritise and schedule clearing. **Figure 6** shows the updated Nbal map, with clearing priorities and proposed scheduling, based on the K2C CIP Medium-term Restoration Plan.

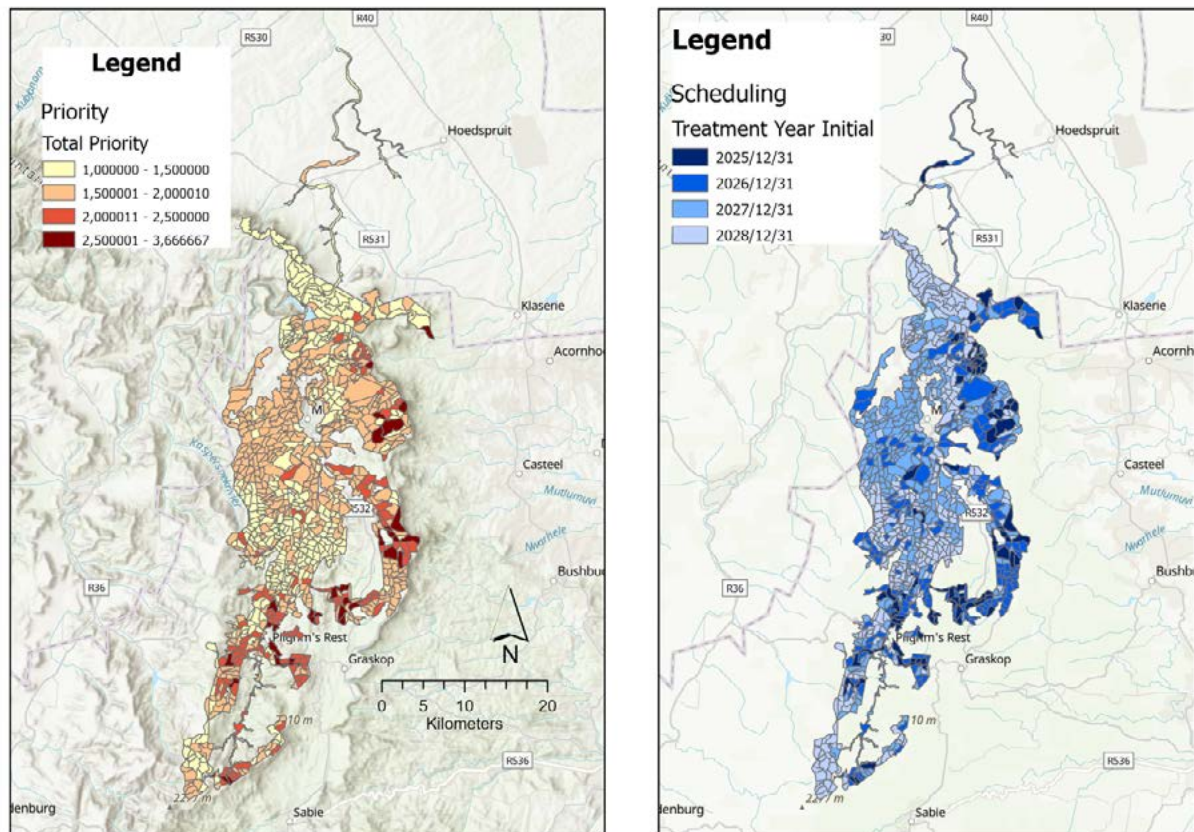


Figure 6: Updated Nbal mapping in the Blyde catchment, showing AIP clearing priorities and proposed scheduling of treatments.

This updated spatial analysis revealed widespread IAP infestation across the Blyde River Catchment area, with 63,206 ha (40% of the catchment area) invaded. Over-grazing is a challenge throughout the upper catchment. An area of 10,559 ha of grassland was identified for restoration by engaging communal farmers (**Figure 4**). GBM practices will be implemented through an incentives-based approach that offers improved access to markets and livestock management support by eco-rangers.

12. Marais (2025)

4.2. Biophysical modelling

A variety of hydrological models have been widely applied at the catchment scale both globally and in South Africa. Each of these models offers specific advantages and limitations depending on the objectives of the study, the availability and resolution of data, and the complexity of the catchment system being analysed. Due to the available data at the site of interest, the recent development of the SWAT GIS interface and the level of land use information required for the scenario modelling, SWAT+ was chosen as the most appropriate model to use.

4.2.1. Data used in the hydrological modelling

Data used to set up the SWAT+ model included:

Climate Data

Climate data included rainfall, temperature, solar radiation, relative humidity, and wind speed. Projections of changes in climate were obtained to adapt the climate variables for each station to allow for an indication of future peak/extreme events or prolonged drought. The WorldClim database was used to illustrate the potential future impacts of predicted changes in precipitation (mm) and temperature (°C).

Elevation Data

Digital Elevation Models (DEM) were used to delineate the watershed and define the stream network, sub-basin boundaries, and flow direction within the SWAT+ model.

Land Use/ Land Cover Data

High-resolution (30m) land use/land cover (LULC) data was used to represent current land cover conditions within the catchment. The South African National Biodiversity Institute (SANBI) National Land Cover (SANLC) dataset for South Africa was updated using Nbal mapping and IAP spread model outputs.

Soil Data

The Usersoil database was modified to include the specific physical and hydrological attributes of each soil type identified in the spatial dataset.

Flow data

Historical flow records were obtained from the Department of Water and Sanitation (DWS) via the National Integrated Water Information System (NIWIS).

Modelling Invasive Alien Plant Spread

The approach used was recommended by a local expert and draws upon a study conducted by Versfeld et al. (1998). The model incorporates an exponential rate of increase and reduces the expansion rate as available space becomes saturated.

Modelling Sediment

In SWAT+, sediment modelling was integrated using the Modified Universal Soil Loss Equation (MUSLE)¹³.

13. Williams (1975)

4.2.2. Simulating the Blyderivierspoort Dam

The Blyderivierspoort Dam, completed in 1974, was constructed primarily to supply irrigation and domestic/municipal water, playing a vital role in supporting agriculture and communities in the region. The dam's operating rules are governed by the DWS. These rules aim to ensure sustainable water allocation, infrastructure protection, and ecological balance¹⁴. Understanding and incorporating these operating rules into the SWAT+ model is critical, as they directly influence downstream flow regimes, water availability for users, and the ecological performance of the catchment. These operating rules affect water allocation priorities, storage and release.

The dam is now managed through simplified curtailment strategies. Specifically, all abstractions cease when the dam volume falls below 25% of capacity (11.75 million m³) due to insufficient pressure for gravity-fed distribution¹⁵. When the volume drops below 70% of capacity (32.9 million m³), voluntary irrigation reductions of 20% are theoretically implemented. Importantly, ecological water releases are maintained regardless of dam levels. These operational rules and abstraction volumes were integrated into the modelling framework after hydrological simulations were completed, ensuring that water demand scenarios reflect current management practices.

4.2.3. Scenario modelling of NbS

The estimated benefits of NbS interventions are assessed by comparing a future 'Intervention' scenario to an alternative Business-as-Usual scenario. The 'Business as Usual' scenario represents the likely progression of land use and management conditions from 2025 to 2055, assuming no intervention takes place. It includes the continued spread of IAPs and reflects projected trends of current practices and pressures. Future climate projections are incorporated to simulate changing environmental conditions. The 'Intervention' involves implementation of the two NbS for the K2C CIP (IAP clearing and GBM practices between 2025-2055).

Bussiness as Usual Scenario (BAU)

A "worst case" scenario



No Intervention AND
Spread of IAPs

Intervention Scenario

A "best case" scenario



IAP Clearing



Grazing Best
Management Practices

14. Van der Zaag et al (2010)

15. https://award.org.za/wp/wp-content/uploads/2019/03/Technical-Documentation_Lower-Olifants-Op-Rules_Final.pdf

4.2.4. Important results from the SWAT+ modelling

A sample of the modelling results for the Business-as-Usual and Intervention scenarios are shown below to demonstrate the impact of NbS on catchment hydrology. **Figure 7** illustrates the annual reservoir storage (in million m³) in the Blyderivierspoort Dam. Over the entire simulation period, the Intervention scenario maintained an average of 13.7 million m³ more water in storage than the Business-as-Usual scenario, with significantly reduced variability and more stable reservoir levels. The enhanced storage capacity under the Intervention scenario translates into fewer irrigation shortfalls and greater reliability of water supply, supporting improved agricultural productivity and water security in the region.

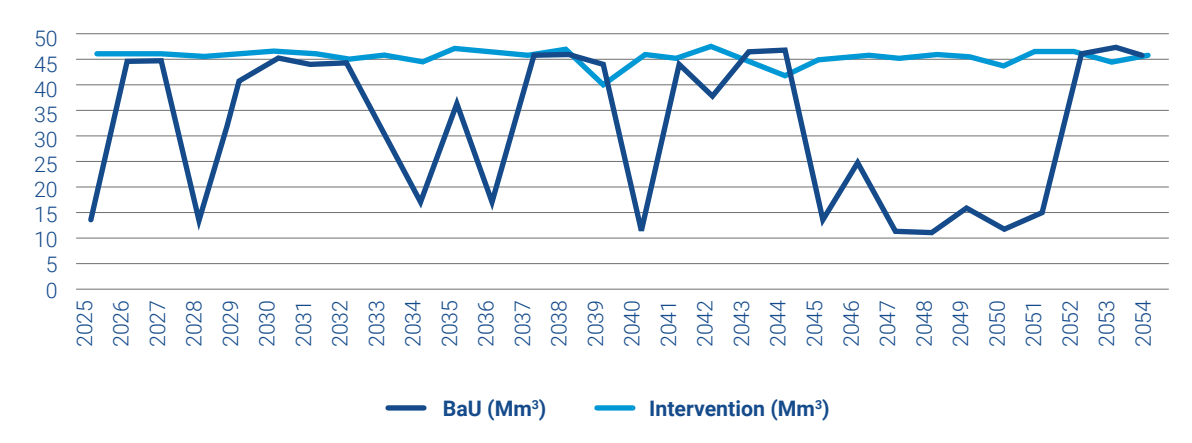


Figure 7: Simulated dam volume between the Business-as-Usual (BaU) and the Intervention scenarios accounting for sedimentation.

The reduction in sediment inflow under the Intervention scenario also leads to a significantly lower rate of sedimentation within the reservoir. In the Business-as-Usual scenario, sediment accumulation results in a 4.51% loss of total dam capacity over the simulation period. In contrast, the Intervention scenario shows only a 0.76% reduction in capacity (**Figure 8**). This difference suggests that the dam’s operational lifespan could be extended by nearly a factor of six under the Intervention scenario, highlighting the long-term benefits of catchment restoration for water infrastructure sustainability.

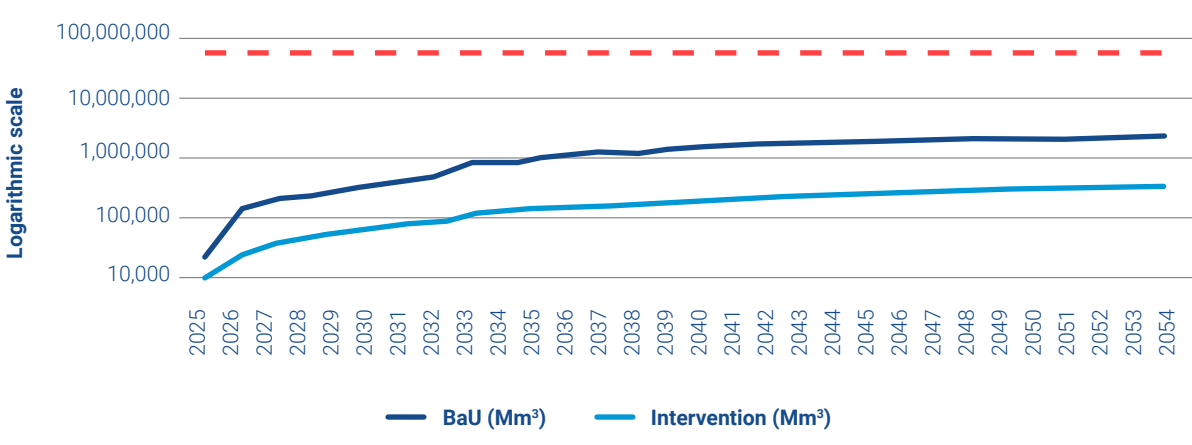


Figure 8: Sediment accumulation in the dam over the study period represented on a logarithmic scale. The dashed red line represents the point at which dam capacity is completely compromised due to the accumulation of sediment.

4.3. Valuing the benefits of NbS

There are four broad benefit categories covering Water Security, Poverty Alleviation, Carbon Offsets, and Ecosystem Restoration and Biodiversity (**Figure 9**). Each of the NbS delivers benefits across some or all of these categories and can have a direct and indirect impact on several beneficiaries. Where possible, the monetary value of the benefits in these categories has been integrated into the economic analysis¹⁶.

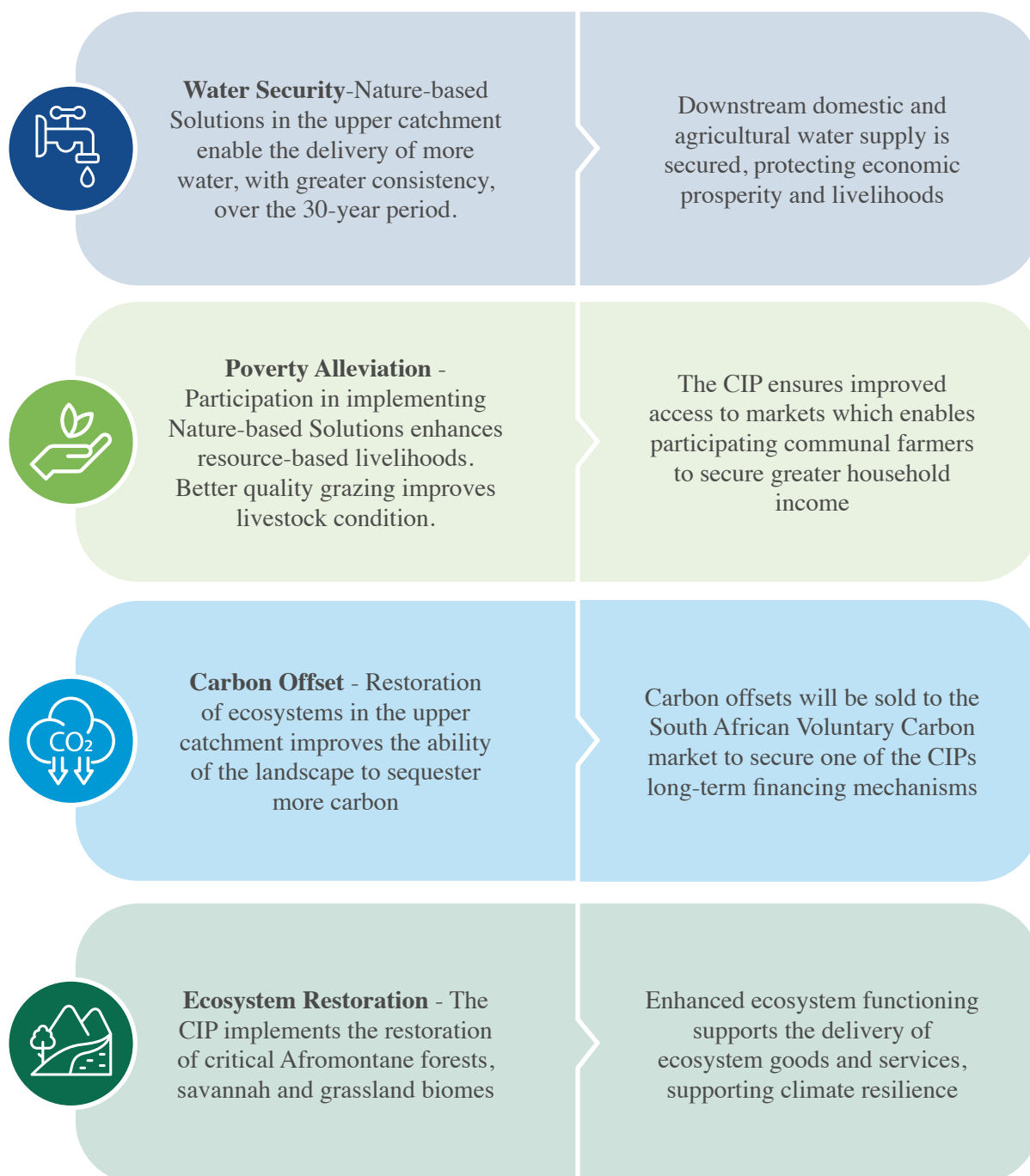


Figure 9: Benefit Framework for the Kruger to Canyons CIP

16. It should be noted that investing in NbS also delivers additional ecosystem services such as climate change adaptation and flood attenuation. However, these have not been explicitly quantified in the Benefits analysis.

4.3.1. Benefits of avoided water shortages

The direct impact of irrigation supply shortages was estimated using the value of mango and citrus yields that are dependent on water supply from the Blyderivierspoort Dam.

Reducing irrigation supply reduces crop yields and negatively impacts farming revenue. In periods where the Blyderivierspoort Dam volume drops below 25%, abstraction for irrigation is not possible¹⁷, and irrigation supply is completely restricted. This results in significant agricultural losses. This is forecasted to happen frequently in a business-as-usual scenario, while the implementation of NbS helps to regulate the supply of water from the catchment and therefore avoid such agricultural losses in the future (**Figure 10**).

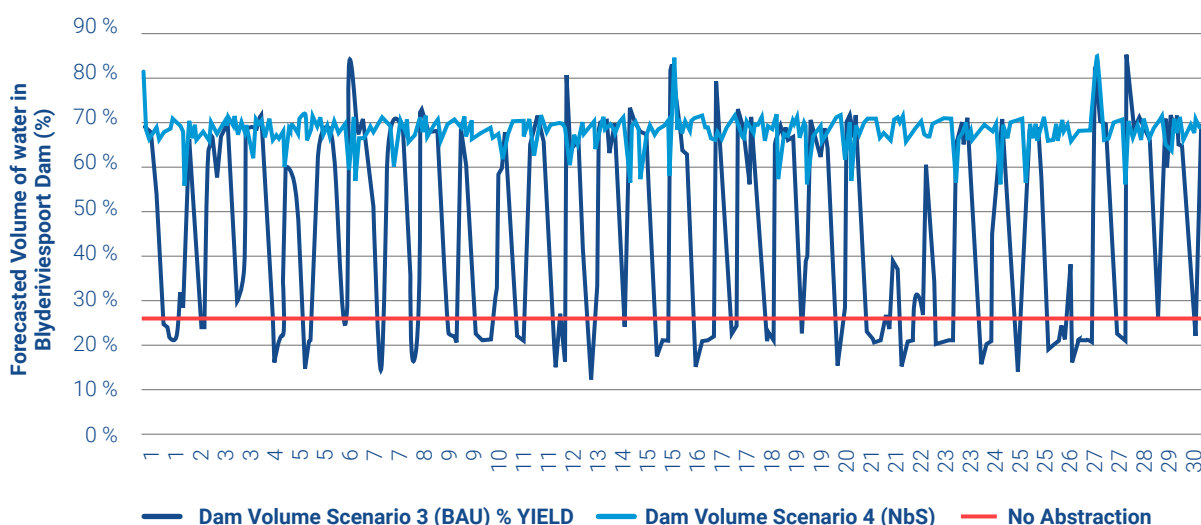


Figure 10: The projected monthly volume of water in the dam expressed as a percentage of dam capacity, over the 30-year period of the K2C CIP¹⁸ for Scenario 3 (Business-as-Usual – grey line) and Scenario 4 (NbS Intervention – blue line). Note that the water volumes included in the graph account for abstraction.

The potential monetary benefit to agriculture from investing in NbS is estimated to be between ZAR 4.9 billion and ZAR 13.5 billion over the 30-year period of the K2C CIP through avoided irrigation losses. This equates to between ZAR 2.7 billion and ZAR 7.3 billion in present day terms (discount rate of 3.66%¹⁹). The range in possible values is due to the fact that there are different ways to quantify the relationship between irrigation reduction and the impact on agricultural yield²⁰. A reduction in irrigation also impacts job losses if crop areas are taken out of production, with both permanent and temporary jobs affected. During the 27 years of the analysis period, approximately 24,000 full-time equivalent²¹ (FTE) job-years are lost when losses are considered across both permanent and temporary workers. On average, this results in impacts on approximately 800 workers per year over the CIP's 30 years.

17. https://award.org.za/wp/wp-content/uploads/2019/03/Technical-Documentation_Lower-Olifants-Op-Rules_Final.pdf

18. This figure takes into account the fact that sediment accumulation reduces the capacity of the dam over time. The 100% value represents the initial capacity of the dam.

19. The discount rate used is the South African social discount rate, based on Fenichel et al. (2018).

20. Engagement with local farmers highlighted that citrus is sensitive to irrigation changes and that the % irrigation loss corresponds directly to the % reduction in crop yield. However, the literature on citrus productivity loss suggests lower levels of loss under reduced irrigation. In the absence of empirical studies from the field, the range of possible levels of yield loss were therefore estimated using existing literature (at the lower end of yield loss) and inputs from farmers (at the higher end of estimated yield loss).

21. A full-time equivalent (FTE) job is a measure that converts the hours of part-time and full-time employees into a single unit of a standard full-time position. It is calculated by dividing the total hours or days worked by an employee (or group of employees) by the standard number of hours or days for a full-time job. In the current case, this is estimated per year, and the total FTE is equal to the total number of FTE job years lost over the 27 year period of the agricultural job loss analysis. This is not necessarily the same as a 'job', which is usually defined as full-time employment of a person.

In addition to the monetary benefit of avoided water shortages to the agricultural sector, implementing NbS also delivers significant benefits to those responsible for the management of the Blyderivierspoort Dam and the sale of water to the irrigation sector. The implementation of NbS reduces sedimentation of the Blyderivierspoort Dam by an estimated 795,000 tons of sediment each year, extending the lifespan of the dam by an estimated factor of six.

4.3.2. Co-benefits of implementing NbS

The monetised component of the **Poverty Alleviation** benefit considers the impact on community participants in the CIP. The positive impacts on communal farmers who participate in improved GBMPs consist of (i) increased income from improved livestock condition and access to markets, and (ii) cost efficiencies for participating communal farmers (avoided cost of winter feeding, veterinary services etc.). Together, the increased revenue from livestock sales and the reduced costs of feeding and veterinary services sum to ZAR 19,404,000 (*undiscounted*) over the programme's lifespan²².

The **Carbon Offset** benefit represents the additional revenue to the CIP from the sale of verified carbon offsets in South Africa's voluntary carbon markets. The restoration of grasslands enables sequestration of up to 2 tonnes of CO₂ (equivalent) per hectare per year. This carbon gain is converted to credits that can be sold on South Africa's mandatory carbon markets at a rate of ZAR 308/tonne²³ to create sustainable revenue for the CIP. Over the lifetime of the programme revenue received exceeds ZAR 63.8 million (using the market value of carbon, and before discounting is applied). The **Ecosystem Restoration** benefit represents the area (hectares) of key habitats restored through NbS, contributing to an increase in important biodiverse areas under conservation management.

The CIP would also deliver several additional non-monetised co-benefits, the most critical being the protection of employment through securing the ecosystem services that underpin livelihoods. GBMPs support an estimated 780 cumulative FTE job-years over the 30 years of the CIP and IAP clearing supports an estimated 4,013 cumulative FTE job-years over the same period. Combined with the estimated job impacts from reduced irrigation to the agriculture sector (both permanent staff and seasonal labourers) of approximately 24,000 cumulative FTE job-years, the CIP helps to create or protect almost 29,000 FTE job-years over the lifetime of the CIP. On average, this results in impacts on approximately 960 workers per year over the 30-year lifespan of the CIP, with an average of 160²⁴ jobs created per year, and an average of 800 jobs protected.

22. Costs as per the 2025 calendar year.

23. This is the current (2025) value of carbon.

24. It is important to note that the number of jobs created through the IAP programme will be significantly higher during the high impact phase of the work (an estimated 265 FTE jobs per year).

4.4. Estimating costs

The cost modelling considers IAP and GBMP costs, as well as costs for programme management and monitoring and evaluation. These are used to develop a cost profile for the K2C CIP. All estimates are presented in real terms, with constant 2025 prices applied to exclude the effect of inflation²⁵.

4.4.1. Costing IAP clearing

IAP clearing costs were derived from the K2C CIP Medium-term Restoration Plan model, referenced previously in this document (**Table 2**).

Table 2: A summary of the costs (ZAR) of initial clearing, follow-up and maintenance for the IAP clearing programme. Values show totals for the 30-year period analysed (*before discounting*)

Phase	Currency	Cost	% Total
Initial clearing	ZAR	130,020,274	37%
1st follow-up	ZAR	21,980,169	6%
2nd follow-up	ZAR	21,562,101	6%
3rd follow-up	ZAR	21,273,048	6%
4th follow-up	ZAR	21,153,146	6%
Maintenance	ZAR	137,495,449	39%
Total		353,484,187	100%

This profile highlights the significant upfront investment required for initial clearing, with progressively lower but still substantial costs allocated to the follow-up phases that are essential to secure lasting ecological and hydrological benefits.

4.4.2. Costing Grazing Best Management Practices

GBMPs are costed using the operational norms of the *Herding for Health* (H4H) programme, led by Conservation International, which is already active in the Blyde buffer zones. This provides a robust and context-specific benchmark for scaling the intervention across the CIP. The cost of GBMPs is principally driven by the maximum number of cattle that can be sustainably accommodated within the protected grazing area. For the CIP, an estimated 10,559 hectares of rangeland will be managed to sustainably support 2,640²⁶ head of cattle per year, with this stocking level maintained consistently throughout the programme. The herd size directly determines the scale of intervention costs, including equipment, supplies, monitoring and evaluation, human resources, and associated expenditures such as training and uniforms.

25. This approach follows the methodology of the Nature for Water Facility (N4W) and ensures that the long-term financial and economic viability of the programme can be assessed without distortion from inflationary movements.

26. Best practice indicates 0,25 heads of cattle per hectare

The programme will employ approximately 26 eco-rangers each year, creating local employment opportunities while ensuring continuous oversight of rangeland management. Eco-rangers are responsible for monitoring grazing pressure, enforcing rotational practices, preventing overgrazing, and supporting the resilience of restored landscapes. The total cost of implementing GBMPs under the CIP is estimated at approximately ZAR 240.6 million, before discounting (**Table 3**).

Table 3: A breakdown of the costs associated with the GBM practices component of the CIP. Values show totals for the 30-year period analysed (*before discounting*)

Category	Currency	Cost	% Total
Human Resources	ZAR	66,533,324	27%
Equipment	ZAR	6,477,903	3%
Supplies	ZAR	121,334,400	51%
Training	ZAR	10,303,200	4%
Other (uniforms & associated)	ZAR	35,910,000	15%
Total	ZAR	240,558,827	100%

4.4.3. Programme Management and Monitoring and Evaluation Costs

The largest share of programme management expenditure is attributed to staff costs, which cover core personnel including programme management staff, an implementation lead, a restoration manager, and a dedicated programme coordinator for IAP activities (**Table 4**). The budget also includes allocations for laptops and equipment, travel and meetings, as well as a range of office, consumables, licenses, and professional services. In addition to staff-related expenses, the M&E framework incorporates recurring and once-off expenditures for monitoring water volume and quality, terrestrial biodiversity assessments, and socio-economic impact monitoring (**Table 5**).

Table 4: Programme Management costs for the K2C CIP. Values show totals for the 30-year period analysed (*before discounting*)

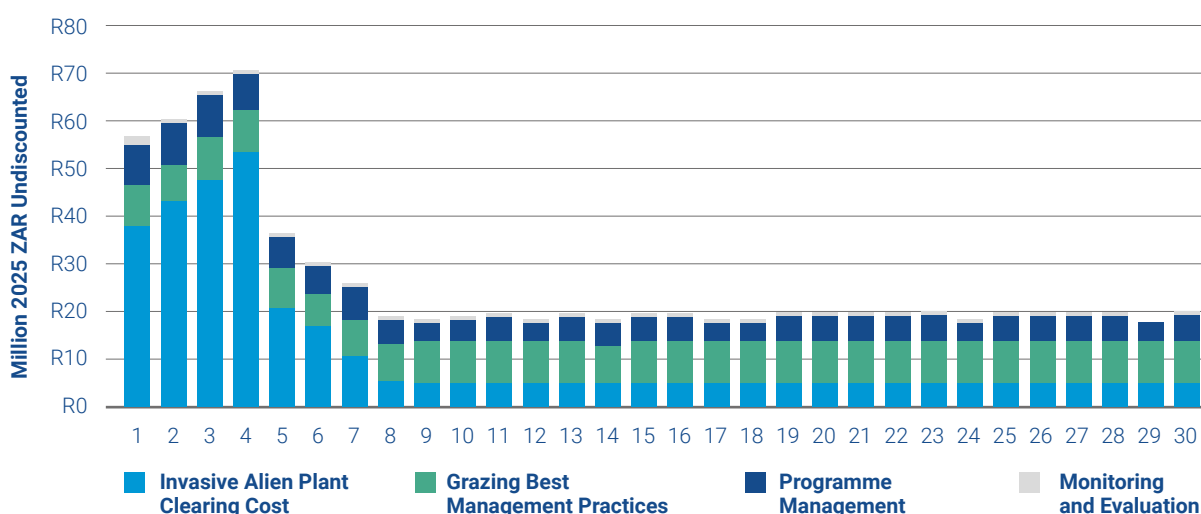
Category	Currency	Cost	% Total
Staff costs	ZAR	140,056,500	85.90%
Equipment	ZAR	2,720,000	1.70%
Office, consumables, licenses and professional services	ZAR	6,246,600	3.80%
Travel	ZAR	13,140,000	8.10%
Trainings and meetings	ZAR	945,000	0.60%
Total	ZAR	163,108,100	100%

Table 5: M&E costs for the K2C CIP. Values show totals for the 30-year period analysed (*before discounting*)

Category	Currency	Cost	% Total
M&E Staff costs	ZAR	34,500,000	83.10%
Recurring water volume costs	ZAR	3,254,665	7.80%
Once-off water volume costs	ZAR	151,415	0.40%
Recurring water quality costs	ZAR	2,196,000	5.30%
Once-off water quality costs	ZAR	6,600	0.00%
Terrestrial Biodiversity Once-off costs	ZAR	620,000	1.50%
Recurring socio economic impact costs	ZAR	750,000	1.80%
Once-off socio economic impact costs	ZAR	50,000	0.10%
Total	ZAR	41,528,680	100%

4.4.4. Cost profile

The overall cost profile of the programme management and intervention activities closely mirrors that of other Catchment Investment Programmes (CIPs) (**Figure 11**). In particular, IAP clearing follows a front-loaded pattern, with high initial costs required for intensive clearing in the early years, followed by progressively lower follow-up costs and a transition to regular, long-term maintenance. This structure reflects the operational reality that upfront investments are needed to achieve rapid ecological gains, while ongoing expenditure is essential to sustain those benefits over time. GBMPs, programme management, and M&E costs establish a baseline of recurring commitments that remain relatively stable throughout the life of the programme. Taken together, this profile provides both the intensive early investment required to unlock catchment benefits and the predictable long-term costs necessary to maintain them.

**Figure 11:** The cost profile of the K2C CIP over a 30-year period

4.4.5. Cost summary

Over the 30-year programme horizon, the total projected undiscounted costs amount to ZAR 798.7 million (**Figure 12** and **Table 6**). The largest cost component is IAP clearing, which accounts for 44% of the budget (ZAR 353.5 million) and reflects the intensive, front-loaded nature of initial restoration efforts followed by ongoing maintenance. GBMPs represent 30% of the total (ZAR 240.6 million), providing long-term support for sustainable rangeland management and livelihood co-benefits. Programme management costs are estimated at ZAR 163.1 million (20% of total), ensuring effective coordination, governance, and administration over the full duration of the CIP. Finally, Monitoring and Evaluation (M&E) represents 5% of costs (ZAR 41.5 million), consistent with international benchmarks for climate finance projects and ensuring robust measurement and verification of outcomes. This balanced cost profile highlights the dual focus of the programme on delivering upfront ecological gains while maintaining predictable, sustainable costs for long-term impact.

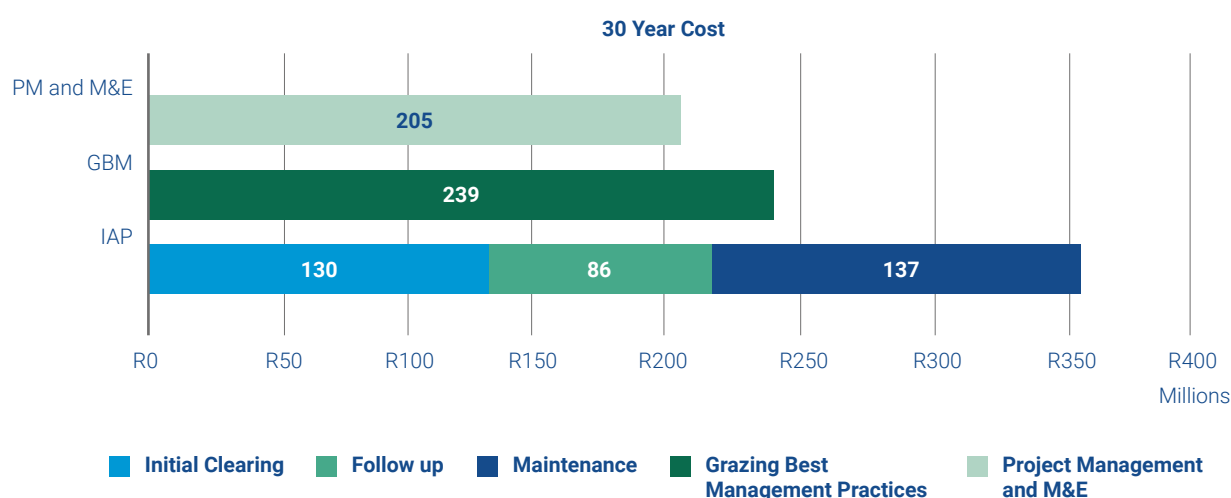


Figure 12: The contribution of each category to the costs of the K2C CIP over the 30-year period (before discounting)

Table 6: A breakdown of the costs per category for the K2C CIP over 30 years (before discounting)

Category	Currency	Total Cost (ZAR)	% of Total
IAP Clearing	ZAR	353,484,187	44%
GBM Practices	ZAR	240,558,827	30%
Programme Management	ZAR	163,108,100	20%
Monitoring & Evaluation	ZAR	41,528,681	5%
Total	ZAR	798,679,794	100%

4.5. Building a discounted timeline for impact delivery

Following common practice, the annual time series of costs and benefits that the CIP is expected to deliver are discounted to ascertain the present value of future costs and benefits. The South African social discount rate of 3.66% is used for this analysis. The timeline accounts for ecosystem restoration dynamics in that benefits are only fully realised after catchments are restored to their full functionality. The discounted timeline of costs and benefits for the K2C CIP using the lower range of agricultural benefits (Scenario 2) is shown in **Figure 13**. The discounted timeline of costs and benefits for the upper range of agricultural benefits (Scenario 1) is shown in **Figure 14**.

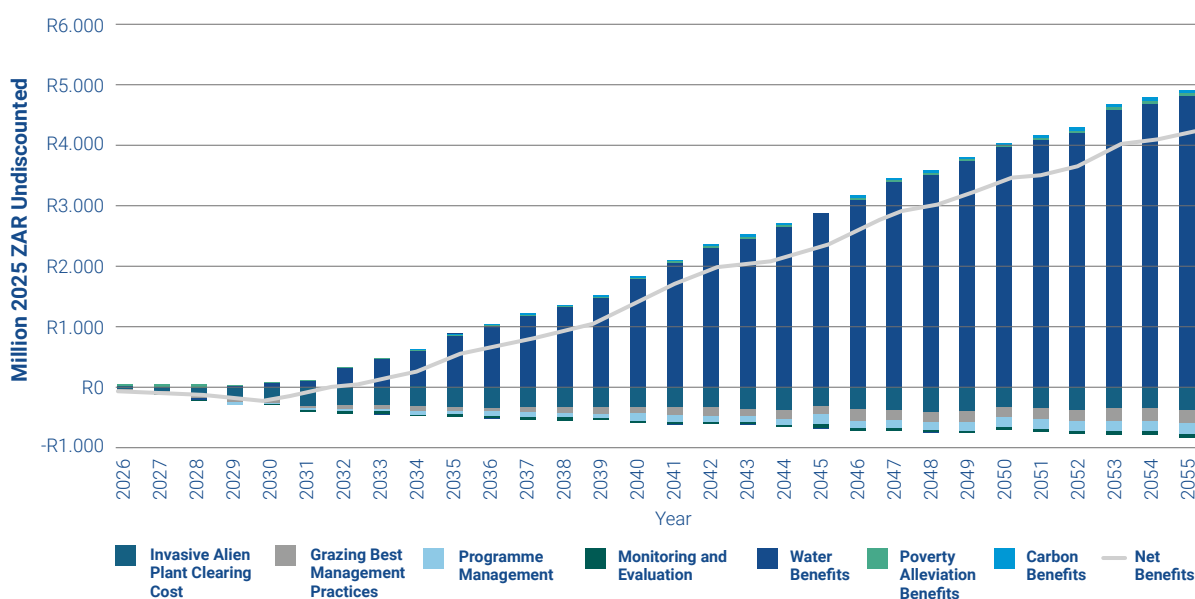


Figure 13: Cumulative discounted timeline of costs and benefits for the Kruger to Canyons CIP for Scenario 2 (using lower range estimates of agricultural benefit)

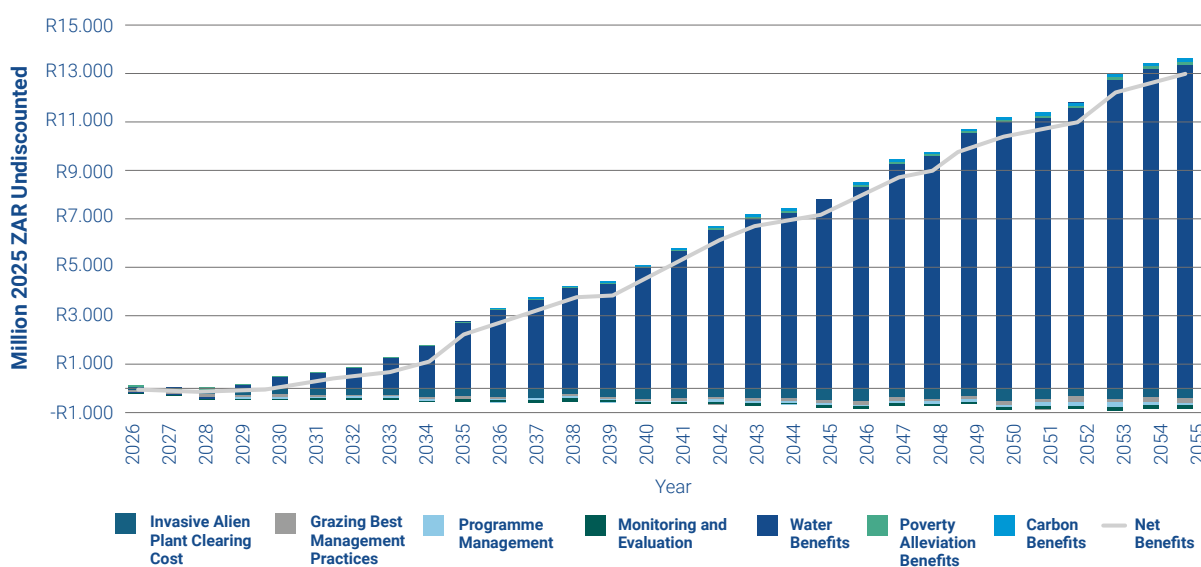


Figure 14: Cumulative discounted timeline of costs and benefits for the Kruger to Canyons CIP for Scenario 1 (using upper range estimates of agricultural benefit)

4.6. Evaluating the net benefit of NbS interventions

The benefits are unlocked in several categories. The primary benefit is the additional 13.7Mm³ water maintained in storage on average each year, resulting in an avoided loss of an estimated 700 million m³ of irrigation water to the agricultural sector over the 30-year period of the programme. This contributes to protecting between ZAR 2.7 billion (USD 160.9 million) and ZAR 7.3 billion (USD 435 million) worth of agricultural yield in the mango and citrus farms downstream of the Blyderivierspoort Dam. Additional streamflow at the catchment outlet also benefits large towns and industries further downstream, predominantly the Phalaborwa Mining Complex.

Other benefits include poverty alleviation worth ZAR11.7 million (USD 697k) as a result of additional household income for upstream communities involved in improved grazing BMPs, the restoration of over 74,000 ha of biodiverse ecosystems, and over ZAR 43.8 million (USD 2.6 million) in carbon offset value. The financial and economic appraisal presented in this updated Business Case for the K2C CIP shows that, for every South African Rand invested in NbS, a return of between ZAR 4.91 and ZAR 13.33 is generated, depending on how the relationship between irrigation reduction and the impact on agricultural yield is defined. Cumulatively, the interventions create and protect almost 29,000 FTE job-years over the lifetime of the CIP. On average, this results in impacts on 960 workers per year over the 30-year lifespan of the CIP, with an average of 160 jobs created per year, and an average of 800 jobs protected.

Over a 30-year period, results show that a lifetime investment of ZAR 554.9 million (USD 33.1 million) in Nature-based Solutions unlocks benefits worth between ZAR 2.7 billion (USD 157 million) and ZAR 7.4 billion (USD 441 million).



05 |

Stewarding
investment
in nature:
Protected areas
expansion

The broader Kruger to Canyons Biosphere Region, within which the Blyde River Catchment is located, contains extremely high levels of biodiversity and endemism, with diverse plant communities supporting an equally rich variety of birds, mammals, reptiles and insects (**Figure 15**). Yet this landscape has become fragmented, with tenuous ecological corridors between the Kruger National Park in the lowveld to the escarpment and the upper Blyde River Catchment in the highveld.

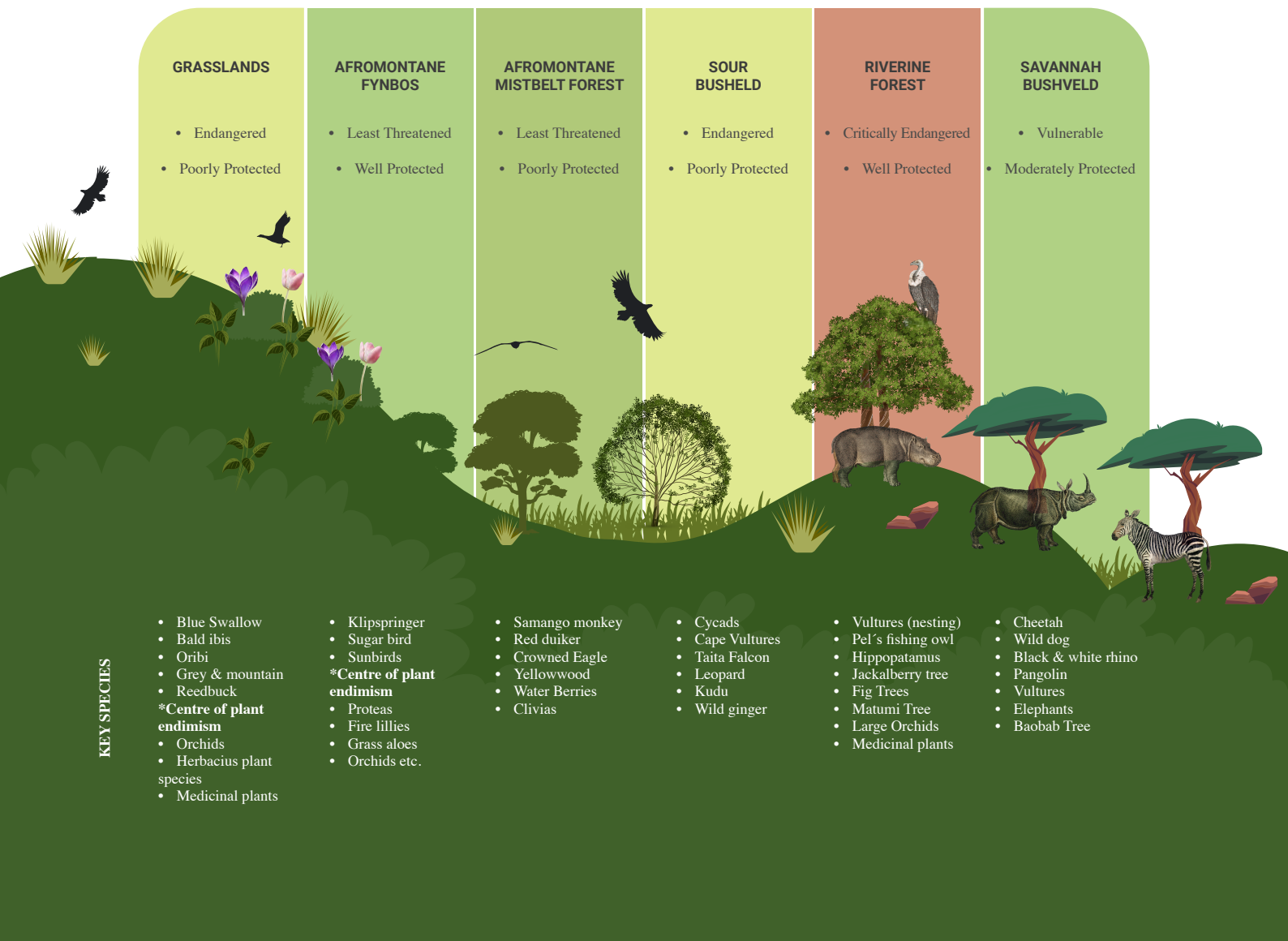


Figure 15: Biodiversity within the Kruger to Canyons Biosphere Region

To date, only 16% of the Kruger to Canyons Biosphere Region is protected, highlighting the need for an approach that supports scaling up interventions. A large portion of this unprotected area coincides with the Strategic Source Water Area. This undermines the ability of the catchment to deliver water security, as future land-use changes are left unchecked. To secure the investment in nature, the CIP has identified that formally protecting the areas where solutions are implemented contributes to securing the long-term success of the programme.

One of the most flexible approaches to expanding protected areas is via biodiversity stewardship. Agreements are made with private and communal landowners to protect and manage their land identified within biodiversity priority areas and in return landowners receive benefits, such as fiscal and rates rebates, along with management assistance. The majority of the remaining intact forests, grasslands, savannahs and wetlands in the Blyde River Catchment fall within priority areas listed under the country's National Protected Area Expansion Strategy (2016). This presents an opportunity to protect these remaining diverse ecosystems within the CIP focus area. The CIP will engage with key and willing beneficiaries and landowners to facilitate the expansion of priority protected areas (**Figure 16**) to secure the long-term impact of the Nature-based Solutions implemented by the programme.

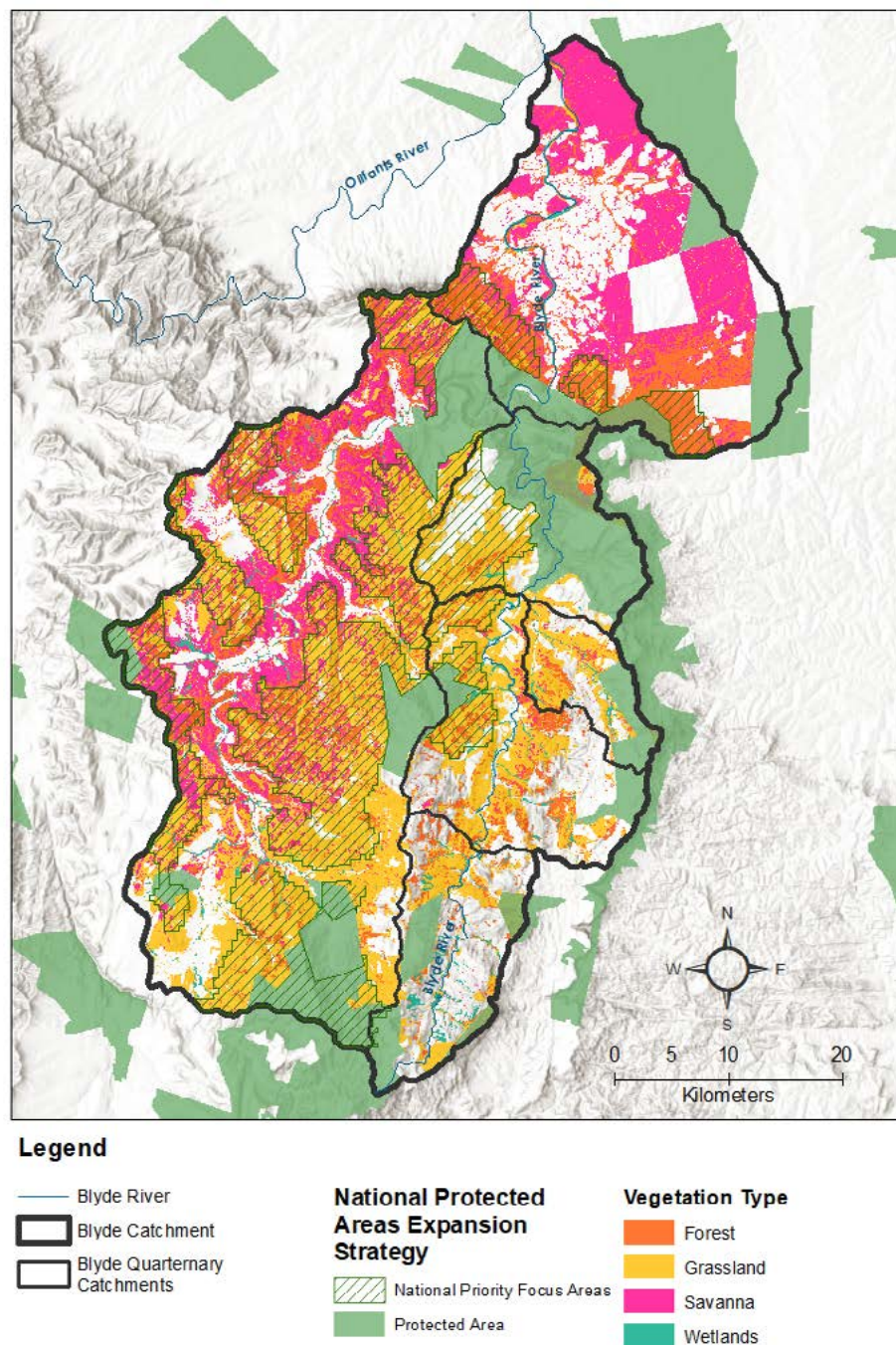


Figure 16: Priority areas for Protected Areas Expansion



06 |

Measuring the impact of the K2C CIP

The CIP is designed to have lasting, positive impact across the Kruger to Canyons Biosphere Region. Measuring and accounting for the impact is a cornerstone of the CIP's purpose and longevity. This will be achieved by implementing a practical Monitoring and Evaluation Plan, which has the following purposes: (i) enabling efficient monitoring, collection and analysis of data from NbS implementation, including assessment of the hydrological responses to IAP removal; (ii) accounting for impact to Kruger to Canyons donors, partners and investors, on a regular basis; and (iii) leveraging strong, verified impact metrics to crowd-in new partners and investors.

To achieve this, a Monitoring and Evaluation (M&E) Plan is being developed for the K2C CIP which provides critical guidance on the indicators that will need to be monitored to track progress. The following thematic areas have been identified for the M&E Plan for the K2C CIP:

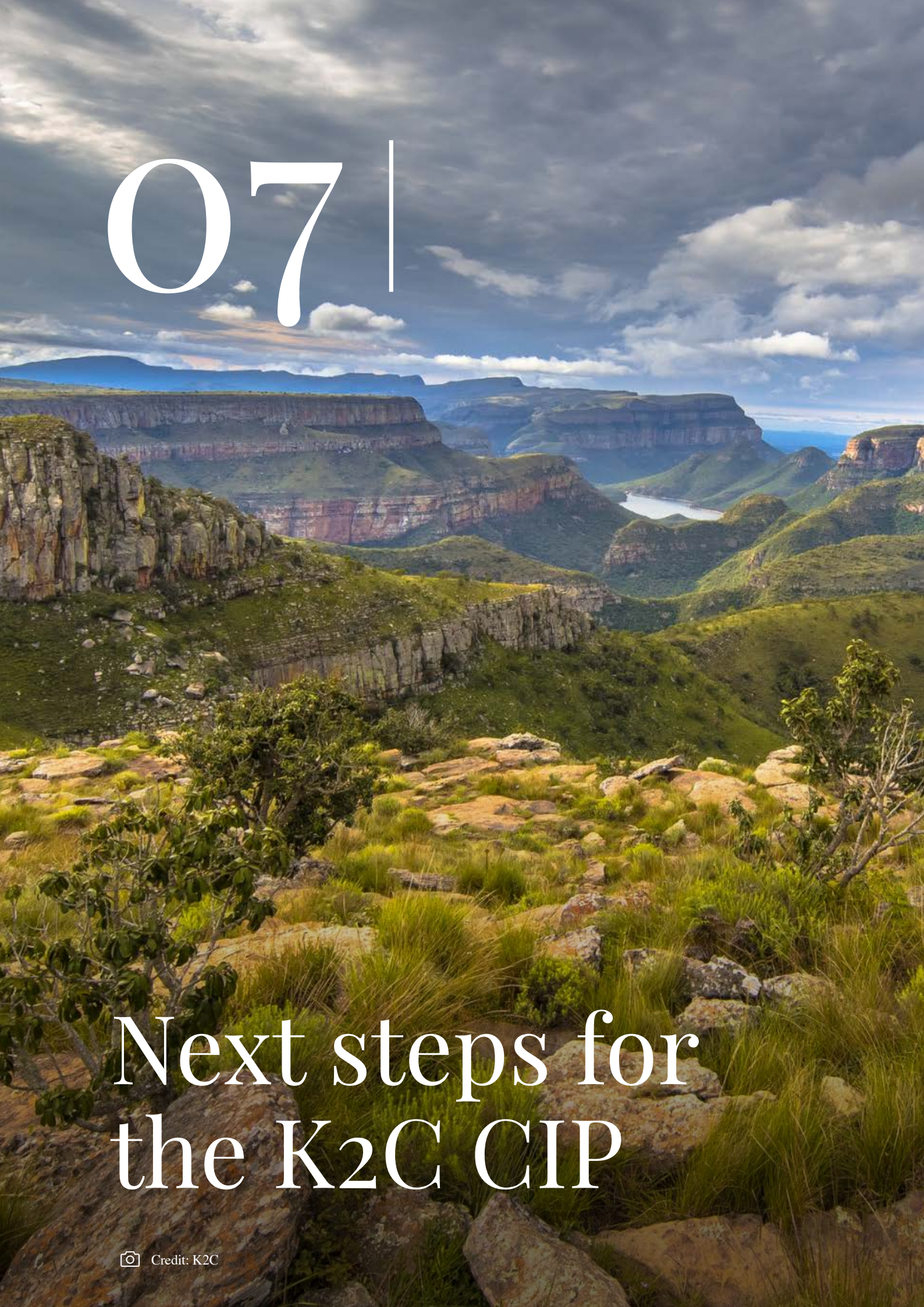
- Thematic Area 1: **Water**
- Thematic Area 2: **Biodiversity**
- Thematic Area 3: **Management and Operational Effectiveness**
- Thematic Area 4: **Socio-economic Impacts**
- Thematic Area 5: **Governance**

Importantly, two systems are already in place to assist with aspects of monitoring, and these will be included in the K2C CIP M&E Plan:

- The '**Decision Support System**' (DSS) has been developed by the Nature for Water Facility²⁷ for use in multiple landscapes and combines hydrological, biological and financial information to monitor, report and verify the impact of NbS interventions. It is a planning, management and reporting tool that helps track NbS implementation progress, inform the scheduling of follow-up activities and communicate progress against targets to project managers, funders and other interested parties.
- K2C's **online ArcGIS platform** which provides a daily project management tool to track contractor progress and ensure alignment with implementation protocols.

An additional foundational component of the M&E system for the K2C CIP, is the establishment of a 'paired catchment experiment' which will help validate or refine the results of the hydrological models used to quantify the impacts of IAPs on streamflow.

27. The Decision Support System (DSS) has been designed to support multiple catchment investment programmes. K2C will be able to use this platform beyond the period of funding and support from N4W.



07 |

Next steps for the K2C CIP

To realise all of these long-term benefits, the CIP will be established in two phases. In the first five to six years – the High-Impact Phase, involving initial clearing and follow-up for IAP clearing, along with initiation and establishment of the GBM component of the programme – the CIP requires an estimated investment of ZAR 294 million (USD 17.5 million) to initiate and scale-up the NbS interventions that are needed. Over this period the CIP will also fully establish its governance arrangements and its long-term sustainable financing mechanisms. Seed capital provided for the High-Impact Phase will support the CIP’s ability to demonstrate its impact. This demonstrated ability to implement effectively is expected to catalyse longer-term support from a range of sustainable finance providers. The source of sustainable finance will likely be a blend of biodiversity compensation payments, fee-for-service income, carbon credits and potential catchment levies. Options related to a water bond or structured note are also being explored. If the investment in the first phase is successful, this will enable a sustainably funded catchment restoration and conservation programme for the next 30 years (**Figure 17**).

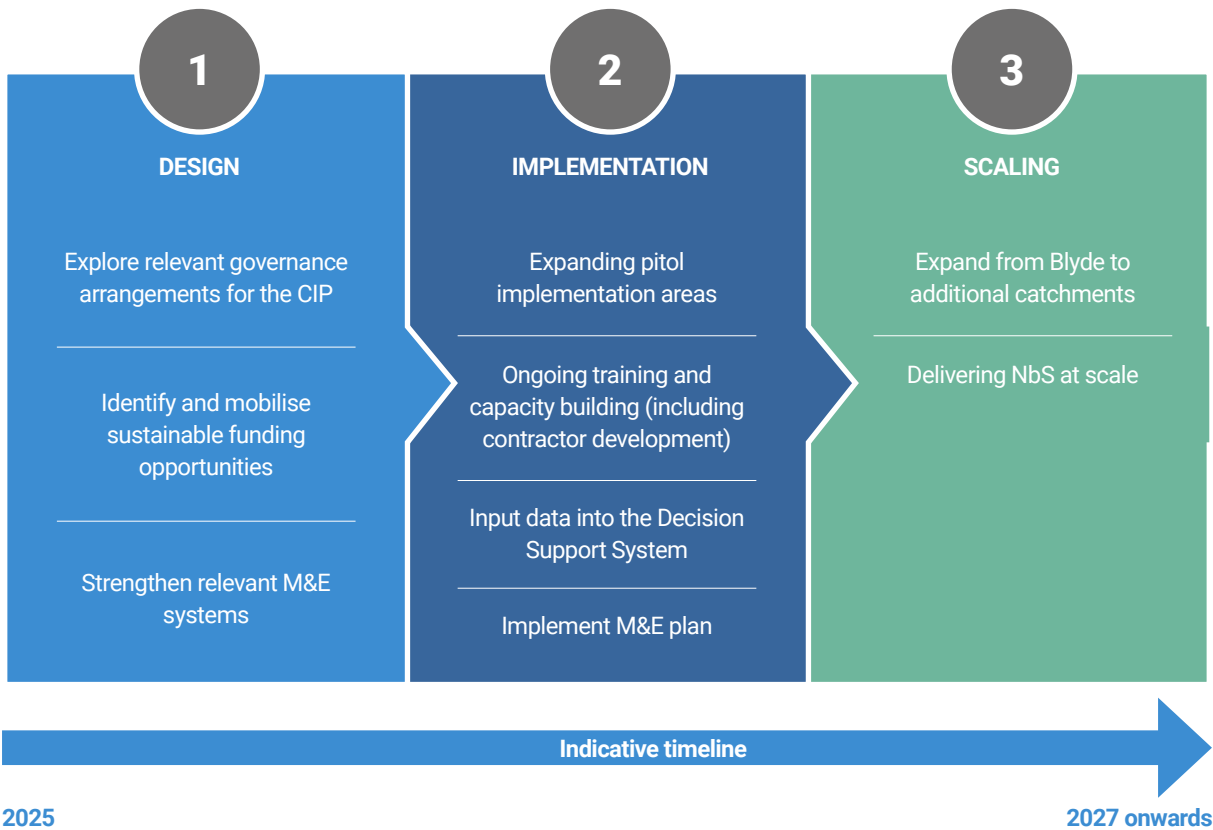
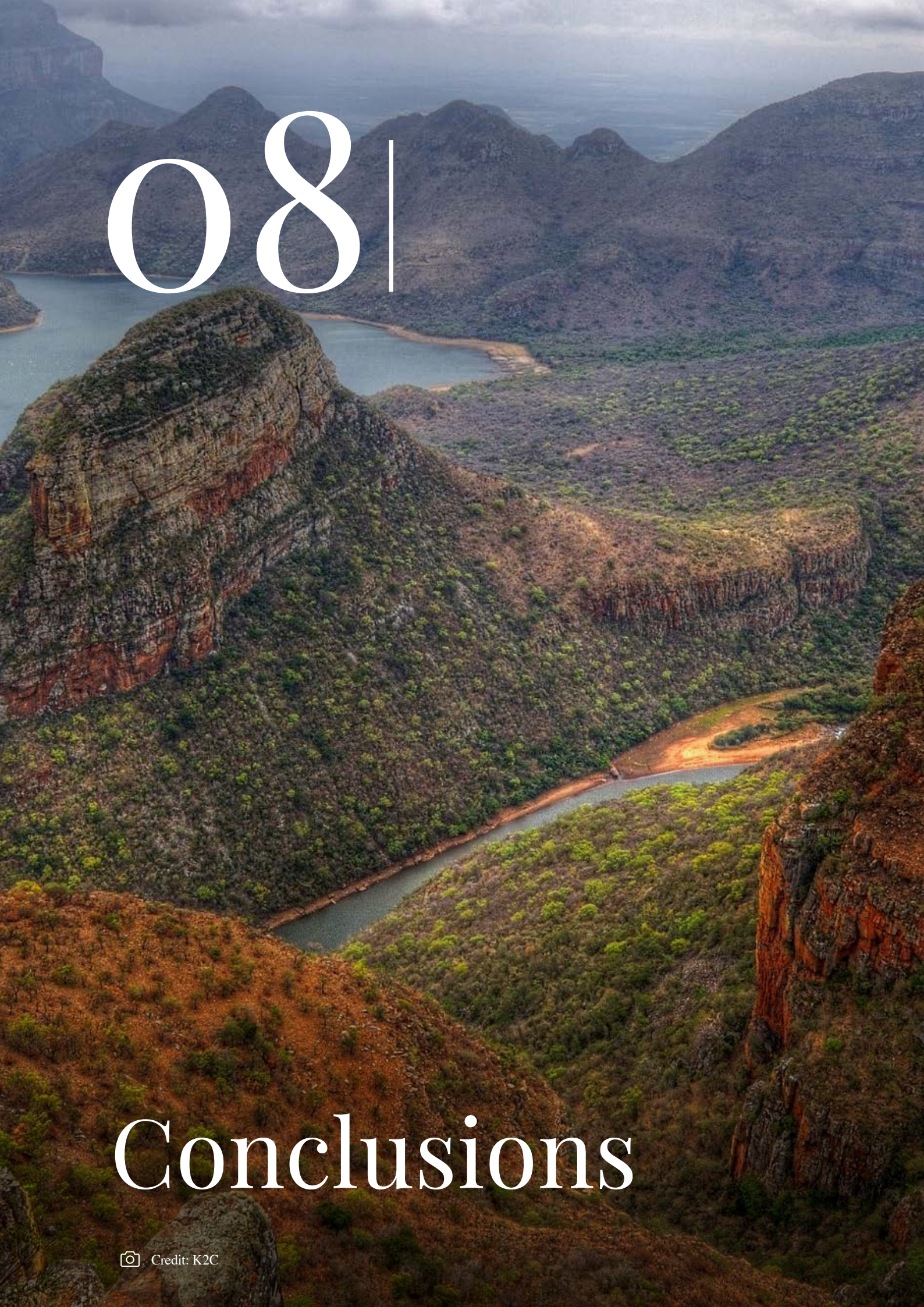


Figure 17: The Next Steps for the Kruger to Canyons CIP



08 |

Conclusions

The activities forming part of the K2C CIP, along with the expected direct impacts and outcomes over the 30-year period of the programme are summarised in **Figure 18**.

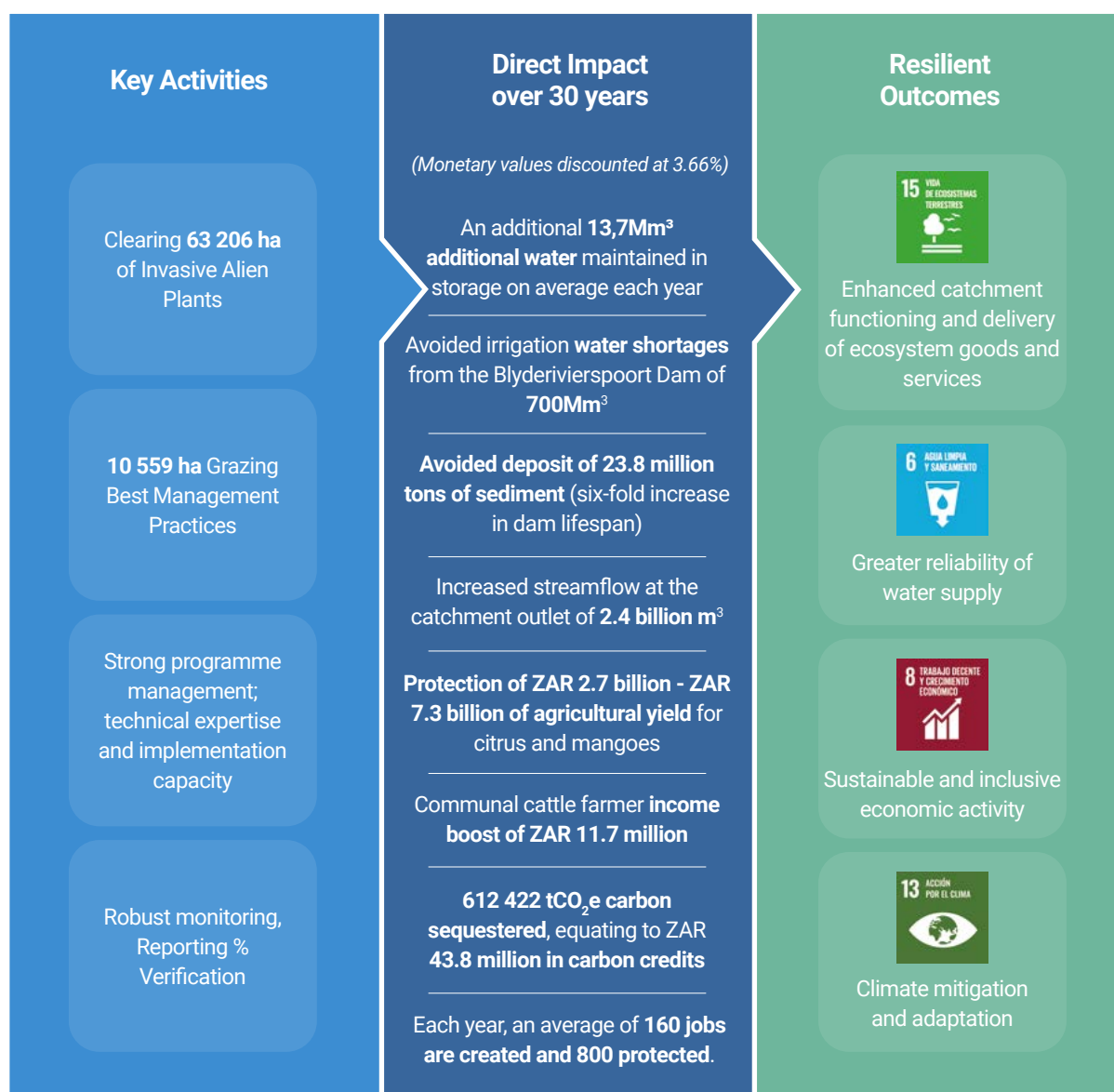


Figure 18: A summary of the activities of the K2C CIP and the expected direct impacts over the 30-year period of the programme

The updated Business Case for the K2C CIP has shown that a lifetime investment of R554.9 million (USD 33.1 million) in NbS unlocks benefits worth between ZAR 2.7 billion (USD 157 million) and ZAR 7.4 billion (USD 441 million). To realise all of these long-term benefits, the CIP must be established in two phases. In the first 5 years – the *High-Impact Phase* – the CIP requires significant upfront funding to initiate operations and scale-up NbS implementation. Over this period the CIP will also need to fully establish relevant governance arrangements, long-term sustainable financing mechanisms and robust monitoring processes.

WATER RESOURCES OF THE BLYDE RIVER CATCHMENT SUPPORT



Domestic
water supply



Livelihoods



Commercial
Agriculture



Tourism



Industry



Biodiversity
Loss



Over
Grazing



Poor Land
Management



Climate
Change

THREATS AND
CHALLENGES INCLUDE

the solution is

The K2C Catchment Investment Programme

is a Collective Action Mechanism that supports Nature-based Solutions for Resilience

Invasive
Alien Plant
Clearing

Grazing Best
Management
Practices

Protected
Areas
Expansion

Water

An additional
13.7 million m³ water
is maintained in storage in the
Blyde dam each year.

Avoided deposit of
23.8 million tons
of sediment in the Blyde Dam over
the lifetime of the CIP

Avoided irrigation
losses protect between
**ZAR 2.7 and
ZAR 7.3 billion**
in agricultural yields over the
lifetime of the CIP

Economic Resilience and Poverty Alleviation

Improved access to markets
leading to increased communal
farmer income of
ZAR 11.7 million
over the lifetime of the CIP

24,094
permanent and seasonal agricultural
FTE job years protected over the
lifetime of the CIP

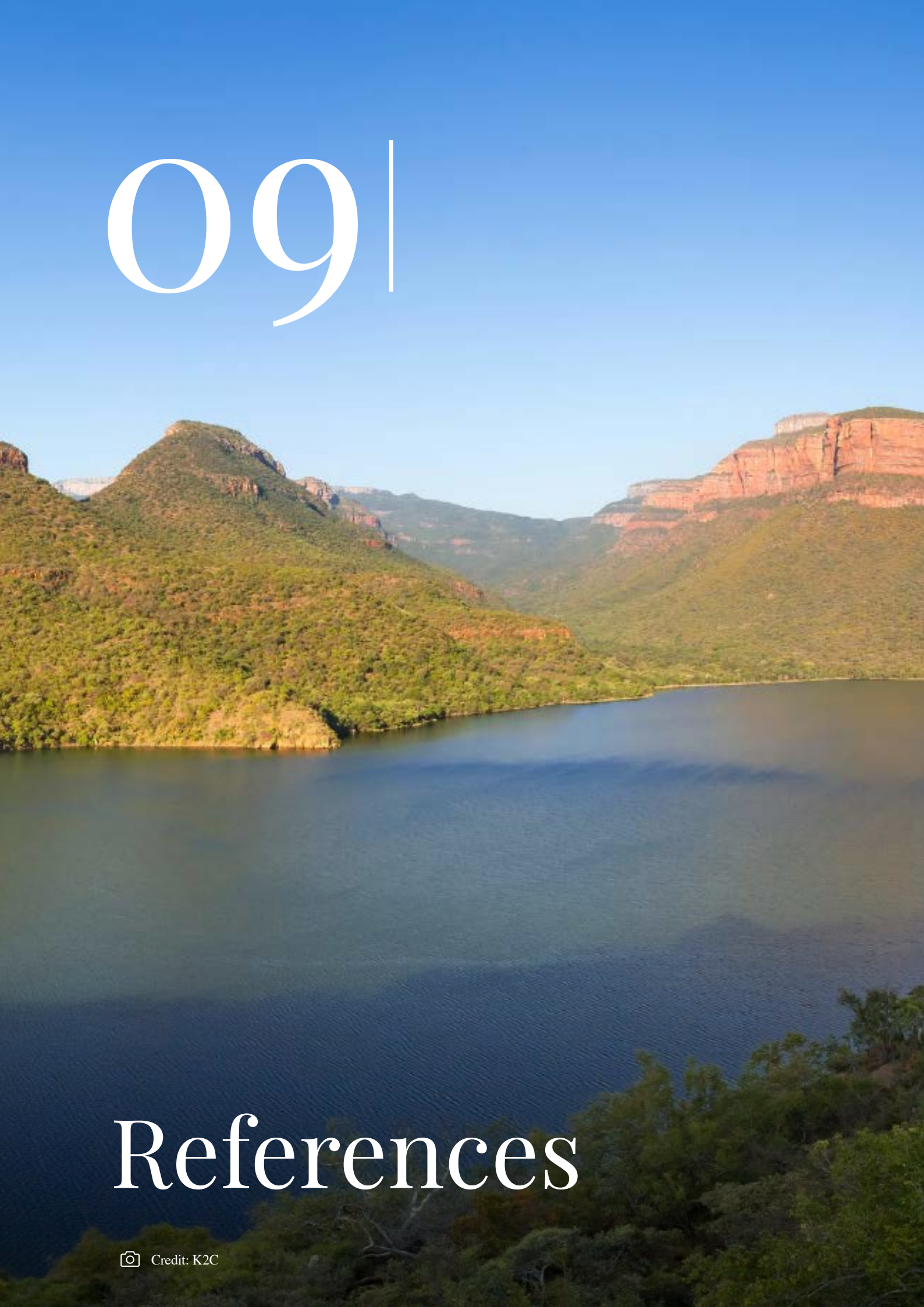
4,793 FTE
job years created over the CIP
lifetime (average of 160 jobs
each year)

Biodiversity

More than
70,000 Ha
of restored habitats by year 5 of
the CIP (grassland, Afromontane
forest, and savannah)

Climate

612,400 tCO₂e
carbon sequestered over the
lifetime of the CIP



09 |

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