



# Rituals and Residues: Mapping Mining Landscapes and Spatial Practices Along South Africa's Klip River

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## Abstract

Gold mining along South Africa's Witwatersrand mining belt began in the late nineteenth century, significantly impacting water ecosystems, especially the Klip River, the largest tributary of the Vaal River. Despite challenges of acid mine drainage and compromised water quality, century-old religious practices like river baptisms persist, demonstrating cultural resilience as communities maintain their traditions amidst environmental adversity. This case study aims to illustrate how cultural resilience manifests through ritual practices and to propose a framework for addressing the socio-environmental complexities of post-mining landscapes.

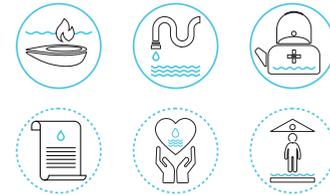
## Policy Recommendations

- Promote Community-Led Environmental Education. Implement interactive programs to engage residents, especially youth and leaders, in understanding the Klip River's ecological significance and pollution issues, empowering them to advocate for sustainable practices.
- Ensure inclusive governance for river management. Prioritize the involvement of marginalized communities in decision-making processes, creating platforms for meaningful participation to ensure policies reflect their needs and values.

## KEYWORDS

toxicity  
Klip River  
river baptisms  
cultural resilience  
environmental degradation

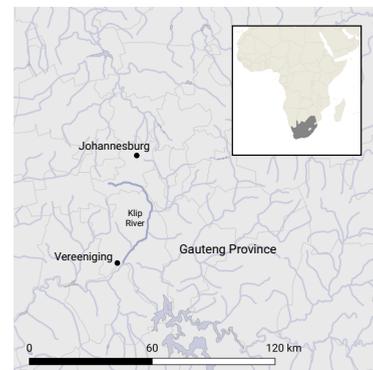
## WATER VALUES



## CLIMATE



**Cwa:** Humid subtropical climate



< Fig. 1 Grumeti River hippo pool - Migration Camp (Source: Self-photographed, 2019. CC BY-SA 4.0 via Wikimedia Commons).

## Introduction

Flooding, drought and pollution can affect water sources that are often used for spiritual practices, such as river baptisms. Churches, especially African Initiated Churches (also known as African Independent, Indigenous or Instituted Churches), continue to baptize in polluted waters due to the scarcity of clean alternatives, reflecting the tension between spiritual necessity and environmental hazards. Flooding events during baptisms have sometimes resulted in tragic accidents, as seen in recent reports where rising waters during ceremonies have led to fatalities in South Africa (Christianity Today 2023). This raises critical questions: Are these practices a sign of faith overriding practical concerns, or a response to the lack of clean water? Recognizing both the cultural significance of water and the urgent need for environmental stewardship can help ensure spiritual needs and public health are balanced, something which is becoming increasingly important in the face of climate change.

The Klip River (or in Afrikaans: *Kliprivier*, lit. 'Stone River') in South Africa spans approximately 120 km, forming the largest tributary of the Vaal River (Freeman, et al. 1997). The river, functioning as a conduit for water and sediments, has played a pivotal role in shaping its surrounding landscape. Situated in the densely populated province of Gauteng, the Klip River serves as the primary drainage system for the Witwatersrand region, encompassing the southern part of Johannesburg, including the central business district (CBD) and the township of Soweto. Ultimately merging with the Vaal River at Vereeniging, the Klip River assumes a crucial role in Gauteng's broader hydrological network, supplying water downstream of the Vaal Dam (Pheiffer et al. 2014).

Since the late nineteenth century, gold mining along the Witwatersrand mining belt has left an indelible mark on the Gauteng region, with lasting consequences for its water ecosystems. Among gold mining's consequences are increased urbanization, acid mine drainage, heavy metal pollution, and compromised water quality. The Klip River and its extended network of wetlands face challenges stemming from mining effluents and industrial pollution, which flow downstream to the Vaal River and its extended dam system, contributing to an advanced degree of collapse (Bengu et al. 2017; McCarthy et al. 2007; Olasupo and Buah-Kwofie 2021) in the Klip River, creating a spatial manifestation of toxicity that resonates through time (Chetty et al. 2021; Freeman et al. 1997; Marara and Palamuleni 2019).

Embedded within this intricate narrative is the temporal nature of religious practices, notably river baptisms and immersion practices, which have parallelly endured over the course of a century (Kgatle and Modiba 2023; Kiernan and West 1977). These rituals draw from both Christian and pre-Christian traditions, blending spiritual cleansing with healing practices rooted in African cultural beliefs (Chamberlain 2012; PBS 2023). The symbolism of water as a source of renewal connects these practices to historical traditions across the African diaspora, underscoring their cultural resilience amidst environmental challenges.

The intersection of these practices with the urban environment unfolds as a rich socio-temporality, coinciding with the historical legacy of gold mining toxicity. Despite the looming threat of contamination from nearby mine sewage and waste, congregants in Klip River continue to partake in baptisms, immersing themselves in "holy water" believed to possess spiritual significance (Bega 2021; Mas-

weneng 2023). This century-old cultural practice not only reflects the resilience of religious traditions but also introduces a paradox – the coexistence of cleansing rituals with the potential hazards posed by the legacy of toxic gold mining.

## Methodology

This study employs a novel methodology that integrates scientific mapping with socio-spatial practices to construct a nuanced understanding of how water systems, rituals, and historical legacies of resource extraction interact (fig. 2). Focusing on the Klip River, the research is organized into three methodological layers. What this methodology makes possible is an integrated analysis of environmental and cultural dynamics, enabling the identification of intersections between spiritual practices and ecological degradation.

The first methodological layer involves a comprehensive archival investigation using the Barlow Rand Mines Archive, covering the 1930s to 1950s. These records offer crucial insights into the origins of toxicity, documenting the shift from underground mining to surface contamination, including mine dumps and unlined tailings. This historical research is enriched by scientific mapping techniques, including contemporary satellite imagery like Google Earth, which identifies abandoned mining sites and persistent toxic residues, underscoring the lasting impact of contamination. Additionally, mapping of mining landscapes is supported by OpenStreetMap data and updated mining infrastructure from Tahira Toffah's study *Mines of Gold, Mounds of Dust: Resurrecting the Witwatersrand* (Toffah 2012). The second layer introduces a scientific dimension, incorporating existing literature and em-

pirical data on the Klip River's ecological state. This involves analyzing water quality parameters, such as pH levels and concentrations of pollutants like heavy metals and polycyclic aromatic hydrocarbons (PAHs) throughout the river (Bengu et al. 2017; McCarthy et al. 2007; Olasupo and Buah-Kwofie 2021). Scientific mapping and data on aquatic systems, wetlands and peatlands provide a comprehensive view of ecological degradation and its spatial extent downstream (Pheiffer 2014). This layer elucidates the connections between mining effluents and water toxicity, emphasizing the cumulative impact on wetlands and downstream ecosystems.

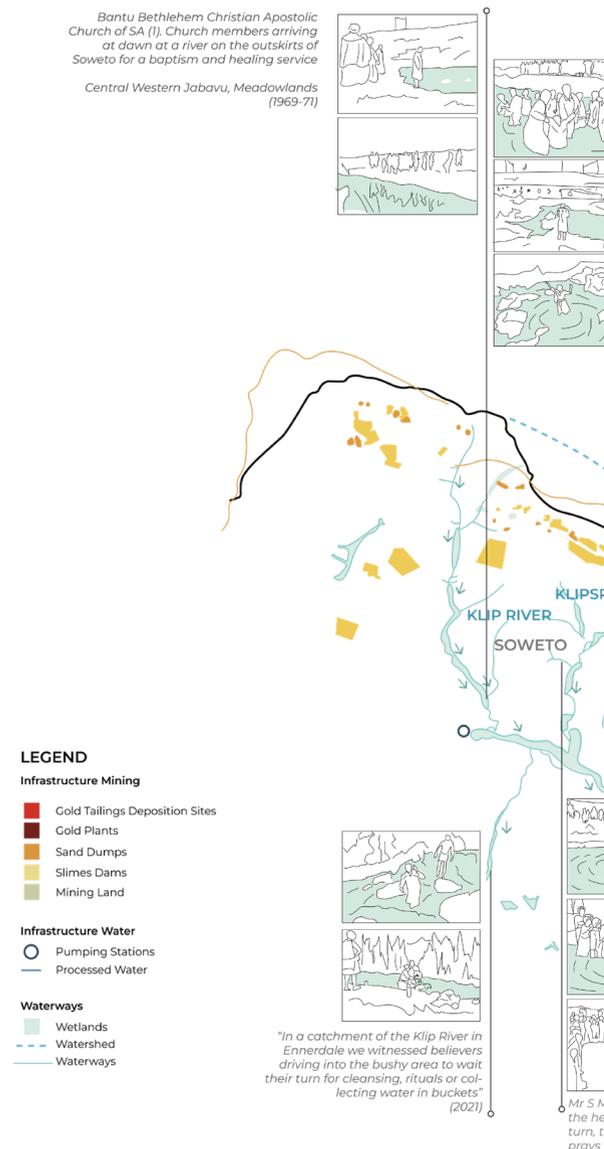
The third layer explores socio-cultural dimensions through photographic essays and archives, journalistic reports, and social media documentation. Departing from the traditional colonial narrative that often centralizes mining as a driver of economic progress and industrialization, the focus shifts to the Klip River as a site hosting small-scale spatial practices, in particular the baptism practices and immersion rituals that take place in its streams. Martin West's photo essay on the African Independent Churches of Soweto serves as a primary reference, offering insights into spiritual practices along the Klip River (Kieran and West 1977). More recent sources, including news articles and social media, further illuminate how these practices persist despite environmental contamination. By geolocating photographic records of baptism rituals along the river, this layer reveals the complex relationships between religious tradition, environmental degradation and public health concerns.

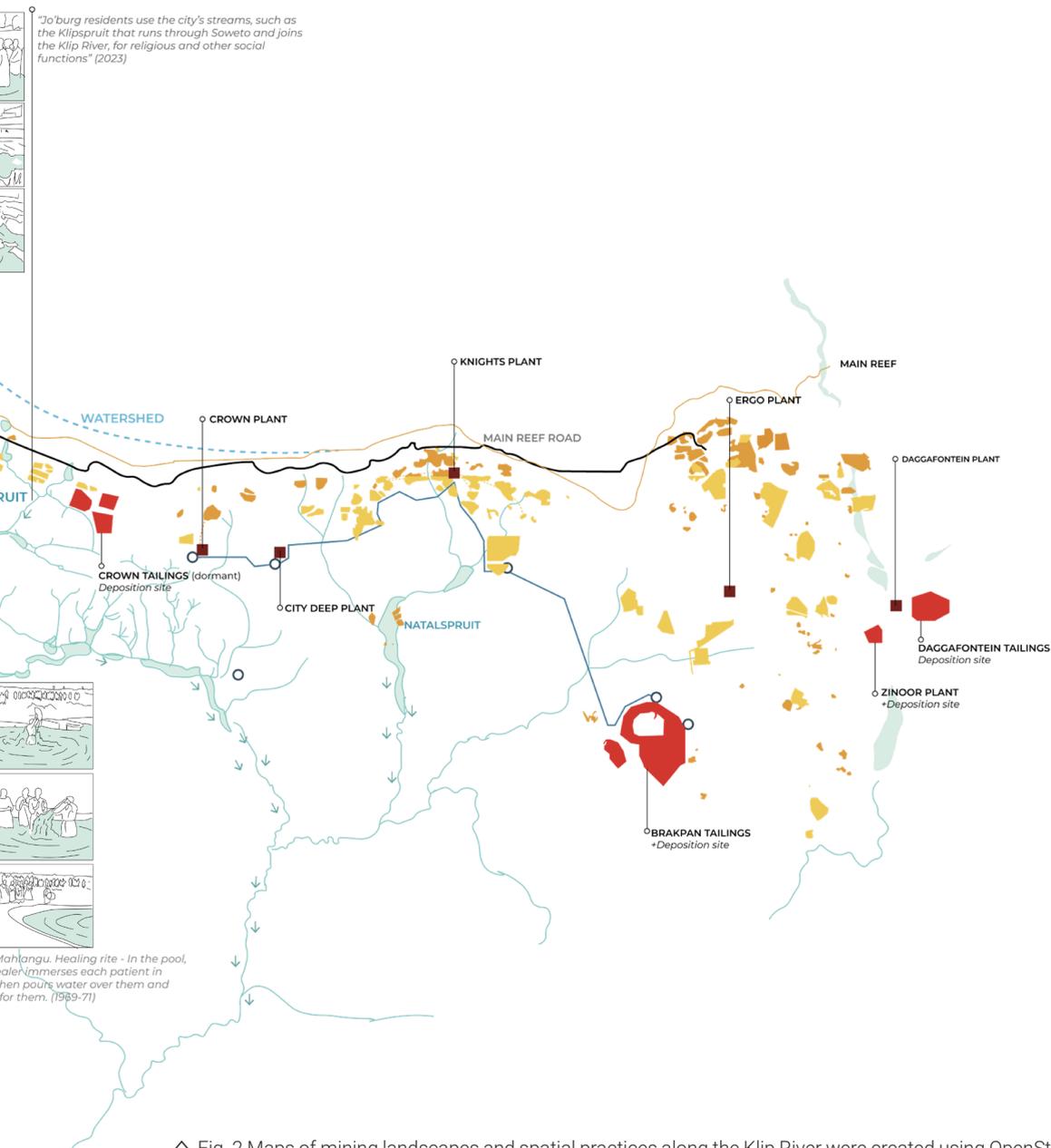
By situating the research within these frameworks, the study seeks to elucidate the historical and systemic dimensions of resource

extraction, particularly in post-mining landscapes like the Klip River in Soweto. This critical approach prompts reflections on power dynamics, environmental injustices, and the politics of resource governance, thereby enriching understanding beyond surface-level resource depletion to encompass broader socioecological transformations over time. By integrating scientific tools with cultural analysis, the study bridges gaps between environmental science and heritage management, fostering a deeper understanding of how ecological degradation intersects with cultural practices. The connection to heritage management lies in recognizing cultural practices, such as river baptisms, as living heritage that is inseparably tied to the natural environment. This perspective emphasizes the need to safeguard not only the physical integrity of natural ecosystems but also the cultural traditions and knowledge systems that depend on them. Understanding these interconnections allows heritage management to adopt a more inclusive approach, valuing both tangible environmental assets and intangible cultural practices.

### From Mines to Rivers

The gold mining industry in South Africa's Witwatersrand region starkly illustrates the extensive environmental and social costs associated with mineral extraction. Deep-level gold mining, dating back to the early 1900s subjected workers to perilous conditions, exposure to extreme heat and hazardous substances like silica dust (Dube et al. 2021). The extraction process, involving explosives, crushing and cyanide solution, generated toxic waste stored in large dams, leading to groundwater contamination and atmospheric pollution (Durand 2012; McCarthy 2010).





^ Fig. 2 Maps of mining landscapes and spatial practices along the Klip River were created using OpenStreetMap data, which provides up-to-date cartographic information on transportation and land use, alongside modified mining infrastructure data sourced from Toffah's study on the Witwatersrand (Toffah 2012). This mining infrastructure data highlights the spatial footprint of historical gold mining operations and abandoned sites. Additionally, waterways and wetlands infrastructure from Pheiffer's study on aquatic ecosystems in Soweto and Lenasia (Pheiffer et al. 2014) was integrated to depict the hydrological connections and contamination pathways. The maps aim to visualize the intersections of environmental degradation and cultural practices, offering insights into the socio-spatial dynamics of the Klip River landscape (Source: Shreya Sen and Michele Tenzon, 2025).

Cartographic representations from archives often separated the above-ground world of city life from the below-ground world of mining – as can be seen in the “General Plan of the Goldfields” created by the Consulting Engineers Mining Drawing Office in 1964, despite the tangible impact of underground mining on miners.

While the map meticulously outlines the intricate network of mining infrastructure underground, it highlights only mining towns central to the gold industry, while excluding settlements that were impacted but not economically tied to mining. This reflects a colonial focus on industrial centers, ignoring broader social and environmental consequences.

Contamination plumes, underground aquifers rendered contaminated and unusable, rivers choked with mining effluents, and marginalized communities lacking access to clean water, are all eclipsed by the map's focus on industry and extraction.

It was not until acid drainage began seeping out of abandoned mines, alongside effluents mixing in surface and groundwater, that geological processes—once largely invisible to the public—became a tangible force shaping the city's political and environmental challenges. The leaching of toxic substances from mine tailings and the contamination of aquifers turned geology into a persistent and visible actor, influencing public health, access to water, and urban planning (McCarthy 2010). This interplay between geological forces and human systems marked a shift, drawing attention to the lasting impact of mining beyond its economic benefits. This situation exemplifies what Rob Nixon (2013) describes as ‘slow violence’—a subtle but enduring form of harm that unfolds over extended periods, often con-

cealed by layers of abstraction and historical narratives. The slow degradation of water quality, the long-term health consequences of exposure to pollutants, and the cumulative environmental collapse illustrate the insidious nature of this violence. It is crucial to acknowledge that colonial cartographic records not only serve as historical artifacts but also reinforce ideologies, shaping public perceptions of mining and perpetuating exploitative systems.

### **The Journey Downstream**

The Klip River is a crucial component of Gauteng's hydrological network, vital for managing and distributing water across Johannesburg and its surrounding areas. Historically, the river has supported human movement, trade and settlement since ancient times (Tempelhoff 2006). However, its role has been compromised by mining activities, which have introduced pollutants that travel downstream, ultimately contaminating the Vaal River.

The river's transformation into a conduit for industrial waste has had severe ecological and health implications. Mining pollutants have significantly impacted the Klip River's wetlands, which once served as natural filters. Increased contamination and anthropogenic pressures have led to issues such as eutrophication and heavy metal release into the Vaal River, exacerbating water quality problems. Mining-related contamination has severe consequences, including the infiltration of radioactive pollutants into water, soil, livestock, and agriculture (Durand 2012). This contamination underscores the complex interplay between mining activities and environmental health.

## Riverbank Rituals

In the late nineteenth century, African independent churches emerged in South Africa, particularly in Soweto, blending African and Western religious elements (West 1977). They maintain a reverence for ancestral spirits, emphasizing their potency and incorporating them into their belief systems. These churches also place significant emphasis on purification and healing rites, often conducted through immersion in rivers or streams. These purification ceremonies serve dual purposes: healing specific ailments and offering protection against spiritual malevolence. Prophets within these independent churches play a crucial role in prescribing healing methods, including immersion, and guiding congregants through spiritual practices, highlighting the importance of spiritual leadership in navigating urban life. Additionally, prophets are distinguished from other healers present in Soweto, such as faith-healers and diviners *sangomas*, by their centrality within the church hierarchy and their focus on supernatural healing methods (Kiernan & West, 1977).

Martin West's ethnographic analyses and photographic essays document how these churches adapted traditional African rituals to urban settings, with river immersion for baptism and healing becoming a central element of their practices (fig. 4). The Klip River is a sacred site for Zionist-type Independent Churches, where prophets prescribe immersion rituals for healing and spiritual protection. These rituals, integral to their religious practices, involve early morning gatherings with prayers, dancing, and individual immersions led by senior church members (West 1977).

The river's significance as a spiritual focal point remains central in the view of religious participants, who regard its waters as possessing

sacred qualities essential for purification and healing rituals. However, it is not clear to what extent participants in the immersion rituals are aware of the risks to their health posed by the environmental contamination of the river. Reports suggest that some religious leaders acknowledge the river's pollution but maintain that its spiritual power supersedes physical contamination, while others downplay or deny the severity of health risks associated with environmental toxins, even in the face of outbreaks such as cholera (Masweneng 2023).

Mining activities and rapid urban development have led to the depletion of aquifers and the contamination of the river with toxic substances like arsenic, mercury, and lead (McCarthy et al. 2007). The river's contamination undermines the very rituals intended to offer purification and healing, creating a paradox where sacred practices coexist with environmental hazards. This stark contrast underscores the urgent need for action to restore the river's health. A comprehensive approach that integrates environmental cleanup with public health measures, while engaging religious leaders and communities to address misconceptions and build awareness, is essential to ensure the river can once again support both spiritual and ecological well-being.

## Conclusion

The Klip River embodies the complex interactions between human activities, environmental dynamics and cultural significance, reflecting the legacy of gold mining in the Gauteng region since the nineteenth century. Decades of mining have left enduring problems such as acid mine drainage and heavy metal. The river's deteriorating water quality has a direct impact on SDG 6: Clean Water and Sanitation.

Despite these challenges, baptism rituals continue to be practiced along the riverbanks, underscoring the spiritual and cultural significance of water in the region. This paradox of cleansing rituals coexisting with mining hazards highlights the complex relationship between spirituality and environmental degradation. It also connects with SDG 11: Sustainable Cities and Communities, emphasizing the need to respect cultural practices while fostering safe and sustainable environments.

Exploring these interconnections offers an important perspective on resource dynamics and socio-spatial relationships, revealing the multifaceted interplay between human activities and environmental resources. This includes the degradation of aquatic ecosystems, which pertains to SDG 14: Life Below Water, and the damage to terrestrial landscapes, relevant to SDG 15: Life on Land. The juxtaposition of baptism rituals and environmental degradation calls attention to historical injustices within the mining landscape, highlighting broader issues of environmental justice. Recognizing the significance of socio-cultural practices in shaping resource use can inform more inclusive and equitable resource management approaches, prioritizing the well-being of both human communities and the natural environment in line with these SDGs.

To address the multifaceted challenges facing the Klip River, an integrated remediation strategy must be developed and implemented. This strategy should involve collaboration between government bodies, local communities and environmental experts to tackle pollution, restore habitats and adopt sustainable water treatment technologies. Importantly, it must align with local cultural practices to ensure that environmental actions also respect and support the river's spiritual significance to the community.

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