

**URBAN CLIMATE RISK PROFILE
FOR
RUMURUTI MUNICIPALITY**

2026



**COUNTY GOVERNMENT
OF LAIKIPIA**



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Foreword

It is my privilege to present the Urban Climate Risk Profile for Rumuruti Municipality — a concise yet comprehensive assessment that captures the climate realities we face today and those we must prepare for tomorrow.

As the administrative headquarters of Laikipia West Sub-County, Rumuruti is growing steadily, driven by its county role, improved connectivity, and rising economic activity. At the same time, we are confronting intensified climate hazards: prolonged dry spells that strain water supply and peri-urban agriculture, flash floods that overwhelm drainage systems, rising heat stress in our markets, schools and homes, accelerating land degradation, and solid waste challenges that worsen flooding and public health risks. These impacts fall most heavily on informal settlement residents, women, youth, persons with disabilities, pastoralists and low-income households — the very groups with the least resources to adapt.

This profile, developed through close collaboration with the Municipal Board, County departments, national agencies, civil society, private sector partners and our local communities, clearly identifies current and projected risks across infrastructure, services, populations and natural assets. It highlights priority hotspots and offers realistic, phased solutions — from immediate community-led actions (drain clean-ups, rainwater harvesting, tree planting) to mid-term infrastructure upgrades and nature-based interventions, and long-term investments in resilient drainage, renewable energy, secure tenure and integrated water management.

The recommendations are deliberately designed to align with our existing capacity, to be affordable at the start, and to scale over time. By mainstreaming these findings into our Integrated Development Plan, spatial planning, annual budgets, building codes and disaster risk strategies, we can turn climate challenges into opportunities for more inclusive, equitable and sustainable urban growth.

I therefore call on all stakeholders, residents, community groups, county and national partners, private investors and development agencies to treat this document not as an end, but as a practical foundation for decisive, coordinated action. The resilience we build today will directly determine the safety, prosperity and dignity of the generations that follow.



Jackson Maina Kibocha
Municipal Manager
Rumuruti Municipality

Executive Summary

Rumuruti Municipality, the administrative headquarters of Laikipia West Sub-County in Kenya's Laikipia County, spans approximately 32 km² at an elevation of 1,828 m ASL and serves as a rapidly growing secondary urban center with a population projected to rise from around 15,000–17,000 in recent years to over 22,000 by 2030 and 28,000 by 2035, driven by its county headquarters status, improved transport links, in-migration, and emerging economic opportunities in agribusiness, services, and trade. Anchored in livestock, rainfed agriculture, and small-scale commerce on predominantly agricultural land (64%), with dense informal settlements like African Location and Kandutura lacking secure tenure, the municipality faces escalating climate risks in a semi-arid zone characterized by low, erratic rainfall (400–500 mm annually), bimodal seasons, and increasing extremes. Key current hazards include **pluvial flooding** from intense rainfall overwhelming undersized, clogged drainage; **drought** and prolonged dry spells depleting water resources and straining groundwater-dependent supply; **Extreme Heat** amplifying urban heat island effects in built-up areas; **land degradation** from erosion, overgrazing, deforestation, and wetland encroachment; and **solid waste-related risks** exacerbating blockages, pollution, and health threats, particularly in informal and peri-urban zones. These hazards disproportionately burden vulnerable populations—women, youth, persons with disabilities, resource-poor households, informal settlement residents, and pastoralists—through water scarcity, food insecurity, livelihood disruptions, displacement, disease outbreaks, and social exclusion, while exposing critical urban elements such as stormwater systems, water/wastewater infrastructure, transport networks, markets, schools, health facilities, and natural assets like the Ewaso Narok River, Marura Wetland, and peri-urban farms to major to catastrophic impacts.

Future projections under SSP2-4.5 (moderate) and SSP5-8.5 (high-emission) scenarios forecast continued warming (~1.7°C by 2050s, up to ~3.5°C by 2100), more frequent/intense droughts, variable but potentially reduced seasonal rainfall, heightened extreme precipitation events, greater aridity, and compounding Extreme Heat, elevating hazard levels to high across most categories by mid-century and sustaining them long-term. This trajectory intensifies risks to water and wastewater management (very high from drought/heat), economic and social infrastructure (catastrophic from heat in markets and facilities), informal settlements and vulnerable groups (very high to catastrophic across hazards), and natural assets (very high from degradation and drought-driven dieback), creating vicious cycles of scarcity, reduced ecosystem services, and inequitable burdens without intervention.

This Urban Climate Risk Profile underscores the urgent need to mainstream resilience into municipal planning instruments including the Rumuruti Local Physical and Land Use Plan (2021–2031), Integrated Development Plan (2023), capital expenditure, and disaster reduction frameworks through inclusive, multi-stakeholder approaches aligned with Laikipia County's Climate Change Action Plan, national policies, and funding mechanisms like FLLoCA. Prioritizing equity-focused, hybrid solutions such as immediate community-led clean-ups, rainwater harvesting, and awareness campaigns; mid-term upgrades to permeable infrastructure, wetland restoration, composting integration, and tenure regularization; and long-term grey-green drainage masters, renewable energy transitions, sanitary landfills, connected green-blue networks, and climate-smart peri-urban agriculture will build adaptive capacity, reduce vulnerabilities, safeguard urban elements, advance social inclusion, and foster sustainable, equitable growth in a changing climate. Immediate next steps include stakeholder co-design of prioritized actions, resource mobilization, pilot implementation in high-risk hotspots (e.g., informal settlements and flood-prone zones), and robust monitoring to ensure adaptive management and alignment with county and national resilience goals.

Table 1. Summary of Pluvial Flooding risks for Rumuruti Municipality

Categories	Risk Levels				
	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services					
Stormwater Drainage	High	High	Very High	High	Very High
Water & Wastewater Management	Medium	Medium	High	Medium	High
Solid Waste Management	High	High	Very High	High	Very High
Transport and Mobility	Medium	Medium	High	Medium	High
Energy	Low	Low	Low	Low	Low
Economic Infrastructure	Medium	Medium	High	Medium	High
Social Infrastructure	Low	Low	Medium	Low	Medium
Emergency Services	Low	Low	Medium	Low	Medium
Populations					
Urban Residents	Medium	Medium	High	Medium	High
Informal Settlement Residents	High	High	Very High	High	Very High
Vulnerable and Marginalized Groups	Very High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	Medium	Medium	High	Medium	High
Urban Blue Infrastructure	High	High	Very High	High	Very High
Peri-urban and Agricultural Systems	High	High	Very High	High	Very High

Table 2. Summary of Drought risks for Rumuruti Municipality

Categories	Risk Levels				
	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services					
Stormwater Drainage	Low	Medium	Medium	Medium	Medium
Water & Wastewater Management	High	Very High	Very High	Very High	Very High
Solid Waste Management	Medium	High	High	High	High
Transport and Mobility	High	Very High	Very High	Very High	Very High
Energy	Medium	High	High	High	High
Economic Infrastructure	High	Very High	Very High	Very High	Very High
Social Infrastructure	High	Very High	Very High	Very High	Very High
Emergency Services	High	Very High	Very High	Very High	Very High

Populations					
Urban Residents	Medium	High	High	High	High
Informal Settlement Residents	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Very High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	High	Very High	Very High	Very High	Very High
Urban Blue Infrastructure	Medium	High	High	High	High
Peri-urban and Agricultural Systems	High	Very High	Very High	Very High	Very High

Table 3. Summary of Extreme Heat risks for Rumuruti Municipality

Categories	Risk Levels				
	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services					
Stormwater Drainage	Low	Medium	Medium	Medium	Medium
Water & Wastewater Management	High	Very High	Very High	Very High	Very High
Solid Waste Management	High	Very High	Very High	Very High	Very High
Transport and Mobility	High	Very High	Very High	Very High	Very High
Energy	Medium	High	High	High	High
Economic Infrastructure	Very High	Very High	Very High	Very High	Very High
Social Infrastructure	High	Very High	Very High	Very High	Very High
Emergency Services	High	Very High	Very High	Very High	Very High
Populations					
Urban Residents	High	Very High	Very High	Very High	Very High
Informal Settlement Residents	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Very High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	Medium	High	High	High	High
Urban Blue Infrastructure	High	Very High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	High	Very High	Very High	Very High	Very High

Table 4. Summary of Land Degradation risks for Rumuruti Municipality

Categories	Risk Levels				
	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services					
Stormwater Drainage	High	High	Very High	Very High	Very High
Water & Wastewater Management	High	High	Very High	Very High	Very High
Solid Waste Management	Medium	Medium	High	High	High
Transport and Mobility	Medium	Medium	High	High	High
Energy	Low	Low	Medium	Medium	Medium
Economic Infrastructure	Medium	Medium	High	High	High
Social Infrastructure	High	High	Very High	Very High	Very High
Emergency Services	High	High	Very High	Very High	Very High
Populations					
Urban Residents	Medium	Medium	High	High	High
Informal Settlement Residents	High	High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Very High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	High	High	Very High	Very High	Very High
Urban Blue Infrastructure	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Very High	Very High	Very High	Very High	Very High

Table 5. Summary of Solid Waste Related risks for Rumuruti Municipality

Categories	Risk Levels				
	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services					
Stormwater Drainage	Medium	High	High	Very High	Very High
Water & Wastewater	Medium	High	High	Very	Very

Management				High	High
Solid Waste Management	Medium	High	High	Very High	Very High
Transport and Mobility	Low	Medium	Medium	High	High
Energy	Very Low	Low	Low	Low	Low
Economic Infrastructure	Medium	High	High	Very High	Very High
Social Infrastructure	Low	Medium	Medium	High	High
Emergency Services	Low	Low	Low	Medium	Medium
Populations					
Urban Residents	Medium	High	High	Very High	Very High
Informal Settlement Residents	Medium	High	High	Very High	Very High
Vulnerable and Marginalized Groups	High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	Low	Medium	Medium	High	High
Urban Blue Infrastructure	Medium	High	High	Very High	Very High
Peri-urban and Agricultural Systems	Medium	High	High	Very High	Very High

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List of Acronyms

Apx.	Approximately
CIDP	County Integrated Development Plan
HH	Household
IDeP	Integrated Development Plan
KMD	Kenya Meteorological Department
Km	Kilometers
KNBS	Kenya National Bureau of Statistics
M	Meters
MED	Municipal Environment Department
NbS	Nature-based Solution
NCCD	National Climate Change Date
NDMA	National Drought Management Authority
NDVI	Normalized Difference Vegetation Index
NEMA	National Environment Management Authority
RCRA	Rapid Climate Risk Assessment
SSP	Shared Socioeconomic Pathways
WRA	Water Resources Authority

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1. Context

1.1. Objective

This Urban Climate Risk Profile aims to:

- a. Develop policies and strategies at national and local government levels that outline how to address current and future climate risks
- b. Integrate resilience into long-term urban plans such as **Rumuruti Local, Physical and Land use plan** (2021-2031), **Rumuruti Integrated Development Plan 2023**, capital expenditure plans and disaster reduction plans.
- c. Set standards and guidelines e.g. building codes and construction permits that ensure infrastructure development manages future climate risks.
- d. Plan and deliver climate resilient infrastructure so as to withstand current and future climate impacts and minimizes climate risks for its citizens.

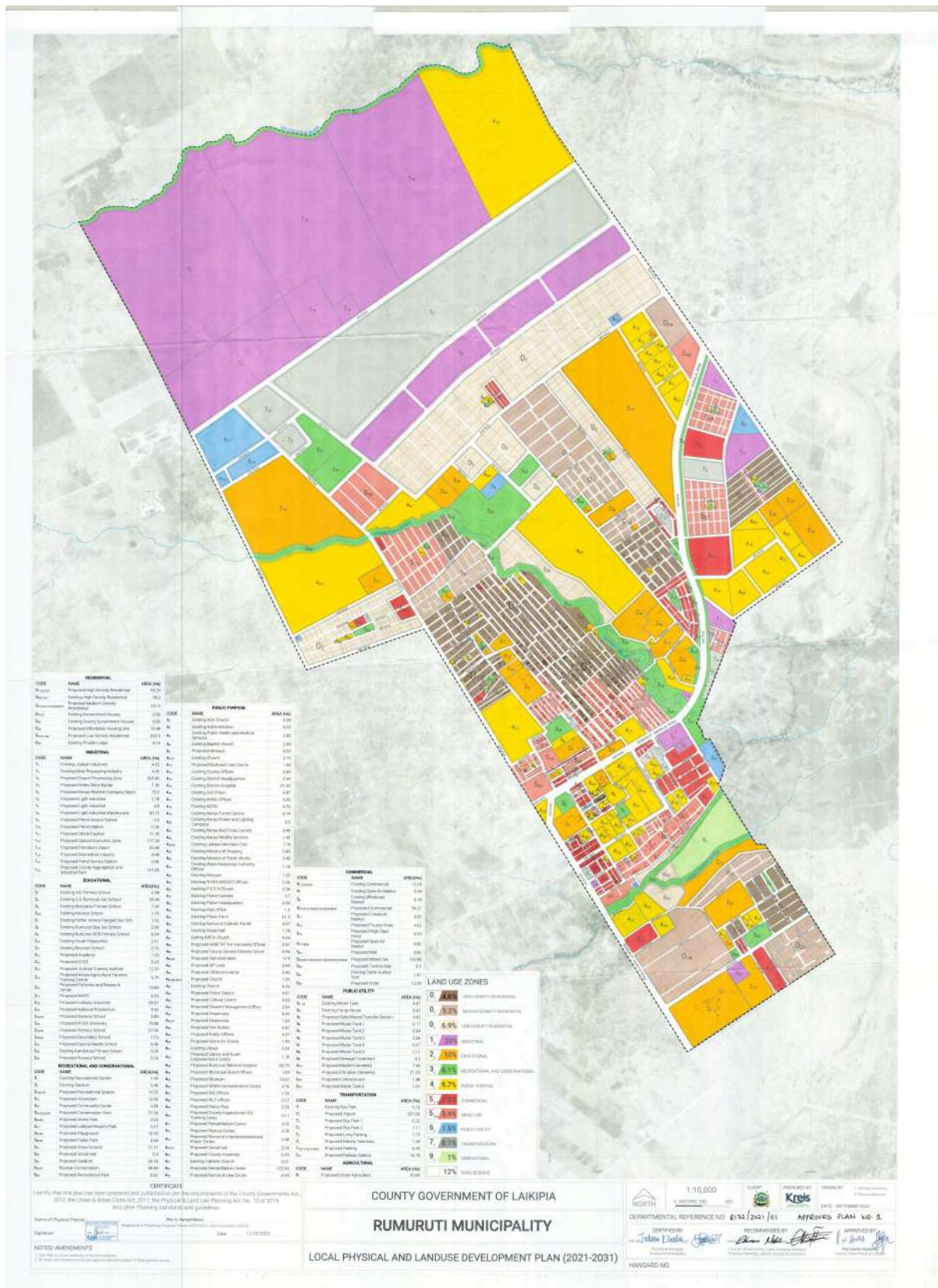
1.2. Urban Context

1.2.1. Geographic area

Rumuruti Municipality is the formal headquarters for Laikipia County. It lies on coordinates **0.25996°N, 36.53633° E**. It is 40 Km due North of Nyahururu town and the elevation is **1828m ASL**. It covers approximately 32 km² within its official planning and administrative boundary, as adopted for the Urban Climate Risk Profile assessment.

The defined boundary encompasses the town core and adjacent peri-urban neighbourhoods that fall under the formal municipal jurisdiction of Rumuruti. It also corresponds to the area used by local authorities and planning agencies for **urban mapping, service delivery assessments, and climate vulnerability analyses**. The Municipality has two sub-units i.e. Rumuruti Ward and Sosian Ward.

Map 1; Rumuruti Municipality Geographic area



1.2.2. Governance Structure

The governance and management of **Rumuruti Municipality** is undertaken through a coordinated institutional framework involving the **Municipal Board**, the **Municipal**

Administration, and relevant **Laikipia County Government departments**. These entities collectively provide oversight, technical input, and implementation support for urban planning, climate resilience, and sustainable development initiatives.

The **Urban Climate Risk Profile (UCRP)** is developed through a multi-sectoral approach led by the Municipal Administration in collaboration with County departments responsible for **environment, climate change, physical planning, water, infrastructure, and disaster risk management**. The findings of the UCRP directly inform the preparation and updating of the **Integrated Development Plan (IDeP)** by ensuring climate risks and adaptation priorities are mainstreamed into urban development planning, budgeting, and implementation.

Link between UCRP and Integrated Development Plan (IDeP)

- The **Environment & Climate Change Unit** coordinates the **Urban Climate Risk Profile** process.
- Findings and priority actions are shared with the **Physical Planning and Economic Planning units**.
- Climate risks, adaptation measures, and resilience investments are then **mainstreamed into the Integrated Development Plan (IDeP)**, sector plans, and annual budgets.
- The **Municipal Board** provides oversight to ensure alignment with county and national climate policies.

The institutional arrangement and key stakeholders responsible for urban governance, climate risk assessment, and development planning in Rumuruti Municipality includes at the apex the Laikipia County Government, providing overall policy direction through the County Executive Committee (CEC) and relevant sector departments, including Environment and Climate Change, Lands and Physical Planning, Water and Sanitation, Roads and Infrastructure, and Disaster Risk Management.

The **Rumuruti Municipal Board** provides policy oversight and strategic guidance for municipal development. The Municipal Manager oversees day-to-day administration and coordinates municipal departments and units.

Within the municipal administration, the Environment and Climate Change Unit lead the development of the Urban Climate Risk Profile, working collaboratively with the Physical Planning, Engineering and Infrastructure, Water and Sanitation, Disaster Risk Reduction, and Finance and Economic Planning units. Outputs from the Urban Climate Risk Profile are subsequently integrated into the Integrated Development Plan (IDP) through the Physical Planning and Economic Planning units, ensuring climate risks and resilience actions are mainstreamed into urban development priorities, investment planning, and service delivery.

1.2.3. Socio-economic Context

Rumuruti Municipality's population has grown steadily over recent years — from about **13,055 in 2019** to approximately **17,200 by 2025**, with continued growth expected due to its role as **Laikipia County headquarters** and **strategic transport location**. The town's demographic is predominantly youthful, with a large proportion of the population below 35, which has implications for services such as education, employment, health, and housing.

The demographic increase in Rumuruti is influenced by:

- Its status as **county headquarters**, attracting public servants and private sector services.
- **Improved transport connectivity**, including the Nyahururu–Maralal road, enhancing mobility and trade opportunities.

- **In-migration for economic opportunities**, with expanding commerce, livestock markets, real estate investment, and infrastructure development drawing residents from neighbouring rural areas and farther afield.

Table 6. Population growth trends in Rumuruti Municipality.

Year	Projected Population	Remarks
2019	13,055	Base year population
2025	17,200	Growth driven by county HQ services
2030	22,000	Continued investment & migration
2035	28,200	Urban expansion and economic growth

Figure 1. Population growth chart.

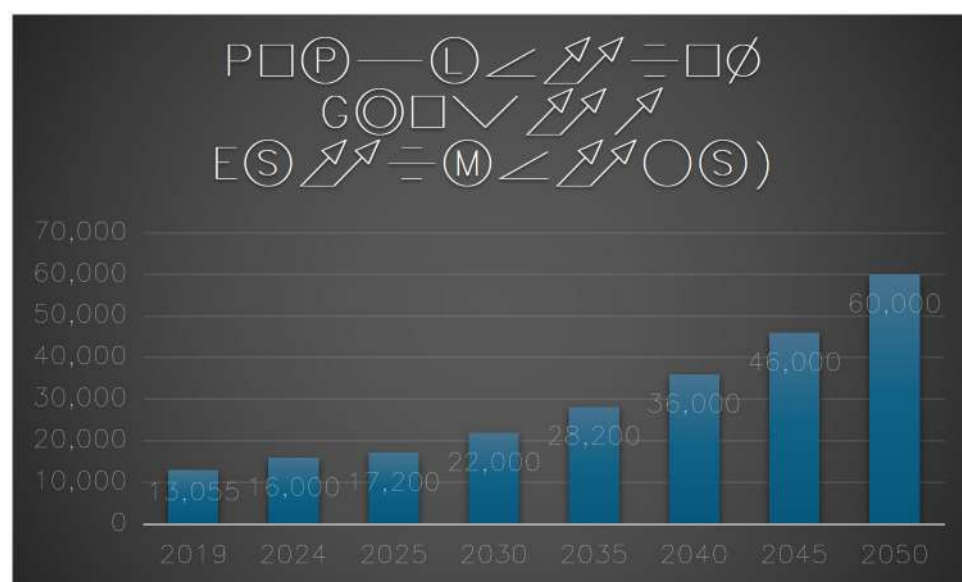


Table 7. Population Age structure

Age Group	Percentage (%)	Estimated Population (2025)
Youth (0–17 years)	45%	7,740
Working Age (18–64 years)	50%	8,600
Elderly (65+ years)	5%	860

Table 8. Population density

Indicator	Value
Municipal Area	32 km ²
Estimated Population (2024)	17,200
Population Density	538 persons per km ²

The observed and projected population growth, coupled with a predominantly youthful population structure, is expected to increase demand for housing, water supply, sanitation, solid waste management, transport infrastructure, and employment opportunities. The relatively high population density underscores the need for compact, climate-resilient urban development and enhanced service provision, particularly in peri-urban areas.

1.2.4. Economic Context

Rumuruti's economy is currently anchored in livestock production, crop agriculture, and small-scale trade. The concentration of county government offices has increased demand for services, housing, and transport, supporting gradual urban growth.

Table 9. Key Economic Indicators; Current & Projected

Indicator	2025(Current)	2035 (Mid-Term)	2050(Long-Term)
Urban Population	17,200	28,200	60,000
Agriculture (Value Added)	Low-Medium	Medium-High	High (Value Chains)
Employment Rate (Formal)	Low	Moderate	High
Industrial Output	Emerging (CAIP Start)	Moderate (Operational Industrial Park)	High (SEZ+ Agribusiness)
Business & Services Growth	Moderate	High	Very High
Infrastructure Index (roads,power,water)	Improving	Strong	Robust
Real Estate Activity	Increasing	Rising	High Demand

Economic outlook; By 2050, Rumuruti is expected to emerge as a key secondary urban center in Laikipia County. Growth will be driven by agribusiness value addition, expansion of services, and industrial development, resulting in higher employment and increased demand for urban infrastructure.

1.2.5. Land-use Context

Most of the land in the municipality is owned by individuals with big number of the C.B.D having letters of allotment and leases. The Department of Lands and Physical Planning has

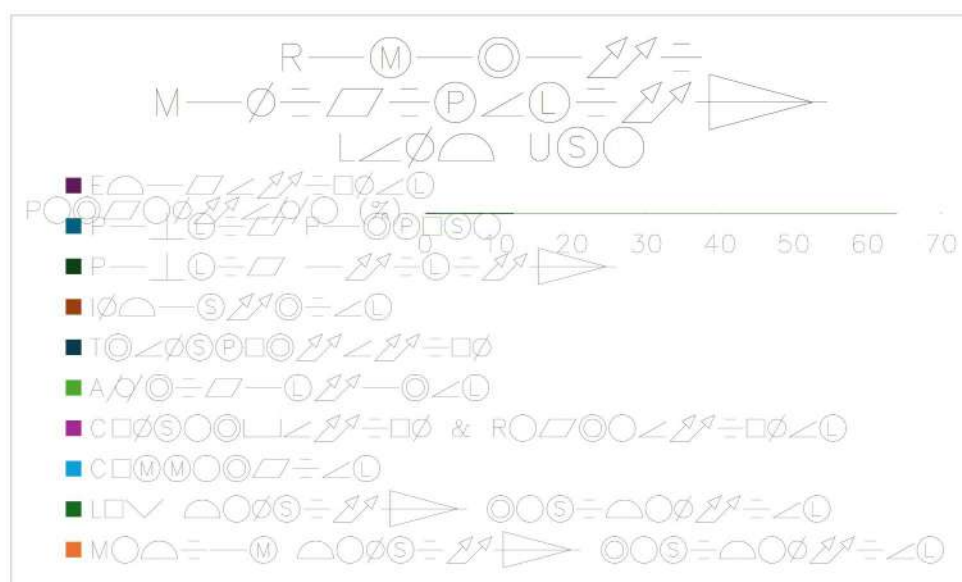
prioritized planning and survey of informal settlements within the municipality such as African Location, Kandutura and Kahari for tenure regularization exercises.

The Rumuruti Local Physical and Land Use Development Plan was developed to ensure proper zoning and coordination of Land Uses within the municipality. The settlements in the municipality are clustered as per the Zones. The type of land in the municipality is either Leases, permanent with letters of Allotment from N.L.C and temporary occupation license (TOL). The small size land holding is approximately 0.045 Ha.

According to the Rumuruti Spatial plan 2021-2031 the existing land use with percentages is as follows;

Table 10. Land use cover with percentage.

<u>Land Use</u>	<u>Percentage (%)</u>
High density residential	3.3
Medium density residential	3.6
Low density residential	3.3
Commercial	0.9
Conservation & Recreational	5.6
Agricultural	64
Transportation	12
Industrial	0.9
Public utility	0.1
Public Purpose	4.9
Educational	1.7



1.3. Key Stakeholders & Inclusiveness

The preparation of the **Rumuruti Urban Climate Risk Profile** adopted a **multi-stakeholder and inclusive approach** to ensure that identified climate risks and adaptation priorities reflect local needs and institutional responsibilities. Key stakeholders included the **Laikipia County Government, Rumuruti Municipal Board and technical departments, national agencies** (notably the Kenya Meteorological Department and NEMA), **civil society organizations**, the **private sector**, and **local communities**.

County and municipal institutions provided leadership, policy guidance, and technical data, while national agencies supported climate information and regulatory oversight. Local communities—particularly **women, youth, farmers, pastoralists, and informal settlement residents**—contributed firsthand knowledge of climate impacts such as drought, flooding, water scarcity, and Extreme Heat, recognizing their high vulnerability to climate risks.

Inclusiveness was emphasized by engaging vulnerable groups, integrating community knowledge with technical analysis, and ensuring cross-sector representation. This participatory approach strengthened ownership, improved the accuracy of risk identification, and enhanced the relevance of proposed climate resilience measures for Rumuruti’s urban development.

Table 11. Stakeholder mapping for Rumuruti Municipality

High	<u>High Influence – Low Interest</u> - County Assembly (Relevant committees) - National Government Agencies (Transport, Water, Health) - Private Sector (Major investors)	<u>High Influence – High Interest</u> - Laikipia County Government (Executive & Planning Dept.) - Rumuruti Municipal Steering Committee/Technical Team - County Climate Change Committee - Kenya Meteorological Dept. (Regional) - National Environment Management Authority (County) - Climate Advocacy groups
Low	<u>Low Influence – Low Interest</u> - Utility providers (Electricity, telephone) - Academic/ Research Institutions - Local radio stations - Financial service providers (Local banks, SACCOs)	<u>Low Influence – High Interest</u> - Local residents - Small holder farmers - Pastoralists - Youth & Women Groups - Community Based Organizations - Local Businesses (Retail, Transport)

Participation Strategy

- **High Influence – High Interest** must be engaged continuously through technical working groups and steering committees.
- **High Influence – Low Interest** need targeted awareness and alignment with sector priorities to support climate profiling decisions (e.g., current investment plans).
- **Low Influence – High Interest** are primary beneficiaries and data sources; their voices improve risk profiling accuracy and are crucial for localized adaptation strategies.

- **Low Influence – Low Interest** can be engaged for peripheral support (data, awareness) but are lower priority for decision leverage.

2. Hazard Assessment

Rumuruti Municipality is increasingly exposed to climate-related hazards arising from changing rainfall patterns, rising temperatures, and ongoing urban expansion. The municipality lies within a medium rainfall zone of Laikipia County and experiences both hydro-meteorological and environmental hazards, particularly flooding, drought, and land degradation. These hazards are influenced by the intensity and variability of rainfall, pressure on water resources, and land-use changes associated with urban growth and infrastructure development.

This hazard assessment identifies and characterizes the key climate hazards affecting Rumuruti Municipality to inform risk-based urban planning and climate-resilient service delivery. The assessment draws on observed climate trends, sectoral data, and local environmental conditions to establish the likelihood and potential impacts of each hazard. The findings provide a basis for prioritizing adaptation measures, strengthening municipal preparedness, and integrating climate risk considerations into spatial planning, infrastructure investment, and environmental management.

2.1. Key Climate Hazards

Rumuruti Municipality is exposed to multiple climate hazards that pose increasing risks to urban infrastructure, services, populations, and natural assets. The dominant hazards are **pluvial flooding, drought, Extreme Heat, land degradation, and solid waste-related risks**, which are already affecting urban functionality and service delivery. Pluvial flooding represents the most pervasive risk, driven by high-intensity rainfall events, limited stormwater drainage capacity, and blockage of drainage systems by solid waste, resulting in recurrent disruption to transport networks, economic activities, and social infrastructure. Drought and water scarcity continue to constrain water and wastewater services and place pressure on urban green spaces and peri-urban agricultural systems. Extreme Heat is an emerging and intensifying hazard, increasing risks to public health, energy systems, and labour productivity, particularly among vulnerable populations. Land degradation in peri-urban areas is reducing ecosystem services and increasing runoff and sedimentation within the urban area. These hazards interact and compound over time, leading to escalating and unevenly distributed climate risks across Rumuruti Municipality.

Table 12. Hazard screening for Rumuruti Municipality.

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Extreme Heat				
Average surface temperature increase	Yes	No	No	No
Extreme heat	Yes	No	No	No
Marine heatwaves	No	No	No	No
Cold Stress				
Average surface temperature during winter	No	No	No	No

Extreme cold (e.g., cold spells, frost)	No	No	No	No
Snowfall and ice storms	No	No	No	No
Flooding				
Changes in precipitation patterns	Yes	No	No	No
Pluvial (surface level) flooding, including flash flooding and urban flooding	Yes	No	No	No
Fluvial (river) flooding	No	No	No	No
Sea level rise	No	No	No	No
Coastal flooding, including storm surges	No	No	No	No
Waterlogging	No	No	No	No
Water Stress				
Drought (meteorological, hydrological)	Yes	Yes	Yes	Yes
Groundwater salinization	No	No	No	No
Saline intrusion	No	No	No	No
Wildfire				
Wildfires & bushfires	No	No	No	No
Storms				
Extreme wind	No	No	No	No
Tropical cyclones	No	No	No	No
Sand and dust storms	No	No	No	No
Hailstorms	No	No	No	No
Mass Movement				
Landslides	No	No	No	No
Coastal erosion	N/A	N/A	N/A	N/A
Gully erosion	No	No	No	No
Marine Conditions				
Ocean acidification	N/A	N/A	N/A	N/A
Geophysical*				
Subsidence	No	No	No	No
Earthquakes	N/A	N/A	N/A	N/A
Volcanos	N/A	N/A	N/A	N/A

** These hazards, if present, can be highly impactful and are therefore included in the screening step, as they may significantly influence the urban planning informed by this urban climate risk profile.*

2.2. Climate Indicators and Hazard Thresholds

Thresholds are **qualitative**, based on **observed impacts, exposure, and sensitivity** rather than fixed numerical cut-offs, in line with **urban climate risk profiling practice**. **Flooding and drought** emerge as the **highest-priority hazards** for Rumuruti Municipality.

Table 13. Climate indicators and hazard thresholds selected for the assessment

Key Hazard	Climate indicator	Data source	Threshold		
			Low	Medium	High
Pluvial Flooding	Intense rainfall events(mm/day)	KMD			
	Stormwater drainage capacity exceedance	Laikipia CIDP Municipal engineering records		✓	
Drought/ Scarcity	Water				
	Prolonged dry spells Seasonal rainfall deviation Groundwater abstraction vs recharge	KMD WRA County water dept SPEI Database		✓	
Extreme Heat	Mean annal temperature (°C)	KMD			
	No. of hot days Nighttime temp. increase	NCCD KNBS Climate summaries	✓		
Land Degradation & Soil erosion	Vegetation cover loss (%)	County environment office			
	Sedimentation in streams/drains	NEMA reports NDVI		✓	✓
Solid waste related environmental risks	Waste collection coverage (%)	WRA borehole data			
	Total dissolved solids	County Environment department	✓		

2.3. Current Hazard Levels and Climate Projection

Hazard levels reflect both the **probability** of hazard's occurrence and its likely **severity (or magnitude, intensity)**.

Table 14. Current and future hazards levels for Rumuruti Municipality.

Hazard	Hazard Level				
	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Pluvial Flooding	Medium	Medium	High	Medium	High
Drought	Medium	High	High	High	High
Extreme Heat	Medium	High	High	High	High
Land Degradation	Medium	High	High	High	High
SW Related Risks	Low	Medium	Medium	High	High

For this Urban Climate Risk Profile, hazard levels should be interpreted in accordance with the table below.

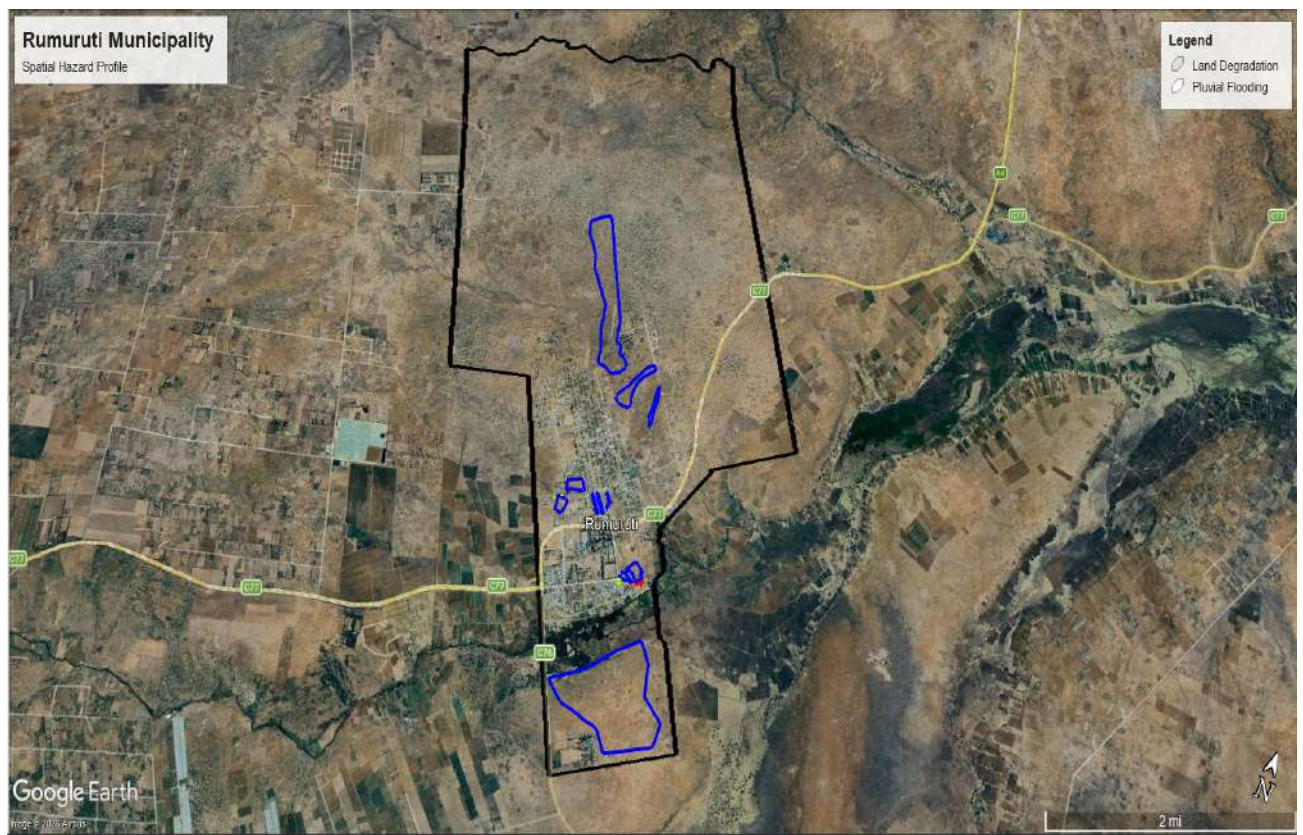
Table 15. Interpretation of hazard levels

Level	Interpretation
High	Hazard events that are likely to occur with high frequency and/or intensity
Medium	Hazard events that are likely to occur with moderate frequency and/or intensity
Low	Hazard events that are likely to occur with low frequency and/or intensity

2.4. Current and Future Hazard Impact Areas.

In Rumuruti Municipality, current hazard impact areas are concentrated in low-lying peri-urban and informal settlement zones (notably African Location and Kandutura), along poorly drained sections of the Ewaso Narok River corridor, and in the densely built urban core where undersized and frequently clogged stormwater drainage systems converge. These areas experience the most severe effects from pluvial flooding during intense rainfall events, prolonged water scarcity and borehole depletion during droughts, and elevated heat stress due to limited tree cover and heat-retaining surfaces. Peri-urban agricultural lands surrounding the town are also heavily impacted by drought-induced crop and pasture failure, land degradation from erosion and overgrazing, and occasional flash-flood inundation. Looking to the future (2050–2100 under SSP2-4.5 and SSP5-8.5 scenarios), these impact areas are projected to expand and intensify. Hazard levels rise to high or very high for drought, extreme heat, and land degradation across most of the municipality, with pluvial flooding hotspots growing in extent due to heavier downpours and continued urban expansion on marginal land. Without adaptation, informal settlements, peri-urban farms, and the town's water and transport networks face compounding risks of chronic water stress, heat-related health and productivity losses, accelerated ecosystem degradation, and more frequent flood damage, disproportionately affecting vulnerable populations already living in the most exposed and least serviced locations.

Map 2; Rumuruti Municipality Spatial Hazard Profile.



SN	HAZARD NAME	COLOR CODE
1	Pluvial Flooding	Blue
2	SW Related Risks	Green
3	Land Degradation	Red

3. Exposure & Vulnerability Assessment

The exposure and vulnerability assessment evaluates the degree to which populations, infrastructure, livelihoods, and urban systems in Rumuruti Municipality are exposed to climate-related hazards and the extent to which they are susceptible to harm. Exposure is influenced by the spatial distribution of settlements, critical infrastructure, and economic activities in relation to hazard-prone areas, while vulnerability is shaped by socio-economic conditions, quality of infrastructure, access to basic services, and institutional capacity. Together, these factors determine the potential severity of impacts arising from climate hazards such as flooding, drought, and rising temperatures.

In Rumuruti Municipality, exposure and vulnerability are heightened in areas characterized by unplanned development, limited drainage infrastructure, and reliance on climate-sensitive livelihoods and water sources. Vulnerable groups, including low-income households, informal traders, women, youth, the elderly, and persons with disabilities, face disproportionate risks due to constrained adaptive capacity and limited access to resources. This assessment provides a basis for identifying priority areas and populations for targeted adaptation interventions and supports the integration of inclusive, risk-informed measures into municipal planning, service delivery, and climate resilience strategies.

3.1. Urban Elements.

Urban elements are the components that make up the urban systems, including communities, the built environment and nature. These elements can be described based on their **spatial location** (e.g. wards, neighbourhoods, informal settlements), **asset types** (e.g. house, hospital, power plant) or **function in association with sector** (e.g. transportation, wastewater management)

Table 16. Urban elements inventory

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater drainage conveyance network	No	No	
	Stormwater storage	No	No	
Water & Wastewater Management	Pumping stations	No	No	
	Groundwater abstraction	No	No	
	Water treatment facilities	No	No	
	Water supply networks	Yes	No	NYAHUWASCO
	Sewer networks	No	No	
	Wastewater treatment facilities	No	No	
Solid Waste Management	Transfer facilities	No	No	
	Landfills and dump	No	No	

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	sites			
	Recycling centers	No	No	
	Collection fleet	No	No	
Transport and Mobility	Road networks	Yes	Yes	Primary, Secondary, Tertiary
	Bridges	Yes	Yes	
	Public transport networks (rail, bus, mini-bus, etc.)	Yes	Yes	380, 730M of road
	Transportation terminals	No	No	
	Vehicle depots	No	No	
	Non-motorized transport networks	No	No	
	Freight and logistics hubs	No	No	
	Energy power plants	Yes	Yes	Wind Mills
	Poles and power lines	Yes	Yes	
Energy	Transformers and substations	Yes	Yes	Rumuruti Sub station
	Streetlighting	Yes	Yes	
	Markets	Yes	Yes	Rumuruti Fresh Produce Market
	Businesses and commercial hubs	Yes	Yes	Supermarkets, Commercial shops
Economic Infrastructure	Industrial zones/parks and logistics parks	Yes	Yes	Rumuruti CAIP
	Government buildings and service centers	Yes	Yes	County govt offices, National Govt. Offices
	Education facilities	Yes	Yes	Library, JSS, Senior secondary, TVET
Social Infrastructure	Healthcare facilities	Yes	Yes	Dispensaries, Level 3 County LHS
	Public spaces	Yes	Yes	Playgrounds, Rumuruti Stadium
	Faith-based buildings	Yes	Yes	Churches
	Cultural and heritage assets	Yes	Yes	Historical Monuments
	Fire stations	No	No	
	Police stations	Yes	Yes	Rumuruti Police Station
Emergency Services	Telecommunications networks	Yes	Yes	Safaricom Mast
	Early warning systems	NO	No	
	Disaster management centers and shelters	No	No	
	Evacuation routes	N/A	N/A	
Populations				
Urban	Population	Yes	No	Census 2019

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Residents	Households	Yes	No	Census 2019
Informal Settlement Residents	Population living in informal settlements	Yes	No	Census 2019
	Households lacking land tenure	Yes	No	Census 2019
	Households / residents lacking access to basic services	No	No	
Vulnerable and Marginalized Groups	Low-income households	No	No	
	Women-headed households	No	No	
	Children and youth	No	No	
	Elderly persons	No	No	
	People with disabilities (PWD)	Yes	No	County Dept. of Social services
	Homeless populations	No	No	
	Unemployed or precariously employed workers	No	No	
	Seasonal workers / migrant laborers	No	No	
	Nomadic groups in peri-urban areas	No	No	
	Urban refugees and migrants	N/A	N/A	
	Minority ethnic groups in urban areas	Yes	No	
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	Yes	Yes	Rumuruti Memorial Park, arboretum
	Green corridors	No	No	
	Street landscaping	No	No	
	Urban forests and forest reserves	No	No	
Urban Blue Infrastructure	Natural wetlands	Yes	Yes	Marura Wetland
	Rivers	Yes	Yes	Ewaso Narok River (36,541M)
	Riparian zones	Yes	Yes	
	Lakes, ponds and reservoirs	No	No	
	Coastal ecosystems	N/A	N/A	
	Urban agriculture	Yes	No	Dept. of Agriculture
Peri-urban and Agricultural Systems	Peri-urban agriculture	Yes	No	
	Agroforestry systems	Yes	No	
	Forests and forest reserves	Yes	No	KFS
	Protected areas and	No	No	

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	national parks			
	Savannahs and rangelands	No	No	

3.2. Exposure, Vulnerability, and Impacts of Climate Hazards on Urban Elements

For this Urban Climate Risk Profile, exposure and vulnerability levels should be interpreted in accordance with the table below.

Table 17. Interpretation of exposure and vulnerability levels

Level	Exposure Level Interpretation	Vulnerability Level Interpretation
High	Few or no critical urban elements lie within the hazard footprint or area of impact.	The urban element is vulnerable to the climate hazard due to high natural sensitivity – considering physical and non-physical characteristics – and limited adaptive capacity.
Medium	A moderate number or a mix of low- and medium-value urban elements are located within the hazard footprint.	The urban element is somewhat vulnerable to the climate hazard due to moderate sensitivity and adaptive capacity.
Low	A large number and high-value urban elements (e.g., critical infrastructure, dense neighborhoods, major economic assets) are located within the hazard footprint.	The urban element is minimally vulnerable to the climate hazard due to limited sensitivity and/or a high degree of adaptive capacity.

For this Urban Climate Risk Profile, the following matrix summarizes likely impacts on each urban element by combining the assigned exposure and vulnerability levels.

Table 18. Impact Matrix

		Vulnerability Level		
		Low	Medium	High
Exposure Level	High	Moderate	Major	Catastrophic
	Medium	Minor	Moderate	Major
	Low	Insignificant	Minor	Moderate

Table 19. Exposure, Vulnerability, and Impacts of Pluvial Flooding on Urban Elements

Hazard: Pluvial Flooding

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Intense short duration rainfall leading to flash floods and blocked drains especially on DEB Road, Nyamakima street and African location roads	High	Sensitivity: - Undersized and poorly maintained drains - High sediment load from unpaved areas Adaptive Capacity: - Regular desilting and unclogging - Can be improved with upgrades	Medium	Major
Water & Wastewater Management	Groundwater contamination	Medium	Sensitivity: - Limited redundancy - Limited sewerage coverage Adaptive Capacity: - Flood proofing - Limited investment in climate-resilient WASH infrastructure	Medium	Moderate
Solid Waste Management	- Floodwaters dispersing uncollected waste - Flooding of the open dumpsite	Medium	Sensitivity: - Open dumping and poor/irregular collection coverage Adaptive Capacity: - Limited equipment, staffing and funding	High	Major
Transport and Mobility	Apx 18 Km of both earth & gravel roads within the African Location & Kandutura settlement with poor drainages	Medium	Sensitivity: - Most roads are earth unpaved and graveled but with poor drainage system Adaptive Capacity: - Investment in resilient road network - Upgrade of gravel roads to cobble stone	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			standards with a green infrastructure feature to combat climate change risks		
Energy	Windy rainfall damage to overhead powerlines	Low	Sensitivity: - Exposed distribution network - Limited renewable integration Adaptive Capacity: - Invest in microgrids - Reactive maintenance - Investment in renewable energy	Low	Insignificant
Economic Infrastructure	- Flooding of markets (Rumuruti fresh produce) and informal business areas (Soko Mjinga) - Supply chain disruptions	Medium	Sensitivity: - Informal structures in flood prone areas Adaptive Capacity: - Construction of Rumuruti Modern market - Development of green infrastructure within the market and flood prone areas	Medium	Moderate
Social Infrastructure	Some schools are affected by flash floods especially in Kandutura area	Low	Sensitivity: - Buildings are not flood resilient Adaptive Capacity: - Retrofitting to be included in development plans or schools and institutions for flood resilience	Medium	Minor
Emergency Services	Overwhelmed during disasters	Medium	Sensitivity: - Limited equipment - Weak early warning systems - Inadequate staffing Adaptive Capacity: - Training of first respondents and disaster management team - Investment in DRM plan and implementation - Adequate staffing equipped with training	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			and knowledge to combat disasters regarding to flooding.		
Populations					
Urban Residents	Flooding of streets and businesses within the CBD	Medium	Sensitivity: - Poorer HH are more exposed to flooding risk - Disruption of mobility Adaptive Capacity: - Middle income HH can recover faster - Support offered to the affected HH	Medium	Moderate
Informal Settlement Residents	Settlements i.e. African Location & Kandutura are located in low lying poorly drained zones	High	Sensitivity: - Severe displacement especially in Kandutura - Livelihoods and housing highly sensitive to flooding Adaptive Capacity: - Limited financial support from the local government	Medium	Major
Vulnerable and Marginalized Groups	Disproportionately affected by floods due to social and economic exclusion	High	Sensitivity: - Small flood events can have catastrophic consequences Adaptive Capacity: - Reliance on external support i.e. NGOs such as UNHABITAT	High	Catastrophic
Natural Assets					
Urban Green Infrastructure	- Damage to vegetation - Water logging - Erosion	Medium	Sensitivity: - Vegetation & Soil are sensitive to prolonged inundation - Loss of ecosystem services Adaptive Capacity:	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Restoration & expansion of green spaces possible		
Urban Blue Infrastructure	- Wetland & river overflow during heavy rainfall - Sedimentation of Ewaso Narok River	High	Sensitivity: - Directly linked to flood dynamics - Contamination of water sources - Ecosystem degradation Adaptive Capacity: - Wetland restoration and buffer zones to reduce risks	Medium	Major
Peri-urban and Agricultural Systems	- Localized crop losses - Farmlands flood	High	Sensitivity: - High reliance on rainfed agriculture - Crops and soils are highly sensitive to excess water Adaptive Capacity: - Engage in climate smart agriculture - Enhance soil conservation - Promote agroforestry	Medium	Major

Table 20. Exposure, Vulnerability, and Impacts of Drought on Urban Elements

Hazard: Drought

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
& Services					
Stormwater Drainage	• Prolonged dry periods cause soil contraction and sediment accumulation • Reduced functionality of drainage system	Low	Sensitivity: • Drains are mainly designed for runoff not dry conditions • Structural damage from ground shifts increases maintenance needs • Accumulation of dry weather pollutants reduce water quality if first rain flush. Adaptive Capacity: • Limited upgrades in urban planning to handle indirect drought effects • Reliance in basic infrastructure within the municipality. • Repurposing for alternative water conveyance with retrofitting	Medium	Minor
Water & Wastewater Management	• Directly exposed to reduce raw water supplies (aquifers) • Decline in per capita water availability due to reduced rainfall and high evaporation • Increased demand for treated water for basic needs	High	Sensitivity: • High dependence on surface water sources that dry up during droughts • Increased salinity/ pollutant concentration in water sources strains treatment Adaptive Capacity: • Diversification of sources (desalination, recycling, tiered pricing) • Groundwater management policy exists although there's poor implementation •	Medium	Major
Solid Waste Management	• Increased dust and fire risks at the dumpsite •	Medium	Sensitivity: • Open dumpsite is vulnerable to fires and dust dispersion • Informal waste affected by resource scarcity Adaptive Capacity:	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			- Community based adaptive capacity limited - Low investment in modern waste facilities		
Transport and Mobility	- Subsidence and soil cracking damage roadbeds - Dust storms reduce visibility and damage vehicles	High	Sensitivity: - Road surface deterioration. - Infrastructure damage increases maintenance cost and disrupts logistics Adaptive Capacity: - Use of drought-resilient materials in design - Limited routine grading and dust suppression ...	Medium	Major
Energy	- Increased electricity demand for water pumping. - Reliance on charcoal and firewood for energy provision	Medium	Sensitivity: - Hydropower and biomass are highly sensitive to rainfall variability. Even short droughts can disrupt supply. - Drought simultaneously affects agriculture and water, increasing competition for resources and worsening energy insecurity. Adaptive Capacity: - Limited local renewable and backup systems.	Medium	Moderate
Economic Infrastructure	- Reduced water supply affecting markets and small enterprises - Disruptions to industrial activities from water shortages - GDP losses from agricultural and service sector impacts	Medium	Sensitivity: - Economic sectors reliant on water & agriculture highly affected. - Urban markets disrupted by supply chain issues Adaptive Capacity: - Vision 2030 aim at resilience but urban	High	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			bias limits reach. • Insurance & businesses continuity can help.		
Social Infrastructure	- Schools, hospitals & public buildings face operational challenges due to water scarcity for sanitation, cooling and hygiene. - Increased health risks from malnutrition and disease outbreaks	Medium	Sensitivity: - Decline in service quality esp. hospital-acquired infections risks rises - Facilities operation at a reduced capacity - Educational disruptions from displacement and resource scarcity Adaptive Capacity: - Integration of climate plans but gaps in implementation - Installation of rainwater tanks for rapid adaptation	High	Major
Emergency Services	- Fire risks increase dramatically due to dry vegetation and materials - Water pressure for firefighting may be low due to overall system strain	High	Sensitivity: - Increased frequency & intensity of urban/interface fires - Strained response capacity across multiple simultaneous incidents Adaptive Capacity: - Dedicated non-portable water reserves - Public awareness campaigns - Incorporation of indigenous knowledge for early warning systems. - NDMA Coordination	Medium	Major
Populations					
Urban Residents	- Food insecurity from disrupted supply chains. - Exposure to worsened heat island due to drought - Intermittent water shortages and rising water costs	Medium	Sensitivity: - Dependence on piped and vendor-supplied water Adaptive Capacity: - Moderate access to information and services	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Informal Settlement Residents	- Acute water scarcity and reduced sanitation services - Highly exposed due to pre-existing lack of piped water, relying on expensive or distant vendors.	High	Sensitivity: - Poor housing, limited WASH infrastructure - First to lose access to water, hygiene severely compromised. - Livelihoods (often informal, day labor) disrupted quickly. Adaptive Capacity: - Limited financial, social, and political capital to adapt. Rely on community solidarity and external aid. - Low income, limited coping options	Medium	Major
Vulnerable and Marginalized Groups	- Disproportionate exposure to water and food insecurity	High	Sensitivity: - Difficulty accessing distribution points or afford water. - May not receive or understand public warnings. - Elderly, children, persons with disabilities highly drought-sensitive Adaptive Capacity: - Limited access to social protection - Dependent on social safety nets, outreach programs, and community support, which are often inadequate.	High	Catastrophic
Natural Assets					
Urban Green Infrastructure	- Prolonged moisture stress and vegetation dieback - Loss of cooling, aesthetic, and recreational benefits.	Medium	Sensitivity: - Increased susceptibility to pests and diseases when stressed. - Limited tree cover and irrigation Adaptive Capacity: - Limited tree cover and irrigation	High	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Switch to drought-resistant native species, efficient irrigation (e.g., drip, greywater).		
Urban Blue Infrastructure	Rivers, streams, ponds, and wetlands experience reduced flow, drying, and water quality degradation.	Medium	Sensitivity: - Degraded riparian zones - Loss of ecosystem services: cooling, flood attenuation, recreation Adaptive Capacity: - Largely dependent on watershed health and upstream water management. Artificial maintenance is water/resource intensive. - Protection and restoration measures in place but non reliant	Medium	Moderate
Peri-urban and Agricultural Systems	- Farms and community gardens at the urban fringe lose irrigation water, leading to crop failure. - Rainfall failure affecting crops and pasture	High	Sensitivity: - Contributes to local food price inflation and reduced food security. - High reliance on rain-fed agriculture Adaptive Capacity: - Switch to drip irrigation or drought-tolerant crops, but capital and knowledge are barriers. - Limited irrigation and climate-smart practices	Medium	Major

Table 21. Exposure, Vulnerability, and Impacts of Extreme Heat on Urban Elements

Hazard: Extreme Heat

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
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Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	- Most systems in Rumuruti are minimal, designed for infrequent heavy rains, not heat. - High heat rarely interacts with this infrastructure directly. - Limited vegetation cover along drainage corridors	Low	Sensitivity: - Heat-induced cracking of concrete drain - Sediment drying and blockage due to reduced moisture - Main issue is potential for materials (like PVC pipes) to soften/degrade over time with sustained high ground temps. Adaptive Capacity: - Stormwater systems are passive; management focus during heat is minimal. No direct operational adjustments needed. - Minimal shading or green buffers - Limited routine maintenance during dry periods	Medium	Minor
Water & Wastewater Management	- Water demand surges due to drinking, cooling, and irrigation needs. - Storage tanks and shallow pipelines exposed to high temperatures	Medium	Sensitivity: - Increased demand strains limited supply, potentially leading to shortages, especially in high-demand zones like the town center. - Increased risk of pipe bursts and leakage Adaptive Capacity: - Capacity to meet surge demand is limited by source capacity	High	Major
Solid Waste Management	Open dumpsites and waste collection points are highly exposed. Heat accelerates chemical and biological reactions.	High	Sensitivity: - Increased odor, leachate generation, and vermin activity at the dump site and its environs - Health risks to waste handlers Adaptive Capacity:	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			. Limited resources for frequent collection, covering waste, or managing dumpsite conditions. - Limited waste segregation and controlled disposal		
Transport and Mobility	- Unshaded roads, walkways. Unpaved and tarmac roads exposed to thermal expansion and softening, especially around the busy market area.	Medium	Sensitivity: - Road surface degradation (rutting, cracking) increases, raising maintenance costs for roads - Extreme Heat for pedestrians and boda boda operators Adaptive Capacity: - Limited municipal budget for proactive road maintenance using heat-resilient materials. Little infrastructure (shade shelters, trees) for pedestrian relief.	High	Major
Energy	Electricity distribution lines (by KPLC) are exposed to thermal sag and increased resistance. - Overhead power lines exposed to heat	Medium	Sensitivity: High risk of blackouts/brownouts from overloaded transformers (e.g., near commercial centers) and line faults - Increased cost for households and businesses relying on generators during outages. Adaptive Capacity: - Limited grid redundancy - Low uptake of energy-efficient cooling technologies	Medium	Moderate
Economic Infrastructure	Open-air markets (Rumuruti Fresh produce Market), workshop & kiosks are directly exposed	High	Sensitivity: - Perishable goods spoil faster. - Livestock in saleyards experience Extreme Heat, losing value. - Reduced productivity and working hours	High	Catastrophic

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: Low-Moderate. Most SMEs (jua kali artisans, market traders) have no financial capacity to install cooling. Work hours may shift, reducing income		
Social Infrastructure	Schools (e.g., Rumuruti DEBPrimary), health facilities (Rumuruti Sub-County Hospital), and churches are exposed, often with poor thermal design (iron sheet roofs).	High	Sensitivity: - Hot classrooms reduce student concentration and performance. Heat exacerbates recovery for hospital patients, especially in maternity wards. - Increased patient load from heat-related illnesses strains health facilities. Adaptive Capacity: Very Low. Institutions lack budgets for air conditioning, adequate fans, or building retrofits (insulation, ventilation)	Medium	Major
Emergency Services	Demand for services (heatstroke, dehydration, fires) increases	High	Sensitivity: - Equipment (vehicles) can overheat. - Reduced response efficiency due to heat fatigue Adaptive Capacity: - No dedicated heat emergency plan. Budget constraints prevent scaling up for peak demand.	Medium	Major
Populations					
Urban Residents	The entire population of Rumuruti town is exposed to high ambient temperatures, worsened by the urban heat island effect in built-up areas with limited tree cover.	High	Sensitivity: - Increased cases of heat exhaustion, dehydration, and exacerbated respiratory/cardiovascular conditions. - Increased household water demand Adaptive Capacity: - Those with concrete houses, ceiling fans,	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			and reliable water have moderate capacity. Many in older houses or renting single rooms have very low capacity to cool their homes.		
Informal Settlement Residents	- Densely packed housing with iron-sheet roofs. - Poor ventilation and no green space	High	Sensitivity: - Indoor temperatures become dangerously high. - Lack of private water access compounds dehydration risk. - High prevalence of pre-existing health conditions increases susceptibility. Adaptive Capacity: - Low income limits adaptive measures	Medium	Major
Vulnerable and Marginalized Groups	Prolonged exposure during heat waves	High	Sensitivity: - Higher susceptibility to heat stroke and dehydration - Limited mobility and health resilience Adaptive Capacity: - Very low due to poverty, social isolation, and lack of targeted municipal outreach or cooling centers.	High	Catastrophic
Natural Assets					
Urban Green Infrastructure	Street trees, parks and open spaces exposed to prolonged dry heat.	Medium	Sensitivity: - Native and exotic vegetation can experience scorching, leaf drop, and mortality without supplemental watering, reducing the very cooling benefits needed. Adaptive Capacity: - Municipal capacity for irrigation is non-	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			existent. Survival depends on rainfall or private watering, which is deprioritized during water shortages. Community groups may emerge but are ad-hoc		
Urban Blue Infrastructure	Natural waterways (e.g., the Kandutura River tributaries) and any man-made ponds are exposed to increased evaporation and reduced flow.	High	Sensitivity: - Water levels drop, water temperatures rise, degrading water quality and aquatic life. These spaces lose their cooling microclimatic effect. Adaptive Capacity: - Limited protection of riparian buffers - Weak enforcement of abstraction controls - Entirely dependent on broader catchment health and upstream water use, which is beyond municipal control. No resources for artificial maintenance	Medium	Major
Peri-urban and Agricultural Systems	Farms and pasturelands surrounding Rumuruti are directly exposed to radiant heat and increased evapotranspiration	High	Sensitivity: - Crop wilting and reduced yields - Livestock Extreme Heat and water shortages Adaptive Capacity: - Most smallholder farmers lack irrigation and are rain-fed. Shifting to drought/heat-tolerant crops requires new seeds, knowledge, and market access, which are significant barriers.	Medium	Major

Table 22. Exposure, Vulnerability, and Impacts of Land degradation on Urban Elements

Hazard: Land degradation

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	- Channels and culverts (e.g., along Kiambiriria Road) can be clogged by eroded soil. - Exposed to increased siltation and sediment load from eroded upland areas and bare urban plots during rains.	High	Sensitivity: - Reduced drainage capacity increases flood risk during heavy rains. - Increased maintenance costs for de-silting.	Medium	Major
			Adaptive Capacity: - Limited upstream catchment protection - Inadequate routine desilting and erosion control - Municipal capacity for regular, proactive clearing of sediment is limited.		
Water & Wastewater Management	Water sources (boreholes, rivers) exposed to contamination from sediment and agro-chemical runoff from degraded lands. Wastewater infiltration fields can become clogged or inefficient in degraded, compacted soils.	Medium	Sensitivity: - Increased turbidity and pollutants raise water treatment costs and risk to public health. - Reduced groundwater recharge and declining yields - Increased turbidity and contamination of water	High	Major
			Adaptive Capacity: Limited capacity to treat highly turbid water. Protecting upstream catchment areas (e.g., Marmanet Forest) is beyond direct municipal control and requires inter-agency cooperation.		
Solid Waste Management	The municipal dumpsite is exposed to erosion and leachate runoff, which can contaminate surrounding degraded land.	Medium	Sensitivity: Land degradation around the dumpsite can exacerbate environmental pollution, but the primary hazard originates from the	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
	Scavenging on unstable, degraded slopes poses risks.		waste itself. Adaptive Capacity: The dumpsite is largely unmanaged. No engineered lining or leachate control to prevent soil and groundwater contamination.		
Transport and Mobility	Unpaved roads (many feeder roads in Rumuruti) are highly exposed to gully erosion and dust generation, Road embankments can be destabilized by erosion, especially near degraded riverbanks.	Medium	Sensitivity: - Roads become impassable in rains due to ruts and gullies (e.g., roads to outlying estates). Dust storms from degraded land reduce visibility and air quality. Adaptive Capacity: - Limited slope stabilization and drainage improvements	Medium	Moderate
Energy	Exposure is indirect. - Dust from degraded lands can settle on solar PV panels, reducing efficiency.	Low	Sensitivity: - Rumuruti's energy supply is from the national grid, so local land degradation has minimal direct impact on generation. Dust on solar panels is a minor, manageable issue. Adaptive Capacity: - Panel cleaning is simple. The municipality has little control over upstream watershed management affecting hydropower.	Medium	Minor
Economic Infrastructure	Business premises, markets, and other facilities exposed to dust, sedimentation, and the visual blight of degraded surrounding landscapes.	Medium	Sensitivity: - Dust damages goods, increases cleaning costs, and deters customers. Poor road access disrupts supply chains for agro-dealers and other businesses. Adaptive Capacity: - Individual businesses can control their immediate premises but cannot fix	Medium	Moderate.

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			surrounding land degradation. Collective action (e.g., business association funding road gravel) is possible but challenging.		
Social Infrastructure	Schools and health clinics exposed to dust pollution and may face access issues if access roads erode. - Playing fields and grounds can become bare and dusty.	High	Sensitivity: - Dust exacerbates respiratory illnesses (asthma, infections), increasing patient load at clinics. - Loss of recreational space affects community well-being. Adaptive Capacity: - Limited geotechnical assessment before construction & Inadequate landscaping and soil protection	Medium	Major
Emergency Services	Access for fire engines and ambulances is exposed to risks from eroded or blocked roads, especially in informal and peri-urban areas.	High	Sensitivity: - Critical minutes lost during emergencies due to impassable roads. This directly threatens lives and property. Adaptive Capacity: - Limited alternative access routes - Poor integration of land degradation risks in emergency planning	Medium	Major
Populations					
Urban Residents	Exposed to increased ambient dust (affecting air quality), reduced water quality, and higher food prices due to impacts on peri-urban agriculture.	Medium	Sensitivity: - Health impacts from poor air and water quality. Economic sensitivity from increased cost of living. Adaptive Capacity: - Moderate ability to improve plots - Limited awareness of land conservation measures	Medium	Moderate
Informal Settlement	Directly exposed to dust & erosion gullies	High	Sensitivity: Living conditions are worsened by	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Residents			constant dust and lack of vegetated buffers. - Often rely on degraded common lands for grazing or fuelwood, forcing longer, more difficult collection trips Adaptive Capacity: - Low-income limits land improvement - Insecure tenure discourages conservation investments		
Vulnerable and Marginalized Groups	Subsistence farmers, the elderly, and disabled are exposed to loss of productive land and ecosystem services they directly depend on.	High	Sensitivity: - Loss of fertile soil directly threatens food security and livelihood for small-scale farmers. - Disproportionate livelihood and health impacts - Limited mobility to relocate Adaptive Capacity: - Dependence on external assistance - Limited access to extension and support services	High	Catastrophic
Natural Assets					
Urban Green Infrastructure	The few public green spaces, street trees, and private gardens are exposed to soil nutrient depletion, compaction, and water stress, hindering growth.	High	Sensitivity: Degraded, compacted urban soils cannot support healthy vegetation, leading to stunted growth, higher mortality, and loss of ecosystem services (shade, cooling, aesthetics) Adaptive Capacity:	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Municipal and household resources for soil amendment (compost, aeration) are minimal. Survival often depends on hardy, often non-native species		
Urban Blue Infrastructure	Rivers and streams are exposed to high sedimentation from eroded banks and uplands, changing their course and ecology.	High	Sensitivity: - Sedimentation reduces water storage capacity, increases flood risk, destroys aquatic habitats, and increases water treatment costs. Adaptive Capacity: - Weak riparian protection and enforcement	Medium	Major
Peri-urban and Agricultural Systems	The core exposed asset. Farmland and grazing lands surrounding Rumuruti are directly exposed to soil erosion, nutrient depletion, and salinization from poor irrigation practices.	High	Sensitivity: - Direct loss of the productive resource base. Reduced crop and livestock yield directly undermine food security, incomes, and the local economy (potato farming, dairy). Adaptive Capacity: - Adoption of soil conservation practices (contour farming, agroforestry) is knowledge- and capital-intensive for smallholders. Short-term survival often outweighs long-term sustainability.	High	Catastrophic

Table 23. Exposure, Vulnerability, and Impacts of Solid Waste Related risks on Urban Elements

Hazard: Solid Waste Related Risks

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Stormwater Drainage	Exposed to blockage by indiscriminate solid waste disposal. Drains and culverts, especially in the town center and market area, become dumping sites	High	Sensitivity: - Blocked drains lead to localized flooding during rains, damaging adjacent infrastructure and properties. - Contaminated runoff pollutes waterways. Adaptive Capacity: - Municipal capacity for regular drain cleaning is overstretched. Public compliance with proper disposal is low, making it a recurring problem	Medium	Major
Water & Wastewater Management	Water sources (shallow wells, rivers) are exposed to leachate contamination from dumpsites and waste piles. Wastewater systems are not directly exposed but can be mimicked by clogged septic systems from improper waste disposal.	High	Sensitivity: - Leachate from the main dumpsite and scattered waste piles infiltrates groundwater, a key source for many residents. This increases waterborne diseases and treatment costs Adaptive Capacity: - Limited protection zones around water infrastructure - Inadequate monitoring of water quality	Medium	Major
Solid Waste Management	- High waste generation with limited collection coverage - Reliance on open dumping and burning	Medium	Sensitivity: - System is overwhelmed by volume, leading to service failures. Workers face health risks (cuts, infections, respiratory issues). - Dumpsite is a persistent environmental and public health hazard. Adaptive Capacity: - Insufficient equipment and manpower - Low waste segregation and recycling levels	High	Major
Transport and	Roads and pathways are exposed to	Medium	Sensitivity:	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Mobility	illegal dumping and litter, which can obstruct traffic and pedestrian movement.		- Waste piles on road shoulders (e.g., along African Location feeder roads) narrow passage, create visual blight, and can cause traffic hazards. Scavenging animals on roads pose risks. Adaptive Capacity: - Ad hoc clearance rather than planned maintenance. - Limited public awareness on proper disposal		
Energy	Exposure is low. No waste-to-energy facility. Power lines are not significantly affected by waste, though fires at dumpsites could theoretically threaten nearby lines.	Low	Sensitivity: - No direct functional link between waste and energy supply in Rumuruti. Adaptive Capacity: Not Applicable	Low	Insignificant
Economic Infrastructure	Markets, shops, and hotels are exposed to unsightly and unhygienic waste accumulation, which deters customers	High	Sensitivity: - Poor waste management directly affects business viability by repelling customers, increasing pest infestations (rodents, flies), and creating foul odors, especially around the main market. Adaptive Capacity: - Larger businesses may pay for private collection. Business associations could lobby for better service but collective action is often weak.	Medium	Major
Social Infrastructure	Schools and health facilities are exposed to waste accumulation on their premises and in surrounding areas, creating health risks for their core populations.	Medium	Sensitivity: - Increased disease transmission risks - Unhealthy learning and care environments Adaptive Capacity: - Inconsistent waste collection	Medium	Moderate

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Limited institutional waste management plans		
Emergency Services	Access routes for ambulances and fire engines can be obstructed by illegal waste dumping, especially in informal settlements and alleys.	Medium	Sensitivity: - Higher demand for emergency response - Delayed access due to blocked routes Adaptive Capacity: - Limited integration of waste risks into emergency planning - Resource constraints	Low	Minor
Populations					
Urban Residents	Exposed to public health risks from vectors (flies, mosquitoes, rodents) breeding in waste, and to air pollution from burning waste.	High	Sensitivity: - Increased incidence of malaria, dengue, diarrhea, typhoid, and respiratory infections. - Reduced quality of life from odors and unsightliness. Adaptive Capacity: Moderate, but unequal. Those in planned areas may have slightly better collection service. Household-level capacity (proper storage, composting) is limited by knowledge and space.	Medium	Major
Informal Settlement Residents	Extremely high exposure due to no formal collection service, leading to pervasive waste accumulation in open spaces, drainage channels, and near homes in areas like African Location & Kandutura	High	Sensitivity: Extreme. Direct contact with waste, highest risk of disease, and frequent flooding from waste-clogged drains. Adaptive Capacity: - Low-income limits access to collection services - Insecure tenure reduces incentives for waste improvement	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	Waste pickers (including children), the elderly, and people with pre-existing illnesses are directly and disproportionately exposed.	High	Sensitivity: - Waste pickers at the dumpsite face direct chemical, biological, and physical hazards without protective gear. The ill and elderly are more susceptible to resulting diseases Adaptive Capacity: - Dependence on social support systems - Limited capacity to relocate or adapt	High	Catastrophic
Natural Assets					
Urban Green Infrastructure	Parks and street trees are exposed to contamination from dumped waste and leachate, which can poison soil and stunt plant growth.	Medium	Sensitivity: High. Soil and vegetation health degrade where used as informal dumping grounds. Plastic waste can entangle and kill plants. Adaptive Capacity: - Limited maintenance and restoration efforts - Weak enforcement of land-use regulations	Medium	Moderate
Urban Blue Infrastructure	Rivers and streams are directly exposed to use as liquid waste disposal channels. Waste is dumped into or along waterways.	High	Sensitivity: - Direct pollution kills aquatic life, destroys ecosystems, and eliminates safe recreational use. Contributes to downstream water quality problems. Adaptive Capacity: - Riverbank cleanup is labor-intensive and temporary without systemic waste collection improvement.	Medium	Major
Peri-urban and Agricultural Systems	Farmland is exposed to contamination from plastic waste (which does not decompose) and from using contaminated water (mixed with waste) for irrigation.	High	Sensitivity: - Soil contamination and reduced crop quality - Health risks from polluted irrigation water	Medium	Major

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Limited monitoring of soil and water quality. - Low uptake of safe waste reuse practices		

4. Climate Risk Assessment

The Climate Risk Assessment for Rumuruti Municipality provides a systematic analysis of current and future climate-related hazards and their potential impacts on urban systems, communities, and natural assets. Located within a climate-variable region of Laikipia County, Rumuruti is increasingly exposed to risks such as drought, flooding, Extreme Heat, land degradation, and solid waste-related environmental hazards, which interact with rapid urbanization and infrastructure constraints. This assessment evaluates exposure, sensitivity, and adaptive capacity across key sectors to identify priority risks and inform evidence-based adaptation and resilience planning aligned with municipal development objectives and county and national climate policies.

For this Urban Climate Risk Profile, the following matrix summarizes overall risk for each urban element by combining the assessed hazard level and the estimated impact level.

Table 24. Risk matrix

		Hazard Level		
		Low	Medium	High
Impact Level	Catastrophic	High	Very High	Very High
	Major	Medium	High	Very High
	Moderate	Low	Medium	High
	Minor	Low	Low	Medium
	Insignificant	Very Low	Low	Low

For this Urban Climate Risk Profile, risk levels should be interpreted based on the table below.

Table 25. Interpretation of risk levels

Level	Interpretation
Very High	Very high risks are unacceptable. Risk should be avoided, reduced or transferred. Immediate planning and implementation of risk reduction measures is required. Allocate resources and coordinate interventions to prevent or minimize impact.
High	High risks should be actively addressed. Develop and implement mitigation actions promptly. Monitor environmental indicators and ensure readiness of emergency or adaptation measures.
Medium	Medium risks should be managed. Plan and implement mitigation activities to reduce them to acceptable levels. Regularly review climate data and risk levels.
Low	Low risks are acceptable under current conditions. Minimal control or monitoring is needed, provided they remain stable and do not escalate.
Very Low	Very low risks are negligible in terms of likelihood and consequences. No immediate action is required beyond routine monitoring and periodic review.

4.1. Current and Future Climate Risks on Urban Elements

Rumuruti Municipality, the administrative headquarters of Laikipia West Sub-County in Kenya's Laikipia County, sits in a semi-arid agro-ecological zone characterized by low and highly variable annual rainfall (typically 400–500 mm), bimodal rainy seasons, and

increasing exposure to climate extremes. As a growing urban center reliant on rainfed peri-urban agriculture, limited water infrastructure, and natural ecosystems such as nearby wetlands (e.g., Ewaso Narok Swamp) and forests, Rumuruti faces escalating climate risks that threaten its urban elements—built infrastructure, essential services, resident populations, and natural assets.

Current Climate Risks Observed changes since the 1980s include a mean temperature rise of approximately 0.5–1°C (more pronounced in the first half of the year), erratic rainfall with shortened and drier long rains (March–May) and extended but variable short rains (October–December), and a marked increase in extreme precipitation events (from fewer than 3 per year in the 1980s to over 10 in some periods post-2000). Prolonged dry spells—averaging 30–45 days of moisture stress—and recurring droughts (at least 10 major seasons between 1990–2015) have intensified water scarcity, depleted groundwater, and strained urban water supply systems reliant on boreholes, pans, and seasonal rivers. Flash floods from intense rainfall events damage stormwater drainage, roads, bridges, and informal settlements, causing property loss, displacement, soil erosion, and waterborne diseases (e.g., cholera, typhoid). Land degradation from deforestation (county forest cover at ~6.7%, below national targets), overgrazing, charcoal burning, and wetland encroachment exacerbates runoff, reduces recharge, and heightens flood and drought vulnerability. Vulnerable populations—women, youth, children, persons with disabilities, resource-poor households, and informal settlement residents—bear disproportionate burdens, including extended water-fetching distances, food insecurity, livelihood disruptions (e.g., peri-urban crop failure), and health risks from Extreme Heat, pests, and disease vectors.

Future Climate Risks Projections under moderate (RCP 4.5) and high-emission (RCP 8.5) scenarios indicate continued warming (temperature increases of ~1.7°C by the 2050s and up to 3.5°C by century's end), more frequent and severe droughts (with extended consecutive dry days), intensified extreme rainfall events, and greater variability in precipitation patterns. Northern and western parts of Laikipia, including Rumuruti, are expected to experience reduced overall rainfall in key seasons, increased aridity, and higher evaporation rates, further depleting water resources and stressing urban and peri-urban systems. Flood risks will rise with heavier downpours, while prolonged dry spells and heatwaves amplify risks to energy demand, waste management (e.g., methane emissions from landfills), transport accessibility, and social infrastructure (e.g., schools and health facilities). Without adaptation, these trends could accelerate land degradation, biodiversity loss, invasive species spread, and resource conflicts, undermining urban resilience, economic stability, and equitable development. Vulnerable groups face heightened risks of malnutrition, school dropouts, migration, and social exclusion.

In summary, Rumuruti's urban elements are already under strain from compounding hazards drought-driven scarcity, flood-induced damage, and ecosystem degradation that disproportionately affect marginalized residents and informal areas. Future trajectories demand urgent, inclusive action to build resilience through hybrid structural, non-structural, and nature-based solutions aligned with municipal capacity, as outlined in Laikipia County's Climate Change Action Plan and related frameworks. Addressing these risks is essential not only for safeguarding infrastructure and services but for advancing equity, reducing inequality, and fostering sustainable urban development in a changing climate.

Table 26. Summary of Pluvial Flooding risks for Rumuruti Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Medium	Medium	High	Medium	High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Major	High	High	Very High	High	Very High
Water & Wastewater Management	Moderate	Medium	Medium	High	Medium	High
Solid Waste Management	Major	High	High	Very High	High	Very High
Transport and Mobility	Moderate	Medium	Medium	High	Medium	High
Energy	Insignificant	Low	Low	Low	Low	Low
Economic Infrastructure	Moderate	Medium	Medium	High	Medium	High
Social Infrastructure	Minor	Low	Low	Medium	Low	Medium
Emergency Services	Minor	Low	Low	Medium	Low	Medium
Populations						
Urban Residents	Moderate	Medium	Medium	High	Medium	High
Informal Settlement Residents	Major	High	High	Very High	High	Very High
Vulnerable and Marginalized Groups	Catastrophic	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Moderate	Medium	Medium	High	Medium	High
Urban Blue Infrastructure	Major	High	High	Very High	High	Very High
Peri-urban and Agricultural Systems	Major	High	High	Very High	High	Very High

Table 27. Summary of Drought risks for Rumuruti Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Medium	High	High	High	High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Minor	Low	Medium	Medium	Medium	Medium
Water & Wastewater Management	Major	High	Very High	Very High	Very High	Very High
Solid Waste Management	Moderate	Medium	High	High	High	High
Transport and Mobility	Major	High	Very High	Very High	Very High	Very High
Energy	Moderate	Medium	High	High	High	High
Economic Infrastructure	Major	High	Very High	Very High	Very High	Very High
Social Infrastructure	Major	High	Very High	Very High	Very High	Very High
Emergency Services	Major	High	Very High	Very High	Very High	Very High
Populations						
Urban Residents	Moderate	Medium	High	High	High	High
Informal Settlement Residents	Major	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Catastrophic	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Major	High	Very High	Very High	Very High	Very High
Urban Blue Infrastructure	Moderate	Medium	High	High	High	High
Peri-urban and Agricultural Systems	Major	High	Very High	Very High	Very High	Very High

Table 28. Summary of Extreme Heat risks for Rumuruti Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Medium	High	High	High	High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Minor	Low	Medium	Medium	Medium	Medium
Water & Wastewater Management	Major	High	Very High	Very High	Very High	Very High
Solid Waste Management	Major	High	Very High	Very High	Very High	Very High
Transport and Mobility	Major	High	Very High	Very High	Very High	Very High
Energy	Moderate	Medium	High	High	High	High
Economic Infrastructure	Catastrophic	Very High	Very High	Very High	Very High	Very High
Social Infrastructure	Major	High	Very High	Very High	Very High	Very High
Emergency Services	Major	High	Very High	Very High	Very High	Very High
Populations						
Urban Residents	Major	High	Very High	Very High	Very High	Very High
Informal Settlement Residents	Major	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Catastrophic	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Moderate	Medium	High	High	High	High
Urban Blue Infrastructure	Major	High	Very High	Very High	Very High	Very High
Peri-urban and Agricultural Svstems	Major	High	Very High	Very High	Very High	Very High

Table 29. Summary of Land Degradation risks for Rumuruti Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Medium	Medium	High	High	High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Major	High	High	Very High	Very High	Very High
Water & Wastewater Management	Major	High	High	Very High	Very High	Very High
Solid Waste Management	Moderate	Medium	Medium	High	High	High
Transport and Mobility	Moderate	Medium	Medium	High	High	High
Energy	Minor	Low	Low	Medium	Medium	Medium
Economic Infrastructure	Moderate	Medium	Medium	High	High	High
Social Infrastructure	Major	High	High	Very High	Very High	Very High
Emergency Services	Major	High	High	Very High	Very High	Very High
Populations						
Urban Residents	Moderate	Medium	Medium	High	High	High
Informal Settlement Residents	Major	High	High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Catastrophic	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Major	High	High	Very High	Very High	Very High
Urban Blue Infrastructure	Major	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Catastrophic	Very High	Very High	Very High	Very High	Very High

Table 30. Summary of Solid Waste Related risks for Rumuruti Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Low	Medium	Medium	High	High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Major	Medium	High	High	Very High	Very High
Water & Wastewater Management	Major	Medium	High	High	Very High	Very High
Solid Waste Management	Major	Medium	High	High	Very High	Very High
Transport and Mobility	Moderate	Low	Medium	Medium	High	High
Energy	Insignificant	Very Low	Low	Low	Low	Low
Economic Infrastructure	Major	Medium	High	High	Very High	Very High
Social Infrastructure	Moderate	Low	Medium	Medium	High	High
Emergency Services	Minor	Low	Low	Low	Medium	Medium
Populations						
Urban Residents	Major	Medium	High	High	Very High	Very High
Informal Settlement Residents	Major	Medium	High	High	Very High	Very High
Vulnerable and Marginalized Groups	Catastrophic	High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Moderate	Low	Medium	Medium	High	High
Urban Blue Infrastructure	Major	Medium	High	High	Very High	Very High
Peri-urban and Agricultural Systems	Major	Medium	High	High	Very High	Very High

4.2. Climate Risk Hotspots

Climate risks in **Rumuruti Municipality** are not evenly distributed across the urban area but vary spatially according to land use, topography, settlement patterns, and access to infrastructure and services. The **urban core and commercial center** experience heightened risks associated with **Extreme Heat, solid waste accumulation, and stormwater drainage congestion**, driven by dense development, extensive hard surfaces, and limited urban green cover. These areas are particularly prone to localized flooding during intense rainfall events due to blocked or undersized drains, as well as elevated public health risks from poor waste management and heat exposure in open markets and transport nodes.

The **informal and peri-urban settlements**, often located on **marginal land such as riparian zones, low-lying areas, or erodible slopes**, face the highest overall climate risk. These areas are disproportionately exposed to **flooding, land degradation, and water contamination**, compounded by inadequate drainage, unplanned development, insecure tenure, and limited access to basic services. Housing constructed with temporary materials and poor ventilation further increases sensitivity to Extreme Heat, while low household incomes constrain the ability to invest in adaptive measures.

In contrast, **planned residential neighborhoods and institutional areas** generally exhibit lower exposure and vulnerability due to better road networks, drainage, and service coverage. However, these areas are still affected by **water scarcity during prolonged dry periods**, rising temperatures, and localized erosion where vegetation cover has been removed. **Peri-urban agricultural zones** surrounding the municipality are particularly vulnerable to **drought, land degradation, and declining water availability**, which in turn affect urban food security and livelihoods. Overall, climate risk in Rumuruti reflects a clear spatial pattern where the greatest impacts are concentrated in densely populated, poorly serviced, and environmentally fragile areas, underscoring the need for place-based and equity-focused adaptation interventions.

5. What's Next?

5.1. Key Findings

The climate risk assessment for Rumuruti Municipality reveals that the area, situated in Laikipia County's semi-arid Laikipia West Sub-County, is already experiencing intensified hazards including prolonged dry spells leading to recurrent droughts, erratic and increasingly variable rainfall patterns, flash floods from extreme precipitation events, rising temperatures (with anomalies projected at +1.7°C by the 2050s under moderate scenarios), frost incidents, emerging pests and diseases, and widespread land degradation from deforestation, overgrazing, and wetland encroachment. These current risks severely impact urban elements such as water scarcity straining limited infrastructure, crop and livestock failures exacerbating food insecurity in peri-urban and informal settlements, infrastructure damage from floods and erosion, and heightened vulnerability among marginalized groups including women, youth, persons with disabilities, resource-poor households, and pastoralists, who face disproportionate livelihood disruptions, health risks, and social exclusion. Future projections under RCP 4.5 and 8.5 scenarios indicate continued warming (up to +3.5°C by century's end), more frequent and intense droughts in arid zones, variable but potentially decreasing seasonal rainfall (particularly in March-May and October-December), increased extreme rainfall events, and greater overall aridity, which could amplify water stress, ecosystem degradation, resource conflicts, and economic instability without intervention. These findings underscore the urgent need for Rumuruti to prioritize inclusive, capacity-aligned adaptation and resilience-building measures—integrating structural upgrades, non-structural policies and community education, and nature-based solutions such as rainwater harvesting, wetland restoration, and urban greening—to safeguard urban residents, infrastructure, services, and natural assets while advancing equity and sustainable development in line with Laikipia County's Climate Change Action Plan and national frameworks. The next steps involve translating these insights into prioritized, phased implementation strategies, stakeholder engagement for co-design, securing funding through mechanisms like FLLoCA, and establishing monitoring systems to track progress and adaptive management.

Table 31. Summary of climate risks affecting urban elements for Rumuruti Municipality

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Infrastructure & Services			
Stormwater Drainage	Pluvial flooding	- Pluvial flooding - Solid waste related risks	Pluvial Flooding
Water & Wastewater Management	- Drought - Extreme Heat	- Drought - Extreme Heat	Drought
Solid Waste Management	- Solid waste related risks - Pluvial flooding	- Solid waste related risks - Pluvial flooding	- Solid Waste related risks - Pluvial flooding
Transport and Mobility	Pluvial flooding	Pluvial flooding	Pluvial flooding

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
		• Extreme Heat	• Extreme Heat
Energy	• Extreme Heat	• Extreme Heat	• Extreme Heat
Economic Infrastructure	• Pluvial flooding	• Pluvial flooding	• Pluvial flooding • Extreme Heat
Social Infrastructure	• Pluvial flooding	• Pluvial flooding • Extreme Heat	• Pluvial flooding • Extreme Heat
Emergency Services	• Pluvial flooding	• Pluvial flooding	• Pluvial flooding
Populations			
Urban Residents	• Extreme Heat	• Extreme Heat	• Pluvial flooding • Extreme Heat
Informal Settlement Residents	• Pluvial flooding • Drought • Extreme Heat	• Pluvial flooding • Drought • Extreme Heat	• Pluvial flooding • Drought • Extreme Heat
Vulnerable and Marginalized Groups	• Pluvial flooding • Drought • Extreme Heat • Land degradation	• Pluvial flooding • Drought • Land degradation • Extreme Heat	• Pluvial flooding • Drought • Land degradation • Extreme Heat
Natural Assets			
Urban Green Infrastructure	• Drought	• Drought • Extreme Heat • Pluvial flooding	• Drought • Extreme Heat • Pluvial flooding
Urban Blue Infrastructure	• Pluvial flooding • Land degradation	• Drought • Extreme Heat • Pluvial flooding	• Drought • Extreme Heat • Pluvial flooding
Peri-urban and Agricultural Systems	• Drought • Extreme Heat • Pluvial flooding • Land degradation	• Drought • Extreme Heat • Pluvial flooding • Land degradation	• Drought • Extreme Heat • Pluvial flooding • Land degradation

Based on the climate risk assessment, a central and urgent conclusion is that the city's future resilience will be determined by its capacity to manage the dual, interlocking crisis of drought and Extreme Heat. While pluvial flooding presents acute shocks, the chronic, pervasive, and intensifying threats of water scarcity and extreme heat form the fundamental climate challenge, undermining the city's ecological, social, and infrastructural foundations.

Drought is the critical long-term resource constraint, directly threatening the core utility of water and wastewater management and driving a cascading crisis for natural and agricultural systems. It depletes urban green infrastructure, exacerbates land degradation, and strains the water-dependent cooling of energy generation. Concurrently, Extreme Heat acts as a powerful force multiplier on this scarcity, dramatically increasing urban water demand for both human consumption and ecosystem irrigation while simultaneously reducing the efficiency and increasing the failure rates of critical infrastructure, from the energy grid to social services. This combination creates a vicious cycle: drought reduces water availability for cooling and irrigation, which in turn diminishes the natural and engineered capacity to mitigate heat, leading to greater strain and vulnerability.

The human toll of this compound hazard is severe and inequitable. Extreme Heat is the dominant health and productivity risk for the general urban population, while drought compounds food and water insecurity, particularly for vulnerable groups and informal settlements. Together, they degrade the very natural assets—urban greenery and blue spaces—that are essential for climate regulation, water absorption, and community well-being. Therefore, strategic adaptation must pivot to prioritize an integrated water-energy-heat nexus approach. This requires moving beyond isolated responses to instead champion water conservation as critical heat mitigation, expand nature-based solutions for cooling and groundwater recharge, harden infrastructure against thermal stress, and proactively protect the most vulnerable populations from this escalating, chronic emergency.

Solid waste related risks represent a persistent and escalating operational and environmental hazard for the city. Currently centered on clogged drainage, public health issues, and pollution, these risks directly intensify pluvial flooding. By mid-century, flooding is projected to become the primary amplifier of waste-related problems, dispersing contaminants and creating complex contamination events. Looking to 2100, the interaction with Extreme Heat will likely worsen, accelerating decomposition and leachate production, thereby turning waste management into a more toxic and volatile challenge under a hotter climate.

Land degradation operates as a slower yet fundamentally eroding process that undermines the city's ecological foundation. It is a key threat to vulnerable populations, urban blue infrastructure, and peri-urban agricultural systems. This degradation—manifesting as soil erosion, compaction, and loss of fertility—directly reduces the land's natural capacity to absorb stormwater (worsening flood impacts), sustain food production, and support the green spaces critical for cooling and biodiversity. Over the long term, it acts as a risk multiplier, diminishing the natural assets the city depends on for resilience against droughts, floods, and heat

5.2. Climate Adaptation and Resilience Solutions

Table 32. Climate adaptation and resilience solutions recommended for Rumuruti Municipality

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Infrastructure & Services			
Stormwater Drainage	- Launch a community “Adopt A Drain” clean-up program for desilting existing channels through the MED - Routine drain clearance linked to solid waste control.	- Upgrade culverts with permeable materials - Enact and enforce a stormwater management bylaw	Implement a comprehensive, climate-designed grey-green drainage master plan for the urban core
Water & Wastewater Management	- Promote household rainwater harvesting e.g. gutter systems and storage tanks. - Protection of water points and boreholes through the County Department of Water. - Greywater reuse demos in schools/ public facilities.	- Construct community-level harvesting pans/wetlands for treatment - Protect and rehabilitate critical upstream catchment areas - Expansion of water storage and rainwater harvesting in public facilities	- Full wastewater treatment plant integrated with blue infrastructure (e.g., restored riparian zones) - Climate-resilient piped water supply expansion with groundwater recharge via wetlands - Implement integrated water resource management (IWRM) through collaboration with WRA - Full wastewater treatment plant integrated with blue infrastructure (e.g., restored riparian zones)
Solid Waste Management	- Organize monthly community clean-ups in partnership with youth groups & CBOs. - Improved waste collection coverage in informal and low-income areas through the MED - Community awareness and source separation	- Integrate composting into urban agriculture - Establish community collection points - Formalize and support waste-picker cooperatives, integrating them into the municipal system.	- Develop a sanitary landfill with proper lining and leachate management. - Implement a “polluter-pays” principle and extended producer responsibility (EPR) schemes.

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Transport and Mobility	- Promote non-motorized paths with shade trees - Routine road maintenance schedules - Grade and gravel key access roads in informal settlements.	- Upgrade footpaths/cycle lanes with permeable surfaces - Plant native, drought-resistant trees along major transit corridors for shade. - Construct all-weather paved roads connecting to economic zones.	Develop a climate-resilient, integrated urban mobility plan prioritizing non-motorized and public transit
Energy	- Promote and subsidize the sale of affordable, efficient cookstoves to reduce deforestation. - Install solar street lights in high-traffic public areas. - Solar lantern distribution for vulnerable households - Energy efficiency awareness through community <i>barazas</i>	- Pilot public-private partnerships for solar micro-grids in underserved neighborhoods. - Retrofit key public buildings (clinics, administration) with solar PV and cool roofs.	- Transition municipal operations to 100% renewable energy; establish a municipal energy efficiency fund for businesses and households. - Energy-efficient buildings with passive design
Economic Infrastructure	- Market shading with trees for resilience (nature-based). - Provide climate risk training and micro-grants to small businesses for basic weatherproofing	- Climate-resilient market redevelopment incorporating drainage and shading - Develop a covered, ventilated municipal market with rainwater harvesting.	- Develop climate-resilient industrial parks with integrated water recycling and green spaces. - Diversified, low-carbon local economic hubs
Social Infrastructure	- Install solar-powered fans and rainwater tanks in all schools and health clinics. - Awareness programs for vulnerable groups.	Retrofit facilities with rainwater harvesting, Extreme Heat and flood resilience.	Mandate and enforce climate-resilient building codes for all new public infrastructure.
Emergency Services	- Develop and communicate early warning systems for heatwaves and flash floods via community radio. - Pre-position emergency supplies in vulnerable areas	- Train and equip community-based disaster response teams (CBDRTs). - Establish a dedicated emergency operations center. - Strengthening emergency access routes and equipment	- Integrated disaster risk management and response systems. - Integrate real-time climate data

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Populations			
Urban Residents	Launch public awareness campaigns on Extreme Heat, water conservation, and flood preparedness.	- Livelihood programs in climate-smart agriculture - Participatory planning - Establish community resilience hubs in each ward for information and training. - Support establishment of community gardens and tree nurseries.	- Foster strong community networks and social capital as a core resilience strategy. - Inclusive urban policies for resilience - Mainstreaming climate resilience into urban living standards
Informal Settlement Residents	- Drainage improvements and waste services in informal areas. - Rainwater harvesting pilots - Community clean-ups and bunds	- Co-design and implement in-situ upgrading projects featuring rain gardens drainage, communal water points, waste services, and shaded green spaces. - Formalize land tenure to enable investment in resilience.	- Fully integrate upgraded informal settlements into the municipal service grid with secure tenure. - Inclusive, climate-resilient neighborhood redevelopment
Vulnerable and Marginalized Groups	- Create targeted social protection programs (e.g., cash-for-work in resilience projects) for the elderly, disabled, and low-income households. - Targeted awareness and asset provision (e.g., water tanks)	- Training in NbS for livelihoods (e.g., agroforestry) - Priority access to resources - Ensure all new public spaces and infrastructure are universally accessible.	- Equity-focused policies and monitoring - Mainstream gender and social inclusion in all municipal planning and budgeting processes.
Natural Assets			
Urban Green Infrastructure	- Launch a "Tree Planting Week" focusing on public spaces and schools using drought-tolerant species. - By-laws to protect existing mature trees and green spaces.	Develop linear parks and green corridors along drainage ways and roads.	- Connected green networks for cooling, drainage, and biodiversity - Achieve and maintain a minimum urban tree canopy cover target (e.g., 20%)
Urban Blue Infrastructure	- Remove solid waste from and rehabilitate sections of critical streams. - Enforcement of riparian protection and buffer zones	- Restore riparian buffers along urban waterways with native vegetation. - Construct artificial wetlands for wastewater polishing. - Rehabilitation of rivers and wetlands for flood attenuation	Fully restore the hydrological function of urban streams as part of the green-blue network.

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Peri-urban and Agricultural Systems	• Train farmers on climate-smart agriculture (CSA) techniques like drought-resistant crops and zai pits. • Promote agroforestry	• Develop community-managed small-scale irrigation using harvested runoff. • Support farmers' cooperatives for collective marketing and seed banks.	• Resilient peri-urban landscapes supporting food security and ecosystem services. • Implement large-scale landscape restoration and soil conservation in the municipality's watersheds.

These solutions prioritize community ownership (e.g., via FLLoCA-inspired local investments), low-cost starts (e.g., using existing tree nursery), and equity (e.g., targeting informal/vulnerable areas). Implementation should involve stakeholder engagement, monitoring, and alignment with county plans for funding/sustainability. Prioritize pilots in high-risk areas for quick wins and scaling.

Across all phases and sectors, recommended solutions:

- **Prioritize informal settlements and low-income areas**, where exposure and vulnerability are highest.
- **Reduce service inequities** in drainage, water, waste, and energy provision.
- **Strengthen participation of women, youth, elderly, and marginalized groups** in planning and implementation.
- **Favor low-regret, scalable interventions** that can be expanded as municipal capacity grows.
- **Combine adaptation and mitigation**, especially through energy efficiency, renewables, and nature-based solutions.

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Annex 1. Historical Hazard Events

Hazard Event/Type	Drought
Date or Period	2014-2016
Location	Rumuruti town & peri-urban wards
Intensity	Part of 2014–2016 national drought emergency
Social Impacts	Food insecurity for pastoral & low-income households; malnutrition in children; increased water-fetching burden on women & girls.
Physical Impacts	Borehole yields dropped significantly; urban water supply rationing; drying of seasonal pans & shallow wells
Economic Impacts	Major livestock deaths (cattle, goats); peri-urban crop failure (maize, beans, potatoes); rising food prices
Ecological Impacts	Severe vegetation die-off; loss of grazing & browse; reduced soil moisture & groundwater recharge

Annex 2. Data Sources

Page	Data	Data Source
11–12	Key climate hazards (pluvial flooding, drought, extreme heat, land degradation, solid waste related risks)	Laikipia County Climate Change Action Plan (2023–2027); Participatory Climate Risk Assessments (PCRA/FLLoCA); NDMA Drought Bulletins
12	Climate indicators and hazard thresholds (intense rainfall, prolonged dry spells, mean annual temperature, vegetation cover loss, waste collection coverage)	KMD (rainfall & temperature data); WRA (groundwater abstraction vs recharge); SPEI Database; NDVI satellite data; County Environment Office & NEMA reports
12–13	Current and future hazard levels (baseline and projections to 2050 & 2100 under SSP2-4.5 and SSP5-8.5)	KMD historical trends & climate summaries; NCCD; IPCC-aligned downscaled projections (CMIP6/CORDEX); Laikipia County CIDP
13	Current and future hazard impact areas (spatial description – maps referenced)	Municipal engineering records; Laikipia County spatial data; Community consultations (FLLoCA/PCRA)
14–15	Urban elements inventory (infrastructure, populations, natural assets)	KNBS 2019 Census; Rumuruti Municipality records; NYAHUWASCO; KFS; County Dept. of Agriculture; County Dept. of Social Services
16–26	Exposure, vulnerability and impact tables (Tables 17–19: Pluvial Flooding)	Municipal engineering records; Community consultations (African Location, Kandutura); KMD rainfall data; WRA borehole data
26–32	Exposure, vulnerability and impact tables (Table 20: Drought)	WRA groundwater data; NDMA drought bulletins; County water department; KMD seasonal rainfall deviation; SPEI Database
32–37	Exposure, vulnerability and impact tables (Table 21: Extreme Heat)	KMD temperature records; NCCD; KNBS climate summaries; Municipal health & education facility reports
37–42	Exposure, vulnerability and impact tables (Table 22: Land degradation)	County Environment Office; NEMA reports; NDVI satellite data; Community observations
42–47	Exposure, vulnerability and impact tables (Table 23: Solid Waste Related risks)	County Environment Department; WRA borehole water quality data; Municipal waste management records; Community consultations
34–38	Current & future climate risks	KMD long-term climate data; NCCD; Laikipia County

	narrative (observed changes since 1980s, projections)	Climate Change Action Plan; IPCC RCP/SSP projections
38	Climate risk hotspots (urban core, informal settlements, peri-urban agriculture)	Participatory mapping (PCRA/FLLoCA); Municipal spatial planning data; Community & ward-level consultations
39	Key findings (intensified hazards, future projections, equity implications)	Synthesis of KMD, NDMA, WRA, NEMA, KNBS, and participatory assessments
40–63	Climate adaptation and resilience solutions (Table 32)	Laikipia County Climate Change Action Plan; FLLoCA guidelines; GCA Urban Climate Risk Profile Preparation Guidelines (2025); Municipal engineering & environment unit inputs
60	Summary of climate risks affecting urban elements (Table 31)	Synthesis of Tables 19–23 and hazard projections (KMD, WRA, NDVI, NDMA)
Various (Tables 1–5, 26–30)	Summary risk tables (pluvial flooding, drought, extreme heat, land degradation, solid waste)	Derived from exposure/vulnerability tables (3.2), hazard levels (2.3), and risk matrix (Table 24)