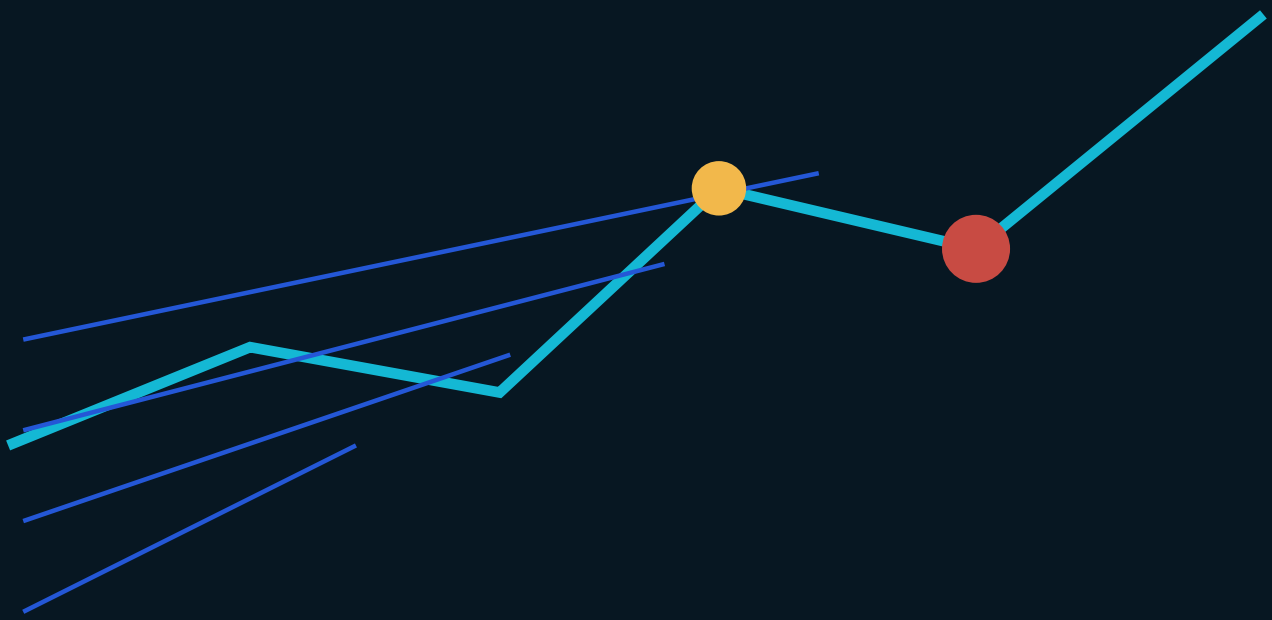
TECHNICAL METHODOLOGY AND USER GUIDE

Ngong Drainage Explorer

A transparent guide to the screening logic, data sources, table meanings, map layers, limitations, and field verification workflow.

Prepared for	Ngong Municipality Board of Directors
Prepared by	Michael Bartonjo, PZGL Studios
Technical snapshot	1,402 flagged locations | Generated 22 to 23 August 2026
Report date	24 August 2026



SECTION 01

Technical summary

The Explorer is a prioritisation aid for field investigation. It is not a flood model, engineering design, or asset-condition survey.

1,402
flagged locations

216
Priority 1

642
Priority 2

544
Review

The workflow compares mapped buildings and roads with terrain-predicted flow paths generated from Copernicus DEM GLO-30. It calculates the nearest modelled separation, assigns a corridor class, and applies distance bands to create three investigation classes.

Decision boundary

A flag means that a mapped asset is close enough to a terrain-predicted flow path to justify verification. It does not prove that flooding has occurred, that the asset caused flooding, that drainage capacity is inadequate, or that an unmapped culvert or drain is absent.

CURRENT EVIDENCE	CORRECT USE	REQUIRED CONFIRMATION
Terrain form, predicted flow corridors, mapped assets, mapped surface water, and the current OSM drainage record.	Prioritise inspections, organise ward work, compare clusters, and prepare a verification list.	Field observation, municipal asset records, levels survey, culvert checks, drainage condition, capacity, and rainfall evidence.

SECTION 02

Purpose, users, and evidence status

The Explorer was designed as a municipal decision-support tool. It turns a large geospatial screening output into a map and sortable table that can be used in a board presentation, technical review, or ward-level inspection planning session.

USER	PRIMARY QUESTION	APPROPRIATE ACTION
Board and executive team	Where should limited verification funds be directed first?	Approve a bounded investigation programme and require a verified evidence return.
Municipal engineer	Which clusters need inspection, survey, or records review?	Create routes, assign staff, and attach field findings to the flagged record.
Ward and planning teams	Which mapped buildings and roads intersect the screening pattern?	Check local names, recent works, known drainage assets, and access constraints.
Consultant or analyst	How was each flag generated, and can it be reproduced?	Re-run the documented workflow on refreshed, quality-controlled inputs.

Evidence status is preserved throughout the tool. Terrain-predicted flow remains model-derived. Roads, buildings, and named watercourses are mapped evidence. Engineered drainage is limited to explicitly mapped public records. The municipal outline remains provisional.

Recommended language

Say: 'screening priority for verification'. Avoid saying: 'confirmed flood hotspot', 'failed drain', or 'missing culvert' unless field evidence supports that statement.

SECTION 03

How to use the Explorer

1

Set the question
Choose the ward, priority class, asset type, and contributing-area range that match the investigation task.

2

Read the pattern
Use the map to identify clusters and their relationship to mapped surface water, terrain contours, roads, and predicted flow paths.

3

Select one location
Click a table row. The map centres and zooms to the selected flag, while other Priority 1, Priority 2, and Review markers are hidden.

4

Inspect the detail below the map
Read the asset type, ward, priority, flow-path distance, corridor, and contributing area. Use the Google Maps link only as a contextual cross-check.

5

Record the next action
Assign records review, site inspection, survey, or no-action with a reason. The screening class should not be treated as a final engineering decision.

Map reset

Close the selected-location detail to restore all filtered markers. Local roads and minor terrain-predicted flow paths remain off by default to reduce clutter and can be enabled when needed.

SECTION 04

Flagged locations table: column dictionary

COLUMN	MEANING AND SAFE INTERPRETATION
Location reference	A readable asset description plus ward. A linked Google Maps search supports context checking. It is not a verified building name unless a mapped name exists.
Asset	The mapped infrastructure class: building, local road, secondary road, or primary road.
Ward	The ward assigned by spatial overlay in the dashboard. It should be checked where boundaries are disputed or provisional.
Priority	The rule-based investigation class created from corridor type and modelled separation.
Flow-path distance (m)	The shortest sampled separation from the asset geometry to the nearest terrain-predicted flow segment. It is not distance to a mapped river, stream, or water body.
Area (km2)	The upstream contributing terrain area attached to the nearest predicted flow segment. It is not the asset footprint area and is not a measured flood extent.
Corridor	Primary or minor terrain-predicted flow class. This field does not describe the road hierarchy.

The default sort is priority first, then flow-path distance. A smaller distance can guide inspection order within a class, but it does not replace evidence about drainage condition, rainfall, slope, building level, or road profile.

SECTION 05

Map layer dictionary

LAYER	VISUAL ENCODING	MEANING
Surface water: rivers	Cyan, heavier line	Locally mapped OSM river centrelines. Regional RiverATLAS centrelines are excluded at every zoom.
Surface water: streams	Cyan, lighter line	Locally mapped OSM stream centrelines.
Surface water: water bodies	Cyan fill	JRC and mapped water-body polygons. Included with the surface-water network.
20 m terrain contours	Brown-grey, 1.2 times line weight	Genuine 20 m selections from the underlying 10 m Copernicus-derived contour dataset.
Terrain-predicted primary flow	Cobalt, heavier smooth line	D8 flow accumulation at or above 1 km2 contributing area.
Terrain-predicted minor flow	Cobalt, lighter smooth line	D8 flow accumulation from 0.25 km2 to below 1 km2. Off by default.
Engineered drainage	Maroon	Only explicitly mapped drainage features. Five features are present in the current snapshot.
Roads	Sunset yellow family	Primary and secondary roads are visible. Local roads are off by default.
Boundaries	Neutral outlines	Ward and municipal reference geometry. The municipal outline is provisional.
Flag markers	Red, amber, aubergine	Priority 1, Priority 2, and Review investigation classes.

SECTION 06

Source datasets and provenance

DATASET	SNAPSHOT / ROLE	LICENCE AND SOURCE
Copernicus DEM GLO-30	Retrieved 21 Aug 2026. Elevation, contours, sink-filled terrain, D8 flow direction, and accumulation.	Copernicus data licence. dataspace.copernicus.eu
OpenStreetMap	Snapshot 21 to 22 Aug 2026. Buildings, roads, named places, mapped rivers and streams, and mapped engineered drainage.	ODbL. openstreetmap.org/copyright
JRC Global Surface Water v1.4	Water-body context used in the surface-water network.	European Commission reuse notice. global-surface-water.appspot.com
Kenya ward boundaries	Ward overlays used for filtering and location summaries.	Administrative reference dataset held in the project. Confirm custodian and version before formal publication.
Ngong Municipality public information	Published coordinate extent, area figure, and ISUDP boundary reference used to build the provisional municipal geometry.	ngongmunicipality.kajiado.go.ke/about/ and /documents/
RiverATLAS	Retained as an upstream regional reference in the source audit, but its coarse centrelines are excluded from the Explorer at every zoom.	HydroATLAS terms. hydrosheds.org/products/hydroatlas

Publication control

Record the exact ward-boundary custodian, release date, and licence before issuing the Explorer as an official municipal dataset. Current use is suitable for internal screening with the provisional status stated.

SECTION 07

How the tool was built

STAGE	PROCESSING ACTION
1. Prepare extent	Select four shared-grid GLO-30 terrain tiles, create a provisional municipal geometry, and clip project layers.
2. Derive terrain	Read the clipped DEM, compute elevation statistics, generate contours, fill sinks, then calculate D8 flow direction and accumulation.
3. Classify flow	Mark terrain corridors at 0.25 km2 and 1 km2 contributing-area thresholds. The higher threshold becomes primary flow.
4. Index segments	Split terrain-flow lines into segments and add them to a 30 m spatial grid. Search up to 100 m around candidate asset samples.
5. Screen assets	Compare building-ring vertices and road vertices with the indexed terrain-flow segments using point-to-line-segment distance.
6. Classify flags	Apply the corridor-specific distance bands shown in Section 09. Store priority, confidence, corridor, distance, area, asset identity, and map point.
7. Enrich dashboard	Resolve ward, create readable location references, embed simplified map layers, and provide filters, sorting, centred selection, and detail below the map.

The Explorer is delivered as a self-contained HTML file. The map is drawn in the browser from embedded vector arrays, so the core interaction does not depend on a live web-map tile service.

SECTION 08

Terrain-predicted flow derivation

The terrain model starts with Copernicus DEM GLO-30 elevation. Depressions are filled to permit continuous drainage routing. A D8 algorithm assigns each grid cell to its steepest downslope neighbour, then accumulation counts the upstream terrain draining through each cell.

DERIVED CLASS	CONTRIBUTING AREA	PURPOSE
Minor terrain-predicted flow	At least 0.25 km2 and below 1 km2	Shows smaller headwater and local convergence paths. These are screening paths, not confirmed streams.
Primary terrain-predicted flow	At least 1 km2	Shows larger accumulation corridors used for the strongest investigation bands.

Why predicted and mapped water can differ

Mapped rivers and streams describe recorded surface-water features. Terrain-predicted paths describe where the DEM routes accumulated runoff. Differences can arise from DEM resolution, culverts, embankments, channel modification, mapping gaps, sinks, bridges, roads, and the fact that a predicted path is not automatically a perennial or named watercourse.

Contours in the Explorer are now shown every 20 m. They are selected from the project's genuine 10 m contour dataset. The Explorer does not interpolate extra lines between 50 m indexes.

SECTION 09

Flag-generation criteria

This classification matrix is the current code-level source of truth.

NEAREST CORRIDOR	DISTANCE BAND	CLASS	CONFIDENCE LABEL	OUTCOME
Primary	0 to 15 m	**Priority 1**	Higher	Flag
Primary	>15 to 30 m	**Priority 1**	Moderate	Flag
Primary	>30 to 60 m	**Priority 2**	Moderate	Flag
Primary	>60 to 100 m	**Review**	Lower	Flag
Primary	>100 m	None	Not assigned	Not flagged
Minor	0 to 15 m	**Priority 2**	Moderate	Flag
Minor	>15 to 30 m	**Review**	Lower	Flag
Minor	>30 m	None	Not assigned	Not flagged

Important correction

A minor terrain-predicted flow path does not generate Priority 1 under the current code. Minor paths generate Priority 2 within 15 m and Review from above 15 m to 30 m.

SECTION 10

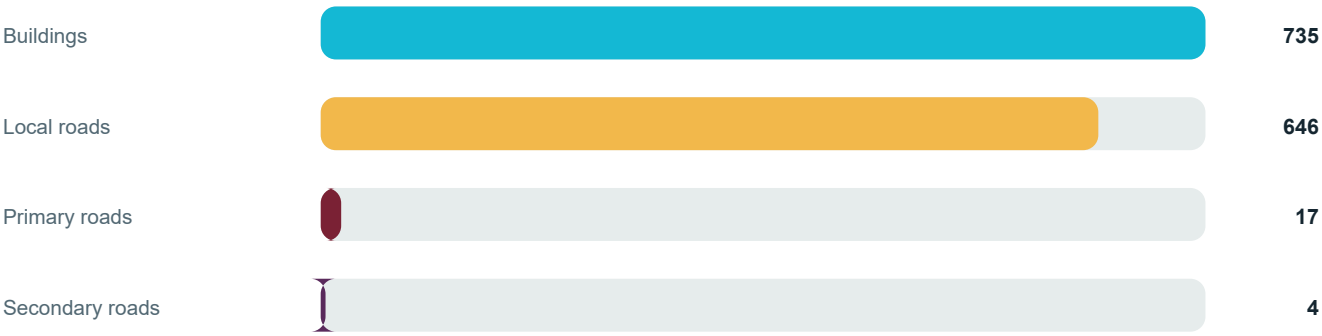
Distance calculation and location placement

ELEMENT	CURRENT IMPLEMENTATION	IMPLICATION
Projection	Local equirectangular conversion centred near latitude -1.379 and longitude 36.686. Latitude uses 111,132 m per degree. Longitude is adjusted by cosine of the reference latitude.	Suitable for short local screening distances, but not a substitute for an authoritative projected survey coordinate system.
Flow distance	Point-to-line-segment Euclidean distance to the nearest indexed terrain-flow segment within the 100 m search envelope.	The result is modelled plan distance. It is not along-channel distance, travel distance, or hydraulic head.
Buildings	All polygon-ring vertices are sampled. The minimum sample distance is classified. The marker is displayed at the first-ring centroid.	The marker can be visually offset from the exact closest building edge. A closest point between source vertices can be understated or overstated.
Roads	Road vertices are sampled. The closest sampled road vertex becomes the marker.	The true closest point may lie between vertices. Densification would improve geometric precision.
Spatial index	Flow segments are stored in 30 m grid cells with a 100 m search radius.	This improves performance while covering the widest classification band.

Distances are rounded to 0.1 m in the output. That display precision should not be interpreted as survey accuracy. The terrain model, source geometry, and vertex-sampling method set the real uncertainty.

SECTION 11

Screening output: current composition

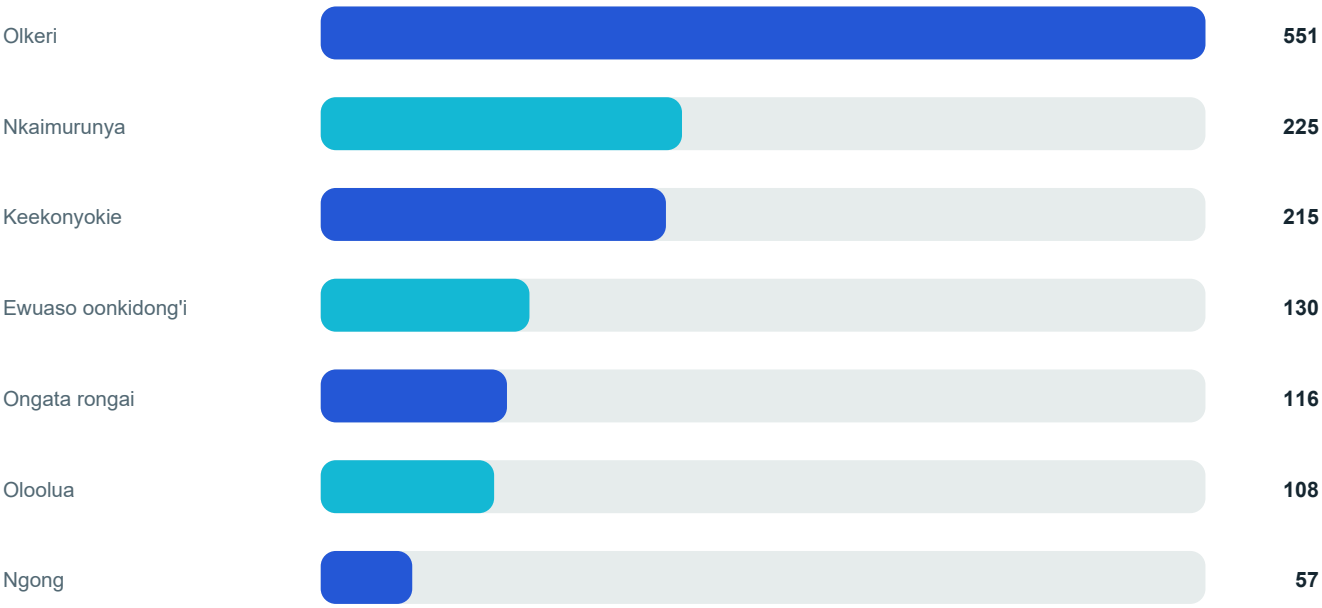


PRIORITY	BUILDING	LOCAL ROAD	PRIMARY ROAD	SECONDARY ROAD	TOTAL
Priority 1	77	136	3	0	**216**
Priority 2	336	294	9	3	**642**
Review	322	216	5	1	**544**
Total	**735**	**646**	**17**	**4**	**1402**

The nearest predicted corridor is primary for 651 flags and minor for 751 flags. Counts describe the current source snapshot and will change when inputs or rules are refreshed.

SECTION 12

Ward screening counts



WARD	FLAGGED LOCATIONS	SHARE OF TOTAL
Olkeri	551	39.3%
Nkaimurunya	225	16.0%
Keekonyokie	215	15.3%
Ewuaso oonkidong'i	130	9.3%
Ongata rongai	116	8.3%
Oloolua	108	7.7%
Ngong	57	4.1%

Do not rank wards by count alone

Counts depend on mapped asset density, ward size, source completeness, and the extent of predicted corridors. A ward with fewer flags can still contain a high-consequence location. Use the filters and field evidence together.

SECTION 13

Output fields and data tables

FIELD	DEFINITION
id / hotspot_id	Stable derived identifier formed from the asset feature identifier.
asset_type	building, road-local, road-secondary, or road-primary.
asset_osm_id	Identifier inherited from the mapped source asset.
coordinates	Point used to display the flag and open contextual map search.
distance_m	Rounded sampled separation to the nearest terrain-flow segment.
corridor	primary or minor terrain-predicted flow.
contributing_area_km2	Upstream terrain area associated with the nearest flow segment.
priority	Priority 1, Priority 2, or Review, assigned by the matrix in Section 09.
confidence	higher, moderate, or lower. This is a rule label tied to distance band, not a statistical probability.
source / sourceDate	Processing lineage and snapshot date.
evidenceStatus	terrain-derived for the screening result.
interpretation / limitation	Safe-use statement stored with every GeoJSON feature.

SECTION 14

Limitations, uncertainty, and robustness

ISSUE	EFFECT ON INTERPRETATION
Terrain resolution	GLO-30 supports municipal screening, but cannot resolve every ditch, kerb, culvert, wall, crown, invert, or building threshold.
Hydraulic process	D8 terrain routing does not simulate rainfall intensity, infiltration, pipe capacity, blockage, backwater, ponding depth, duration, or flood velocity.
Mapped asset completeness	OpenStreetMap varies by place and feature type. The absence of a mapped drain, building name, stream, or culvert is not evidence that it does not exist.
Engineered drainage	Only five explicitly mapped drainage features are present. Municipal drawings, maintenance records, and site inspection are required.
Geometry sampling	Building and road vertices are sampled. Exact edge-to-line distance and road densification are not yet used.
Boundaries	The municipal outline is provisional. Ward overlays require version and custodian confirmation for official use.
Priority semantics	The classes express investigation urgency under the defined rules. They do not estimate annual probability, damage, population exposure, or cost.
Snapshot age	The result reflects source data retrieved in August 2026. New construction, road works, channels, and drainage interventions may be absent.

SECTION 15

Field verification protocol

STEP	MINIMUM EVIDENCE TO RECORD	RESULT
1. Desktop preparation	Flag ID, ward, asset, route access, recent works, known drainage records, and rainfall reports.	Inspection sheet and assigned owner.
2. Site locate	Photographs in four directions, GPS position, asset identity, road/building level context, and access constraints.	Location confirmed, relocated, or not found.
3. Drainage check	Visible channel, inlet, outlet, culvert, ditch, pipe, blockage, erosion, sediment, and flow direction.	Mapped asset record and condition note.
4. Level check	Indicative cross-fall, low point, invert, threshold, embankment, and obstruction. Use survey where consequence is high.	Screening hypothesis supported, contradicted, or unresolved.
5. Consequence check	Buildings, road function, public facilities, access routes, vulnerable users, and observed flood evidence.	Consequence category and escalation decision.
6. Close-out	Named reviewer, date, evidence links, recommended intervention or further study, cost range, and approval status.	Auditable municipal action record.

Escalate before design

Any proposed culvert, channel, road-level change, or building-protection measure should follow survey, catchment review, hydraulic assessment, utility checks, land and access confirmation, and municipal approval.

SECTION 16

Refresh, quality assurance, and change control

- Archive the exact DEM tiles, OSM extract, ward boundaries, municipal geometry, processing scripts, and generated outputs under a dated release identifier.
- Re-run source checks before each formal issue. Compare feature counts, bounds, missing fields, duplicate identifiers, invalid geometries, and unexpected priority shifts.
- Recalculate flags whenever terrain-flow rules, distance bands, source geometries, or asset classes change. Do not patch priority labels manually in the dashboard.
- Validate that the classification matrix, dashboard copy, methodology report, and exported GeoJSON all state the same thresholds.
- Test map controls, filtering, table selection, centred zoom, marker isolation, detail placement, layer defaults, legend collapse, and restoration after closing detail.
- Render and inspect the Explorer at desktop and mobile sizes. Check contrast, labels, line hierarchy, and whether dense clusters remain interpretable.
- Keep a decision log for confirmed field outcomes. Use those outcomes to test whether the current bands are over-inclusive or miss known problems before changing the model.

CURRENT AUTOMATED EXPLORER CHECKS	STATUS
Regional RiverATLAS centrelines excluded at every zoom	**Passed**
Genuine 20 m contour levels embedded and labelled	**Passed**
Surface-water corners rounded	**Passed**
Table selection centres the chosen flag and hides other markers	**Passed**
Closing detail restores all filtered markers	**Passed**

SECTION 17

Recommended next steps and further questions

SEQUENCE	ACTION	OWNER / OUTPUT
Immediate	Select a controlled live-demo cluster using recent rainfall evidence, accessibility, and representation of the screening logic.	Municipal engineer and presenter. Scripted 2 to 3 minute demonstration.
Before field mobilisation	Confirm municipal and ward geometry, obtain drainage asset records, and assign inspection owners.	Municipality. Approved field list and base records.
Field phase	Verify Priority 1 clusters first, then sample Priority 2 and Review locations to test false positives and model coverage.	Inspection teams. Geotagged evidence register.
Post-field	Reconcile observations with model classes and record confirmed, contradicted, unresolved, and intervention-needed outcomes.	Technical review. Updated evidence layer.
Before capital works	Commission survey and hydraulic design for high-consequence confirmed sites.	Municipality and appointed engineer. Design basis and costed programme.

Further questions for the board and technical team

- Which municipal drainage records, road designs, culvert schedules, and maintenance logs can be linked to the Explorer?
- Who is authorised to confirm the municipal boundary and the ward dataset version?
- Which recent rainfall incidents have verified dates, locations, impacts, and photographs suitable for testing the screening pattern?
- What consequence criteria should be added after field verification, such as public facility access, traffic disruption, building exposure, or repeated maintenance cost?
- What release and update cycle should the Municipality own after the initial investigation?

SECTION 18

Source register and reproducibility record

SOURCE	URL	USE IN THIS RELEASE
Ngong Municipality About page	https://ngongmunicipality.kajiado.go.ke/about/	Published coordinate extent, area, and jurisdiction description
Ngong Municipality documents library	https://ngongmunicipality.kajiado.go.ke/documents/	ISUDP boundary reference
Copernicus DEM GLO-30	https://dataspace.copernicus.eu/explore-data/data-collections/copernicus-contributing-missions/collections-description/COP-DEM	Terrain, elevation, contours, and indicative drainage
OpenStreetMap	https://www.openstreetmap.org/copyright	Roads, rail, mapped drainage, land use, buildings, and localities
RiverATLAS	https://www.hydrosheds.org/products/hydroatlas	Upstream regional reference only. Explorer centrelines excluded at every zoom.
JRC Global Surface Water v1.4	https://global-surface-water.appspot.com/	Surface water bodies
Kenya administrative ward boundaries	Project-held administrative dataset. Custodian and release metadata require confirmation.	Ward assignment, filtering, and ward counts.

Release record

ITEM	VALUE
Explorer	Ngong_Drainage_Explorer_Interactive.html
Flag output	conflicts.geojson, generated 22 Aug 2026
Source snapshot	Copernicus GLO-30 and OSM retrieved 21 to 22 Aug 2026
Current dashboard correction	20 m contours and regional RiverATLAS centrelines excluded at all zoom levels
Report generated	24 Aug 2026

Document status

This methodology records the current screening implementation. It should be versioned with the Explorer and updated whenever source data, thresholds, classification logic, or map behaviour changes.