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Data Release Notes

Name of the dataset	GRID3 NGA - Operational Wards v2.0
Name of the file	GRID3_NGA_operational_wards_v2_0.gpkg
Date of data release	April 13, 2026
File format	OGC geopackage
Dataset version	v2.0
Abstract	The *GRID3 NGA - Operational Wards v2.0* dataset contains operational ward boundaries for the following states: Adamawa, Bauchi, Bayelsa, Borno, Delta, Gombe, Jigawa, Kano, Katsina, Kwara, Niger, Ogun, Osun, Oyo, Yobe. This dataset is considered operational and has not been fully validated by government officials. The current version supersedes the GRID3 NGA - Operational Wards v1.0 dataset for these states: Adamawa, Bauchi, Bayelsa, Borno, Delta, Gombe, Jigawa, Kano, Katsina, Kwara, Ogun, Osun, Oyo, Yobe. The following changes were made: ● Updated wards' geometry ● Harmonized wards' names
Dataset citation	Center for Integrated Earth System Information (CIESIN), Columbia University 2026. GRID3 NGA - Operational Wards v2.0. New York: GRID3. https://doi.org/10.7916/gpv6-dq34. Accessed [DAY MONTH YEAR].
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Contacts and data queries	The authors of this dataset appreciate feedback regarding the data, including suggestions, discovery of errors, difficulties in using the data, and format preferences. For dataset-related questions, please send an email to: info@ciesin.columbia.edu

I. Data Inputs

Table 1 describes the input data used to create the *GRID3 NGA - Operational Wards v2.0* dataset.

Table 1 - Data Inputs

Source Name/ Description	Data format	Input year
Nigeria Harmonized Master List of Settlements (MLOS) v2.2 (unpublished)	Spatial points	2013- 2025
GRID3 NGA - Health Facilities v2.0	Spatial points	2024
Household registration data collected during bednet distribution campaigns in Adamawa, Delta, Gombe, Jigawa, Kaduna, Kano, Katsina, Kwara, Niger and Osun States by technical partners on behalf of the National Malaria Elimination Programme (NMEP).	Spatial points	2022-2023
Independent National Electoral Commission (INEC)'s Polling Unit Locations, downloaded from https://cvr.inecnigeria.org/pu between December 2024 and February 2025.	Spatial points	2023
Distribution hubs data collected in Osun State by the Society for Family Health (SFH) on behalf of the National Malaria Elimination Programme (NMEP).	Spatial points	2023
Settlements, health facility, and points of interest data collected in the Ogun, Jigawa, and Gombe States between February - April 2024 by the Society for Family Health (SFH) on behalf of GRID3, and in collaboration with the National Malaria Elimination Programme (NMEP) and CIESIN.	Spatial points	2024
Settlements, Health Facilities, and PoIs layers included in GRID3 NGA - Bayelsa State - Geospatial Base Layers - Unpublished 20251219	Spatial points	2013 - 2025
Settlements, Health Facilities, and PoIs layers included in GRID3 NGA - Oyo State - Geospatial Base Layers - Unpublished 20260210	Spatial points	2013-2025
Settlements, Health Facilities, and PoIs layers included in GRID3 NGA - Kano State - Geospatial Base Layers - Unpublished 20260120	Spatial points	2025
GRID3 Harmonized Ward and LGA names in Nigeria (internal,	Tabular	n.d.

Source Name/ Description	Data format	Input year
unpublished)[1]		
GRID3 NGA - Operational State Boundaries	Polygon	2020
Large Scale International Boundaries (LSIB) v11.4	Polyline	2025
GRID3 NGA - Roads v1.0	Polyline	2016 - 2025
GRID3 NGA - Travel Friction Surface v1.0	GRIDRaster	2024
Rivers and water bodies layer from ESRI's Environmental base map[2]	Webmap	Varies
Coastlines S2Coast-2023	Polyline	2023

II. Methodology

Preprocessing

All spatial point datasets, including settlements, health facilities, household registration points, and polling units, were compiled into a single master dataset. Each point was linked to a harmonized list of State, Local Government Area (LGA), and Ward names. Spatial points falling outside the GRID3 NGA - Operational State Boundaries dataset or beyond the national boundary, as per the LSIB v11.4, were excluded from further analysis.

Linear features

Two types of linear features were considered as barriers for defining spatial blocks and guiding ward boundary delineation:

1. Rivers/Water Networks – Derived using ESRI's basemap as a visual reference.
2. Road Networks – Sourced from OpenStreetMap (OSM), and Facebook's *Map with AI* roads dataset.

Roads data were filtered to include only the drivable network, classified using the highway key. The following road classes were included, in descending hierarchical order: motorway, trunk, primary, secondary, tertiary, unclassified, and residential. Link roads (e.g., highway on/off-ramps) were excluded.

[1] Data inputs used for LGA and Ward names harmonization include: eHealth Africa (Dec 2024), eHealth Africa and Proxy Logics (2020), Gates Foundation (Nov 2024), Independent National Electoral Commission, INEC (downloaded between December 2024 and February 2025), Manpower (downloaded Aug 2024), National Malaria Elimination Program, NMEP (2022–2024), Polio's National Emergency Operations Center, EOC (Dec 2024), WHO (Feb 2025).
[2] ESRI's Environmental base map includes the following data sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, © World Wildlife Fund, Inc., and the GIS User Community

Since OSM provides higher accuracy for major roads, Facebook data was used only for residential roads to supplement minor road coverage.

Block Creation

"Blocks" refer to areas bounded by roads, water features, and state boundaries. These spatial units were used to support the ward boundary delineation.

Two block datasets were created:

1. **Major Blocks** were constructed using only major roads, excluding residential and unclassified classes. A geoprocessing workflow was applied to simplify complex geometries such as divided roadways and roundabouts, into representative lines and junctions. These features were then merged and polygonized to produce the major block polygon layer.
2. **Minor Blocks** were created using the same process but with all roads, including residential and unclassified. This block polygon layer was particularly useful in urban areas where finer detail was needed.

Spatial points processing

Spatial data points were clustered by LGA and ward name attributes to support data cleaning and further processing. Clusters containing less than 10% of the total points were classified as erroneous and excluded. Clusters meeting or exceeding the 10% threshold were considered correct. Cluster groupings under the same LGA and ward names underwent manual verification. In some cases, wards were treated as multipart extents to accommodate disjointed clusters.

Ward Boundary Delineation

Spatial analysis tools were used to construct mini-catchments around each point using an accessibility surface layer at a resolution of 10 meters. The objective was to generate natural “ridgelines” between points, taking into account physical terrain features. Natural barriers such as rivers, steep slopes, and high elevations were assigned a high crossing cost (i.e., low accessibility).

Preliminary ward boundaries were then created by dissolving these point-level catchments based on shared ward and LGA names.

Ward Boundary Post-processing

Further refinements of ward boundaries were done using both the major and minor block polygon layers. This step allowed linear features to guide boundary definition where appropriate: In rural areas, main rivers and roads served as key delineators, where applicable. In urban areas, city blocks and urban water lines were used to define more detailed and accurate boundaries.

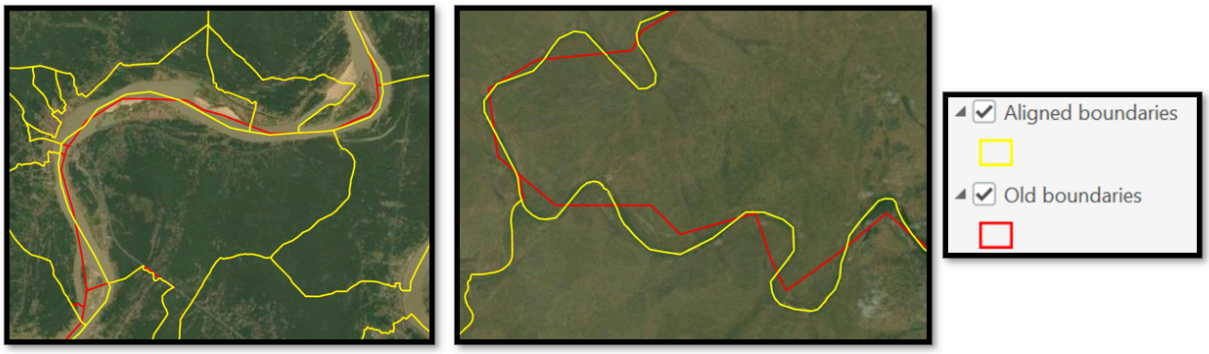

Figure 1: Example of ward boundary edits along rivers or roads.

Coastline alignment

The coastlines of Ogun, Delta, and Bayelsa States were updated and aligned to the S2Coast-2023 dataset as a baseline. Before alignment, several cleaning and simplification steps were applied to the coastline data. These included removing very small islands, extending coastlines in areas where settlements had been excluded, and correcting unenclosed islands. The map below illustrates the coastline before and after alignment.

Figure 2: Coastline alignment

Modifying ward boundaries for crossing over settlement extents

To address settlements intersected by ward boundaries, affected hamlets were first identified and buffered by 20 meters. This buffer was used to smooth the adjusted boundary while minimizing the risk of overlap between neighboring buffered hamlets. The ward boundary layer was then updated using the buffered extents, so that the final adjusted boundary circumvented the hamlets.

Hamlets crossed by ward boundaries were grouped into two categories and processed separately.

1. **Hamlets with PoI:**
   These hamlets were assigned to the ward matching the ward attribute of the PoI. If a hamlet contained more than one PoI with different Ward attributes, and each PoI supported a different side of the ward boundary, the hamlet was left unchanged. If the Ward attribute of a PoI did not agree with the adjacent ward boundary segment, that PoI was disregarded, and the hamlet was assigned to the ward with which it shares the longest boundary.
2. **Hamlets without PoI:**
   These hamlet polygons were assigned to the ward with which they share the longest boundary.

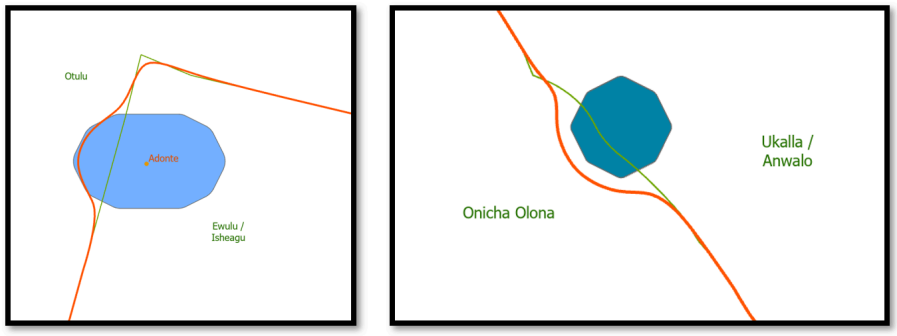

Figure 3: Examples of ward boundary treatment when hamlets are crossed over.

Ward boundaries were not adjusted in cases where larger settlements, such as Small Settlement Areas (SSAs) and Built-up Areas (BUAs), crossed ward boundaries; these refinements are planned for a future release.

Cross-state Reconciliation of Ward Boundaries

All steps described above were initially carried out on a state-by-state basis. After individual state datasets were completed, neighboring states were merged to create seamless ward boundaries across state borders.

This spatial reconciliation focused only on wards located in units bordering neighboring states included in the *GRID3 NGA - Operational Wards v2.0* release. Where mismatches were identified, ward boundaries were edited to ensure spatial consistency and to resolve topology errors generated during the merging of adjacent state datasets. The same rules used in the state-level workflow were applied during this process, including boundary alignment to relevant spatial linear features and spatial assignment based on ward attributes.

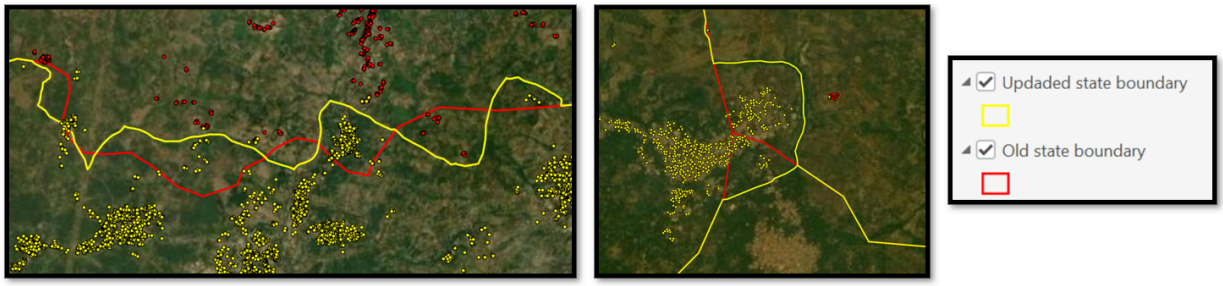

Figure 4: Example of ward boundary adjustments based on Ward attributes.

Summary of State-level Ward Boundary Updates

Table 2 summarizes the current status of ward boundary updates across 15 states included in this release. For each state, the table reports the total ward count, the number of wards represented as multi-part polygons, and how the resulting counts compare against the GRID3 Harmonized Ward Names list and the GRID3 NGA - Operational Wards v1.0. With the exception of Bauchi and Borno, all state-level wards were newly generated. Differences between this release and earlier GRID3 ward counts reflect missing geometries, ward splits, and newly created ward boundaries recently identified during the update process.

Table 2 - State-level Ward Counts

State	Current ward count	Current ward count with multipart polygons	Ward count based on GRID3 Harmonized Ward Names list	Ward count based on GRID3 NGA - Operational Wards v1.0
Adamawa	226	0	226	226
Bauchi	323	0	323	323
Bayelsa	105	23	105	105
Borno	310	0	311	310
Delta	268	27	268	267
Gombe	114	3	114	114
Jigawa	288	5	288	288
Kano	484	19	484	484
Katsina	361	6	361	361
Kwara	193	5	193	193
Niger	275	10	275	275

State	Current ward count	Current ward count with multipart polygons	Ward count based on GRID3 Harmonized Ward Names list	Ward count based on GRID3 NGA - Operational Wards v1.0
Ogun	237	9	237	240
Oyo	351	24	351	351
Osun	331	13	330	332
Yobe	178	1	178	178

Notes on selected states:

In Borno state, Wurge ward in Ngala LGA is missing geometry. In Delta state, two new ward polygons were created: Agbor-Obi 2 in Ika South LGA and Egodor in Burutu LGA.

In Ogun state, Ofada ward includes the areas previously referred as Mowe, Magboro, and Ibafo wards in Obafemi Owode LGA. Additionally, two new ward geometries were created in Shagamu LGA: Oumeme and Botoro/Ado.

In Osun state, Seriki and Tokede wards in Irepodun LGA, and Egan Aaje and Osun Eesa wards in Orolu LGA, were delineated as separate wards. Since Irepodun and Orolu LGAs are not included in the GRID3 harmonized list, these are treated as new additions.

III. Dataset Description

The *GRID3 NGA - Operational Wards v2.0* is a spatial data layer in OGC Geopackage format. The metadata file is included in xml format. The codebook is shown below.

Table 3 - Operational Wards Codebook

Data field	Type	Definition
fid	numeric	Software- generated unique code
geom	text	Software- generated data type
country	text	Country name
iso3	text	Three letter ISO code
state	Text	State name
statecode	Text	Two-letter State code based on ISO 3166-2:NG
lga	Text	LGA name from the GRID3 Harmonized LGA Names list
lga_alt_name	Text	LGA alternative names from 9 different lga list
ward	Text	Ward name from the GRID3 Harmonized Ward Names list

Data field	Type	Definition
ward_alt_name	Text	Ward alternative names from 9 different ward list
ward_v1_grid3	Text	Ward name from the GRID3 NGA - Operational Wards v1.0
multipart_count	Numeric	Number of polygon count if a ward consists of multipart polygons
source	Text	Institution or project providing data inputs for this dataset
date	Numeric	Date of data collection or last edit/ modification in YYYY-MM-DD format
area_sqkm	Numeric	Area of ward polygon in km2, rounded to the next integer.

IV. Known Data Limitations and Disclaimer

The spatial accuracy and overall quality of this dataset depend on both the quality of the input data and the correctness of the edits made during processing. Temporal mismatches exist among the input datasets and reference sources, including satellite imagery, settlement polygons, and other health facility datasets used for comparison. In addition, spelling errors and naming inconsistencies may occur because place names can vary across data sources and local usage. This dataset has not been fully validated by government officials or in-country stakeholders.

These data are part of ongoing work and should not be assumed to be fully accurate or complete. If users identify apparent errors or inconsistencies in the dataset, they should contact CIESIN at info@ciesin.columbia.edu.

The boundary edits included in this release are operational rather than authoritative. As ward boundary editing continues across Nigeria, corresponding changes to Local Government Area (LGA) and state boundaries may also be required to reflect the cumulative effects of these updates.

In this release, ward boundary adjustments were applied only to hamlets intersected by ward boundaries. Ward boundaries were not modified in cases where larger settlement extents, including Built-up Areas (BUAs) and Small Settlement Areas (SSAs), crossed ward boundaries. These cases are planned for a future release. Table 4 summarizes the number of settlement extents intersecting ward boundaries by settlement type.

Table 4 - Ward boundary crossing settlement extent count

Settlement Extent type	Count
BUA	404
Small Settlement Areas	3907

CIESIN, Columbia University, and its co-authors follow procedures designed to ensure that data disseminated by the project are of reasonable quality. If, despite these procedures, users encounter apparent errors or misstatements in the data, they should contact CIESIN, info@ciesin.columbia.edu.

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Portions of this text were revised for clarity using a generative artificial intelligence tool. The final version was subsequently reviewed and approved by project staff.

V. Acknowledgements

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