Republic of Rwanda

NLA
National Land Authority

CADASTRAL SURVEYING PROCEDURE MANUAL

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ABBREVIATIONS

ARP: Antenna Reference Point

BeiDou: Chinese GNSS constellation

CORS: Continuously Operating Reference Stations

CSV: Comma-Separated Values (file format)

DOP: Dilution of Precision (GNSS quality metric)

EDM: Electronic Distance Measurement

EGM2008: Earth Gravitational Model 2008

FE: False Easting

FN: False Northing

GIS: Geographic Information System

GNSS: Global Navigation Satellite System

GPS: Global Positioning System

GLONASS: Russian GNSS constellation

Galileo: European GNSS constellation

Irembo: Rwanda's e-Government Services Platform

ITRF: International Terrestrial Reference Frame

L1, L2: GNSS frequency bands

NGA: National Geospatial-Intelligence Agency of the United States

NLA: National Land Authority

PDOP: Position Dilution of Precision

PLS: Parcel Land Survey (or Parcel Land Surveyor)

PNG: Portable Network Graphics (image format)

PPP: Precise Point Positioning

PPM: Parts Per Million (accuracy term)

RINEX: Receiver Independent Exchange format

RGN: Rwanda GeoNet

RTK: Real-Time Kinematic (GNSS positioning technique)

ROLS: Rwanda Organization of Land Surveyors

SNR: Signal to Noise Ratio

TM: Transverse Mercator projection

TXT: Text file format

UTM: Universal Transverse Mercator projection

XLSX: Microsoft Excel file format

ADDITIONAL CLARIFICATIONS

PDOP and DOP: These are indicators of satellite geometry quality affecting positional accuracy.

ARP: Important GNSS antenna reference point used for height measurements.

SNR: Signal quality metric for GNSS signal observations.

Irembo & ROLS App: Platforms used respectively for submitting documents and zipped survey files.

CSV, XLSX, TXT: Common data file formats used for exporting raw surveyed data

FOREWORD

Cadastral surveying plays a critical role in efficient management and sustainable use of land resources. This Cadastral Surveying Procedure Manual has been developed to serve as an authoritative reference for surveyors and other professionals involved in the process of defining, recording, and managing land boundaries. It brings together the best practices, legal requirements, and technological advancements in the field, ensuring that cadastral surveys are conducted with the highest standards of accuracy, integrity, and consistency.

Land ownership and use are essential to the functioning of modern society, and cadastral surveys are at the heart of these processes. Accurate and reliable cadastral data is crucial not only for determining legal property boundaries but also for supporting economic development, urban planning, resource management, and the protection of the environment. This manual aims to help professionals understand the complexities involved in cadastral surveys and to apply the methods and technologies that ensure legal validity and precision in every survey they undertake.

The development of this manual is grounded in the recognition that cadastral surveying is an evolving field. As technology advances and land management systems become more integrated, it is vital that surveyors remain up to date with the latest tools and techniques. By doing so, they can ensure that their work supports not only legal frameworks and property rights but also the broader goals of sustainable development, social equity, and environmental protection.

This manual serves as a guide to surveyors seeking to uphold these principles. It is intended to be a dynamic resource that will evolve over time to incorporate new innovations and respond to the changing needs of land governance and administration. It is our hope that this document will support surveyors in their important work and contribute to the continued advancement of cadastral surveying practices in Rwanda.

We thank all the professionals, experts, and institutions whose contributions have shaped this manual, and we encourage its use as an indispensable tool for the practice of cadastral surveying.

NISHIMWE Marie Grâce,
Director General/Chief Registrar of Land Titles.

1. INTRODUCTION

The Cadastral Surveying Procedure Manual is a detailed and comprehensive resource that outlines the core principles, methods, and procedures employed in cadastral surveying. It serves as a foundational tool for professionals in the field, ensuring that the processes involved in land measurement and boundary definition are executed accurately and consistently. This manual is not only a reference document for conducting surveys but also a key instrument in the larger framework of land management. Cadastral surveys are critical for mapping out the legal and physical boundaries of land, providing the backbone for property rights and land-use management.

In terms of land management, the Cadastral Surveying Procedure Manual plays a crucial role in promoting the efficient and sustainable use of land. It establishes clear, legally recognized boundaries, which is vital for effective land ownership. By demarcating precise property lines, the manual contributes to a structured approach to land tenure, which is essential for both private landowners and public institutions. This clarity helps minimize disputes and fosters more organized and productive land-use planning, which can be leveraged for sustainable development. Without accurate cadastral surveys, the foundation for equitable land distribution and resource management would be compromised.

The primary goal of this manual is to ensure that cadastral surveys are conducted with precision, legal integrity, and consistency. This consistency is vital for the development of robust land ownership systems and resolving potential boundary disputes. By adhering to clear standards and guidelines, the manual helps prevent errors in the land surveying process that could lead to legal conflicts or mismanagement of land. The importance of this resource lies not just in its technical value but also in its role in supporting governance, peacebuilding, and development. By ensuring that cadastral surveys are both accurate and legally sound, the manual supports the creation of a transparent and efficient land management system, one that is crucial for promoting fairness, economic growth, and sustainability in land use.

1.1 History of cadastral surveying in Rwanda

Cadastral surveying in Rwanda has a rich history that dates back to the colonial period when the Belgian administration introduced land registration systems. During this time, land was surveyed and demarcated for the purpose of establishing formal property rights, primarily for the benefit of the colonial administration and settlers. After Rwanda gained independence in 1962, the country faced challenges in land management due to historical inequities in land distribution and a lack of a comprehensive land registration system.

In the early years of independence, land tenure was largely informal, with limited surveying efforts. However, in the 1990s, following the devastating 1994 Genocide against the Tutsi, Rwanda began to rebuild its institutions, including the land sector. In the post-genocide period, the government made land reform a priority, recognizing the importance of accurate land records for national development and peacebuilding.

The Land Reform Program, launched in the early 2000s, was pivotal in formalizing land ownership through the creation of a national land registry and the implementation of systematic land registration, including cadastral surveys across the country. The government introduced technologies such as Geographic Information Systems (GIS), aerial photography, satellite imagery and field demarcation to improve accuracy and efficiency in land mapping and registration.

Cadastral surveying in Rwanda has evolved through various stages, with significant milestones in its development. The following are key stages:

- L'Institut **Géographique National (IGNB) (1926-1959)**: The Belgian administration implemented a national terrestrial control network for Rwanda. The network used Transverse Mercator formulas based on the Clarke 1880 ellipsoid. Key parameters included a Central Meridian (CM) at 30°E, a scale factor of 0.9999, a False Northing (FN) of 10,000,000 m, and a False Easting (FE) of 500,000 m. However, the control network established by IGNB no longer exists on the ground today;

- **GPS Campaign (1991-1992)**: This campaign was executed by *Landesvermessungsamt Rheinland-Pfalz and Universität der Bundeswehr München* (Office national de topographie de Rhénanie-Palatinat et Université des forces armées fédérales de Munich) in cooperation with Rwanda's "Service de la Cartographie National." The project aimed to cover the entire country but missed some areas in the northeastern part. It involved 28 central stations with eccentric stations located 2-5 km away. The campaign's results showed a high degree of accuracy, with the overall degree of freedom being 147. The mean error ellipse was reported as A=26 mm and B=16 mm, with mean corrections for the X, Y, and Z axes being 4 mm, 5 mm, and 8 mm, respectively;

- **System Rwanda 92 (SR 92)**: SR 92 was developed by transforming the GPS network results from the 1991-92 campaign, which were in ADOS (NSWC 9Z2) datum, into the previous terrestrial system. This system uses the Clarke 1880 ellipsoid with a semi-major axis of 6378249.145 m, a flattening of 1/293.465, and the same parameters for CM, scale factor, FN, and FE as the earlier system. Although SR 92 is a homogeneous and national system, it is essentially a 2+1D system (with x, y, and z coordinates) where height data is derived from the levelling network. There are limited relations with other national or international systems;

- **National Geodetic Vertical Network (NGVN)**: Between 1956 and 1959, under the supervision of IGNB, Rwanda established a national vertical control network based on levelling. These points were included in the GPS campaign of 1991-92. In 2009, the equipotential geoid model EGM2008 was used to transfer ellipsoidal heights to Mean Sea Level (MSL) for orthophoto maps, although no national geoid model exists as of now.

1.2 Current situation

Today, cadastral surveying in Rwanda plays a key role in ensuring land tenure security, resolving land disputes, and supporting sustainable land management and development. The country has made significant progress in modernizing its land administration system, with cadastral surveys being an essential tool in managing Rwanda's land resources. The current situation of cadastral surveying in Rwanda reflects significant progress, especially through key milestones achieved during systematic land registration (2009 -2013). By 2025, the National Cadastral System had recorded approximately 1.9 million land parcels, marking a significant milestone in the advancement of cadastral surveying in modern Rwanda.

In 2014, Rwanda reached another major milestone with the establishment of a national geodetic network, which included 10 Continuously Operating Reference Stations (CORS). This infrastructure is critical for ensuring accurate land surveying and mapping, providing reliable geospatial data for the country's cadastral surveys. The creation of this geodetic network helped to standardize surveying processes and enhanced the overall precision of land data, laying a strong foundation for further advancements in the cadastral system.

Building upon these developments, the Rwanda Organization of Land Surveyors (ROLS) was established in 2017. This organization working closely with National Land Authority has played a pivotal role in professionalizing the land surveying sector, standardizing surveying practices, and ensuring the quality and consistency of land-related data.

In 2018, the National Land Authority took another significant step by introducing new guidelines for cadastral surveying (revised in 2025). These guidelines provided clear standards and procedures, improving the accuracy and efficiency of cadastral surveys and contributing to a more effective land registration system across the country.

Together, these milestones reflect the ongoing evolution of Rwanda's cadastral surveying system, with a focus on increasing transparency, standardizing practices, and improving the quality of land data. The efforts made from 2009 to the present have greatly enhanced land tenure security, supported land-use planning, and helped resolve land disputes, further driving the country's progress towards a more organized and sustainable land management framework.

1.3 Legal framework

In Rwanda, cadastral surveying operates within a legal framework that includes various statutory requirements along with the key legal tools guiding cadastral surveying:

- National Land Policy, June 2019;
- Law N° 27/2021 of 10/06/2021 Governing Land;
- Law N°15/2010 of 07/05/2010 creating and organizing Condominiums and setting up procedures for their registration;
- Law N°55/2011 of 14/12/2011 Governing roads in Rwanda;
- Law N° 32/2015 of 11/06/2015 relating to Expropriation in the public interest;

- Law N°48/2018 of 13/08/2018 on Environment;
- Presidential Order N° 030/01 of 06/05/2022 establishing National Land Authority;
- Prime Minister's Order N° 022/03 of 12/08/2022 governing Registrars of land titles;
- Ministerial order no 004/MoE/22 of 15/02/2022 determining modalities and procedures for resolution of disputes related to land boundaries and systematic land registration;
- Ministerial order n° 008/MoE/22 of 12/05/2022 determining types of servitude;
- Ministerial order n° 007/MoE/22 of 12/05/2022 governing land committees;
- Ministerial order n° 006/MoE/22 of 12/05/2022 on land registration;
- Instructions and guidelines of Director General /Chief Registrar of Land Titles governing certified surveyors practicing land surveying profession in Rwanda;
- Participatory Land Readjustment Guidelines;
- Zoning regulations.

1.4 Institutional Framework

The institutional framework for cadastral surveying in Rwanda involves both public institutions and private stakeholders. It is primarily guided by the Ministry of Environment, which oversees land policies and regulations. The National Land Authority standardizes surveying practices and ensures surveying professionalism across the country, while the Rwanda Organization of Land Surveyors coordinates surveyors and promotes best practices within the profession.

2. SPATIAL REFERENCES FRAMEWORK

The Spatial Reference Framework (SRF) in Rwanda is a system that provides accurate geographic positioning by integrating various geospatial technologies, including GNSS (Global Navigation Satellite System) and CORS (Continuously Operating Reference Stations). It ensures the alignment of spatial data to a common national reference system, supporting precise mapping and geospatial activities. The SRF plays a crucial role in various sectors such as land management, infrastructure development, and environmental monitoring, enhancing the accuracy and consistency of spatial data used across the country.

In this manual, both the National Spatial Reference Framework and the International Terrestrial Reference Frame (ITRF) will be discussed.

2.1 The National Spatial Reference Framework

The National Spatial Reference Framework (NSRF) in Rwanda is a comprehensive geospatial system designed to provide a consistent 3D accurate, and reliable reference for geographic data across the country. It integrates both active and passive components to support various geospatial applications such as land management, infrastructure development, environmental monitoring, and more.

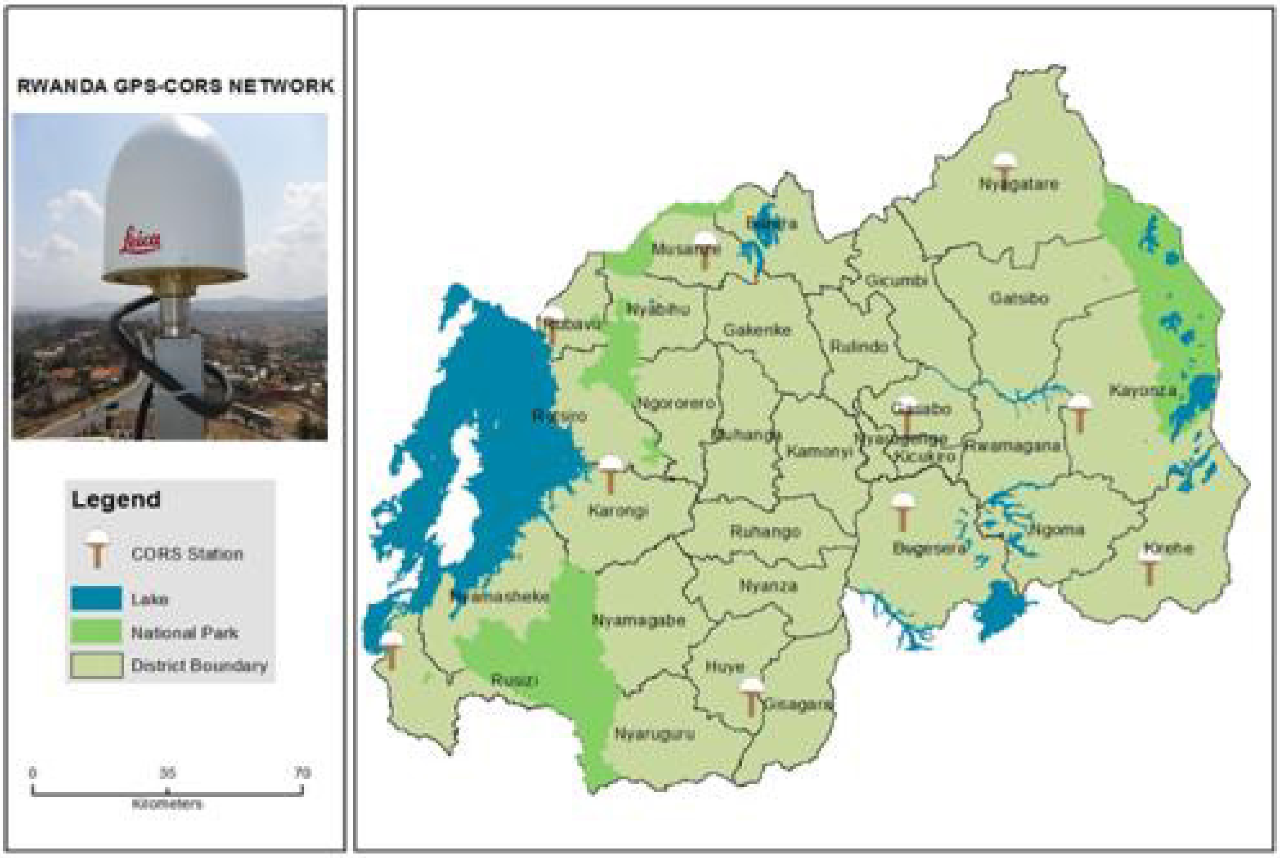
2.1.1 Active Reference control network (Rwanda GeoNet/CORS)

The Rwanda Geodetic Network (RGN) is a network of Continuously Operating Reference Stations (CORS) that provide Global Navigation Satellite System (GNSS) data consisting of carrier phase and code range measurements in support of three-dimensional surveying, positioning, meteorology, space weather and geophysical applications throughout Rwanda and its neighboring countries.

Surveyors, GIS users, engineers, scientists, and the general public who collect GNSS data can use CORS data to enhance position precision. CORS-enhanced post-processed coordinates approach a few centimeters relative to the National Spatial Reference System, both horizontally and vertically.

Currently, there are 10 CORS sites in Rwanda, accessible online through a link provided by NLA which analyzes and distributes data to registered users. Rwanda GeoNet enables users to obtain real-time GNSS data and GNSS raw data in RINEX format from the CORS stations.

Geographic Distribution of the CORS Network



2.2 Location and site names of the CORS network.

CORS SITE NAME AND LOCATION	CORS SITE CODE
Kigali	KGLI
Musanze	MSZE
Huye	HUYE
Bugesera	BUGE
Kayonza	KAYO
Kirehe	KRHE
Nyagatare	NGTRE
Karongi	KRNG
Rubavu	GISE
Rusizi	RSZI

For subscriptions to Rwanda GeoNet (Network RTK service and RINEX data), a user account should be created by NLA. The subscription to CORS network-based services is paid by the registered users to ensure regular maintenance.

The NLA has conducted a feasibility study concerning geoid implementation in Rwanda and currently specifies to use EGM2008 to compute orthometric heights from GNSS observations. The geoid model EGM2008 (original NGA version) must be used to compute orthometric heights. Those end users with surveying equipment without EGM2008 should contact the supplier to provide them with EGM2008 in the right format to enable determination of orthometric heights from the ellipsoidal heights.

2.2.1 Passive Reference control points

The passive component consists of geodetic control points or benchmarks that are established and surveyed over time. These points serve as fixed locations of known coordinates and are used for traditional surveying and mapping activities. They form the foundation of the National Geodetic Control Network and are vital for ensuring long-term stability and consistency in spatial data.

When using the passive control points, post-processing plays a crucial role in enhancing the accuracy of the data. In post-processing, the collected data is analyzed and refined to improve accuracy. After the initial data is recorded, surveyors upload the raw data to specialized software that compares the collected measurements to the established coordinates of the geodetic control points. This process corrects errors, such as signal interference or atmospheric conditions, that may have impacted the accuracy of the measurements during data collection. By using fixed control points, surveyors can adjust the raw data and obtain highly accurate, corrected positions that align with the national spatial reference system.

Post-processing ensures that the final coordinates are consistent with the National Geodetic Control Network, improving the precision of maps and other geospatial applications. It is particularly important for applications that require long-term stability, such as land surveying, infrastructure development, and environmental monitoring, where even small inaccuracies can have significant impacts.

The National Land Authority (NLA) is responsible for establishing, developing, and maintaining geodetic infrastructure in Rwanda. The institutions, agencies, and private companies involved in establishing new ground control points must follow acceptable standards, accuracy and guidelines;

Before setting up the new ground control points, the relevant stakeholders should consult with NLA for non-objection. The newly established control points should be reported to the NLA to update the national geodetic database.

2.3 International Terrestrial Reference Frame (ITRF)

An ITRF has been adopted for use in Rwanda and the Coordinates of all stations in the 1991-92 GPS campaign have been computed to it. The ITRF implemented has the following parameters:

Projection	Transverse Mercator Rwanda (TM Rwanda)
False Easting (FE)	500 000.000000
False Northing (FN)	5 000 000.000000
Central Meridian (CM)	30.000000
Scale factor at CM	0.999900
Latitude of origin	0.000000
Reference ellipsoid	GRS 80
Semi-major axis	6 378 137 m
Flattening	1/298.257222101
Linear unit	Meter
Geographic coordinate system	GCS_IRTF-2005
Datum	D_ITRF_2005
Prime Meridian	Greenwich
Angular unit	Degree

3. CADASTRAL SURVEYING SERVICES AND MEASUREMENT STANDARDS

3.1 Cadastral surveying services

The National Land Authority (NLA) provides various land related services, some of which do not require cadastral surveying. The following are services that require cadastral surveying:

Sporadic land registration of unknown parcel number,
Boundary rectifications,
Land subdivision,
Conversion of parcel rights from old to new tenure for unknown parcel number,
Condominium registration and splits,
Residential site re-plotting,
Transfer of rights on a parcel by court decisions,
Transfer of rights on a parcel by expropriation,

3.2 Measurement standards

The measurement standards for cadastral surveys in Rwanda are designed to ensure consistency, accuracy, and legal recognition of land rights. This manual provides guidance to ensure that surveys adhere to both technical and legal requirements. The following are the key considerations:

- Surveyors should be familiar with the national reference system. Rwanda GeoNet's, RTK service provides coordinates directly in the ITRF2005/TM Rwanda (horizontal) and EGM2008 (vertical) reference frames;

- Surveyors are required to ensure that measurements are accurately determined and defined as fixed boundaries;

- If the local environment around the boundary points suits GNSS measurements, RTK is the most convenient way to measure the boundary points;
- If the network RTK service is not available at the time for the surveying, raw-data logging and post-processing could be used, and the boundary should be surveyed by total station or any other appropriate surveying equipment.

3.2.1 Measurement accuracy

Accurate measurements are critical for proper land registration, dispute resolution, and effective land management. To achieve the highest level of accuracy, surveyors in Rwanda use advanced surveying equipment, including GNSS (Global Navigation Satellite System) receivers, total stations, and laser scanners or any other appropriate surveying equipment. GNSS receivers provide highly accurate coordinates by utilizing satellite signals, while total station combines electronic distance measurement and angle measurement to determine precise positions. Laser scanners are used for capturing detailed topographic data. These tools, when used together, help ensure that cadastral surveys meet the required standards of accuracy for legal and administrative purposes in Rwanda. The recommended surveying equipment and their accuracy are as follows:

A) GNSS-GPS receivers

- For horizontal and vertical measurements, GNSS (Global Navigation Satellite System) should maintain respectively the accuracy of **2-5 cm (horizontal) and 8-10 cm (vertical)** for both rural and urban areas;
- All distances and coordinates presented on a survey report or deed plan must be expressed in meters, rounded to two decimal places.

B) Total station:

Angular Accuracy:

Since cadastral surveys require precise boundary definition, total stations used should have:

- Preferred accuracy: ±1" to ±5" (arc seconds);
- Higher precision: ±1" to ±2" (arc seconds), is recommended for legal, Condominium and high-value property surveys.

Distance Measurement Accuracy:

Total stations measure distances using Electronic Distance Measurement (EDM) technology. The required accuracy is:

- With a Prism: ± (1 mm + 1 ppm) to ± (2 mm + 2 ppm);
- Reflectorless Mode: ± (2 mm + 2 ppm) to ± (5 mm + 3 ppm).

C) 3D Laser scanning

Vertical Accuracy:

- Building height and floor levels: ±5 mm to ±10 mm accuracy;
- Ceiling-to-floor measurements: ±5 mm accuracy;
- Roof and basement elevations: ±10 mm.

Horizontal Accuracy:

- Boundary points (common walls, unit edges): ±10 mm accuracy;
- Common areas and Shared structures (hallways, parking lots, balconies, terraces): ±20 mm accuracy.

3.2.2 Tolerable Error

Tolerable error in cadastral surveying refers to the maximum acceptable level of inaccuracy or discrepancy that can occur in the measurement process without affecting the validity or legal status of the survey results.

This manual establishes a uniform allowable error margin ranging from 0.2% to 0.5% of the total parcel area, applicable to both urban and rural areas.

3.2.3 Maintenance and calibration of surveying equipment

To ensure the accuracy and reliability of surveying instruments, the following standards should be observed:

- All surveying instruments must be properly maintained according to the instructions of the manufacturer to ensure reliable measurements;
- Keep the instrument's firmware and associated software updated to benefit from new features and improvements;
- Surveying instruments shall be calibrated periodically (At least once in 3 years);
- Calibration must be carried out by a certified professional with ISO certification;
- Certificates of calibration should be available for inspection by the National Land Authority (NLA).

4. STEPS FOR CADASTRAL SURVEYING

The process of conducting cadastral surveys involves several key steps and considerations, starting from the selection of certified surveyor by the applicant, preparation phase, the fieldwork and submission of files. This procedure ensures that land boundaries are accurately defined, legally recognized, and properly documented. It requires careful attention to detail, coordination with relevant authorities, and the use of modern surveying technology to guarantee precise results.

4.1 Selection of certified surveyor by the applicant

- The applicant login into Irembo platform and select a surveyor from the list of licensed surveyors;
- Certified surveyor verifies the applicant's information andset the appointment with the applicant to go to the field.

4.2 Preparation phase

Preparation for fieldwork in cadastral surveying is a critical process to ensure accuracy, efficiency, and compliance with legal and regulatory standards. The comprehensive guide for preparing the cadastral surveying fieldwork is the following:

4.2.1 Gather necessary information

- Understand the purpose of the task to be conducted during the field work (e.g., boundary correction, subdivision, sporadic registration of unknown parcel number, etc);
- Collect any existing surveys, maps, or legal documents that describe the land's boundaries or other features;
- Check the land title documents to confirm the owner;
- Obtain any prior survey reports that may provide valuable data or highlight previous challenges or discrepancies;
- Obtain aerial imagery, topographic maps, or other geographical data.

4.2.2 Surveying equipment needed

The certified surveyor should ensure that all surveying equipment are ready, calibrated, and functioning properly and select the measurement method to be used based on the local conditions at the measurement site. The following are the key parameters to be considered depending on the measurement site location:

- **RTK Measurement:** Evaluate factors such as satellite availability, risk of multipath errors, internet connectivity, and current weather conditions.

For GNSS surveying, instruments must meet technical requirements to support accurate, reliable geodetic measurements. This manual outlines the standards for GNSS instruments and their use within the Rwanda GeoNet network as follows:

- The GNSS instrument must be capable of recording both phase and code observations on at least the L1 and L2 frequencies in the GPS system;
- Support for other GNSS constellations e.g., GLONASS, Galileo, and BeiDou is highly recommended;
- GNSS receivers should have in-built capabilities to monitor signal quality and flag issues such as multipath interference or satellite visibility issues. This feature ensures that only high-quality data is used in computations.

4.2.3 Recommended settings for network RTK

Observation types	Only fixed solutions
PDOP	Max 4 allowed
Elevation mask	10–15 degrees
Internal Quality Parameters	Max 5 cm allowed
Epoch interval	1 s – Mean value of 15 epochs is stored as one measurement

- **Total Station Measurement**: To assess the availability of coordinate points connected to the national reference frame for setting the total station, it is recommended to use free station setup instead of positioning directly on a coordinate point, as this helps reduce centering-related errors. At least three control points are required to verify the accuracy of the free station setup. Ensure that the control points used are within the national reference frame.
- **3D** Laser scanner measurement: the surveyor should check the scanner's resolution and make sure that it is adjusted based on site features. Higher resolution is always recommended and It is important to use control points for georeferencing, ideally tied to the national reference frame.

4.3 The fieldwork

Fieldwork in cadastral surveying involves physically assessing the land, setting up equipment, and collecting precise data for mapping, boundary verification, and legal documentation.

4.3.1 Setting up surveying equipment:

- The surveying equipment are set according to manufacturer specifications;
- Surveyors have to make sure that RTK data are available from Rwanda GeoNet;
- Create a new job for each survey;
- Enter a default antenna height (height of pole) correctly in respect to the Antenna Reference Point (ARP);

- Enter a limit for the receiver-reported coordinate quality value (a maximum DOP value can also be entered where maximum 4 is recommended);
- Enter the elevation cut-off angle (e.g. 13 degrees above horizon).
- Enter that a measurement should be stored as a mean value of 15 epochs.

4.3.2 Collecting data

- Verify that you have a single point position (absolute position) before connecting to Rwanda GeoNet;
- Enter the point name;
- Enter a code for the object if desired;
- Verify the antenna height;
- Verify that you have a stable fixed RTK solution;
- Centre the pole carefully over the object, for stable centering a supporting device could be used;
- Start measuring;
- Before storing the measurement, consider the environment in respect to possible multipath, the time to initialization, the stability of the fixed RTK solution, that the communication is continuous, the Signal to Noise Ratio (SNR) and the RTK age;
- If the antenna height is changed during measurements, enter the new height.

4.3.3 Documentation:

- Fill in the Survey report;
- Make sure the coordinates are in ITRF2005 as horizontal coordinates in Transverse Mercator map projection parameters according to TM Rwanda in section 2.2 and mark all data with this information;
- Export the measured points to a surveyed raw data point file. Minimum information for each point shall be:
    - Point name.
    - Northing coordinate.
    - Easting coordinate.
    - Height (ellipsoidal and orthometric)
    - Receiver-reported coordinate quality value (3D or horizontally).
    - PDOP.
    - Number of satellites used.
    - Date for survey.
    - Time for survey.
- Create a shape file of the survey;
- Create a deed plan;
- Parcel Neighbors must be present during data collection and should sign the survey report to ensure transparency and agreement, if one of the neighbors affected by the land measurement is not available, the Land Committee of the Cell prepares a report to be approved by the Executive Secretary of the Cell.

4.4 Submission of files

Documents and data should be submitted through Irembo platform for efficient processing and record-keeping. The Certified surveyors are required to submit the following deliverables:

- the survey report;
- the cadastral plan/deed plan;
- The shape file and the surveyed raw data point file submitted as one zip file through ROLS App;
  - the surveyed raw data point file should be a text file or excel sheet (e.g. xlsx, csv or txt format) of **unchanged** surveyed raw data exported directly from the surveying instrument (without editing);
- The most recent satellite imagery of the surveyed parcel and its surrounding area, it should display clearly survey parcels, along with existing and proposed roads;
- Any other required documents outlined in the Land Administration Forms.