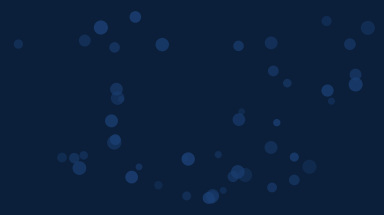
TRISHUNYA CONSULTANCY & INFRASTRUCTURE PVT. LTD.
Advanced Surveying | Drone Survey | LiDAR | GIS | Geospatial Solutions

Tree Enumeration Handbook

A field-ready guide to counting, tagging, GBH measurement and GIS-based tree census surveys



10-PAGE FIELD GUIDE

Methodology · Equipment · GBH & Canopy Measurement · GIS Tagging · Reporting

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FIELD GUIDE

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How to use this handbook

This guide is written as a field-ready reference for survey crews, environmental consultants, and project engineers conducting tree enumeration for road, rail, transmission line, or urban development projects. Each section can be used as a standalone checklist during actual data collection.

SECTION 01

Why Tree Enumeration Matters

Tree enumeration is the systematic counting, measurement, and geo-tagging of every tree within a defined project corridor or site boundary. It converts a forest, avenue, or plantation strip from a visual impression into a structured dataset: exact count, girth class, species, health condition, and coordinate location for every stem above the survey threshold.

For linear infrastructure projects such as roads, railways, and transmission corridors, an accurate tree count is the basis on which forest clearance, compensatory afforestation, and Net Present Value (NPV) payments are calculated. An undercount creates statutory delays later in the project; an overcount inflates compensation cost unnecessarily. Precision at the enumeration stage protects the project timeline on both sides.

Where enumeration is typically required

- Forest (Conservation) Act clearance applications for diversion of forest land
- Right-of-way assessment for power transmission lines and pipeline corridors
- Urban road widening, metro, and smart-city infrastructure projects
- Environmental Impact Assessment (EIA) baseline studies
- Plantation audits, avenue tree census, and municipal green-cover records

100%	GBH	GIS	QC
Stem-level coverage	Girth at breast height standard	Geo-tagged output	Field cross- verification

In practice, enumeration is rarely a single walk-through. It is a structured combination of ground survey and geospatial mapping, most reliable when GNSS positioning and drone orthomosaic imagery are used to cross-check the ground count against canopy cover visible from above.

SECTION 02

Survey Methodology & Grid Planning

The right methodology depends on tree density, terrain, and the purpose of the count. Two approaches dominate practical fieldwork, and most real projects use a combination of both.

Total enumeration (100% count)

Every tree within the defined boundary is counted, measured, and tagged. This is the standard requirement for statutory forest clearance and compensatory afforestation calculations, where an approximate figure is not acceptable. It is labour-intensive but leaves no ambiguity for regulatory review.

Sample plot enumeration

Fixed-radius or rectangular sample plots are laid out at regular intervals across a large forest block, and the counted density is extrapolated to the full area. This is faster and appropriate for preliminary feasibility studies or vegetation density mapping, but it is not a substitute for total enumeration where legal compensation is being calculated.

Typical field workflow

Step	Activity	Field Notes
1	Boundary demarcation	Mark the project corridor or site limit using GNSS/DGPS reference points
2	Grid or chainage layout	Divide the corridor into manageable segments (commonly 100 m chainage blocks)
3	Sequential tagging	Assign a unique tree ID as each stem is measured, tied to chainage and offset
4	Measurement	Record GBH, height class, canopy spread, species, and health at each tree
5	Geo-tagging	Capture coordinates with handheld GNSS or RTK rover for each tagged tree
6	Cross-verification	Reconcile ground count against drone orthomosaic canopy count

Field note

On corridor surveys, chainage-based tagging (e.g. tree tag CH-0450-L-012) is far easier to reconcile during audit than sequential numbering alone, since it lets a reviewer instantly locate any disputed tree back on the ground.

SECTION 03

Equipment & Field Kit

Enumeration accuracy is only as good as the instruments used to record it. A standard field kit balances measurement precision against the pace needed to cover long corridors within a survey window.

Equipment	Purpose
GNSS/DGPS handheld or RTK rover	Sub-metre to centimetre-level coordinate capture per tree
Diameter/girth tape (metric)	Measures GBH directly in centimetres at 1.3 m height
Hypsometer or clinometer	Estimates tree height without felling or climbing
Aluminium/plastic tree tags + nails	Permanent, weatherproof unique ID per stem
Rugged tablet or mobile data collector	Digital form entry with offline GIS basemap
Drone (for canopy cross-check)	Orthomosaic and canopy count validation over the block
Field register (waterproof)	Backup paper record in case of device failure

Why drone cross-check matters

On dense plantation strips or forest patches, ground crews can miss stems hidden behind larger canopies or in difficult terrain. A drone-captured orthomosaic, processed for canopy segmentation, gives an independent overhead count that is reconciled against the ground register. Discrepancies above a set threshold trigger a re-walk of that specific segment before the data is finalised.

> **Kit tip**
> Charge and carry spare batteries for both GNSS units and tablets separately. On corridor surveys running 6 to 8 hours a day, device downtime is the single most common cause of incomplete daily chainage coverage.

SECTION 04

Girth (GBH) & Height Measurement

Girth at Breast Height (GBH) is the standard measurement used across Indian forestry and compensatory afforestation guidelines. It is measured as the circumference of the trunk at 1.3 metres above ground level, taken with a flexible measuring tape wrapped snugly, not stretched, around the bark.

Handling irregular stems

- Multi-stemmed trees: measure each stem separately if the fork is below 1.3 m; record the largest stem's GBH if the fork is above
- Buttressed or swollen-base trees: shift the measurement point above the buttress and note the adjusted height in the remarks field
- Leaning trees: measure 1.3 m along the trunk axis, not vertically from the ground
- Trees on a slope: take the 1.3 m reference from the uphill side of the base

Girth class bands used for reporting

Class	GBH Range	Growth Stage
Class I	< 30 cm GBH	Sapling / young growth
Class II	30 to 60 cm GBH	Semi-mature
Class III	60 to 100 cm GBH	Mature
Class IV	> 100 cm GBH	Large / heritage-scale

Height estimation

Height is generally recorded as a class band (e.g. under 5 m, 5 to 10 m, above 10 m) rather than a precise figure, using a clinometer or hypsometer sighted from a fixed baseline distance. This is faster in the field and sufficiently accurate for compensation and canopy-cover calculations.

Formula reference

Tree height (h) via clinometer: $h = d \times \tan(\theta) + \text{observer eye height}$, where d is the horizontal distance to the trunk base and θ is the angle of elevation to the treetop measured from the observer's eye level.

SECTION 05

Species Identification & Data Fields

Every tree record in a proper enumeration register carries a fixed set of attributes. Missing fields are the most common reason enumeration data gets rejected during forest department review, so field crews should treat this list as mandatory, not optional.

Field	What to Record
Tree ID	Unique tag number, tied to chainage/offset or plot ID
Species (botanical)	Scientific name where identifiable in the field
Species (local/common name)	Regional name as used by the forest department
GBH (cm)	Girth at breast height, measured per Section 04
Height class	Estimated height band
Canopy diameter (m)	Average spread of the canopy, two perpendicular readings
Health condition	Healthy / diseased / dead / dying, with remarks
Coordinates (Lat/Long)	GNSS-captured position, WGS84
Photograph reference	Linked field photo ID for verification
Remarks	Leaning, forked, buttressed, encroaching structure, etc.

Where a species cannot be confidently identified in the field, tag it as "unidentified" with a clear photograph rather than guessing. A wrong species entry is harder to correct later than an honest gap, particularly where species identity affects compensation value under forest working plan schedules.

Local knowledge helps

On rural and forest-fringe corridors, involving a local forest guard or community member for species identification measurably improves accuracy, especially for regional variants that don't match textbook descriptions.

SECTION 06

GIS Tagging & Geo-referencing

Once field data is collected, every tree record is geo-referenced and structured into a GIS layer. This is what turns a paper register into a queryable, mappable asset that can be overlaid on the project alignment, cross-checked against forest compartment boundaries, or shared with regulatory authorities in the required shapefile or geodatabase format.

Standard attribute schema

Each point feature in the GIS layer typically carries the same fields recorded on the ground register: Tree_ID, Species, GBH_cm, Height_Class, Canopy_m, Health, Chainage, Offset, Photo_Ref, and Remarks, plus the geometry itself. Keeping field names consistent with what the regulatory authority expects avoids rework during submission.

Deliverable formats

- Point shapefile (.shp) or geodatabase, WGS84 / UTM as required
- KML/KMZ for quick visual review in Google Earth
- GIS dashboard or web map for stakeholder access without desktop GIS software
- Overlay map showing tree points against the project alignment or site boundary

WGS84	SHP/KML	1:1	QC
Standard coordinate system	Common export formats	Field record to GIS point mapping	Attribute validation pass

SECTION 07

Digital Data Collection Workflow

Paper-based enumeration is still used as a backup, but most current projects run on a mobile data collection app with an offline basemap, so field teams can enter GBH, species, coordinates, and photographs directly against a pre-defined form, even without network connectivity in remote stretches.

- Form-based entry mirrors the fixed attribute list from Section 05, reducing missing-field errors
- GNSS coordinates are captured automatically at the point of entry, removing manual transcription error
- Daily sync to a central GIS project once the team is back in network coverage
- Supervisor dashboard flags incomplete records for same-day correction

SECTION 08

Reporting & Deliverables

The final handover package should let a reviewer, whether a project engineer or a forest department official, verify any single tree without re-walking the site.

Deliverable	Contents
Tree Enumeration Register	Full attribute table, one row per tree, Excel/CSV
Tree Location Map	GIS-based map plotting every tagged tree on the alignment
Summary Statistics	Species-wise and girth-class-wise count tables
Photo Documentation	Field photographs indexed to Tree ID
GIS Data Package	Shapefile/KML layer for import into any GIS software

SECTION 09

Common Field Errors & Quality Checks

Most enumeration disputes trace back to a small set of recurring mistakes. Building these checks into the daily field routine prevents costly re-surveys later.

Common Error	Quality Check
Missed stems in dense clusters	Cross-check ground count against drone canopy count per segment
GBH measured at wrong height	Spot-check a sample of tags mid-survey; retrain if the 1.3 m point drifts
Duplicate or skipped tag numbers	Reconcile daily tag log against the digital record count each evening
Coordinate capture with poor GNSS fix	Set a minimum accuracy threshold in the app; flag and re-capture low-confidence points
Inconsistent species naming	Maintain a shared species reference list for the whole survey team

Tree enumeration sits at the intersection of field botany, land surveying, and GIS data management. Done well, it produces a dataset that stands up to regulatory scrutiny and gives project teams a clear, defensible basis for planning around, or compensating for, every tree on site.

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