

FUNCTIONAL REQUIREMENT SPECIFICATION (FRS)

Proof of Concept (PoC)

GIS-Based Land Survey and Land Asset Management System for KSEBL

1. Background

Kerala State Electricity Board Limited (KSEBL) intends to implement a GIS-enabled digital land survey and a centralised land asset management platform covering all its land holdings across the State, including forest land (subject to necessary clearances and coordination with the Kerala Forest Department), government-leased land, sarkar/purambok land and acquired land. As a first step, a Proof of Concept (PoC) is proposed on five representative pilot parcels to validate the survey methodology, technology stack, GIS platform and workflows before statewide rollout. The PoC shall also establish standards — including the Coordinate Reference System (Datum) and deliverable file formats — for future digital surveys and data management.

2. Objective

The objective of the PoC is to:

- Digitally survey the selected KSEBL pilot land parcels using DGPS with CORS, drone and where necessary, LiDAR technology.
- Create accurate, georeferenced GIS-based digital records of land boundaries and associated electrical assets.
- Develop a centralised, web-based (and mobile-enabled) Land Asset Management System.
- Demonstrate seamless integration of survey outputs with the GIS platform.
- Establish standards, SOPs and a technology blueprint for the subsequent statewide implementation.
- Preparation and submission of a Standard Operating Procedure (SOP) for statewide GIS/DGPS survey based on PoC findings.
- Validate survey accuracy, workflow design and the chosen technology stack.
- The application shall support real-time updating and monitoring of land asset status and encroachments, with dashboard-based status visualization.
- The selected startup firm shall assist KSEBL during planning of the statewide rollout, including recommendations on methodology, standards and lessons learned.
- The application, all survey outputs and all associated Intellectual Property shall be fully owned by KSEBL

3. Scope of Work

The selected startup shall be responsible for both of the following components:

- **Component A — Digital Survey:** High-accuracy DGPS with CORS survey, drone survey and (where required) LiDAR survey of the five pilot parcels listed in Annexure II, including boundary demarcation, benchmark verification and generation of all survey deliverables.
- **Component B — Web-based GIS Land Asset Management Application:** Design, development, deployment and handover of a centralised, role-based, GIS-enabled application (with a companion mobile app for field use) for management of KSEBL's land and associated electrical assets, built for future statewide expansion.

4. Functional Requirements

4.1 Land Parcel Survey

The solution shall support the following survey methods and processes:

DGPS Survey • Total Station Survey (wherever required) • Drone Survey • LiDAR Survey (thick tree canopy / difficult terrain) • CORS-based Georeferencing • Boundary Demarcation • Physical Verification of Benchmarks • Coordinate Validation

Expected accuracy:

- Horizontal accuracy: less than 5 cm.
- Vertical accuracy: as per Survey of India standards.

4.2 Survey Deliverables

The startup shall generate the following outputs for each parcel:

Parcel Boundary • Georeferenced Maps • Orthomosaic Imagery • DEM • DSM • DTM • Contour Maps • Vectorised Boundary Layers • CAD Drawings • Survey Sketches

Supported export formats: GeoJSON, Shapefile (SHP), KML, DXF and GeoTIFF.

4.3 GIS Platform

The web application shall provide:

Interactive Web GIS map viewer • Satellite & OpenStreetMap base layers • Layer management (toggle/opacity) • Spatial search • Attribute search • Distance measurement • Area calculation • Coordinate display • Printing and map export

4.4 Land Asset (Parcel) Data Model

Each land parcel record shall maintain the following categories of information:

Land Information

Land ID • Property Name • Survey Number • Village • Taluk • District • Extent • Latitude/Longitude • Category • Ownership Type • Forest Land Status • Lease Details • Acquisition Details

Legal Information

Title Deed • Registration Details • Mutation Status • Court Cases • Encroachment Details • Compensation Status • Remarks

Survey Information

Survey Date • Survey Agency • Accuracy Achieved • Equipment Used • Coordinate System • Benchmarks • Last Updated

Asset Information (each as an independent GIS layer)

EHT / 220 kV / 110 kV Substations • Transmission Towers • Transformers • Buildings • Roads
• Compound Walls / Fencing • Transmission Lines (HT/LT) • Other Utilities

4.5 Asset Visualisation

Users shall be able to view parcels on the GIS map, overlay satellite imagery, toggle layers, zoom, pan, measure, print and download maps.

4.6 Document Management

The application shall allow attachment of Title Deeds, Land Sketches, Survey Sketches, Survey Reports, Court Orders, Photographs, Encumbrance Certificates and Revenue Records, in PDF, JPG, PNG and TIFF formats.

4.7 Encroachment Management

The application shall support registration and geo-tagging of encroachments, photo upload, notice tracking, action history, status monitoring and a timeline view.

4.8 Litigation Management

The application shall maintain Court Name, Case Number, Petitioner, Respondent, Hearing Dates, Next Posting, Advocate details, Judgments and related documents.

4.9 Land Acquisition Module

The application shall maintain Notification, Award, Compensation, Court Case/Arbitration, Possession, Mutation, Registration and Payment Status details for land under acquisition. Establish a strong digital foundation for land compensation and asset management

4.10 Dashboard & Analytics

Role-specific dashboards (CMD, Directors, Chief Engineers, LMU, Field Officers) shall display Total Land, Total Area, Forest/Government/Lease/Acquired Land, Encroachments, Survey Pending/Completed, and District-wise and Circle-wise summaries. GIS analytics shall include heat maps, buffer analysis, nearest-asset search, area calculation, distance measurement and terrain/elevation profiles.

4.11 Search & Reports

Search shall be supported by Property Name, Survey Number, Village, District, Substation, Asset Type and Land ID. Reports shall include the Land Register, Parcel Register, Asset Register, Survey Status, Encroachment Register, Litigation Register, Compensation Report and Area Statement, exportable to PDF, Excel and CSV.

4.12 Master Data Management

Configurable master data shall be maintained for:

Circle • Region • District • Division • Sub-Division • Section • Village • Taluk • Survey Office • Land Category • Ownership Type • Asset Type • Encroachment Type • Litigation Status • Compensation Status • Coordinate System • Survey Agency • Survey Equipment

4.13 Parcel Registration & GIS Editing

The system shall support creation of land parcels with auto-generated Parcel IDs, parent-child parcel relationships, parcel split/merge, land transfer history and version history. Authorised users shall be able to edit parcel boundaries (add/delete points, modify geometry, merge/split polygons, snap features, undo/redo) with a complete edit history maintained.

4.14 Survey Planning & Field Mobile Application

The system shall support survey work orders, team allocation, scheduling and daily progress monitoring. The companion mobile application shall support GPS-based navigation and position capture, geo-tagged photographs, video capture, voice notes, digital signature, survey sketch upload, QR-code parcel identification, offline survey and background data synchronisation.

4.15 Workflow & Notifications

A configurable approval workflow shall be provided: Survey Completion → Verification → Land Management Unit → Chief Engineer → Approval → Publish to GIS. Notifications (SMS, e-mail, in-app) shall be generated for approvals, survey due dates, expiries and encroachment alerts.

4.16 Audit Trail

The system shall log login/logout events, parcel and geometry changes, document uploads, approval history, deletions and export history, for a complete and tamper-evident audit trail.

5. GIS Layer Specifications

Administrative layers

State • District • Taluk • Village

Land layers

Land Parcels • Survey Boundaries • Forest Boundaries • Revenue Boundaries

Electrical asset layers

EHT / 220 kV / 110 kV Substations • Transformers • Transmission Towers • Transmission Lines (HT/LT)

Infrastructure layers

Buildings • Roads • Compound Walls / Fencing • Water Bodies / Rivers • Vegetation

Survey & elevation layers

DGPS Points • Drone Orthomosaic • LiDAR Point Cloud • DEM • DSM • DTM • Contours

Base / satellite layers

OpenStreetMap • Satellite Imagery (Bhuvan / licensed provider)

6. System Architecture

High-level architecture: Web browser and mobile application clients communicate over HTTPS/REST APIs, optionally through a load balancer, with the application server layer. The application server integrates a GIS engine (GeoServer), a document server (DMS) and a workflow/notification engine, all backed by a PostgreSQL + PostGIS spatial database, hosted within the KSEBL Data Centre with a corresponding Disaster Recovery (DR) setup.

6.1 Application Modules

Master Data Management • User & Role Management • Land Parcel Management • Survey Planning & Assignment • DGPS/CORS Survey Module • Drone Survey Module • LiDAR Survey Module • GIS Map Viewer & Editing • Mobile Survey Application • Land Asset Management • Encroachment Management • Litigation Management • Land Acquisition Management • Document Management • Workflow & Approvals • Notifications • Dashboard & Analytics • Reports • API & Integration • Audit Trail • System Administration

6.2 API & Integration Requirements

The application shall expose REST/JSON APIs secured using OAuth2/JWT over HTTPS, and shall support integration with:

KSEBL HRIS (authentication) • SSO • KSEBL GIS • Document Management System • SAMAGRA ERP • Survey Department data • Revenue Department GIS • Kerala CORS Network • Bhuvan • OpenStreetMap • GeoServer (WMS/WFS/WMTS)

7. User & Role Management

Role-based access control (RBAC) shall be provided, mapped to KSEBL's organisational hierarchy:

CMD / Directors • Chief Engineers • Deputy Chief Engineers • Executive Engineers • Assistant Executive Engineers • Assistant Engineers • Land Management Unit • Survey Team • GIS Administrator • System Administrator

Users shall be able to access and act upon only the data authorised for their role.

8. Non-Functional Requirements

8.1 Performance & Scalability

- Support a minimum of 200 concurrent users and at least 10 million GIS features.
- Map load time under 5 seconds for standard views; search response under 2 seconds.
- Architecture shall scale to cover the entire State, over 1 lakh land parcels, and future GIS layers, mobile apps and API integrations.

8.2 Availability

- Target 99.9% uptime with High-Availability deployment.
- Disaster Recovery support with a zero-data-loss objective for critical transactions.

8.3 Security

RBAC • Multi-Factor Authentication • SSO integration • AES-256 encryption at rest • TLS 1.3 in transit • Secure API gateway • Digital signature support • Watermarking of exported maps • Secure document storage • Complete audit trail

8.4 GIS & Data Standards

The system shall comply with OGC standards (WMS, WFS, WMTS) and support GeoJSON, GML, SHP, KML, GeoTIFF, DXF and standard EPSG coordinate systems. The database shall preferably be PostgreSQL with PostGIS, supporting spatial indexing, full backup and point-in-time recovery.

8.5 Preferred Technology Stack

Open-source technologies are preferred: PHP Laravel or Java Spring Boot; PostgreSQL + PostGIS; OpenLayers or Leaflet; GeoServer; GDAL; Docker containers; REST APIs. The application shall be web-based with responsive design, supporting the latest versions of Chrome, Firefox, Edge and Safari, and shall be compatible with Android and iOS for the mobile/tablet application, with offline capability. Any other suitable technology can suggest.

8.6 Backup, Logging & Maintainability

- Daily full backup and hourly incremental backup, with 180-day retention and an archival policy.
- Centralised logging: application, GIS transaction, database, API and audit logs.
- Modular, API-first architecture with documented source code, Git-based version control and CI/CD readiness.

8.7 Data Migration & Training

The solution shall support migration of existing data from Excel, CAD/AutoCAD, Shapefiles, KML, GeoJSON and CSV sources. The startup shall provide administrator, GIS, field-survey and

technical training, along with training manuals, video tutorials and knowledge transfer to KSEBL officials.

9. Security, Hosting, NDA & Intellectual Property

- The assets being mapped (EHT substations, transformers and grid infrastructure) constitute critical State power infrastructure; the selected startup shall execute a strict Non-Disclosure Agreement (NDA) with KSEBL.
- All spatial and application data shall be hosted only on secure servers owned and managed internally by KSEBL; no data shall be hosted on third-party or public cloud infrastructure without specific KSEBL approval. KSEBL will provide the storage and server space for hosting the application the application.
- Complete source code, database schemas, APIs, GIS configurations, scripts, documentation and all Intellectual Property Rights (IPR) arising from the PoC shall vest exclusively with KSEBL.
- The application shall undergo a security audit by a CERT-In empanelled agency, and the startup shall obtain and submit a "Safe to Host" certificate prior to production deployment.

10. Availability of Revenue Survey Sketch

The following sequence shall govern availability of the Revenue survey sketch for each pilot parcel:

1. Where a Revenue survey sketch for the land is already available with KSEBL, the same shall be handed over to the surveying party as the basis for the survey.
2. Where no such sketch is available with KSEBL, the surveying party shall obtain it from the Survey Department.
3. Where no survey sketch is available from either source, the survey shall be carried out as per the directions of the custodian of the land (i.e., the KSEBL office/officer currently in charge of the parcel).

11. Acceptance Criteria

The PoC application shall be accepted after successful completion of functional testing, integration testing, GIS accuracy verification, security audit, performance testing and User Acceptance Testing (UAT), meeting the following parameters:

- DGPS accuracy better than 5 cm.
- GIS layers displayed correctly for all mapped assets.
- Reports generated correctly in all specified formats.
- Configured workflow functioning end-to-end.
- APIs functioning and integrated as specified.
- Security audit passed and "Safe to Host" certificate obtained.

11.1 PoC Success Criteria

The PoC shall be considered successful if it demonstrates: completion of survey at all five pilot locations; achievement of the specified DGPS accuracy; completed drone mapping (and LiDAR where applicable); an operational GIS platform; a commissioned web application and mobile app; correctly generated reports; working role-based access control; integrated APIs; and handover of complete source code — thereby validating readiness for statewide expansion.

12. Project Deliverables

The selected startup shall provide:

DGPS/Drone/LiDAR Survey Reports & Data • Orthomosaic, DEM, DSM, DTM, Contours • GIS Database • Web GIS Application • Mobile Application • Source Code & Database Scripts • API Documentation • User & Technical Manuals • Training to KSEBL officials • Deployment in KSEBL Data Centre • Vector Boundary • UAT & Warranty Support. • Standard Operating Procedures (SOP) for statewide rollout

13. Indicative Project Milestones & Timeline

Milestone	Indicative Duration
Requirement Study	2 Weeks
FRS/SRS Finalisation	2 Weeks
UI/UX Design	2 Weeks
Architecture Design	2 Weeks
Application Development	12 Weeks
DGPS / Drone / LiDAR Survey	Parallel (12 Weeks)
System Integration	2 Weeks
Testing	3 Weeks
User Acceptance Testing (UAT)	2 Weeks
Deployment	1 Week
Training	1 Week
Warranty Period after go-live	12 Months

14. Warranty, Support & AMC

- 12 months of comprehensive warranty with unlimited bug fixes.
- Critical issues resolved within 24 hours; major issues within 3 working days; minor issues within 7 working days.
- Quarterly preventive maintenance and health checks.
- Optional post-warranty AMC support for up to 5 years with separate proposal.
- Full knowledge transfer to the KSEBL IT team prior to completion of the warranty period.

15. Coding Standards

Development shall comply with OWASP secure coding guidelines, CERT-In cybersecurity guidelines, OGC GIS standards and REST API standards, with OpenAPI (Swagger) documentation. Code shall follow PSR-12 (PHP) or the Google Java Style Guide as applicable, be maintained under Git-based version control, and undergo unit testing, peer code review and static code analysis prior to deployment. Source code ownership and IPR shall vest exclusively with KSEBL. Application ownership rests with KSEBL

16. Deployment Architecture (Data Centre & DR)

Primary Data Centre

Application Server Cluster • GeoServer • PostgreSQL + PostGIS • Document Repository •
Backup Server • API Gateway / Load Balancer

Disaster Recovery

- Mirror application servers with synchronous or scheduled replication of the PostGIS database.
- Daily incremental and weekly full backups, with periodic DR drills.
- Containerised deployment (Docker preferred) on Linux (Ubuntu LTS / RHEL), HTTPS with TLS 1.3, centralised logging and monitoring, and backup retention of at least 180 days — deployed exclusively within KSEBL-owned DC/DR, with no production data on third-party cloud infrastructure unless specifically approved.

17. Selection of Survey / Development Agency

Due weightage shall be given, in the selection/evaluation of the startup, to prior experience of successfully completing survey or GIS assignments for KSEBL on a comparable scope of work, in view of demonstrated technical familiarity with KSEBL's assets and requirements. This shall not, however, create any right in favour of any agency merely on account of having previously undertaken work for KSEBL. KSEBL reserves sole discretion in the selection or omission of the surveying/development agency. Selection shall be routed through Kerala Startup Mission (KSUM) in accordance with applicable Government Orders and Board Orders. For parcels where questions of land custody, boundary or title require adjudication, the matter shall be referred to the Expert Committee already constituted for land issues, in coordination with the Land Management Unit.

ANNEXURE II

List of Pilot Land Parcels Proposed for the PoC Survey

Sl. No.	Region	Site	Land ID / Remarks	Area (Ha)
1	North	Poovaramthod SHEP	1969 to 2010	4.946
2	North	Olikkal SHEP	1985 to 2001	4.825
3	Central	220 kV Substation, Brahmapuram (incl. BDPP land)	240	88.98
4	South	220 kV Substation, Pothencode	211	8.076
5	South	Vydyuthi Bhavanam (Head Office)	531	1.84
		Total		108.667

Note: The pilot parcels span three distinct asset categories — Small Hydro Electric Project (SHEP) land, EHT substation land, and Head Office land — so as to validate the survey methodology across representative site types ahead of the statewide rollout.