ROYAL GOVERNMENT OF BHUTAN

དཔལ་ལྡན་འབྲུག་གཞུང་།

National Land Commission

རྒྱལ་ཡོངས་ས་ཆ་ལྷན་ཚོགས།

Standard Operating Procedure (SOP) for Geodetic Control Observation for National Cadastral Datum Transformation

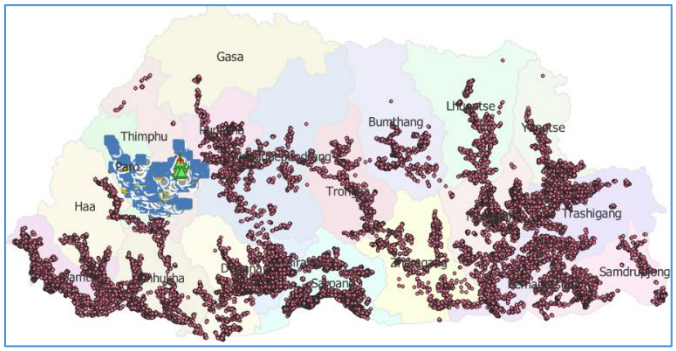
Fieldwork Using GNSS-RTK

2024

1. Project Planning

During the planning phase of survey projects, it is essential to precisely plan and ensure that all necessary preparations for datum transformation are thoroughly completed. The field team should coordinate with Dzongkhag surveyors in line with the adopted transformation procedures and techniques. Proper planning at this stage is crucial to avoid errors, ensure data accuracy, and streamline the subsequent phases of the survey.

Fig 1: Shows the project planning in the designated areas.



Sl No	Dzongkhag	Field work sequence	Survey Team		Tentative Duration (up to)
			NLCS	Dzongkhag / Dungkhag	
1	Gasa	1	1	1	1 month
2	Punakha		1	1	
3	Wangdue Phodrang		2	1	
4	Trongsa		2	1	
5	Bumthang	2	1	1	1 month
6	Lhuentse		2	1	
7	Monggar		2	1	
8	Trashigang	3	2	1	1 month
9	Trashi Yangtse		1	1	
10	Pema Gatshel		2	1	
11	Samdrup Jongkhar	4	3	1	1 month
12	Zhemgang		2	1	
13	Tsirang	5	1	1	1 month
14	Dagana		2	1	
15	Sarpang		2	1	
16	Chhukha	6	2	1	1 month
17	Samtse		2	1	
18	Haa		1	1	

2. Field Preparation

Before the field survey begins, several prerequisites must be completed, including preparing field equipment and software needed to conduct the survey.

2.1 Equipment

(i) GNSS RTK set

(ii) Rover pole

(iii) Dual strut

(iv) Spade

(v) Crower

(vi) Knife

(vii) Field form

2.2 Software.

(i) QGIS

(ii) QField

3. QGIS 3.28

Fig 2: Demonstrating the download of QGIS 3.28 from Google.

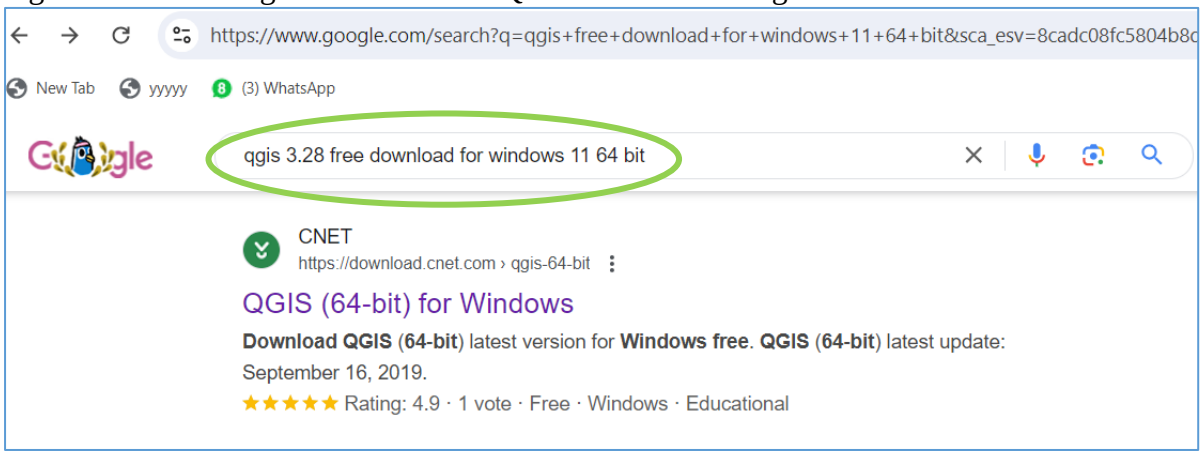


Fig 3: Demonstrate the installation of QGIS 3.28.

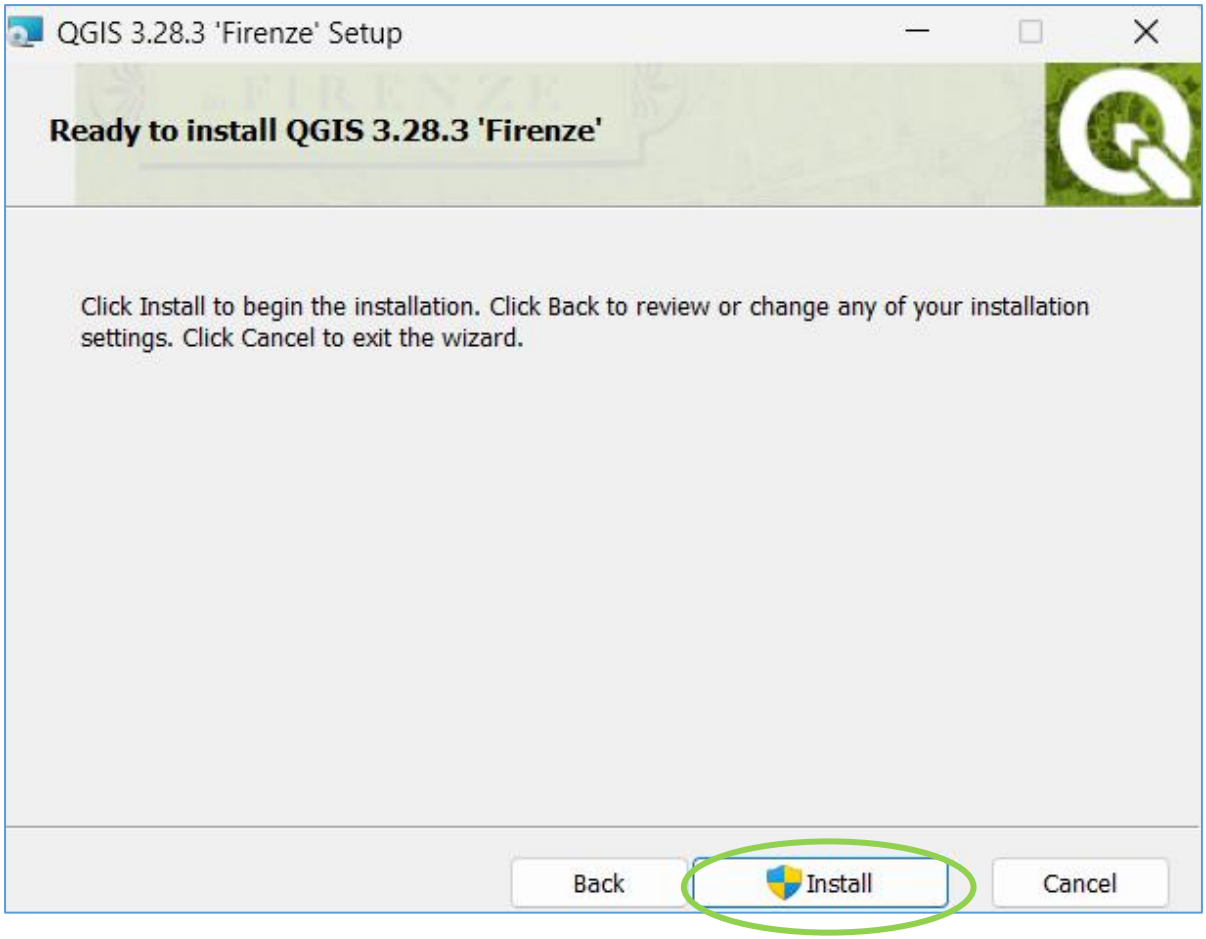


Fig 4: Demonstrates the opening of a new, empty project.

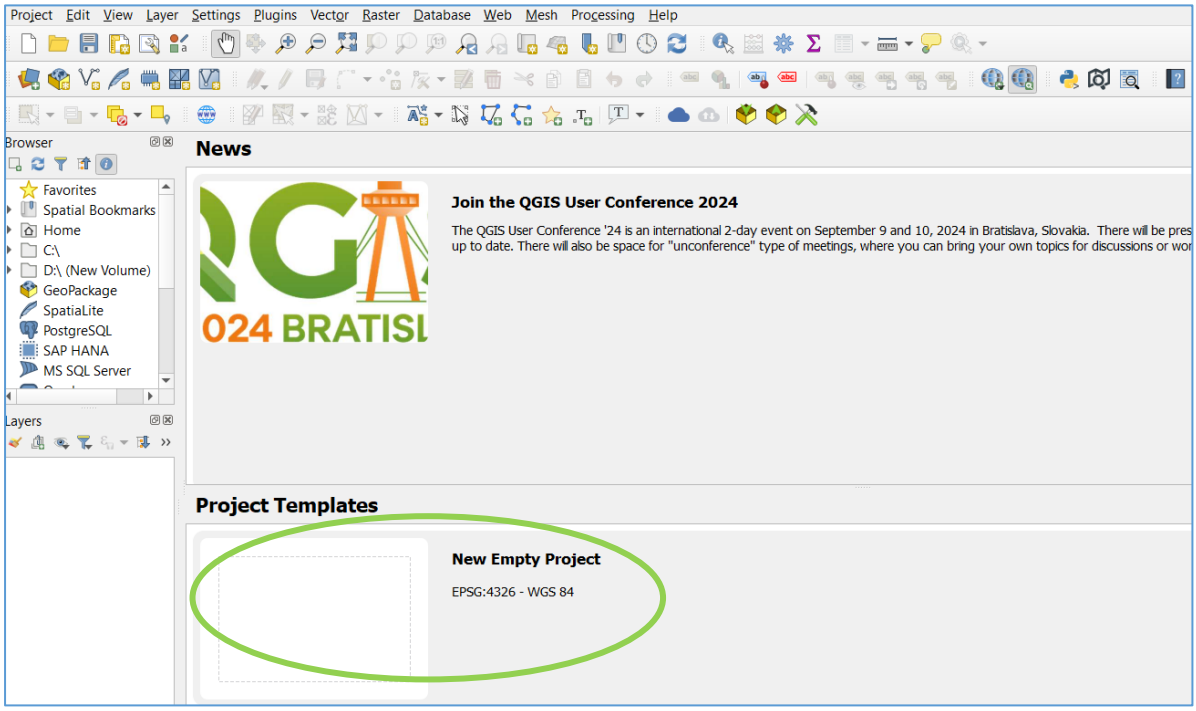


Fig 5: Shows the layers being added to QGIS.

- Layer → Vector → ⊙File →Automatic → select shapefiles from the working folder → open → add → close.

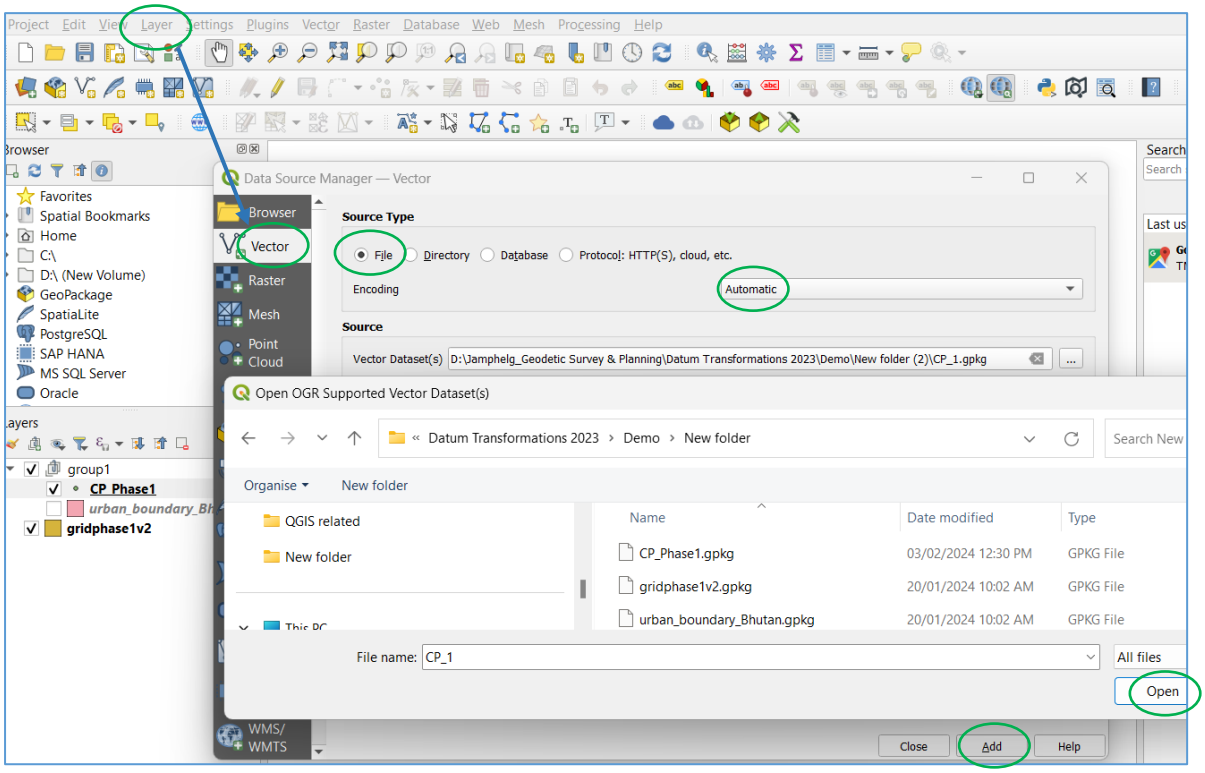


Fig 6: Displaying the layers in QGIS.

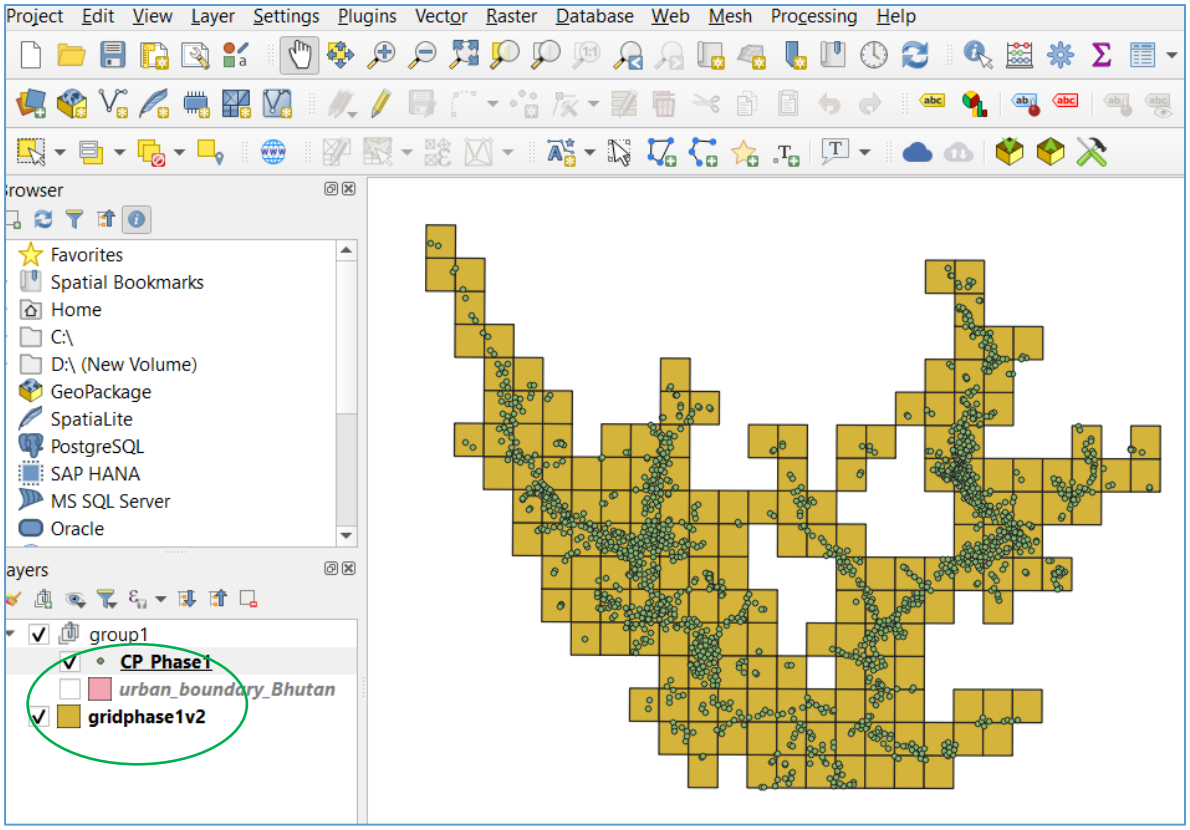


Fig 7: Demonstrates how to add plugins in QGIS.

- Plugins → Manage and install plugins → type ‘qms’ in the search command line → ☑Quick Map Services → Install plugins → close.

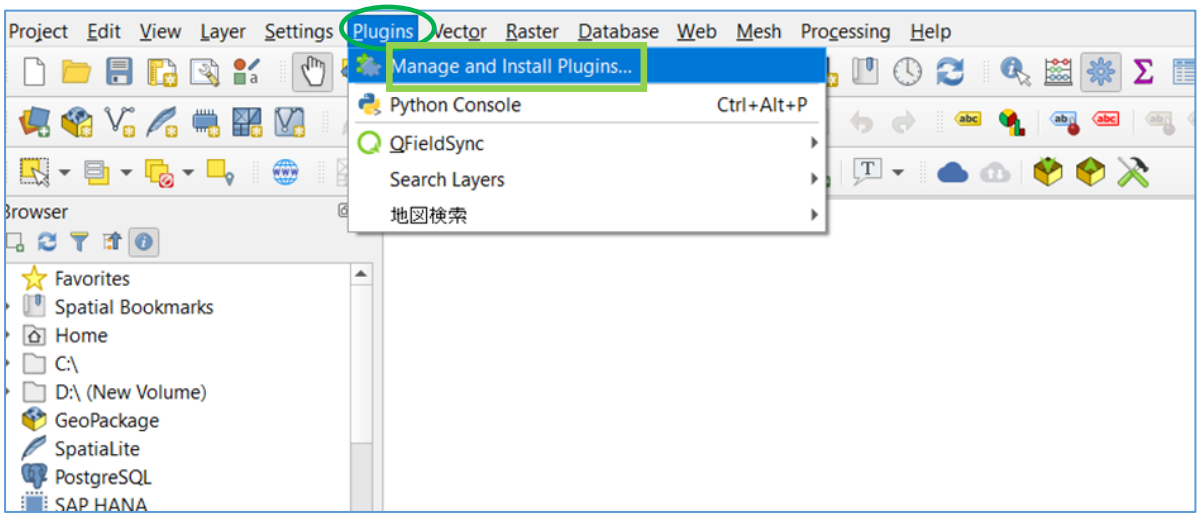


Fig 8: Displays the installed plugin tools in QGIS.

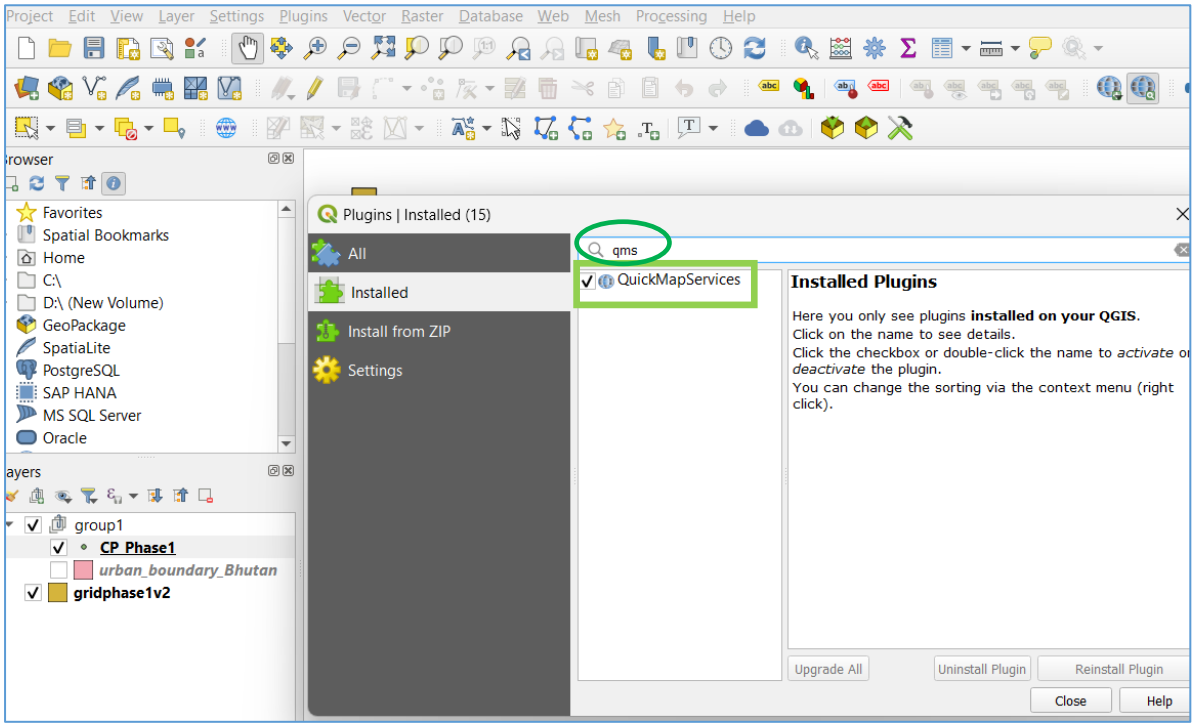
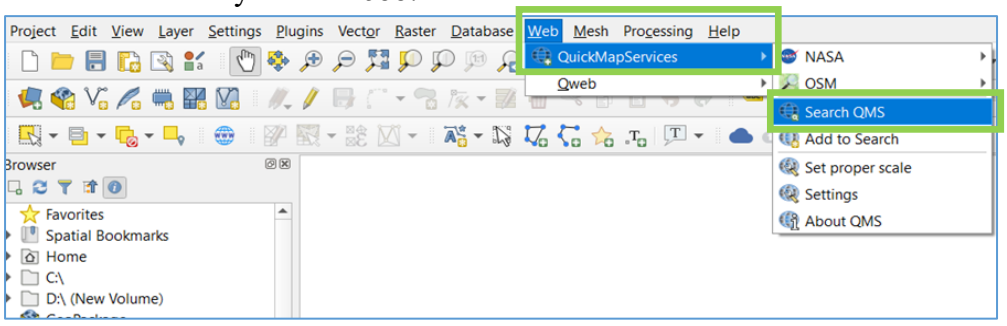


Fig 8: Demonstrates how to add the Google Satellite Hybrid layer in QGIS.

- Web → Quick Map Services → Search QMS. Then in Search QMS: → type “Google Satellite Hybrid” → add.



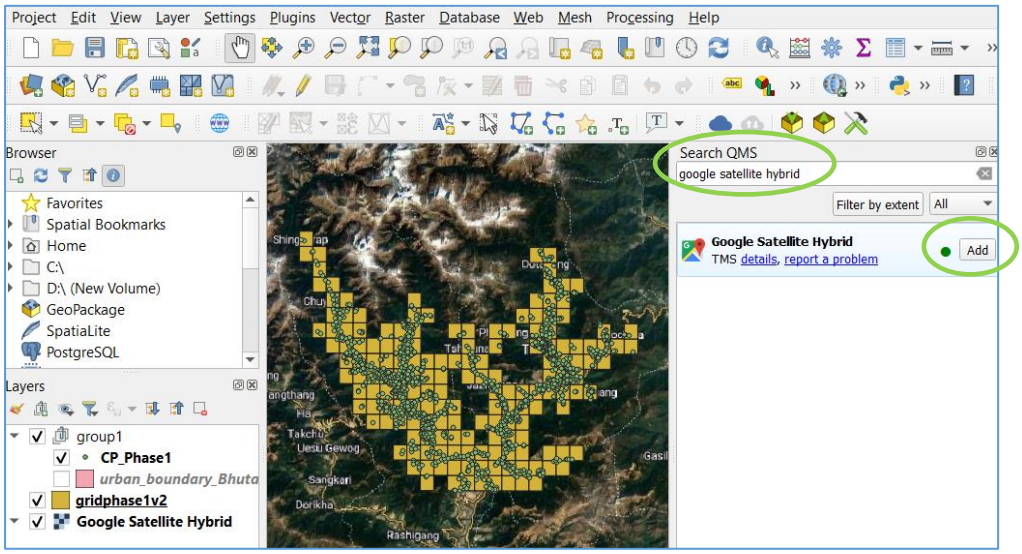


Fig 9: All layers are being ‘Packaged for Qfield’ on the laptop.

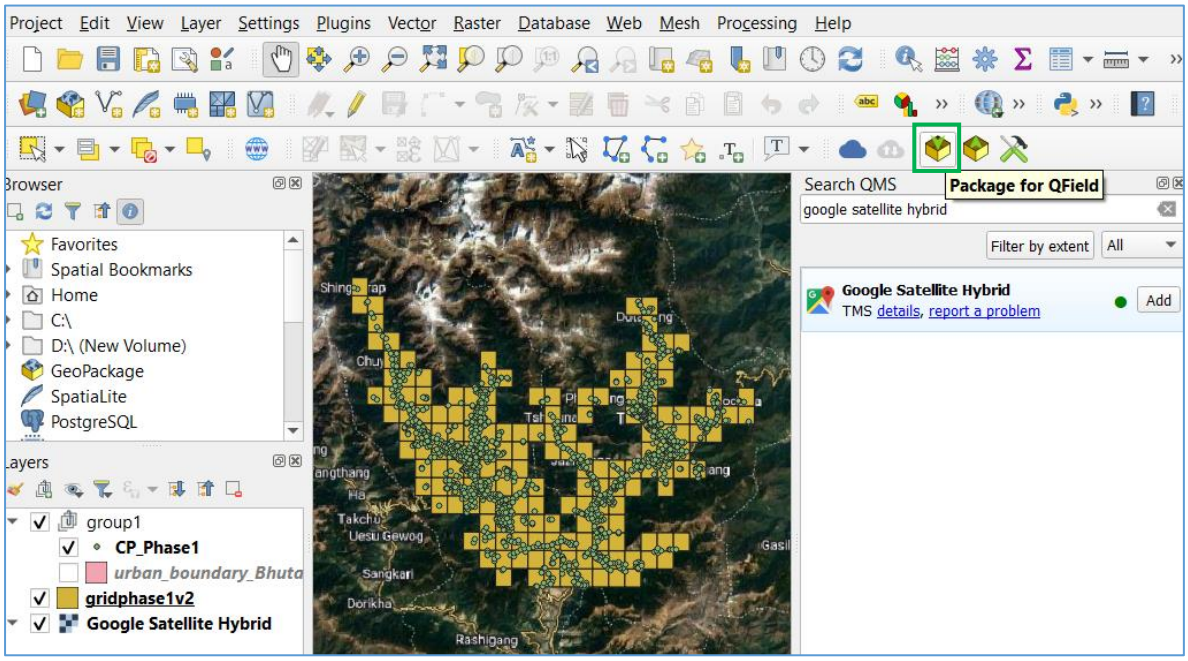


Fig 10: Displays the working folder and the layers being prepared for packaging for QField.

- Select working folder → create a new folder as ‘Datum Field Data’→ just click on the folder → Directory: select require layers → create.

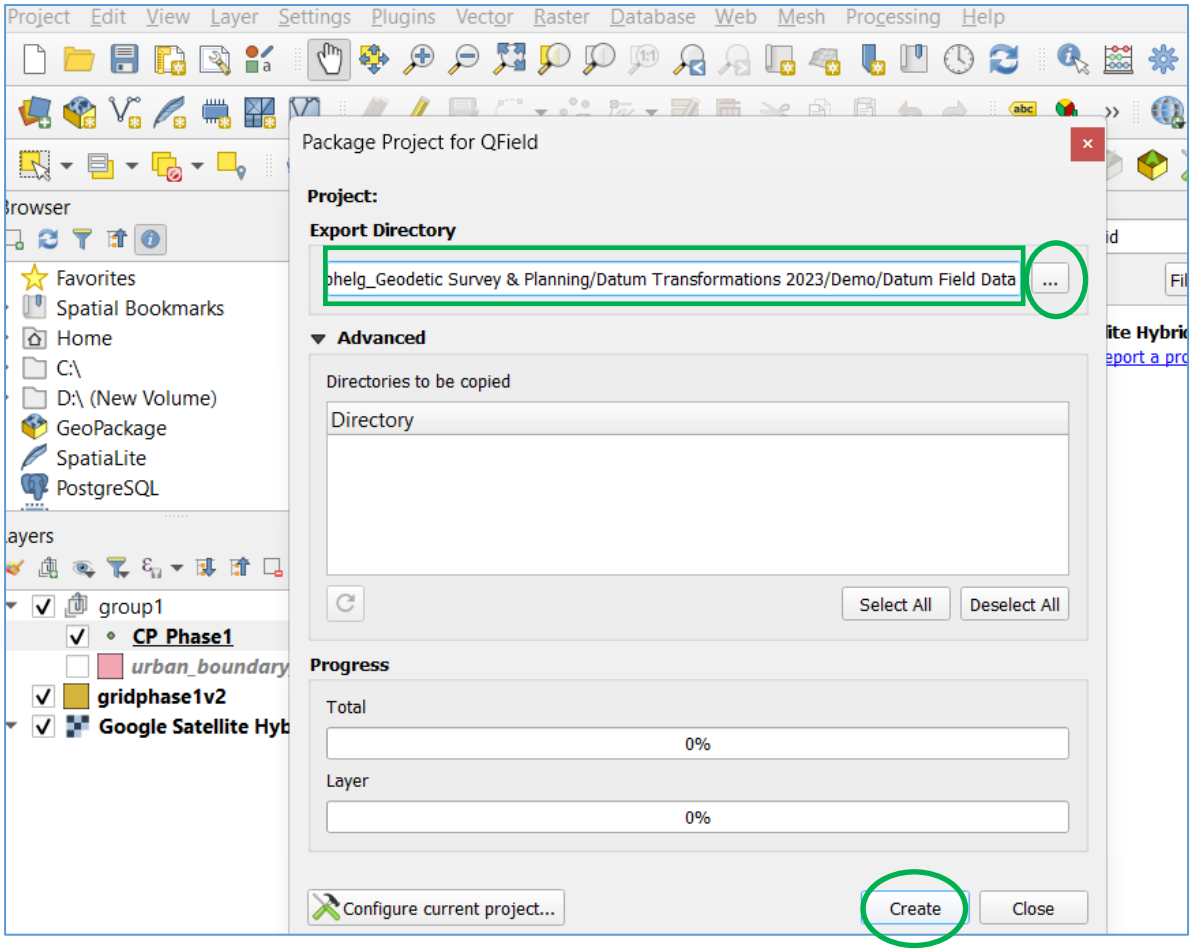
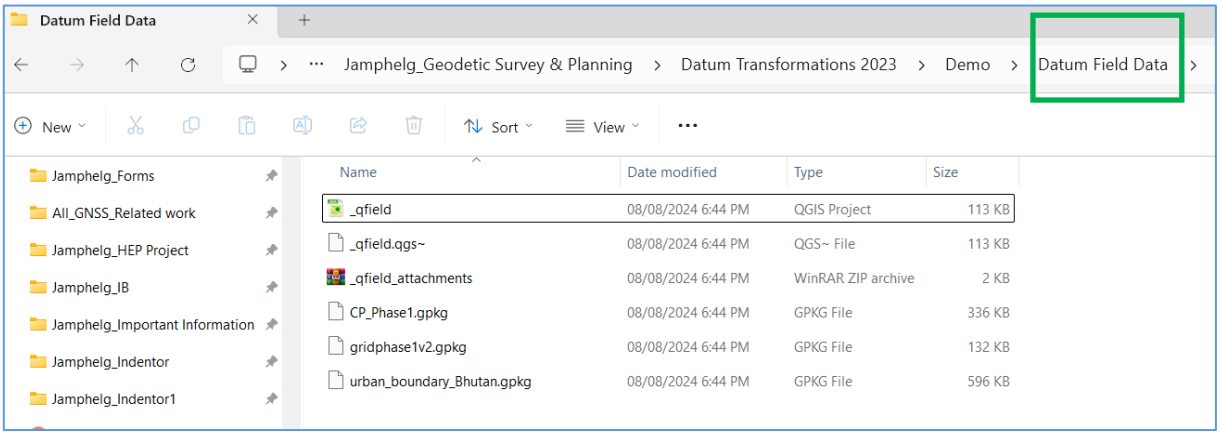


Fig 11: Demonstrates how to copy the 'Package for QField' folder and paste it into the mobile phone's internal memory or SD card.



4. QfieldCloud

The QfieldCloud is use in this Datum Transformation to navigate the selected points to be observe and to view a point details on the phone.

Fig 12: Demonstrates how to install the QField app from the Play Store on a mobile phone and how to set up QField for use with QGIS on the mobile device.

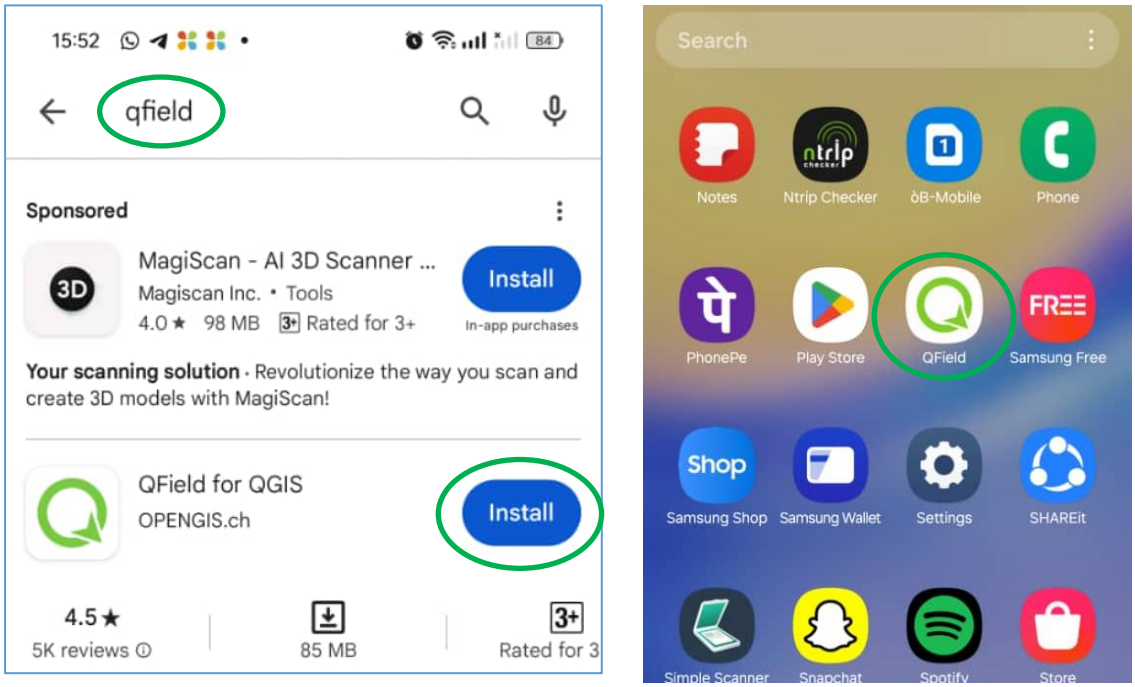


Fig13: Demonstrates how to open QField for QGIS, navigate to 'Open local file/QFieldCloud projects,' click the '+' icon, and select 'Import project from folder.

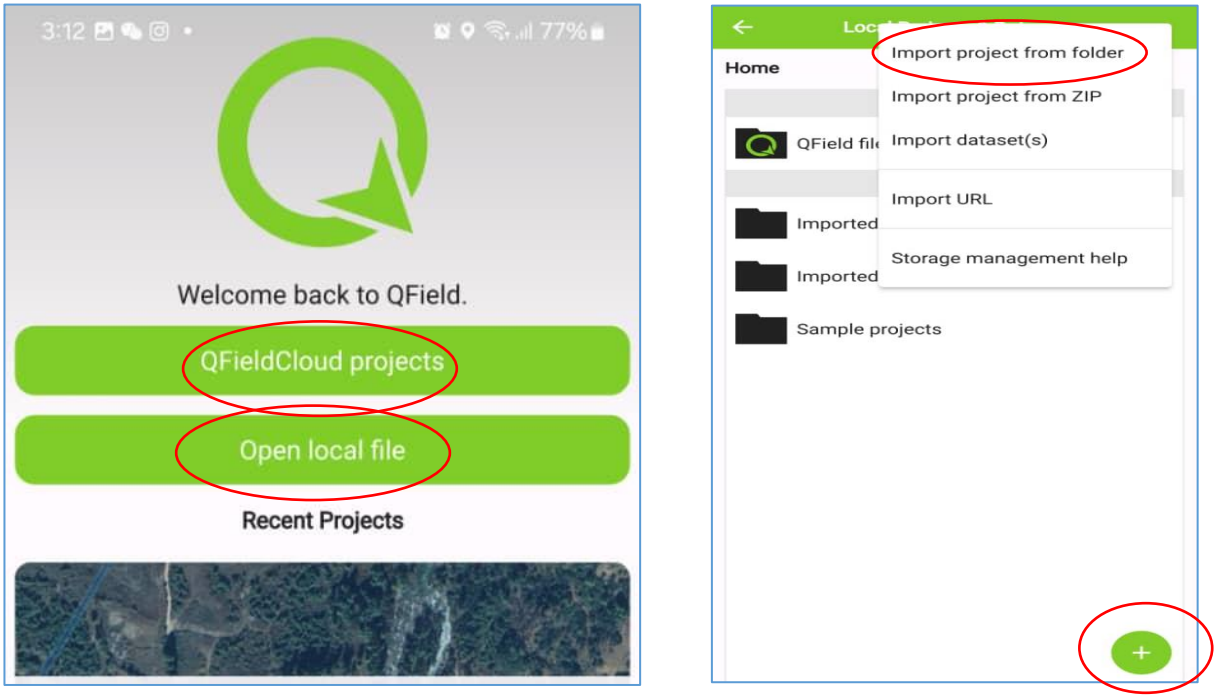


Fig 14: Click on ≡(Recent)→ select ‘Datum Field data’ folder in Phone Internal memory/SD card → then select created ‘Package for Qfield’ folder → then select main QGIS file saved with extension .qgs → Allow Qfield to access files in Datum field data → Allow.

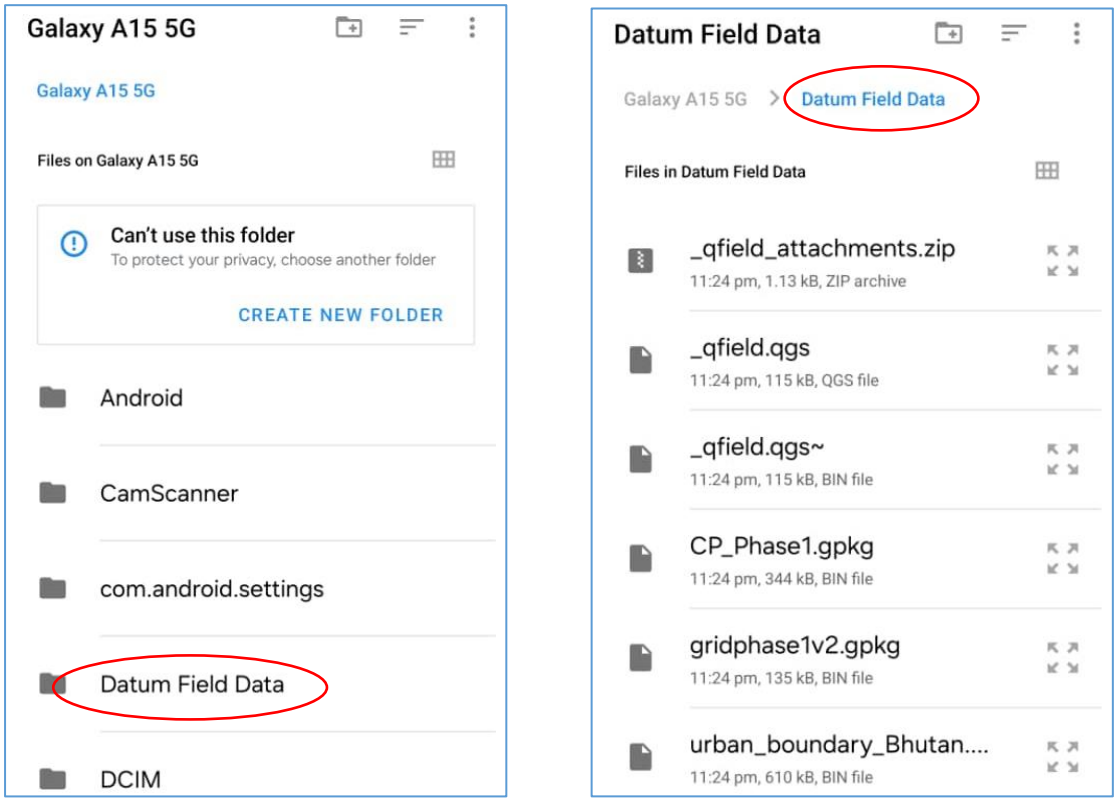
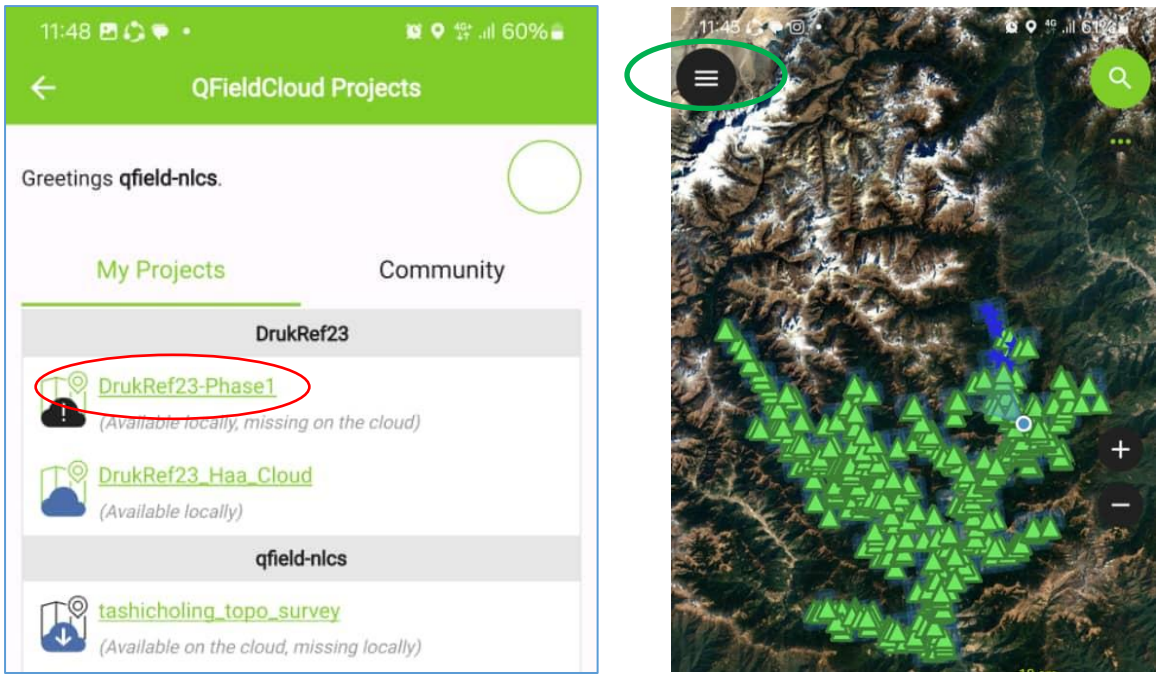


Fig 15: Shows the selection of main QGIS file saved with extension .qfield



5. Login of QfieldCloud account

- Username: qfield-nlcs
- Password: qfield@bhutan

Fig 16: Demonstrates how to navigate to the QField project and select the desired project to open.

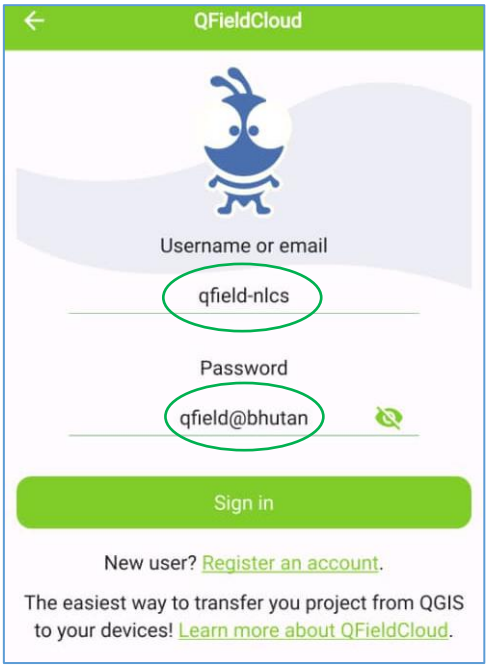
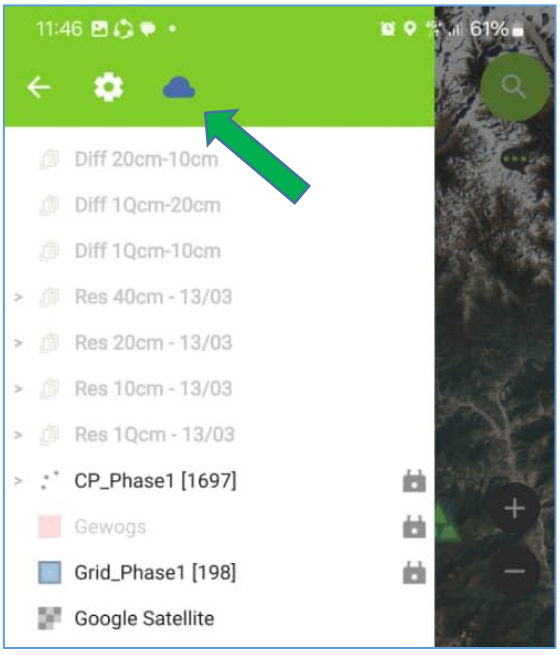
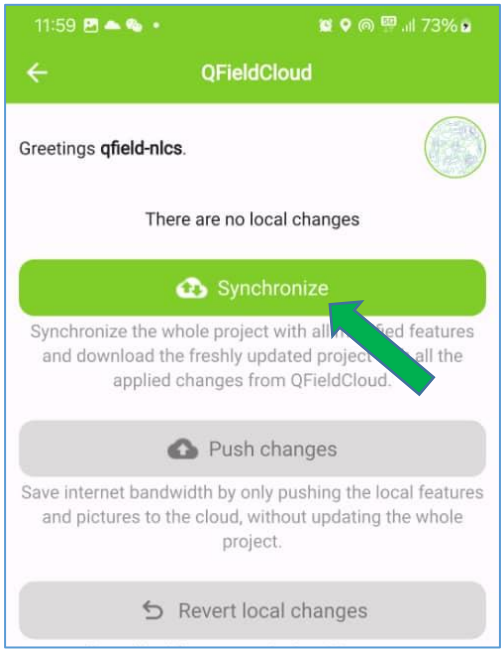


Fig 17: Click the cloud icon on the QField menu bar to synchronize. This will update all data. This process should be done daily to ensure the project is up-to-date before starting fieldwork.





6. Field Operations

Understand the objectives, scope, and methods of the fieldwork. Ensure all necessary equipment is functioning and properly calibrated. Gather materials needed for the fieldwork.

6.1 Site Reconnaissance:

Select a stable, unobstructed location with a commanding view for the base station, ensuring it is positioned away from any potential sources of interference.

6.2. Set a project

The field data will be stored in a project created in Project Manager → New → project name:

"usually date"

- **Projection Parameters**

  Projection mode: Transverse Mercator

  Central meridian: E90.0

  False Northing: 0

  False Easting: 250000

  Scale factor: 1

  Latitude of origin: N0.0

  Ellipsoid name: GRS80

6.3. Instrument Setup using Base Station

- Mount the antenna securely on a tripod.
- Attach the rover antenna to a pole.
- Establish a communication link with the base station.
- **Device** → communication → **Base** → select Base serial number.
- **DataLink** → Internal UHF.
- Elevation Mask → 10 to 15 degree
- Channel → select channel number as same as rover
- Input base coordinate of the base station → Connect
- **Device** → communication → **Rover** → select Rover serial number.
- Channel → select channel number as same as base→ connect.

- Before conducting any survey, it is the surveyor's duty to check at least two known SCP (Survey Control Points) near the base station.

6.4 Regular Checks

Table 1: Shows the field form used to check at least two known SCP (Survey Control Points) near the base station.

DrukRef23 - Check the base station coordinates against at least two other SCP points.

Dzongkhag: **Gewog**

Receiver type: **S/N:**

Known Coordinates				Observed Coordinates			Δ E	Δ N	Δ H	CORS	Baseline	Date
Point Id	Easting	Northing	Elevation	Easting	Northing	Elevation						

Surveyor Name & Signature

(or)

7. Instrument Setup using CORS Station:

- Attach the rover antenna to a pole.
- Connect WIFI if using hotspot/Insert sim card in the controller for internet
- **Device** → communication → select Rover serial number → Connect
- **Rover** → DataLink → Phone Internet
- Elevation Mask → 10 to 15 degree
- Server/Network → CORS/NTRIP
- Set the logging interval for RTK survey → Count 60 on a station.
- CORS Setting: **IP** → ntrip.druknet.net → **Port:** 2101 → **User:** xxxxx → **Pwd:** *****
- Mount point setting: Select your nearest CORS station → Get Access Point → Apply.
- First, input the coordinates of the point to be checked using the stakeout method. If the point is found to be accurate within the tolerance, it can be considered reliable for use in the datum observation project.

Table 2: Displays the field forms that need to be completed while observing a point.

DrukRef23 – Field Data Acquisition

Dzongkhag: **Gewog:** **Date:**

Receiver type: **S/N:** **Reference Station:**

Point Code	Time (UTC)	X	Y	Z	Mast Height (m)	Error H (mm)	Error V (mm)	Fix Amb	Baseline (km)	Remarks

Surveyor Name and Sign

8. Requirements for Maintaining Important Documents in Datum Transformation Field Work:

- Fill in all required fields on the forms before moving to the next station.
- Capture clear photos and a 360-degree video of the station with the GNSS RTK position clearly marked.
- Download the CSV files for the day's work.
- Scan the forms using your mobile phone and save them in PDF format.
- Create a folder with the date and a name like '11082024_JG' to store only the scanned field forms and CSV files.
- Create another folder with the date and a name like '11082024_JG_PhotoVideo' to store only the photos and videos from the day's work.

9. Data Submission:

- Every day, field surveyors will compile the required data and send it to the Datum Transformation team.
- Send the '11082024_JG' folder to the Datum Transformation team for updates.
- Keep the '11082024_JG_PhotoVideo' folder safely on your laptop. If needed for clarification or further verification, specific photos and videos can be sent to the Datum Transformation team.