

# Quarterly Report on EMF Monitoring January-March 2023



འབྲུག་བརྗོད་རྒྱུ་འགྲུལ་དང་བརྗོད་སྐབས་འཛིན།

**Bhutan InfoComm and Media Authority**

**Royal Government of Bhutan**

**April 2023**

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## 1. Background

Electromagnetic Field (EMF) Emissions are the electric and magnetic fields that are produced by radios, microwaves, mobile phones and base stations (mobile towers). Telecommunications transmitters generate electromagnetic fields at radio and microwave frequencies. Transmitters have proliferated with siting of wireless communication networks often co-located among other transmitters and the transmitter used in contact with human bodies. If the EMF exposure is prolonged there may be issues of possible health risks. Such risks must be managed and prevented. Currently International Commission on Non-Ionizing Radiation Protection (ICNIRP) standards and various other standards are adopted on the assessment and compliance of the exposure levels radiated from different electromagnetic spectrum sources according to the permissible levels in order to protect the people from exposure to higher RF radiations. The most sources of exposure include the cellular network using GSM, WCDMA, LTE and others which occupy the VHF, UHF, L and S band frequencies.

The Bhutan InfoComm and Media Authority have always been monitoring and measuring the EMF radiation level of each Telecommunication Base Transceiver station (towers) in the country based on the EMF emission standards. The Authority also certifies the EMF compliance of the mobile towers in the country mainly in urban areas and satellite towns areas.

The EMF emission standard is derived from the EMF radiation threshold developed by ICNIRP and the Authority has standardized the threshold level of EMF radiation exposure based on the regional threshold.

## 2. Monitoring

The Authority has monitored the EMF from January to March, 2023 in following places;

Sl.No	Name of the Monitored Places	Number of towers Monitored
1	Phuentsholing	8
2	Gomtu	3
3	Dorokha	2
4	Samtse	9
5	Gelephu	9
6	Panbang, Zhemgang	3
7	Zhemgang	2

The Authority will continue to monitor and measure the mobile towers in the country and will be issued with the certificate of EMF threshold compliance respectively.

### 3. Objective of the Monitoring

The main objective of the EMF measurement monitoring is:

- To ensure the safe and reliable communication services.
- To test the exposure levels produced by any transmitter or emitter such as telecommunication facilities and mobile telephone base stations for safety purposes and maintain the EMF emission within the standard threshold.
- To ensure that all telecommunication equipment is safe and secure.

### 4. Details of the Equipment used for EMF Compliance Test

The details of existing EMF monitoring equipment of the Authority are as mentioned below:

Equipment Make/Model: Rohde & Schwarz  
Type of the Antenna: Isotropic Antenna/Type (3-Axis)  
Spectrum Analyzer: FSH8  
Calibration details: Calibrated on 21-12-2022 and valid up to 2 to 3 years

### 5. Specification of the Equipment/ Instrument

The specification of the above equipment are as mentioned below:

- 3-axis, E-field antenna 30 kHz to 3 GHz
- Spectrum analyzer covering 9 kHz to 8 GHz
- RFEX Software package
- A 1.5 meter cable to separate the antenna from the meter
- Tripod to hold the antenna



Figure 1: Isotropic Antenna/Type (3-Axis)



Figure 2: Spectrum Analyzer FSH8

## 6. Measurement Parameter

The following quantities are measured while monitoring:

- Electric Field strength E in **V/m**
- Power density in ( **$\mu\text{W}/\text{cm}^2$** )

## 7. Methodology

The following methodology processes are followed while carrying out the monitoring:

- The measurement is done around 10 meters to 20 meters away from the sectoral antenna's BTS towers facing towards the measurement equipment which is based on the ICNIRP standards measurement.
- The measurement result is taken as the average over a time period of 10 to 15 minutes.
- The measurement is done by Frequency selective method. The selected frequency is for 2G, 3G, and 4G for both the operators.
- Measurement values will be recorded and compare the measurement values with the reference level as per the international standard ICNIRP.

## 8. Reference Standards and Regulation/ICNIRP limits

According to Section 10(1), and 10(2) of the “Standard for the Establishment of Telecommunications Tower”

- 10 (1): *All telecommunication and broadcasting sites shall ensure compliance with the ICNIRP Procedures and Standards for general public exposure and take immediate actions to rectify any non-compliant Sites.*
- 10(2): *Antennas in all sites shall not emit the EMF radiation more than the standards shown in the table below;*

Frequency range	Electric field-strength (V/m)		Equivalent plane wave power-density $S_{eq}(\text{W}/\text{m}^2)$	
	general public	occupational	general public	Occupational
0.1 - 30 Hz	$300/(10^{0.5*f^{0.7}} \text{MHz})$	$600/(10^{0.5*f^{0.7}} \text{MHz})$	NA	NA

>30 – 400 MHz	$27.7/10^{0.5}$	$61/10^{0.5}$	0.2	1
>400 - 2000 MHz	$(1.375f^{0.5}(\text{MHz})/10^{0.5})$	$(3f^{0.5}(\text{MHz}))/10^{0.5}$	(f/2000)	(f/400)
>2 - 300 GHz	19.289	43.323	1	5

### 9. Findings and Permissible limits of Electric Field and Power Density

The EMF measurement of the BTS tower was carried out in Phuentsholing, Samste, Gelephu and Zhemgang. It is found that the maximum exposures around all of the base stations are **very low** than exposure limits. The detailed measurement readings , findings, electric field and Power Density results are attached below in **Annexure I**.

### 10. Satellite View of the Measurement Location/Telecom site

The satellite view of the measurement location of each telecom site or transmitter is attached in **Annexure 2**.

## Annexure 1 (Measurement Results)

The detailed measurement readings of Electric Field and Power Density are attached below;

### 1. Phuentsholing (Bhutan Telecom Limited)

SL. No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Phuentsholing Exchange	Phuentsholing	26.859622	89.386829	5121	900 MHz	13.044	0.56879	0.0450	<i>Below the Limits</i>
					21	850 MHz	12.676	0.7950	0.0500	
					232	1800 MHz	18.44	0.3365	0.0300	
2	Tinkilo Densifying Site	Phuentsholing	26.856051	89.393653	180	1800 MHz	18.44	1.88796	0.6575	<i>Below the Limits</i>
3	Pemaling Densifying Site	Phuentsholing	26.857033	89.385168	229	1800 MHz	18.44	1.13862	0.2383	<i>Below the Limits</i>
4	Zangdoperi	Phuentsholing	26.861854	89.381881	241	1800 MHz	18.44	1.00076	0.2245	<i>Below the Limits</i>
					5421	900 MHz	13.044	0.15907	0.0067	<i>Below the Limits</i>
					485	850 MHz	12.676	0.47500	0.0598	

5	Dantak	Phuentsholing	26.863975	89.378916	485	2100 MHz	19.925	0.31326	0.0260	
					227	700 MHz	11.504	0.63007	0.1053	
					223	1800 MHz	18.44	0.35998	0.0344	

## 2. Phuentsholing (Tashi InfoComm Limited)

SL.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Toorsa	Phuentsholing	26.86645317	89.37486267	1821	900 MHz	13.044	0.69179288086	0.2676	<i>Below the Limit</i>
					33161	850 MHz	12.676	0.67615	0.2751	
					11	1800 MHz	18.00	1.0741	0.3060	
2	Phuntsholing - 3	Phuentsholing	26.85998917	89.3826828	1464	900 MHz	13.044	0.37937868233	0.0382	<i>Below the Limit</i>
					3385	850 MHz	12.676	0.50051966	0.0665	
					21	1800 MHz	18.00	0.91952	0.2243	



3	Phuntsholing TX	Phuentsholing	26.86636162	89.38285828	3323	900 MHz	13.044	0.16823905875	0.0075	<i>Below the Limit</i>
					33171	850 MHz	12.676	0.44178385595	0.0518	
					25	1800 MHz	18.00	0.43794214291	0.0509	

### 3. Gomtu, Samtse (Bhutan Telecom Limited)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Gomtu Exchange	Samtse	26.813665	89.194034	5261	900 MHz	13.044	0.30681410279	0.0250	<i>Below the Limits</i>
					388	850 MHz	12.676	0.34439139696	0.0315	
					145	700 MHz	11.504	0.36411383306	0.0352	
					141	1800 MHz	18.44	0.31248631838	0.0259	
2	Gomtu Town	Samtse	26.814766	89.189574	5271	900 MHz	13.044	0.17650838466	0.0083	<i>Below the Limit</i>
					179	850 MHz	12.676	0.20825417588	0.0115	

					114	1800 MHz	18.44	0.74177173884	0.1459	
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#### 4. Gomtu, Samtse (Tashi InfoComm Limited)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Gomtu	Samtse	26.81428909	89.19554901	2151	900 MHz	13.044	0.2275616797	0.0137	<i>Below the Limits</i>
					7182	850 MHz	12.676	0.23205862417	0.0143	
					21	1800 MHz	18.44	0.28340582808	0.0213	

#### 5. Duphucheen, Samtse (BTL)

Sl. No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
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1	Dorokha	Samtse Samtse	26.991972	89.20643	62	1800 MHz	18.44	0.316393371 496042	0.0266	<i>Below the Limits</i>
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#### 6. Dhopochen, Samtse (TICL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Dorokha	Samtse	26.993914	89.206622	23	1800 MHz	18.44	0.35989350 8164688	0.0344	<i>Below the Limits</i>

#### 7. Samtse (BTL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
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1	Samtse Exchange	Samtse	26.899524	89.0965	150	900 MHz	13.044	0.37039	0.0364	<i>Below the Limits</i>
					15	850 MHz	12.676	0.61449545709	0.1002	
					96	1800 MHz	18.44	0.4049545574	0.0435	
2	Samtse Town	Samtse	26.900751	89.093393		900 MHz	13.044	0.506086728631713	0.0679	<i>Below the Limit</i>
					5472	850 MHz	12.676	0.16371012188	0.0071	
					105	700 MHz	11.504	0.42583328422	0.0481	
					113	1800 MHz	18.44	0.62288480223	0.1029	
3	Samtse BPC Colony D-Site	Samtse	26.89833678	89.0973742	424	1800 MHz	18.44	0.58262653556	0.0900	<i>Below the Limit</i>
4	Samtse Checkpost D-site	Samtse	26.896508	89.094451	49	1800 MHz	18.44	0.65844056838	0.1150	<i>Below the Limit</i>
					5571	900 MHz	13.044	0.3311609376	0.0291	<i>Below the Limit</i>
					410	850 MHz	12.676	0.255607834924244	0.0173	

5	Tendu Exchange	Samtse	27.1241996	88.8749977	87	700 MHz	11.504	0.18256139 92	0.0088	
					95	1800 MHz	18.44	0.26733254 976	0.0190	
6	Tendu RGH Densifying Site	Samtse	27.115911	88.875033	224	1800 MHz	18.44	0.77951716 185	0.1612	<i>Below the Limit</i>

### 8. Samtse (TICL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Samtse Town	Samtse	26.90074921	89.09594727	6411	900 MHz	13.044	0.632231 60249	0.1060	<i>Below the Limits</i>
					6191	850 MHz	12.676	0.140118 2507630 21	0.0052	
					11	700 MHz	11.504	0.156494 36848	0.0065	
					22	1800 MHz	18.44	0.779307	0.1611	

								09562		
2	Samtse Tx	Samtse	26.893082°	89.098381°	3441	900 MHz	13.044	0.147092 26335	0.0057	<i>Below the Limit</i>
					23	1800 MHz	18.44	0.560402 40930	0.0833	
3	Tendu	Samtse	27.127589	88.875775	3213	900 MHz	13.044	0.312091 50306	0.0258	<i>Below the Limit</i>
					22	1800 MHz	18.44	0.272202 32091	0.0197	

### 9. Gelephu (BTL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Gelephu Exchange	Sarpang	26.869297	90.488038	4171	900 MHz	13.044	0.339988 92017	0.0307	<i>Below the Limits</i>
					221	850 MHz	12.676	0.776532 81642	0.1599	
					334	1800 MHz	18.44	1.166464 98736	0.3609	
2	Fishery Outdoor	Sarpang, Gelephu	26.870903	90.492272	31	1800 MHz	18.44	0.841496 8793524	0.1878	<i>Below the Limit</i>

								9		
3	Zhaming D-site	Gelephu, Sarpang			239	1800 MHz	18.44	1.026755 22839	0.2796	<i>Below the Limit</i>
4	Hospital Outdoor	Gelephu, Sarpang	26.8746	90.488435	18	1800 MHz	18.44	0.909594 88901	0.2195	<i>Below the Limit</i>
5	Namkhaling	Gelephu, Sarpang	26.864638	90.486184	8241	900 MHz	13.044	0.188053 31905	0.0094	<i>Below the Limit</i>
					301	850 MHz	12.676	0.249522 97538	0.0165	
					447	1800 MHz	18.44	0.651619 9225	0.1126	
6	Rabdiling	Gelephu	26.880703	90.492509	4192	900 Mhz (2G)	13.044	0.152	0.0062	<i>Below the Limit</i>
					253	850 MHz (3G)	12.676	0.01429	0.0001	
					365	1800 MHz (4G)	18.44	0.24818	0.0163	

### 10. Gelephu (TICL)

SL.No	Site	Location	Latitude	Longitude	Cell	Frequency	Limits	Field Strength	Power	
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	Name				ID		V/m	V/m	Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Gelephu Tx	Gelephu, Sarpang	26.87028313	90.4841156	11711	900 MHz	13.044	0.2899848103 9	0.0223	<i>Below the Limits</i>
					11328	850 MHz	12.676	0.5714048994	0.0866	
					12	1800 MHz	18.44	0.5185501953 6	0.0713	
2	Tali Dratshang	Gelephu, Sarpang	26.883681	90.486647	11713	900 MHz	13.044	0.0148453614 8	0.0001	<i>Below the Limits</i>
					21	1800 MHz	18.44	0.6223682713 7	0.1027	
3	Gelephu Office	Gelephu, Sarpang	26.883681	90.486647	11955	850 MHz	12.676	0.3930550550 3	0.0410	<i>Below the Limits</i>
					23	1800 MHz	18.44	1.0085484824 2	0.2698	

### 11. Pangbang, Zhemgang (BTL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
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1	Zhemgang Town	Panbang, Zhemgang	26.8500165	90.9617439	227	1800 MHz	18.44	1.71225923499	0.7777	<i>Below the Limits</i>
2	Galabi	Panbang, Zhemgang	26.847064	90.964182	7031	900 MHz	13.044	1.8748869389	0.9324	<i>Below the Limit</i>
					343	850 MHz	12.676	0.39478811251	0.0413	
					227	1800 MHz	18.44	0.90118591696	0.2154	
					446	1800 MHz	18.44	0.57254558525	0.0870	

## 12. Panbang, Zhemgang (TICL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Panbang Drungkhag	Panbang, Zhemgang	26.84702873	90.96421814	1101	900 MHz	13.044	1.7748869389	0.9324	<i>Below the Limits</i>
					12702	850 MHz	12.676	0.69478811251	0.0413	
					22	1800 MHz	18.44	0.87254558525	0.0870	

**13. Zhemgang (BTL)**

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ( $\mu\text{W}/\text{cm}^2$ )	Remark
1	Zhemgang Town	Zhemgang	27.215355	90.659337	7142	900 MHz	13.044	0.83513612774	0.1850	<i>Below the Limits</i>
					456	850 MHz	12.676	0.7299234777	0.1413	
					227	850 MHz	12.676	2.66114906233	1.8784	
					459	1800 MHz	18.44	1.4964201192	0.5940	
					447	1800 MHz	18.44	0.99332328371	0.2617	

**14. Zhemgang (TICL)**

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band	Limits	Field Strength	Power Density	Remark
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							V/m	V/m	( $\mu\text{W}/\text{cm}^2$ )	
1	Zhemgang Town	Zhemgang	27.2151660 9	90.6587066 7	12771	900 MHz	13.044	0.935136127 7	0.1850	<i>Below the Limits</i>
					12701	850 MHz	12.676	0.629923477 7	0.1413	
					22	850 MHz	18.44	1.993323283 7	0.5940	

## Annexure 2 (Satellite View of Location of Monitored Sites)

The following are the satellite view of the measurement location of the each Telecom site transmitter;

26.899524,89.0965



Figure 3: Samtse Exchange BTS (BTL)

26.900751,89.093393

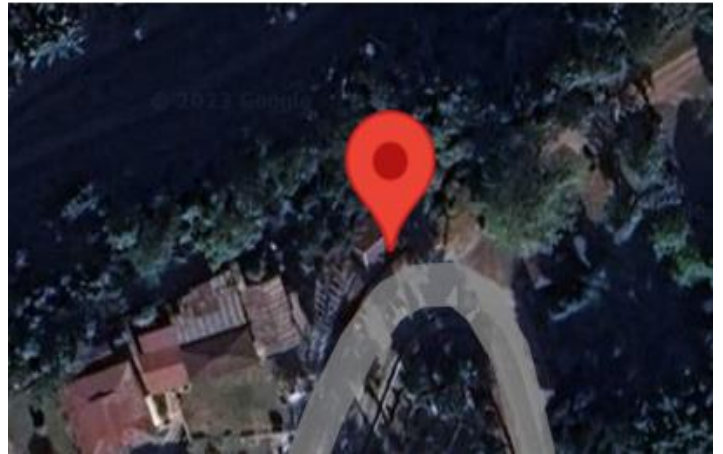


Figure 4: Samtse Town BTS (BTL)

26.896508,89.094451

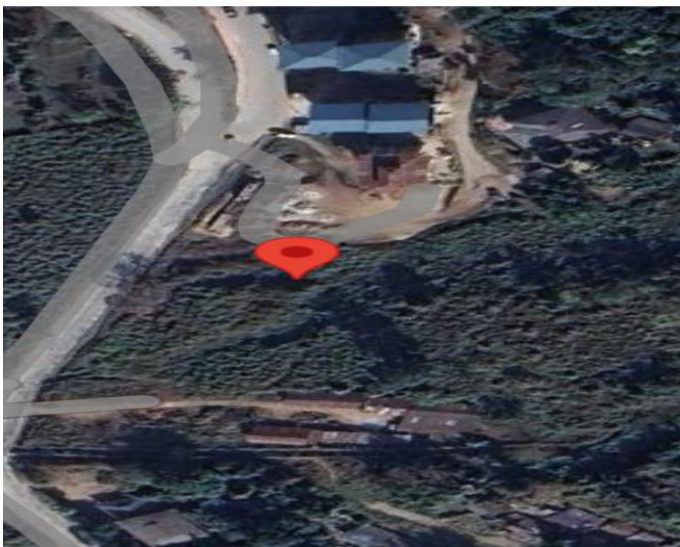


Figure 5: Samtse Checkpost D-site BTS (BTL)

26.8933678,89.0973742

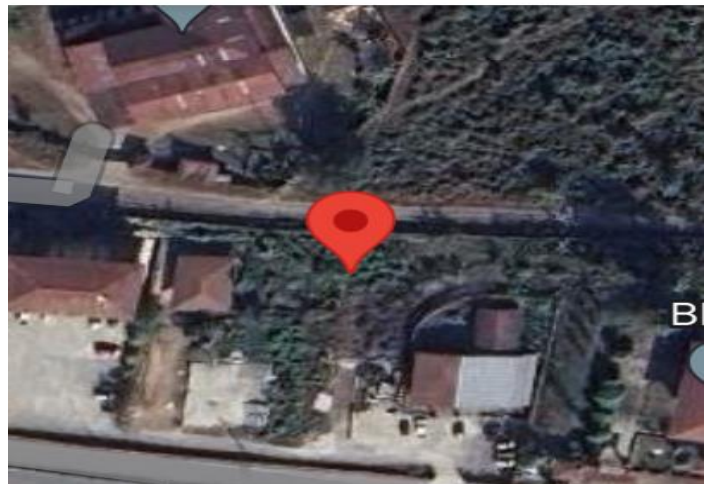


Figure 6: Samtse BPC Conony D-site BTS (BTL)

27.124517,88.874916



Figure 7: Tendu Exchange BTS (BTL)

27.115911,88.875033



Figure 8: Tendu RGH Densifying Site BTS (BTL)

26.900089,89.096413

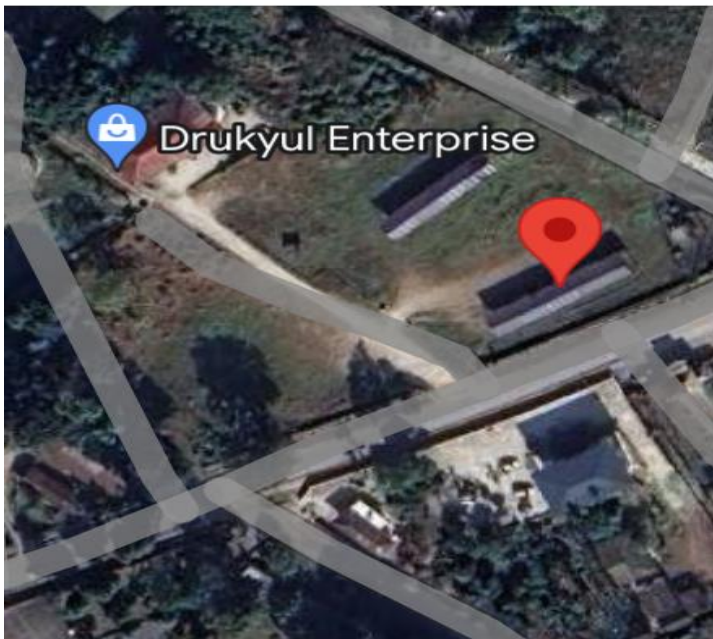


Figure 9: Samtse Town BTS (TICL)

26.893082,89.098381

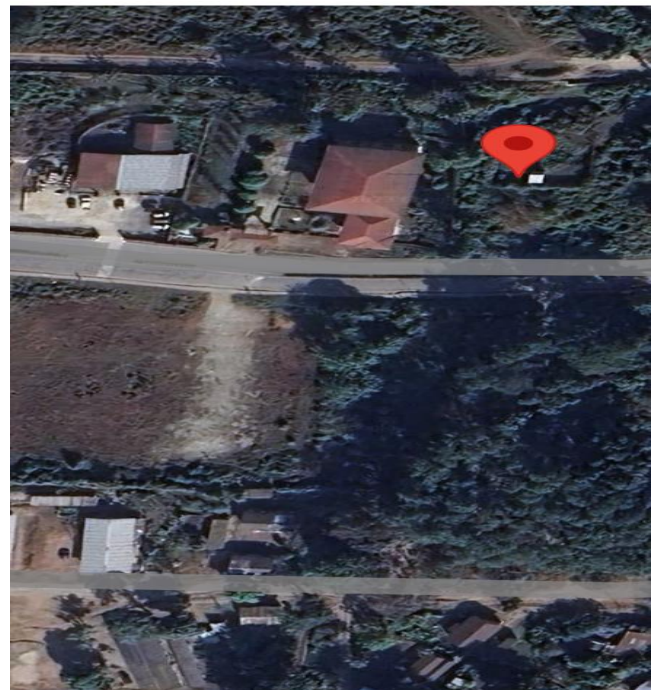


Figure 10: Samtse Tx BTS (TICL)

27.127589,88.87575

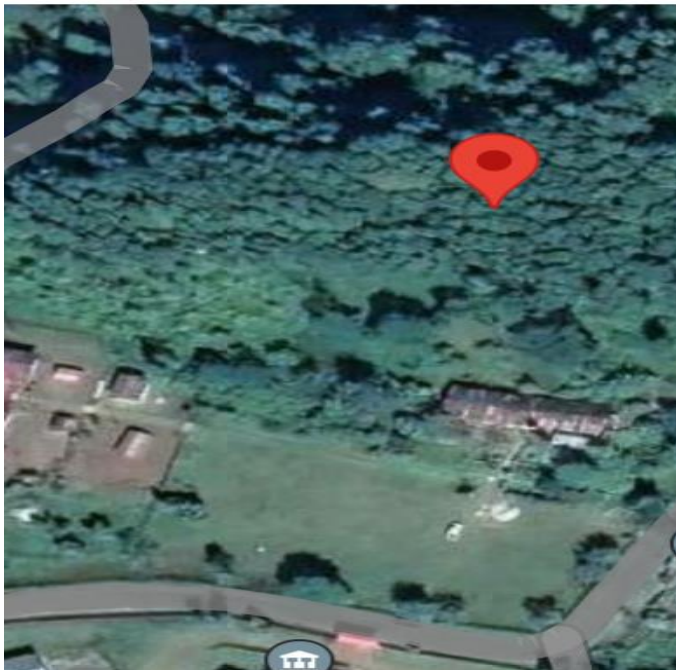


Figure 11: Tendu Town BTS (TICL)

26.993914,89.206622

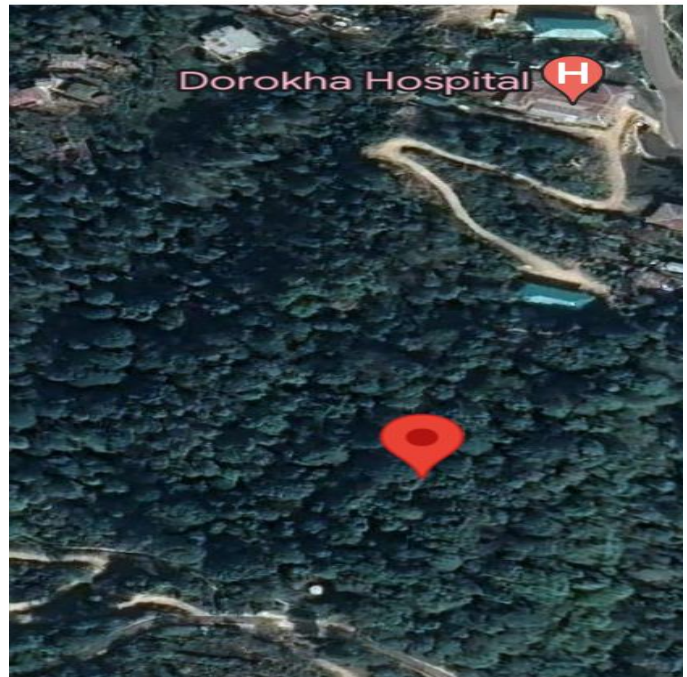


Figure 12: Dorokha BTS (TICL)

26.991972,88.20643



Figure 13: Dorokha BTS (BTL)

26.869297,90.488038



Figure 14: Gelephu Exchange BTS (BTL)

26.8746,90.488435

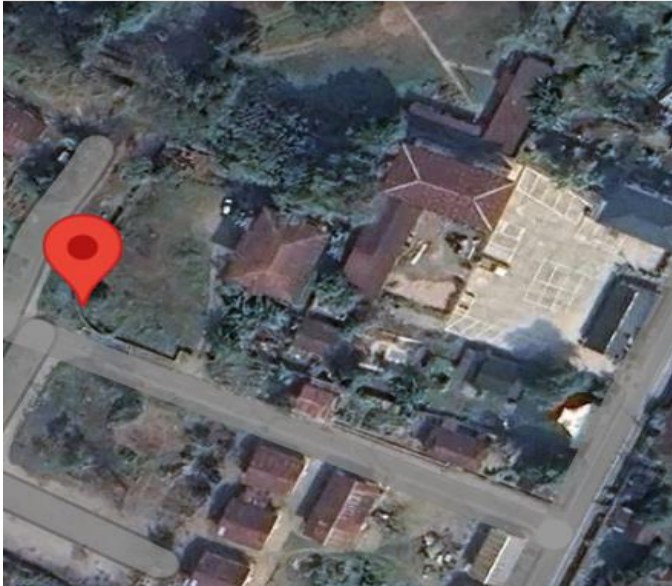


Figure 15: Hospital BTS, Gelephu (BTL)

26.864638,90.486183

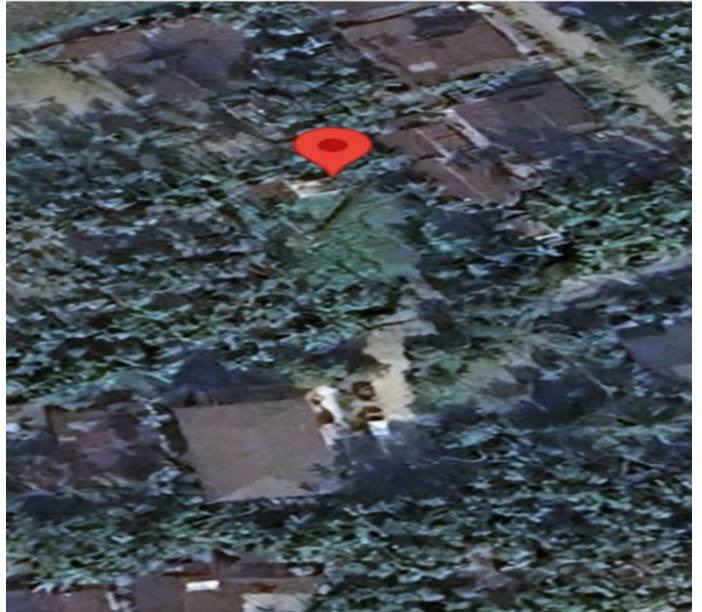


Figure 16: Namkhaling BTS, Gelephu (BTL)

26.870473,90.483800

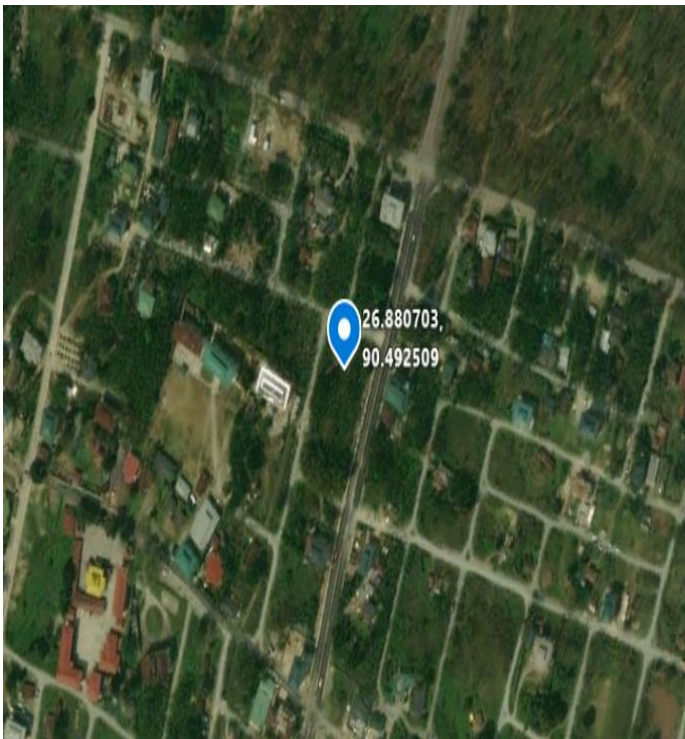


Figure 17: Rabdiling BTS, Gelephu (BTL)

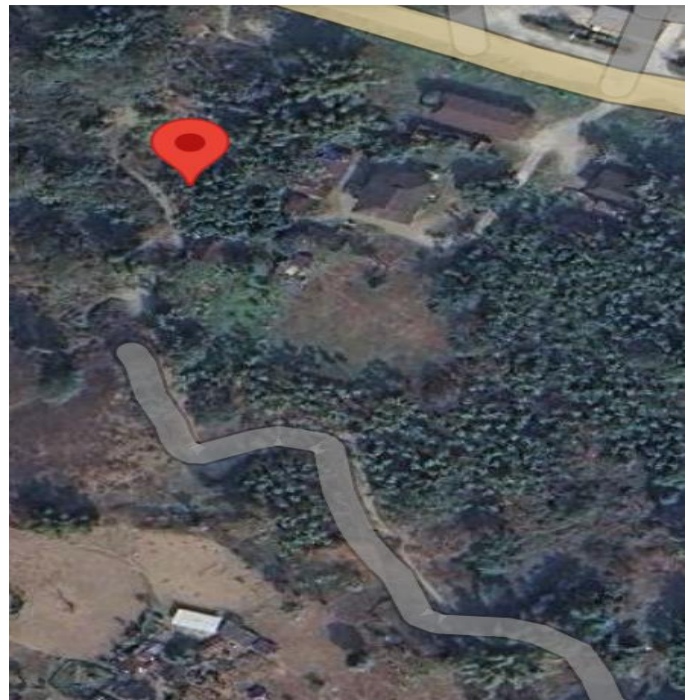


Figure 18: Gelephu Tx BTS, Gelephu (TICL)

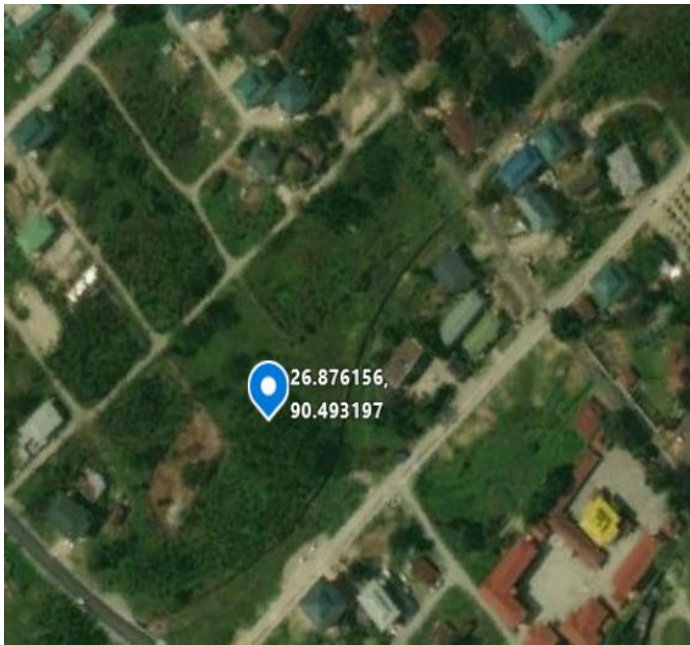


Figure 19: Tali Dratshang BTS, Gelephu(BTL)

26.883681,90.486647



Figure 20: Gelephu Office BTS (TICL)

26.859622,89.386829



Figure 21: Phuentsholing Ex BTS (BTL)

26.856051,89.393653

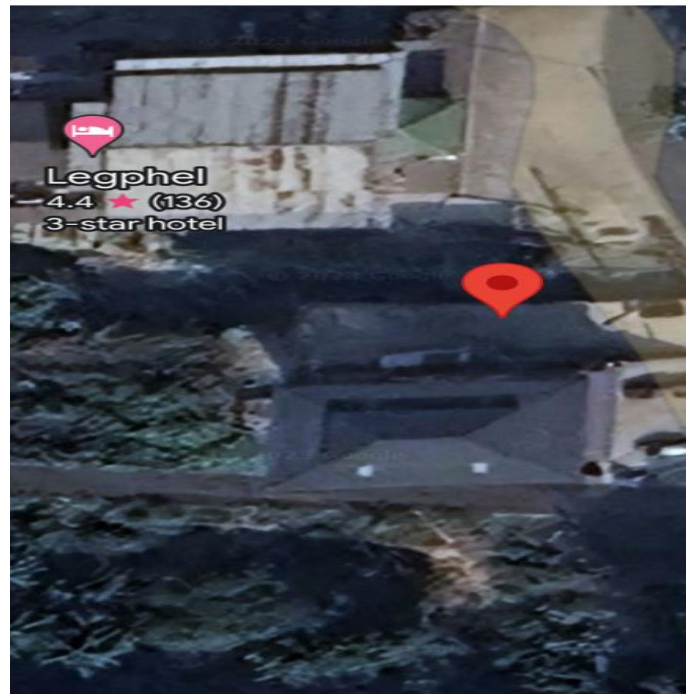


Figure 22: Tinkilo BTS (BTL)



26.857033,89.385168



Figure 23: Pemaling Densifying Site (BTL)

26.861854,89.381881

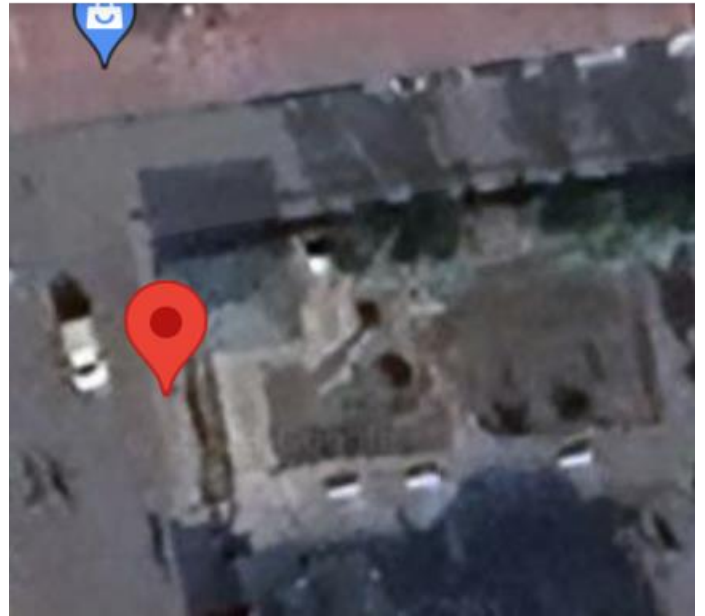


Figure 24: Zangdopelri D-site (BTL)

26.863975,89.378916



Figure 25: Dantak BTS (BTL)

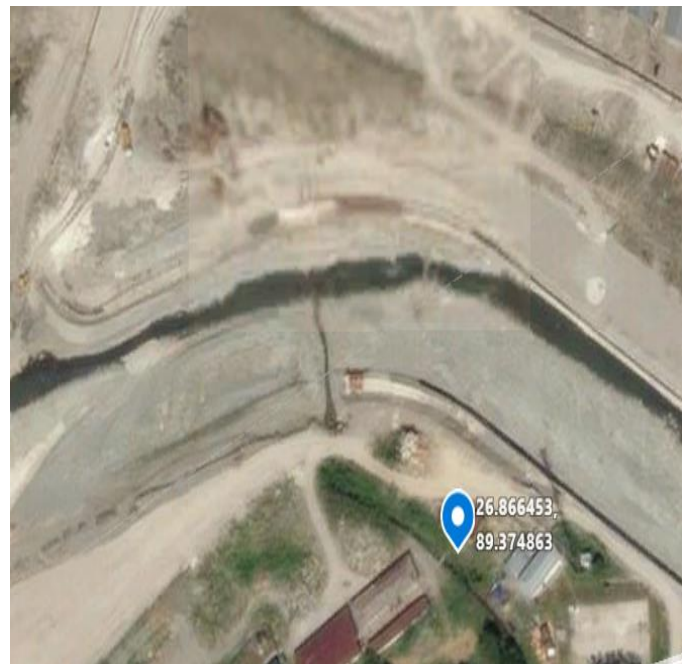
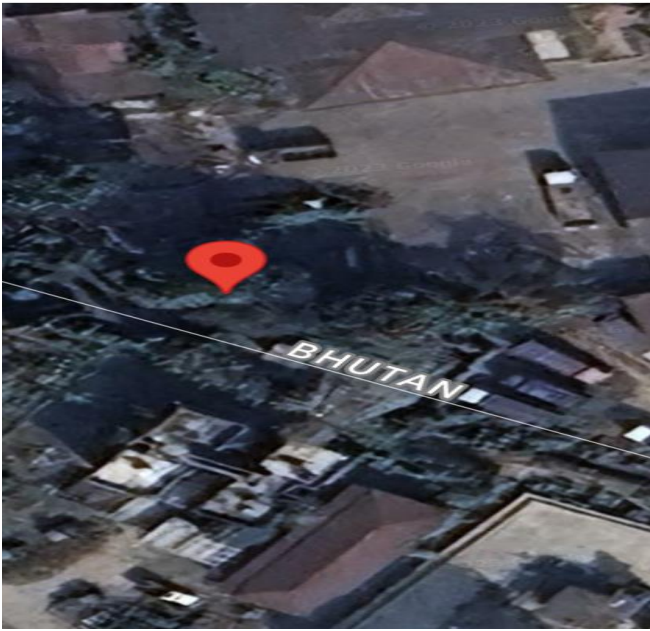


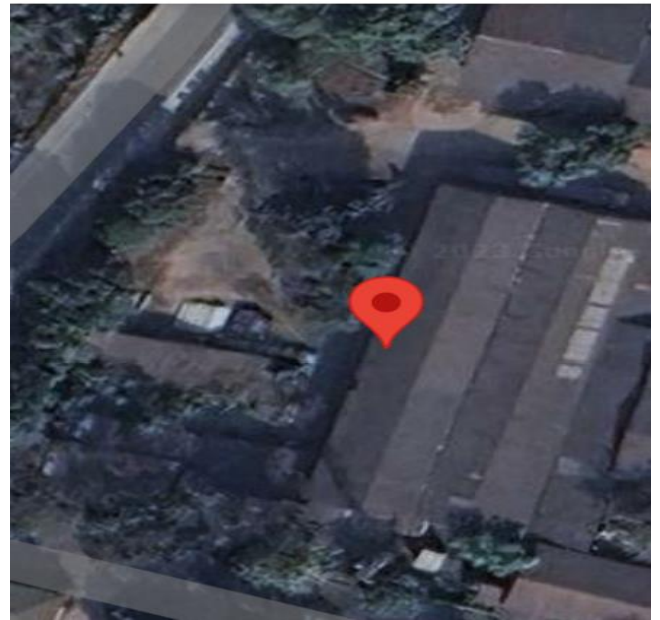
Figure 26: Toorsa BTS (TICL)

26.85998917,89.38268...



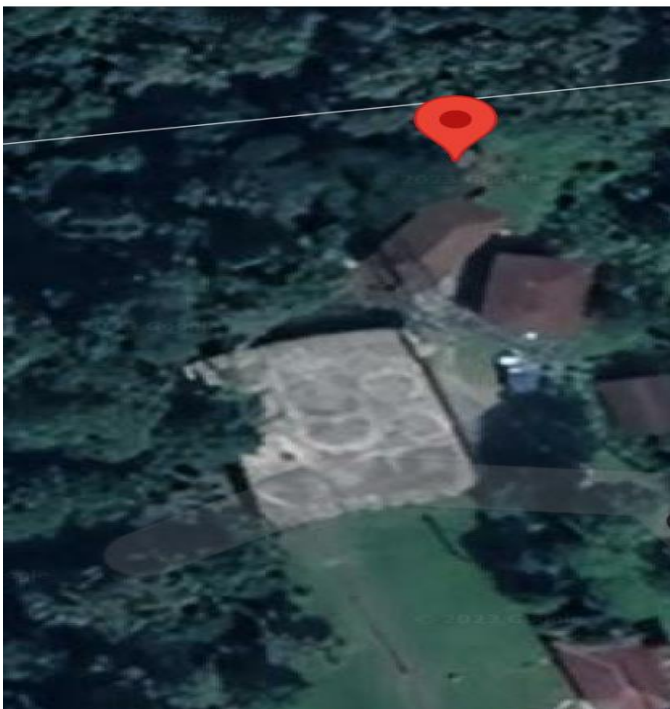
*Figure 27: Phuntsholing - 3 BTS (TICL)*

26.86636162,89.38285...



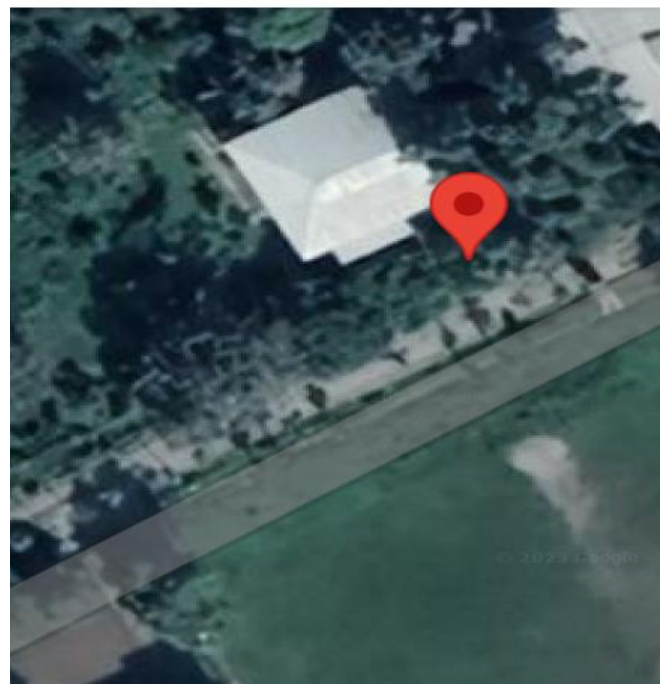
*Figure 28: Phuntsholing TX BTS (TICL)*

26.813665,89.194034



*Figure 29: Gomtu Exchange BTS (BTL)*

26.814766,89.189574



*Figure 30: Gomtu Town BTS (BTL)*

26.81428909,89.19549...

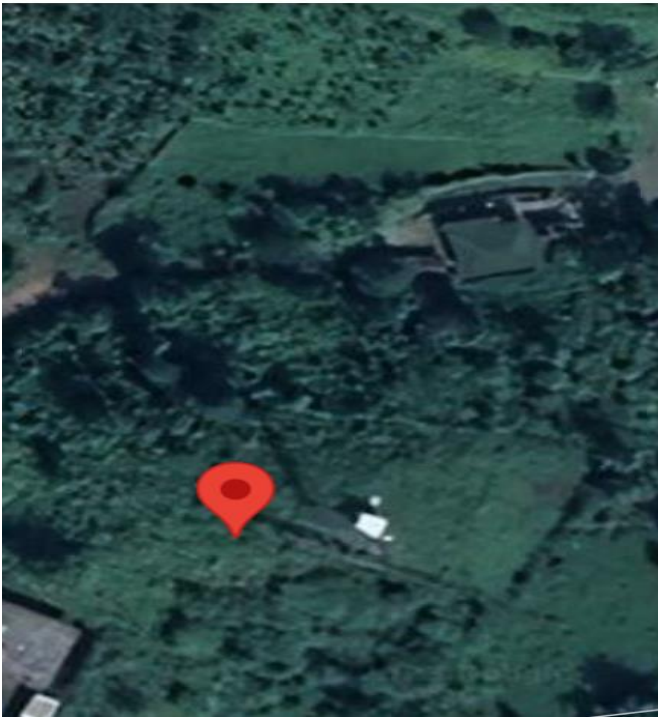


Figure 31: Gomtu Tx BTS (TICL)



Figure 32: Galabi BTS (BTL), Panbang



Figure 33: Zhemgang Town BTS (BTL)

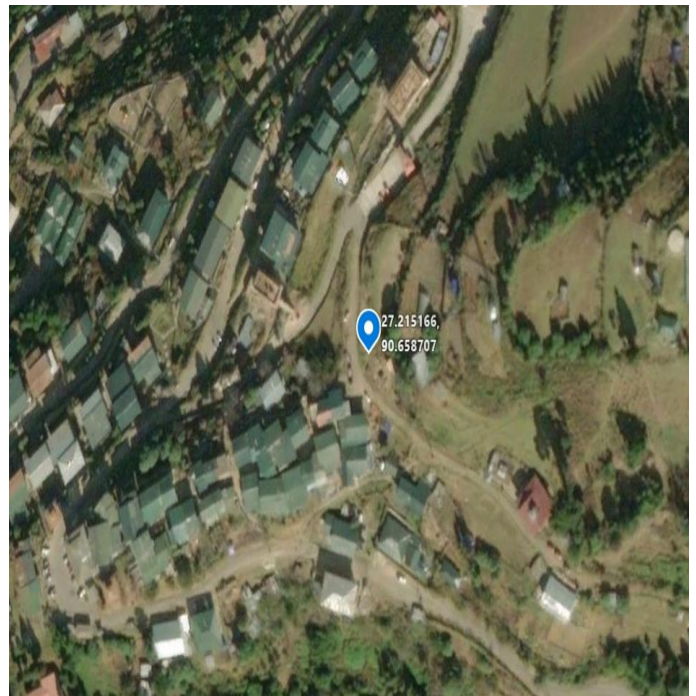


Figure 34: Zhemgang town BTS (TICL)

### Annexure 3 (Image of Monitored BTS)

The following are the images of the each Telecom BTS transmitters;



*Figure 35:Phuentsholing Exchange (BTL)*



*Figure 36:Tinkilo Densifying Site (BTL)*



*Figure 37:Pemaling Densifying Site (BTL)*



*Figure 38: Zangdopelri Densifying Site (BTL)*



*Figure 39: Dantak, Phuentsholing (BTL)*



*Figure 40: Hospital, Phuentsholing (BTL)*



*Figure 41: Toorsa, Phuentsholing (TICL)*



*Figure 42: Phuentsholing-3 (TICL)*



*Figure 43: Phuntsholing TX (TICL)*



*Figure 44: Gomtu Exchange, Samtse BTL*



*Figure 45: Gomtu, Samtse (TICL)*



*Figure 46: Dorokha, Samtse (BTL)*



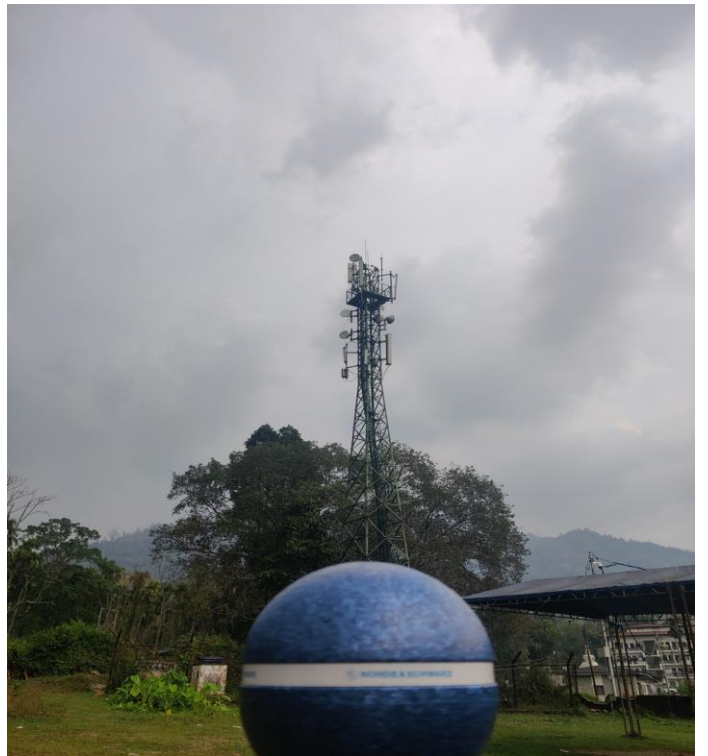
*Figure 47: Gomtu Town, Samtse (BTL)*



*Figure 48: Samtse BPC Colony D-Sit (BTL)*



*Figure 49: Samtse Check post D-Site (BTL)*



*Figure 50: Samtse Town (TICL)*



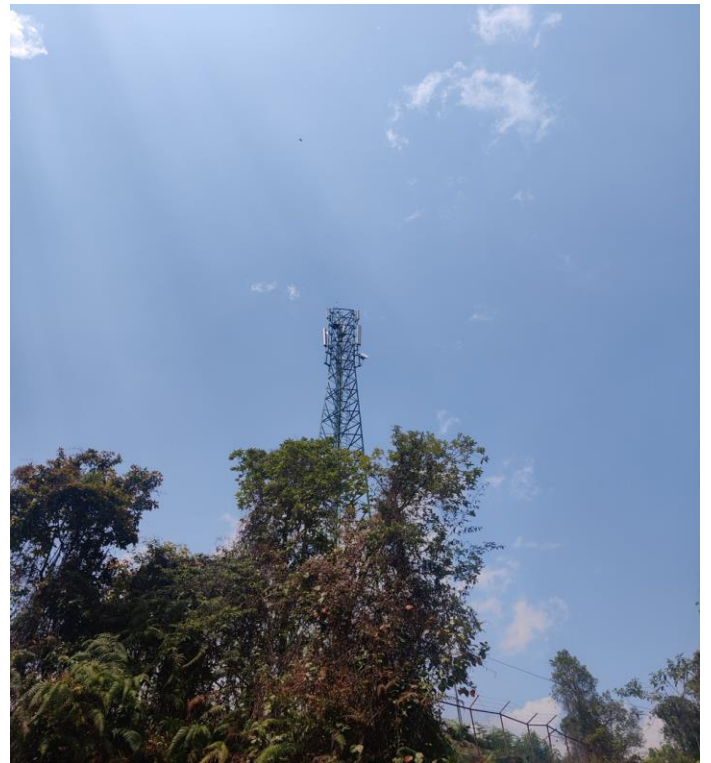
*Figure 51:Samtse TX (TICL)*



*Figure 52:Samtse Exchange (BTL)*



*Figure 53:Tendu RGH Densifying Site (BTL)*



*Figure 54:Tendu Town (TICL)*





*Figure 55: Gelephu Exchange (BTL)  
(BTL)*



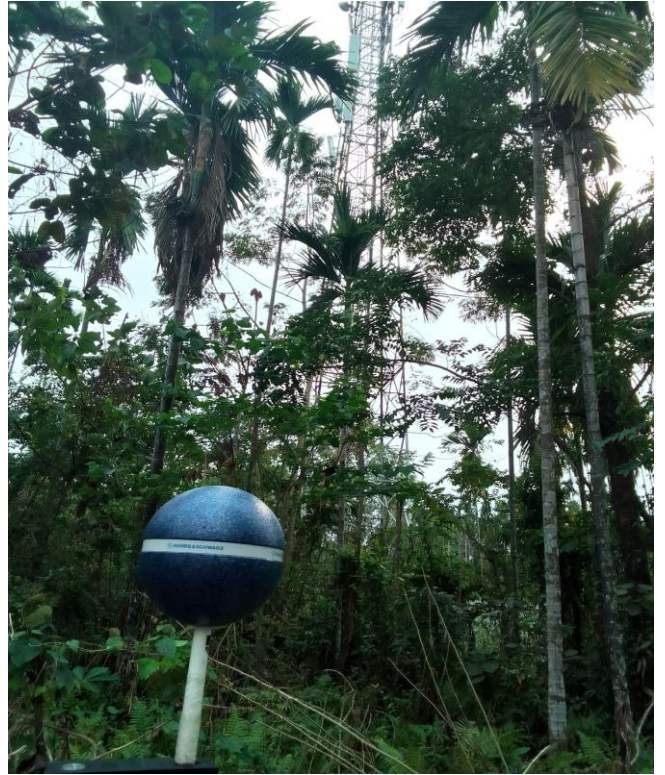
*Figure 56: Fishery Outdoor, Gelephu*



*Figure 57 : Zhamling D-site (BTL)*



*Figure 58: BPC Densifying Site (BTL)*



*Figure 59:Namkhaling, Gelephu (BTL)*



*Figure 60:Rabdeling, Gelephu (BTL)*



Figure 61: Gelephu Tx (TIL)  
(TICL)



Figure 63: Gelephu Office (TICL)

Figure 62: Tali Dratshang, Gelephu



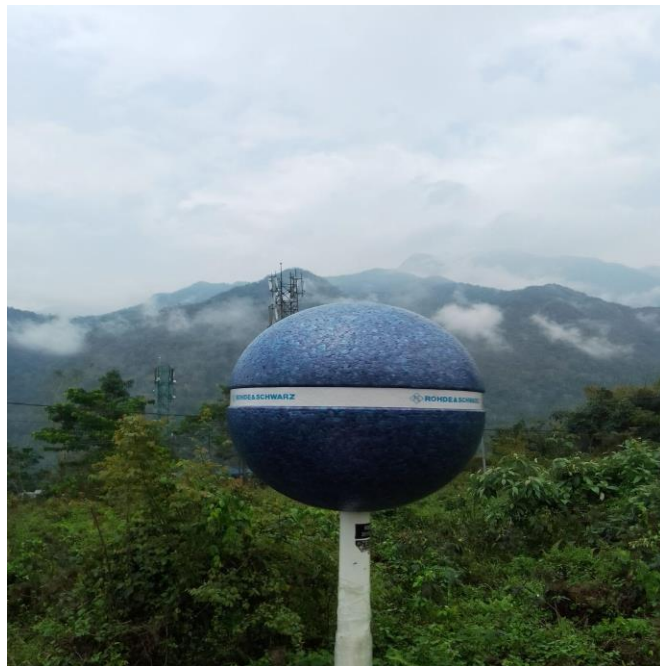
Figure 64: Zhemzang Hospital (BTL)



*Figure 65: Trong, Zhemgang (TICL)*



*Figure 66: Zhemgang Town (BTL)*



*Figure 67: Panbang Town*

*Figure 68: Galabi (BTL)*

