

Quarterly Report on EMF Monitoring (October - December 2023)



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Bhutan InfoComm and Media Authority

Royal Government of Bhutan

December 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 October to December, 2023 in following places;

Sl.No	Name of the Monitored Places	Number of tower Monitored
1	Tsirang Town	5
2	Gelephu Thromde	11
3	Samdrup Jongkhar Thromde	8

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 (**μW/cm²**)

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 $S_{eq}(W/m^2)$	
	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
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9. Findings and Permissible limits of Electric Field and Power Density

The EMF measurement of the BTS tower was carried out in Tsirang , Gelephu Thromde, and Samdrup Jongkhar Thromde. 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. Tsirang (Bhutan Telecom Limited)

SL. No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band (MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Tsirang Exchange	Tsirang	27.138056	90.124242	4471	900	13.044	0.4012276 49449007	0.037	<i>Below the Limits</i>
					124	850	12.676	0.1385220 66113075	0.058	
					120	1800	18.00	0.5071172 89133805	0.313	
2	Tsirang near police station	Tsirang	27.009603	90.123931	4221	900	13.044	0.5324955 24757341	0.53	<i>Below the Limits</i>
					329	850	12.676	0.0294400 016579419	0.396	<i>Below the Limits</i>
					325	700		0.5548109 1299881	0.34	<i>Below the Limits</i>

3	Tsirang Dupi	Tsirang	26.957844	90.143828	4051	900	13.044	0.0052250 818363366	0.0006	<i>Below the Limits</i>
					4053	850	12.676	0.0718809 715345419	0.0003	
					133	1800	18.00	0.0949202 312995097	0.00052	

2. Tsirang (Tashi InfoComm Limited)

SL.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band(MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Tsirang Town	Tsirang	27.00511111	90.10711111	24	900 MHz	13.044	0.03294287 44958463	0.00072	<i>Below the Limit</i>
					3	850 MHz	12.676	0.03294287 44958463	0.0144	
					41	1800 MHz	18.00	0.03294287 44958463	0.00040	
2	Tsirang	Tsirang	26.958436	90.143516	21	900 MHz	13.044	0.00545081 83633661	0.000627	<i>Below the Limit</i>
					3	850 MHz	12.676	0.06188097 15345419	0.0003	

	Dupi				22	1800 MHz	18.00	0.09392023 12995097	0.00052039	
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3. Gelephu Thromde, Sarpang (Bhutan Telecom Limited)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band (MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Gelephu Exchange	Sarpang	26.869297	90.488038	417	900 MHz	13.044	0.326986278801	0.071685	<i>Below the Limits</i>
					330	850 MHz	12.676	1.154894504715 48	0.383888	
					453	700 MHz	11.504	0.363641978343 10	0.088876	
2	Gelephu ISC lab 2	Sarpang	26.884104	90.480442	30	1800 MHz	18.44	0.878022735251 39	0.220564 40163068 3	<i>Below the Limit</i>
3	Gelephu Namkhaling	Sarpang	26.864638	90.486184	249	1800 MHz	18.44	0.538713386160 796	0.066491 26293203 04	<i>Below the Limit</i>
					243	900	13.0442	0.040020056216 9	0.001069 81043347 382	
					419	900 MHz	13.044	0.513115702069	0.175763	

4	Gelephu Rabtenling	Sarpang	26.880703	90.492509	369	1800 MHz	18.44	0.484497202956	0.067598	<i>Below the Limit</i>
					113	700 MHz	11.504	0.525452205792	0.18389	
5	Gelephu Lower market		26.866613	90.486276	30	1800 MHz	18.44	1.172879943729 21	0.396013	<i>Below the Limit</i>
6	Gelephu Site 2		26.877282	90.494902	39	1800 MHz	18.44	1.094870757695 31	0.3451	<i>Below the Limit</i>

4. Gelephu Thromde, Sarpang (Tashi InfoComm Limited)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band(MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Gelephu town	Gelephu	26.874321	90.4788912	1171 1	900 MHz	13.044	0.27687454949 9153	0.051246498 0547567	<i>Below the Limits</i>
					11322	850 MHz	12.676	0.32195315592 8379	0.062729997 7547166	
					31	1800 MHz	18.44	0.78565934578 8337	0.175524982 81511	
					44	700 MHz	11.504	0.20154895475	0.175524982 8151	

2	Gelephu Talidratshang	Gelephu	26.875617	90.47322	21	1800 MHz	18.44	0.723930245037698	0.17552	<i>Below the Limits</i>
3	Gelephu Namkhaling	Gelephu	26.865807	90.483252	22	1800 MHz	18.44	0.591162549870935	0.17552498281511	<i>Below the Limits</i>
4	Gelephu Tashiding	Gelephu	26.883605	90.486626	23	1800 MHz	18.44	0.894479239674875	0.17552498281511	<i>Below the Limits</i>

5. Samdrup Jongkhar Thromde, S/J (BTL)

Sl. No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band (MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	S/Jongkhar Exchange	Samdrup Jongkhar	27.28484	91.52487	61	900 MHz	13.044	0.32728177869451	0.0715933815211528	<i>Below the Limits</i>
					126	850 MHz	12.676	0.176319656973752	0.0186852584526162	

					134	1800 MHz	18.44	0.303002614 313802	0.0612275 56412124 2	
2	S/Jongkhar Pinchina	Samdrup Jongkhar	26.808204	91.49882	161	1800 MHz	18.44	0.341295340 811205	0.0335390 73321471 5	<i>Below the Limits</i>
3	S/Jongkhar Tashipokto	Samdrup Jongkhar	26.795312	91.508293	023	900 MHz	13.044	0.563748583 996699	0.2138254 00295627	<i>Below the Limits</i>
					135	850 MHz	12.676	0.151645756 725548	0.0139115 13059695 9	
					139	1800 MHz	18.44	0.825359922 554783	0.1957629 02855771	
					143	700 MHz	11.504	0.470071679 943159	0.1492140 93731301	
4	S/J D-site Dzong	Samdrup Jongkhar	26.804747	91.503351	139	1800 MHz	18.44	1.032714382 57088	0.3068648 41786687	<i>Below the Limits</i>
5	S/J Pinchina D site	Samdrup Jongkhar	26.811769	91.49512	139	1800 MHz	18.44	0.328603021 345521	0.0311015 25731730 6	<i>Below the Limits</i>

6	S/J town D site	Samdrup Jongkhar	26.79368	91.50335	135	1800 MHz	18.44	0.341295340 811205	0.0335390 73321471 5	<i>Below the Limits</i>
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6. Samdrup Jongkhar Thromde, S/J (TICL)

Sl.No	Site Name	Location	Latitude	Longitude	Cell ID	Frequency Band(MHz)	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	S/Jongkhar thromde	Samdrup Jongkhar	26.801556	91.505472	1171	900 MHz	13.044	0.10645351 8447969	0.0075712223 8624125	
					4	850 MHz	12.676	0.25037106 6988277	0.0379593159 6389	
					22	1800 MHz	18.44	0.45409420 172118	0.0588080774 860406	
2	S/Jongkhar Tashipokto	Samdrup Jongkhar	26.795149	91.508369	1182	900 MHz	13.044	0.56209485 8399669	0.3138254002 95627	
					4	850 MHz	12.676	0.15170575 6725548	0.0239115130 596959	
					42	1800 MHz	18.44	0.37007167 9943159	0.1392140937 31301	

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;

27.138056 90.124242



Figure 3: Tsirang Exchange (BTL)

27.009603 90.123931

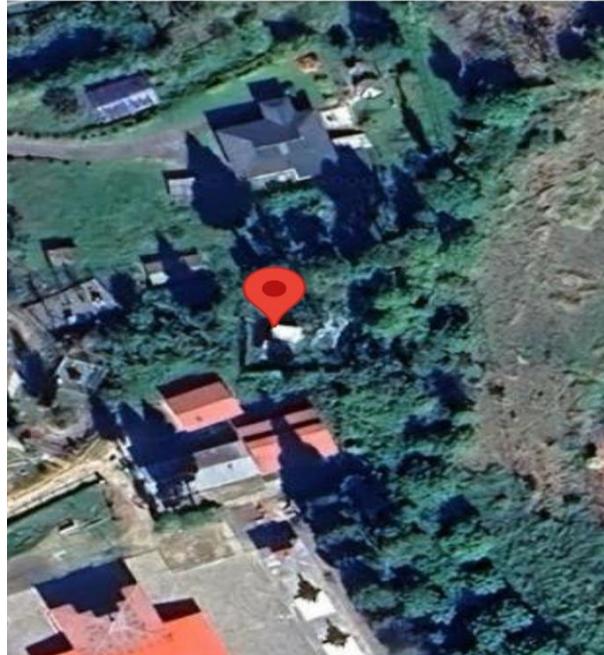


Figure 4: Tsirang near police station (BTL)

26.957844 90.143828

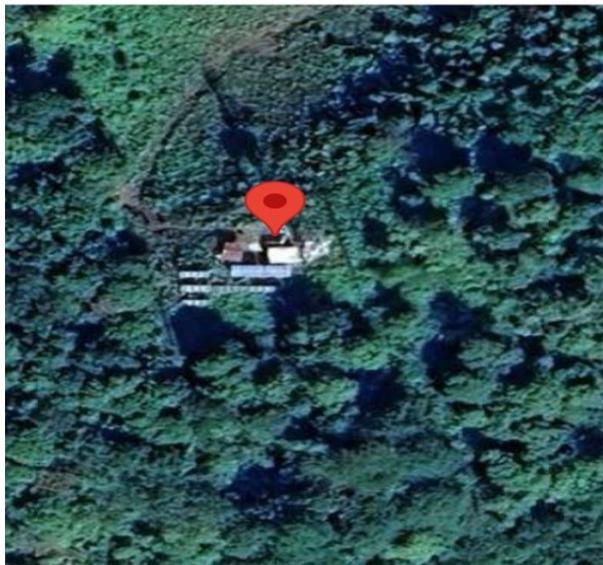


Figure 5: Tsirang Dupi (BTL)

27.00511111 90.10711111



Figure 6: Tsirang Town (TICL)

26.9584336 90.143516

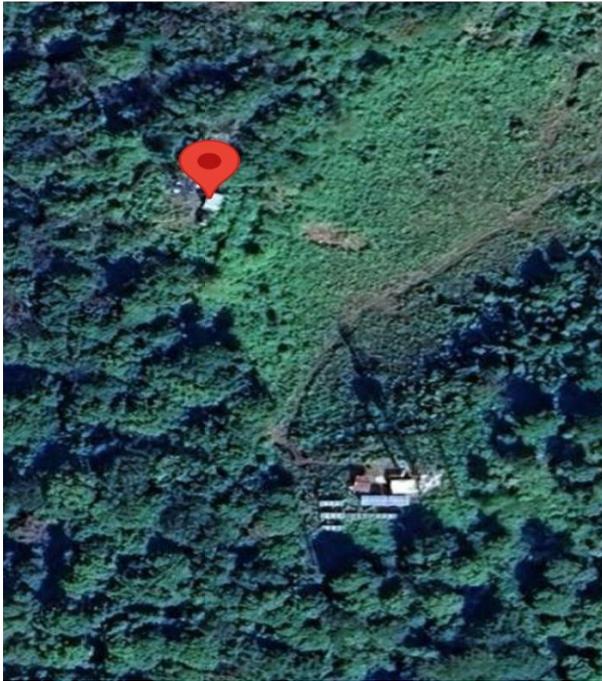


Figure 7: Tsirang Dupi(TICL)

26.869297 90.488038

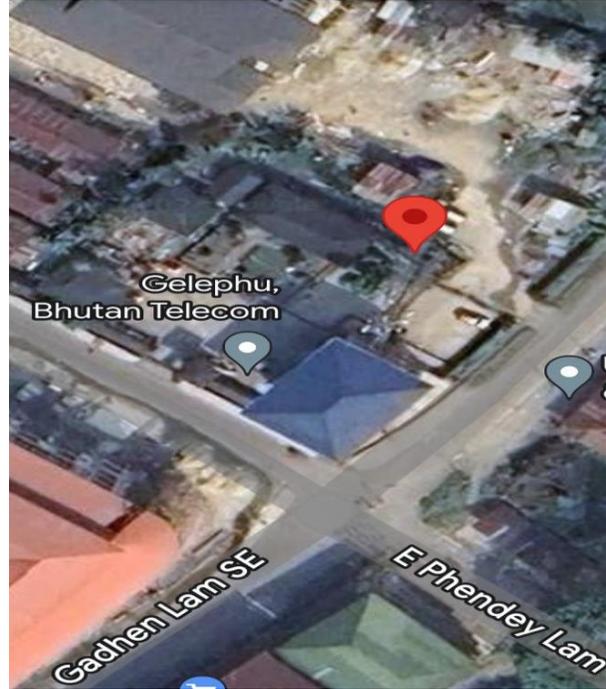


Figure 8: Gelephu Exchange(BTL)

26.884104 90.480442

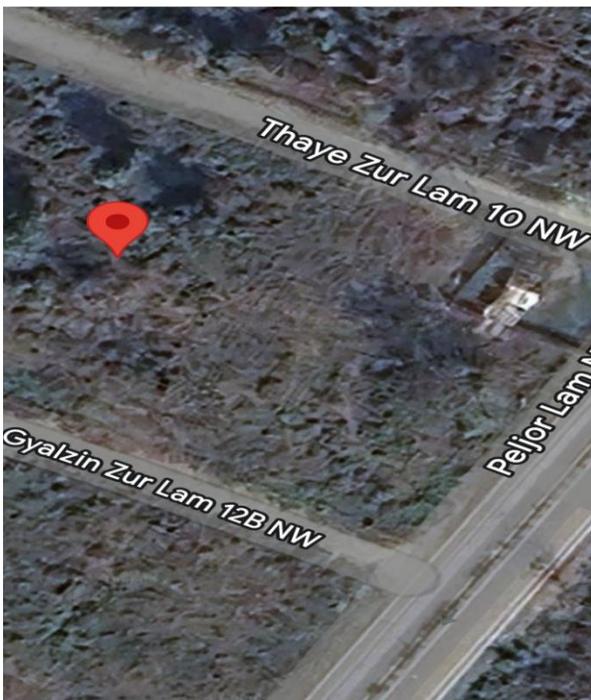


Figure 9: Gelephu ISC lab 2(BTL)

26.864638 90.486184

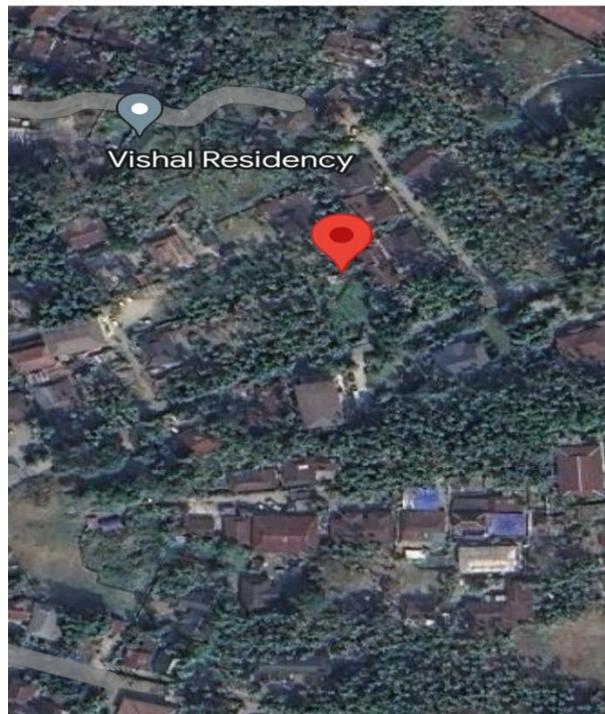


Figure 10: Gelephu Namkhaling (BTL)

26.880703 90.492509

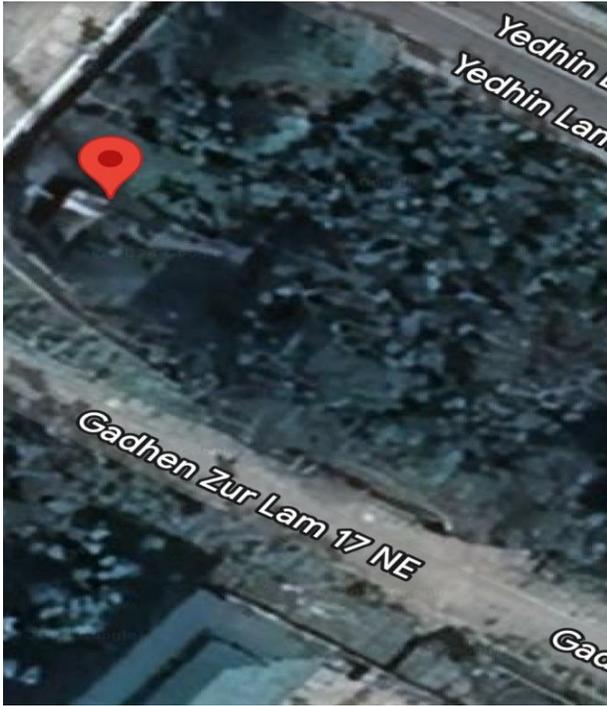


Figure 11: Gelephu Rabtenling(BTL)

26.866613 90.486276

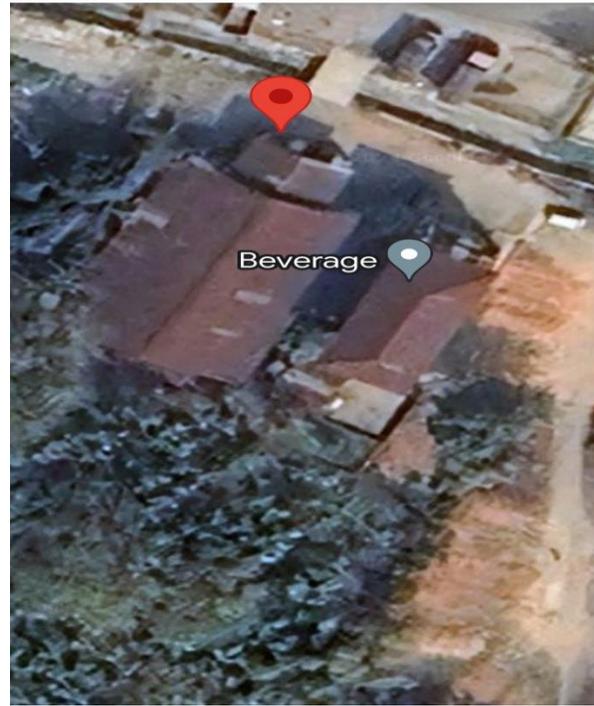


Figure 12: Gelephu Lower market (BTL)

26.877282 90.494902

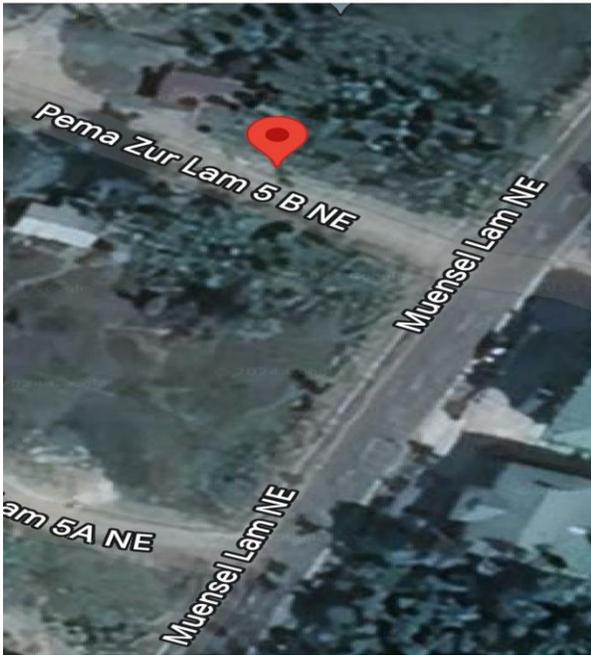


Figure 13: Gelephu Site 2 (BTL)

26.874321 90.4788912

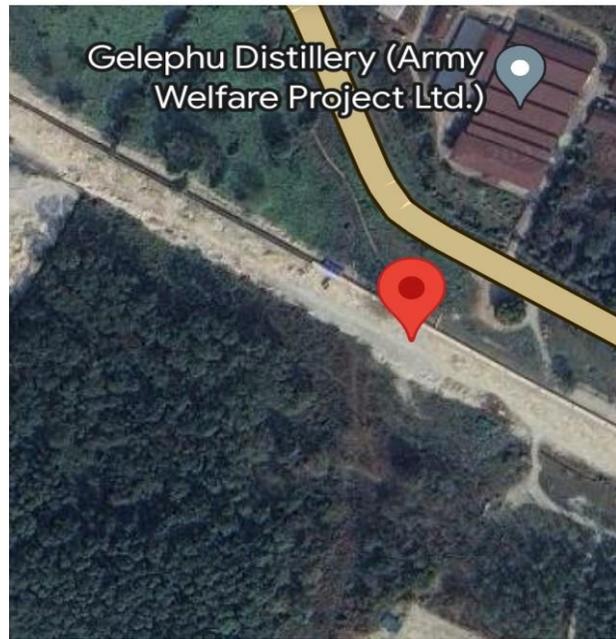


Figure 14: Gelephu town(TICL)

26.875617 90.47322

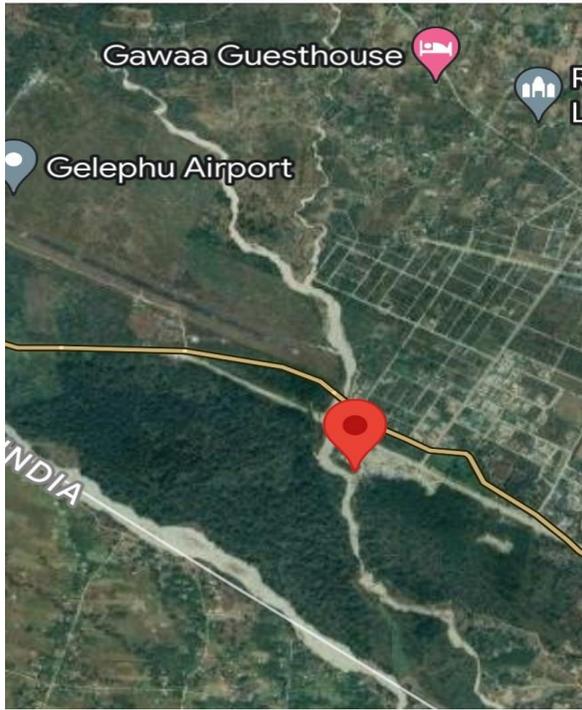


Figure 15: Gelephu Talidratshang (TICL)

26.865807 90.483252

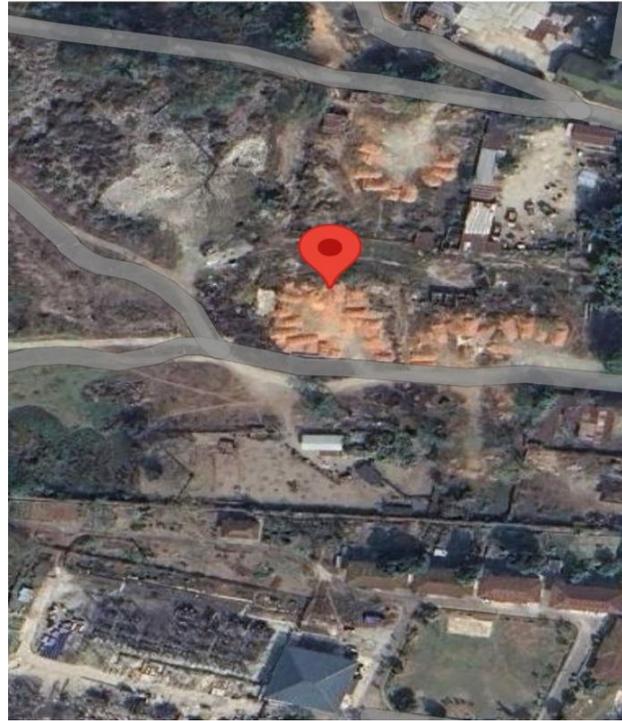


Figure 16: Gelephu Namkhaling (TICL)

26.883605 90.486626

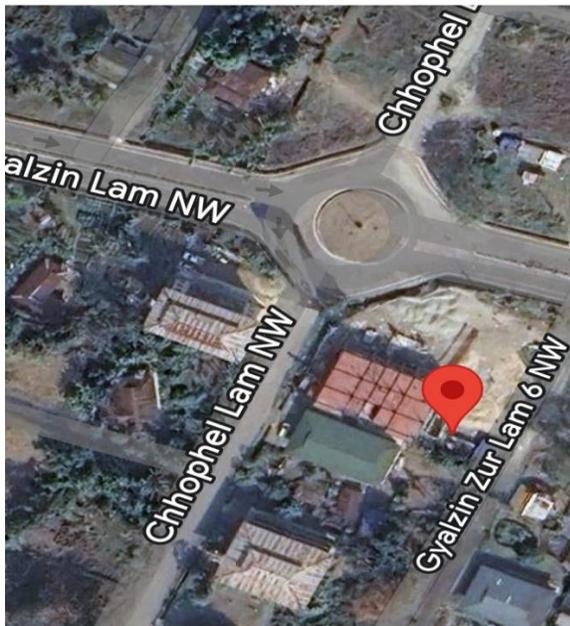


Figure 17: Gelephu Tashiding (TICL)

27.28484 91.52487



Figure 18: S/Jongkhar Exchange (BTL)

26.808204 91.49882

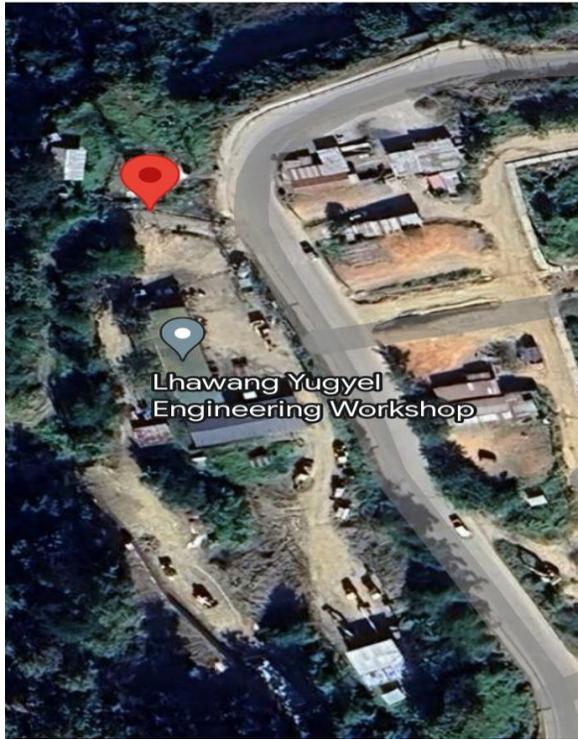


Figure 19: S/Jongkhar Pinchina(BTL)

26.795312 91.508293

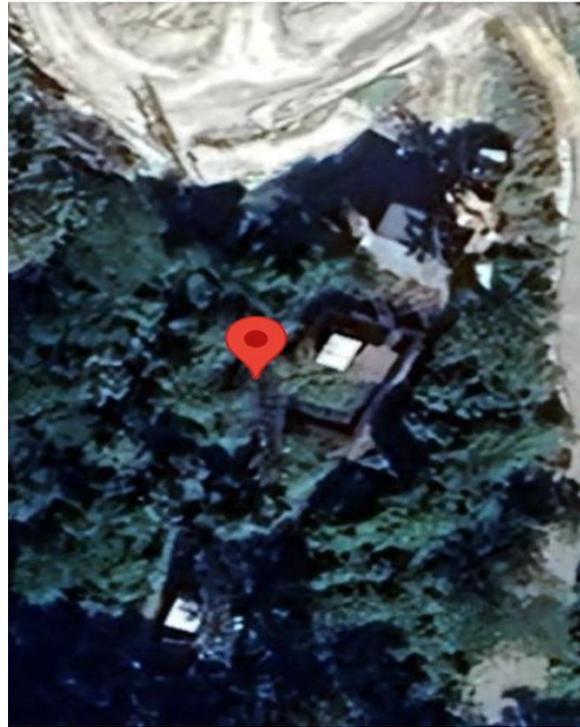


Figure 20: S/Jongkhar Tashipokto (BTL)

26.804747 91.503351

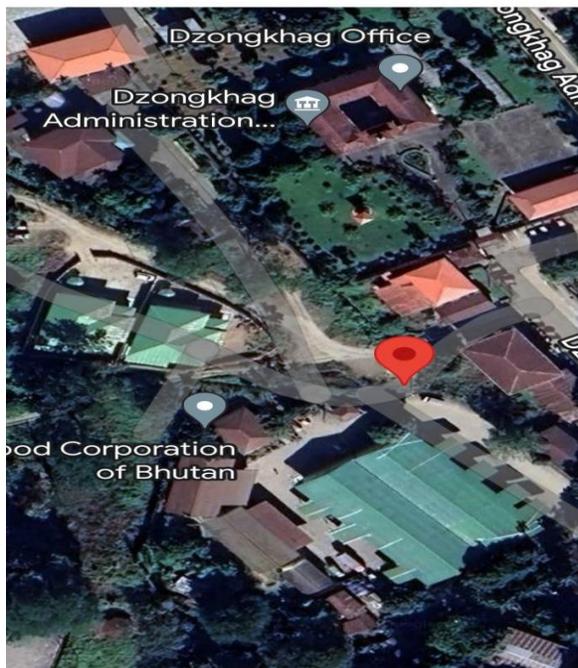


Figure 21: S/J dD-site Dzong(BTL)

26.811769 91.49512

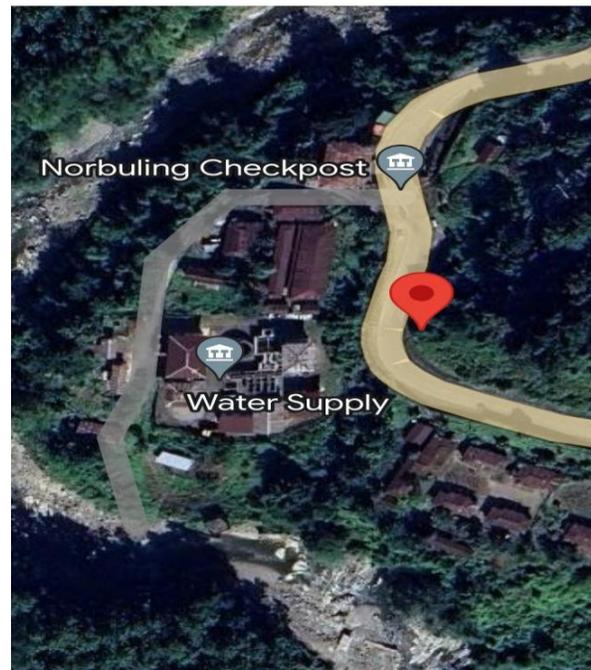


Figure 22: S/J Pinchina D-site (BTL)

26.79368 91.50335

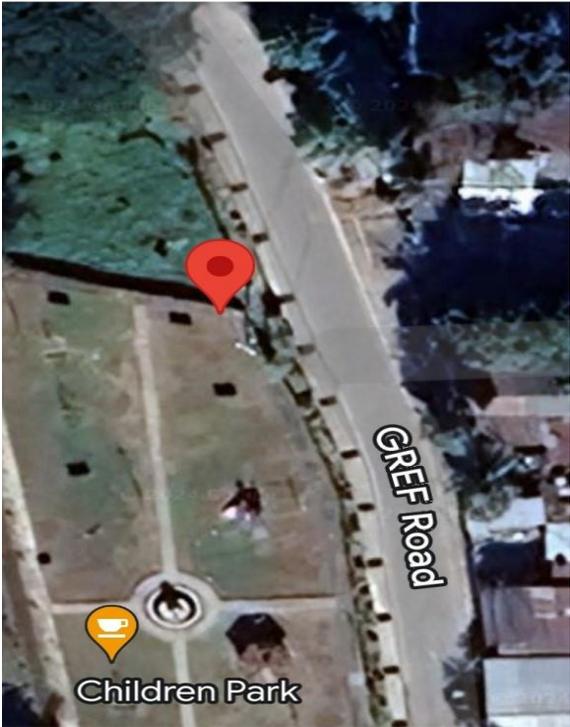


Figure 23: S/J town D-site(TICL)

26.795312 91.508293

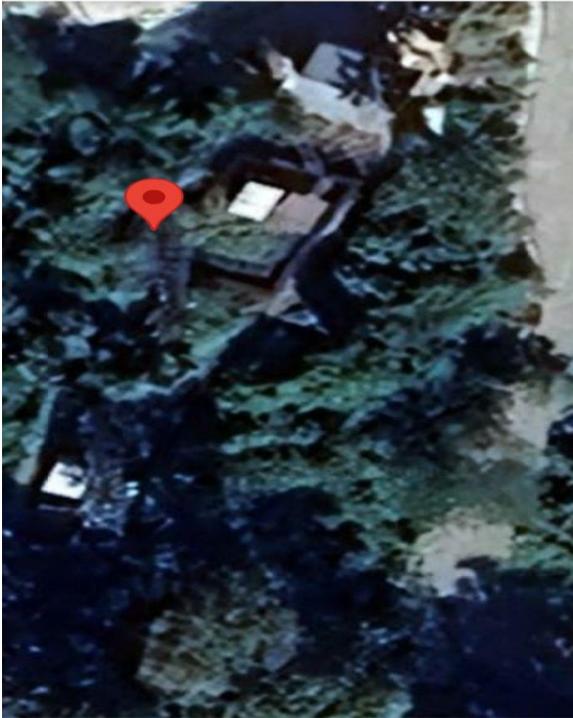


Figure 24: S/Jongkhar Tashipokto(TICL)

Annexure 3 (Image of Monitored BTS)

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



Figure 25: Gelephu (Tashicell)



Figure 26: Tsirang Dupi (Both TICL/BTL)



Figure 27: S/J (BTL)



Figure 38: TSirang Exchange (BTL)



Figure 37: Tsirang Town (BTL)



Figure 38: Gelephu (BTL)