



**Report on  
Establishment of Interim Manual Flood Monitoring  
Gauges at Dechencholing-Taba Bridge on Thimchhu**

**National Center for Hydrology and Meteorology  
Royal Government of Bhutan  
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## **1. Background**

NCHM has a flood monitoring station on Thimchhu at Dodena that provides flood information to Lingkhana palace. Since there are other streams joining the main Thimphu between Dodena station and Lingkhana, the Center received verbal request from the Royal Body Guard (RBG), Dechencholing to establish manual flood monitoring gauges and marking labels at the abutment of Dechencholing-Taba Bridge that would be observed by the RBG duty personnel at the Bridge to provide the flood early warning information to Lingkhana palace and downstream settlement.

The Center through the support of JICA is implementing the “*Project for Capacity Enhancement of Meteorological Observation, Forecasting and Flood Warning, for disaster preparedness and response in Thimphu and Paro River Basins (2018-2023)*”, however, the the implementation of the project was delayed due COVID19 pandemic.

Accordingly, the Center directed Hydro-met Observation and Infrastructure Division and Hydrology and Water Resources Services Division (HWRSD) to study and establish an Interim Flood Monitoring Gauges at Dechencholing Bridge on Thimphu. Team with the following members was constituted to carry out the flood assessment and installation of the manual flood gauges and flood label marking at the Dechencholing Bridge.

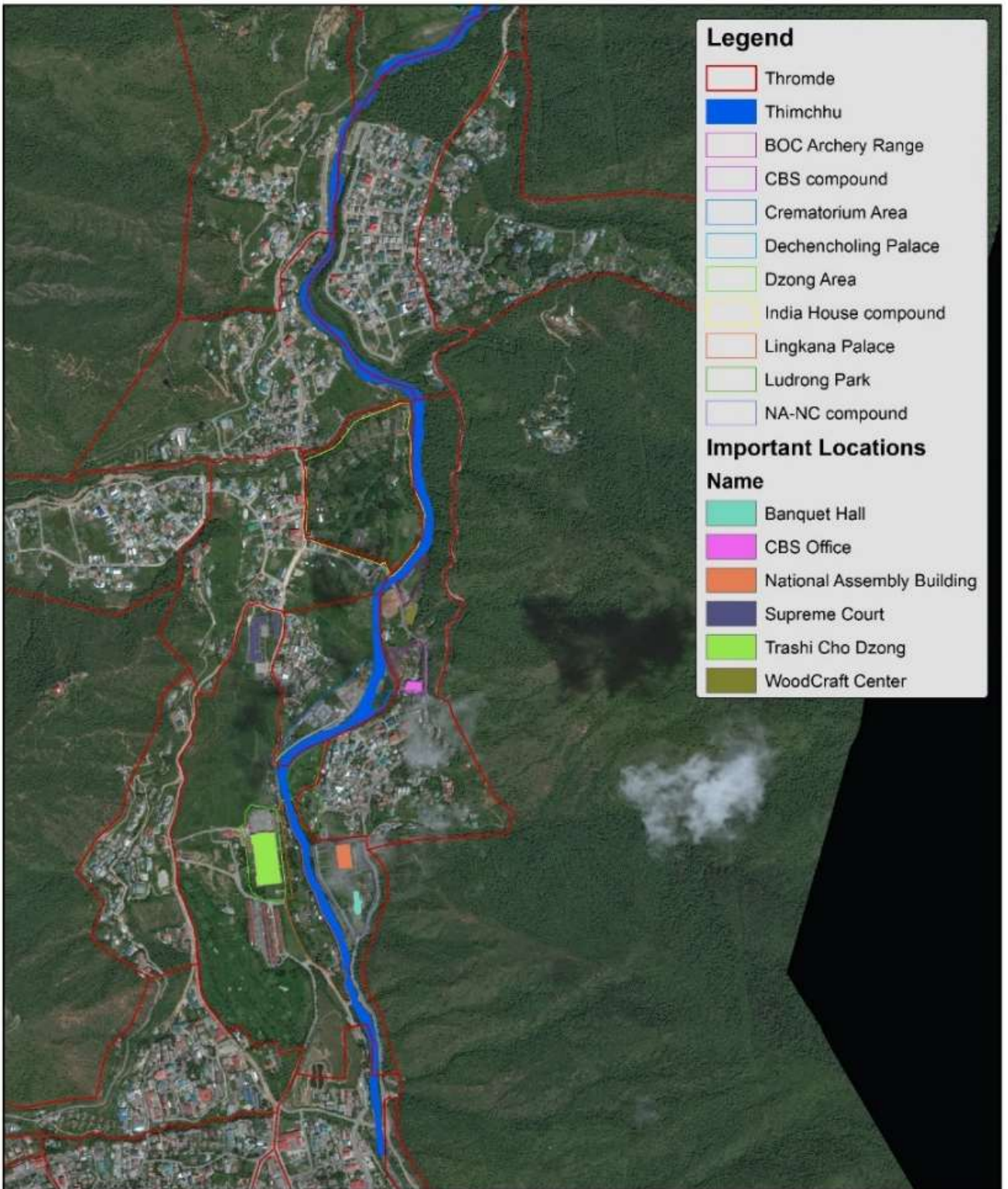
### **Technical Team members:**

1. Tayba Buddha Tamang, Chief, HWRSD, NCHM
2. Pasupati Sharma, Chief, HOID, NCHM
3. Trashy Namgyal, Exe. Engineer, HOID, NCHM
4. Tandin Wangchuk, Dy. Exe. Engineer, HWRS, NCHM
5. Kinley Namgyel, Sr. Hydromet Technician, HOID, NCHM
6. Sonam Dorji, Hydromet Technician, HOID, NCHM

## **2. Hydrological Modelling and Hazard Mapping of Thimphu Thromde**

### **a. Study area**

Study Area is located in the western region of the country extending over a coordinate of Top: 27° 31'31'', Bottom: 27°28'36'', Left: 89°37'43'' and Right: 89°38'47''. The study area covers an area of approximately 7 sq. km (Figure 1) between Dechencholing-Taba Bridge in the North to the new bridge near RAPA constructed by CDCL.



*Figure 1: Map showing the study area*

## b. Data and Methodology

Daily water level and discharge data of 1992-2020 of Lungtenphug Hydrological Station on Thimphu were used for the study. The annual maximum discharge was extracted from the daily discharge data for the flood frequency analysis to calculate various probable discharges at a given return period of 2, 5, 25 and 50 years. Due to increased river flow, the river cross section and flow measurement at Dechencholing bridge could not be carried out.

Digital Terrain Model (DTM) of 1 meter resolution from Department of Human Settlement was used to extract geometry data of the area and the Ortho image of 30 cm is used for the flood inundation mapping.

The survey cross sectional data was processed for the input. The spatial distribution of the surveyed cross section differs from the available DTM due to frequent alteration in the river bathymetry and river channel orientation. The high resolution DTM provided better cross section data since the river is shallow and it closely matches the actual cross-section.

Hydrological model HEC-RAS was used for the flood inundation mapping based on flood frequency analysis of different return periods and past flood events. The flood frequency analysis was done for 2, 5, 14, 25 and 50 years at the Lungtenphu station located near Pelkhil School. Accordingly, the threshold Flood water level of Alert and Alarm were determined for the upstream at Dechencholingbridge on Thimpchu.

Return Period (year)	Flow (Cumecs)	Water Level (meter)
2	87	1.5
5	124	1.9
14	175	2.15
25	250	2.54
50	344	2.9

An interim Alert and Alarm were set at 14 years return period and 50 years return period respectively.

Threshold location	Alert Level (meter)	Alarm Level (meter)
Dechencholing-Taba Bridge	2.15	2.9

## c. Floodplain analysis using HEC-RAS and GIS

1D steady flow analysis was performed for the target area. The flood inundation map for multiple return period is shown below (2 years, 5 years, 25 years and 50 years). Other classification maps are attached as annexures.

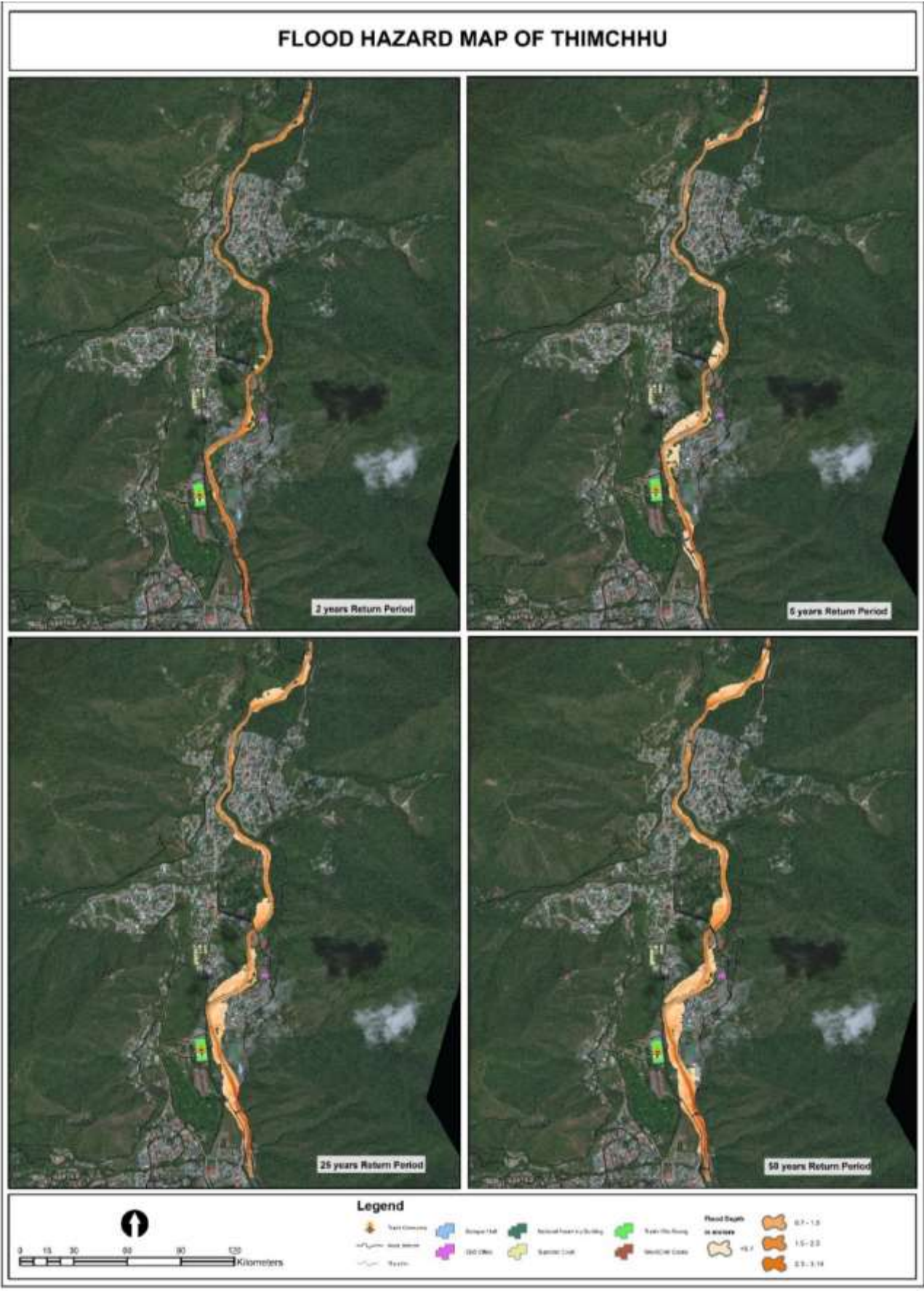


Figure 2: Flood Hazard Map of Thimphu



#### d. Hydrological Monitoring stations

There are 4-existing hydrological stations along the Thimphu River starting from Dodena till downstream of Damchu water level monitoring. These monitoring stations consist of manual and automatic stations with a telemetry system incorporated for real time data transmission. Detail of the stations that are used for monitoring network is shown in the table below:

Sl. no.	Station name	Location	Parameter collected	Remarks
1	Hydrological monitoring station	Dodena	Water level, rainfall and sediment	Secondary station with AWLS
2	Automatic Water level station	Hejo, Bridge	Water level, rainfall & temperature	AWLS
3	Hydrological monitoring station	Lungtephu	Discharge, Temperature, Rainfall, water level & sediment	Principle station with AWLS
4	Automatic Water level station	Damchhu	Discharge, Temperature, Rainfall, water level & sediment	Principle station with AWLS

#### 3. Installation of manual flood gauge at Dechencholing Bridge

Based on the threshold defined for Alert and Alarm water level from the flood modelling and historical records, the new flood gauge was installed at the abutments of Dechencholing bridge at an altitude 2334.10 meter above sea level, Latitude 27° 31'25.73" N and Longitude 89° 38'43.88" E. The gauge height graduation and marking were done on the bridge foundation wall and threshold levelling was marked with different colour viz: **GREEN** for Normal, **YELLOW** for Alert and **RED** for Alarm are done in both the side of the bridge abutments.

**Right bank of bridge**



**Gauge post**



**Left bank of bridge**



Figure 3: Water level marking at Dechencholing-Taba Bridge with Normal (Green), Alert (Yellow) and Alarm (red) water level

The flood gauge threshold set at Dechencholing bridge are as follows;

Station	Normal level	Alert level	Alarm level
<b>Dchencholing Bridge</b>	<b>&lt; 2.0 m</b>	<b>2.0m = &lt;3.0m</b>	<b>=&gt; 3.0 m</b>

*Note: The above thresholds are subject to change depending on the physical changes at the monitoring station.*

#### 4. Field Training to RBG Personnel

After completing the installation of manual water gauge and flood level markings, on-site hands-on training were provided to more than 10 Royal Body Guard (RBG) personnel by the technical team. Further, the team explained about the flood gauge thresholds labels with different colors in different heights at the bridge abutment on both sides.

#### 5. Observation of Gauges

The flood gauge will be observed and monitored manually by RBG personnel on duty at site and share information to the Lingkhana and downstream settlements in the extreme event.



*Figure 4: RBG personnel during the on-site hands-on training*

#### 6. Recommendations

All the activities related to marking and setting up of the flood gauging at Dechencholing and following are some recommendations to improve the flood warning threshold level.

- i. A water level gauge post has been installed near the bridge and there is a need to discuss further with RBG to start regular observation of water level at bridge.
- ii. Take the river cross-section at bridge during lean flow to determine water level with accurate river cross-section;
- iii. Observations of manual gauges at bridges has continued to study the river flow and determine accurate warning thresholds (**ALERT** and **ALARM**) to improve the warning services.

Annexure:



Figure 5: Flood Hazard Map of 14 years (high flow)



Figure 6: Flood Hazard Map of 14 years (high flow) and 50 years return period



*Figure 7: Field Work for the setting up of river gauge post and flood marking*