



**STANDARD OPERATING PROCEDURE FOR
HYDROLOGY AND WATER RESOURCES SERVICES
DIVISION
(Revised Version 2.0)**

**National Centre for Hydrology and Meteorology
Royal Government of Bhutan
2023**

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1. Standard Operating Procedure (SOP)

1.1 Title

Standard Operating Procedure (SOP) for Hydrology and Water Resources Services Division (HWRSD), hereafter referred to as **SOP 2023 for HWRSD**.

1.2 Objective

The Revised SOP provides the operating procedures for the HWRSD to fulfill the vision, mandates and functions of the Centre. It provides standardized linkages and approaches amongst the sections within HWRSD and other Divisions including the management and technical support.

1.3 Effective

The Revised SOP 2023 will be implemented with effect from 1st July 2023

2. HWRSD mandate, function, and structure

2.1 Mandate of HWRSD

Hydrology and Water Resources Services Division (HWRSD) is mandated for water resources assessment, operation and maintenance of hydrological observation network, forecasting, hydrological data management, dissemination of hydrological data and information and issue early warning services related to flood and GLOF

2.2 Functions of HWRSD

Followings are the functions of the Division:

- a. Planning and installation of a national hydrological and flood observation networks including sediment and ambient water quality
- b. Planning and establishment of related hydrological infrastructure including telemetry systems, site office, regional offices, hydraulic structure, etc.;
- c. Administer and implement the hydrological observation network plans and programme;

- d. Maintain and operate national hydrological observations, telemetry systems and related facilities;
- e. Operate and maintain communication and early warning facilities installed in different river basins;
- f. Modernize and upgrade hydrological network stations, telemetry systems, and hydrometric techniques in tandem with changing technologies;
- g. Collection and transmission of hydrological data from remote monitoring stations to the Central Database system, HQ.
- h. Training and capacity building of officials and technicians;
- i. Operation of flood/GLOF early warning systems
- j. Provide hydrological forecast, issue flood/GLOF advisories and early warning services
- k. Operation of National Hydrological Database Management System
- l. Carry out national water resource assessment and maintain river information system
- m. Carry out research and development in the field of hydrological science
- n. Carryout flood hazard assessment and mapping
- o. Provide hydrological data and information
- p. Coordinate with the National Emergency Operation Center (NEOC)/DDM, Hydropower Plants and others for the inter-agencies flood forecasting and warning
- q. Conduct education, training and awareness programs on operation hydrology and GLOF EWS

2.3 Structure of HWRSD

Hydrology and Water Resources Services Division (HWRSD) is organized into five Sections:

- a. Hydrological Observation Section (HOS)
- b. Sediment and Water Quality Monitoring Section (SWQMS)
- c. Hydrological Forecasting and Warning Services (FFS)
- d. Hydrological Information Management Section (HWIS) and
- e. Office of Technical Maintenance Officer (TMO) (GoI Program)

Following is the structure of HWRSD.

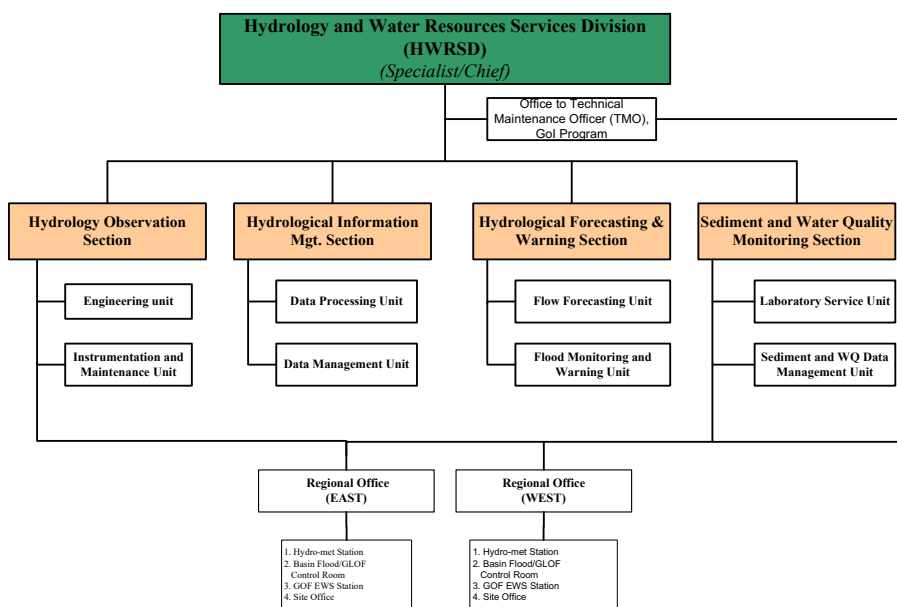


Figure 1: Structure of HWRSD

3. Hydrological Observation Section (HOS)

- a. Planning, establish and operation of national hydrological observation and flood/GLOF Early Warning System (EWS) network along the river basins;
- b. Maintain and operate communication network services for seamless exchange of observation, data and flood/GLOF warning services;
- c. Install and operate water quality monitoring stations/sites based on requirement and needs;
- d. Prepare annual plans and budget in consultation with the Division;
- e. Prepare drawing, cost estimate of works related to establishment of hydrological stations, infrastructure and installation;
- f. Tendering of works related to establishment/construction of hydro-met stations, related infrastructure and installation;
- g. Construction and supervision of hydrological and flood warning network stations, field offices and related infrastructure;
- h. Inventory of hydrological network and infrastructures;

- i. Maintenance of hydrological, flood/GLOF EWS network and infrastructures;
- j. Technical backstopping services to other agencies in operational hydrometry, establishment of hydrological stations and data collection;
- k. Carryout low/lean flow and spot measurements;
- l. Carry out the river cross section survey of hydrological stations;
- m. GIS mapping of hydro-met network stations and infrastructures;
- n. Carry out inspection and monitoring of hydro-meteorological stations.

3.1 Engineering Unit

Planning & Design of hydrological network Infrastructure

Action	Time Frame	Operator	Output/ Result
1. Plan & design of hydrological networks as per targeted activities, budget and schedule	2 weeks	HWRSD/WCSD /CSD Engineer/Survey or/ Field Team	Desk studies carried out. collect field data & information
2. Identify the network's requirements based on the discussion with services divisions.	1 month	HWRSD/WCSD /CSD Engineer/Survey or/ Field Team	Field visits; Budget mobilized. Collect field data & information Produce reports

3. Review the network concentration.	2 weeks	HWRSD/WCSD /CSD Engineer/Surveyor/ Field Team	Detailed assessment of existing network Generate report with recommendation.
4. Carry out field survey for site selections	1 month	Engineer/Surveyor/ Field Team	Field visit & site survey carried out; Collect geo-coordinates Land follow up
5. Cost estimates for installation & maintaining the networks	1 week	Engineer/Surveyor/ Field Team	Prepare tentative cost analysis for setting up station/related infrastructures
6. Prepare implementation plans	3 days	Engineer/Surveyor/ Field Team	Prepare work plan

3.2. Instrumentation and Maintenance Unit

3.2.1. Maintenance Unit

a) Activity: Maintenance of Observational Network

Action	Time Frame	Operator	Outputs/Results
1. Prepare and plan maintenance work in consultation with site staff	7 Days	Hydromet officier/Site Staff	Correspond with site staff for maintenance work budget mobilized
2. Arrange Logistics to carry out maintenance	2 days	Hydromet Officer	- Procurement of equipment and gears - Arranging Equipment and gears
3. Field visit to carry out the maintenance	3 weeks	Field Team	-Field visit -Maintenance carried out

b) Activity: Maintenance of Infrastructure (Major)

Activities of Section	Time Frame	Operator	Outputs/Results
1. Planning maintenance work after consultation with site staffs	7 days	Field Team/Site staffs	Plan maintenance and logistics arranged

2. Field visit	2 days	Field Team	Field visit to prepare drawings and estimates
3. Prepare estimates	2 weeks	Engineer	Prepare estimates using BSR/LMC
4. Submit for Technical Approval	1 week	Engineer	Submit to TSRD
5. Prepare tender documents and advertise tender	7 days	Engineer	Prepare Bid Documents using SBD and relevant rules Advertise in the media
6. Open Tender and Evaluate	2 days	Engineer/B OC/BEC	Opening of submitted bid documents Evaluate bidders using SBD and PRR Present the Evaluation report
7. Award Tender and initiate maintenance	2 weeks	Engineer	Award the work to contractor Sign the contract and issue a work order. Hand over site to contractor
8. Supervise and monitor the work	1 week	Site Staff/Engineer	Monitor construction from Head Office Ask nearest Site office Technician to monitor

9. Take a joint measurement and takeover of site	7 days	Engineer/Contractor	Measurement of construction with contractor Takeover of the sites by Agency
10. Verification and passing of bills	2 days	Engineer/FAS	Verification of submitted bills Clear the bills and make payment

3.2.1 Annual Lean Flow Measurements

Action	Time Frame	Operator	Outputs/Results
1.Planning of spot measurement work	7 days	Field Team	-Budget mobilized -Logistics arranged -Approval sought
2.Field visit to carry out measurement	2 days per site	Field Team	-Measurement of river discharge using current meter/wading/electromagnetic methods

3.2.2 Annual Maintenance of Hydrological Network

Action	Time Frame	Operator	Outputs/Results
1.Planning of the Cross-Sectional survey	1 day	Field Team	-Budget mobilized -Logistics arranged -Approval sought
2.Field visit	2 days per site	Field Team	-Review the proposal received; -Carry out survey using ADCP/Cableway

			measurements -River survey and Cross Section with total Station/Wading/Dumpy level -Repair and maintenance of equipment -Install new staff gauges
3.Prepare reports and submit to relevant officials	2 weeks	Field Team/Engineer	-Prepare reports -Submit to heads -Archive for reference

3 3. Communication

3.3.1 Technical Specification of Hydrological Instrument and Communication equipment

Action	Time Frame	Operators	Output/ Result
Compare different technology available	2 weeks	Engineer	-Desk studies carried out -compare of various equipment -communicate with manufacturer
Design/ select most appropriate communication networks (GPRS, wireless, satellite, etc)	1 day per station + actual travel time	Engineer	-Site visit -Network coverage information -communication type selection
Seeking rates/Price	1 month	Engineer	-Seek budgetary quotation -prepare comparative price

			statement
Review technology and price	2 weeks	Engineer	-Generate report with recommendation

3.3.2 Procurement of Goods (Equipment)

Action	Time Frame	Operator	Output/Result
Consulting with relevant officials of services divisions	2 days	Field team/ HoD	-Incorporate recommendations
Prepare estimates	1 week	Engineer	Budget estimation and drawings
Technical Sanction (Submit estimates and drawings)	3 days	Engineer	-Review the proposal received from the end user -Incorporate recommendations -Accord or redirect the technical sanction
Prepare bidding documents and advertise in media	3 days	Engineer	Prepare bid document using SBD and relevant rules -Advertise in the media
Bid opening and evaluation of the tender	1 week	Engineer/ BOC/ BEC	-Opening of submitted bid documents Evaluate bidders using SBD and PRR
Award of work to the contractor, signing of contract, issuing of supply order	1 month	Engineer/ HoD/ Contractor	-Present the evaluation report -Sign the contract and issue the supply order for the good

3.3.3. Installation of hydrological network Station

Action	Time Frame	Operator	Outputs/Result
Mobilize the team	7 days	Field operator	-budget mobilized -Logistics arranged -Approval sought
Field Visit	2 days installation + actual travel time	Field team	-installation of Hydrological instruments as per Regional and WMO standards

3.3.4. Maintenance Hydrological Observation network

Action	Time Frame	Operators	Output/ Result
1. Routine maintenance	Daily/ Monthly/ Quarterly	Technician	- Check for functionality of the system. - Carry out minor maintenance. - Clearing vegetation.
2. Break down maintenance	Two weeks	Maintenance team/ Technician	- Breakdown and inspection report submitted. - Follow up on maintenance of the station

			<ul style="list-style-type: none"> - Replacement of damaged equipment with available spares. - Repair of equipment.
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3.3.5. Maintenance of Automatic Hydrological Network and Communication System

Action	Time Frame	Action	Outputs/Results
Planning break down/ annual maintenance work for AWLS, ASS, GLOF EWS	7 days	Engineer/Site staffs/HoD	-Correspond with site officials for maintenance work - Budget mobilized
Arranging logistics to carry out maintenance	2 days	Engineer	-Arranging equipment -Procurement of equipment
Field visit to carry out maintenance	2 days per site plus travel time	Field team	Field Visit

4. Sediment and Water Quality Monitoring Section (SWQMS)

A. Sediment Sampling			
1. Sediment data collection from Hydrological Observation site	Daily	Technician	Sediment Sampling collected per schedule/Predetermined time in the prescribed format using the cableway system.
2. Sediment data collection from Flood Warning Site (GoI)	Daily	Technician	Sediment Sampling collected per schedule/Predetermined time in the prescribed format using the cableway system.

5. SOP for Forecast and Warning Section (FWS)

Forecast and Warning Services (FWS) under HWRSD is responsible for various services on the flow/flood forecasting and warning services, following are the SOP for FWS

5.1. Flood/GLOF Early Warning Services & Operation of FMCR

FWS actions	Time Frame	Operator	Output/Result
<p>1. Monitoring of Flood/GLOF EWS.</p> <ul style="list-style-type: none"> - Monitoring AWS and manual hydrological station data - Report on non-reception/failed data transmission 	<ul style="list-style-type: none"> - Daily data is collected - Report non-reception of data to FMCR incharge within 24 hours. 	<p>Control Room Operators and designated officials</p>	<ul style="list-style-type: none"> ● Daily status of Flood/GLOF EWS station data is updated ● Resolved the issues of non-reception of data with Maintenance team
<p>2. Monitor and issue flood warning/advisories/press release</p>	<p>Monitor flow 24/7 and issue flood warning/advisories right after the detection (Rainstorm flood and GLOF EWS)</p>	<p>Flood Forecasters and EWS officials</p>	<ul style="list-style-type: none"> ● Siren activated after confirming flood/GLOF event ● Prepare and issue warning/advisories to stakeholders for safety ● Prepare and issue report of the event

<p>3. Operate Flood Monitoring and Command Room (FMCR)</p>	<p>Daily</p>	<p>Designated officials</p>	<ul style="list-style-type: none"> ● FMCR is operational 24/7 ● Maintained coordination between basin control rooms and FMCR
<p>4. Provide public education awareness on the Flood/GLOF EWS</p>	<p>As per the requirement</p>	<p>Designated officials</p>	<ul style="list-style-type: none"> ● Conduct education awareness programs. ● Public and Relevant stakeholders are made aware of the flooding risk and EWS.

<p>5. Coordinate with the NEOC/DDM and others relevant agencies during the emergencies</p> <ul style="list-style-type: none"> ● Media briefing ● Provide timely flood information ● Coordinate with DDM in-case of flood emergency ● Coordinate and organize emergency meeting during extreme events 	<p>In event of Flood/GLOF</p>	<p>Designated officials</p>	<ul style="list-style-type: none"> ● Well coordination between line agencies during flood emergencies ● Timely flood information provided to relevant stakeholders
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5.2. Flow/flood Forecasting Services

FWS actions	Time Frame	Operator	Output/Result
<p>1. Monitor, prepare and provide daily river flow status services</p>	<p>Monitor flow on 24/7 and issue river status daily</p>	<p>Flood forecasters and officials</p>	<p>Daily flow status is issued</p>

2. Prepare and issue daily flow forecast/outlook	Monitor and issue daily flow forecast/outlook before 5pm	Flood forecasters and officials	Daily flow outlook/forecast is issued
3. Publication of annual hydrological extreme event bulletin	Yearly	Flood forecasters and officials	Flood events are archived and annual report generated
4. Setup, run and validate hydrological model <ul style="list-style-type: none"> Flow forecasting services Water resource management 	As per the requirement and watershed area	Designated officials	<ul style="list-style-type: none"> - Flood/flow forecast model is setup and calibrated - Report in water resource assessment (surface runoff) is issued

5.3. Flood modeling and hazard map services

FWS actions	Time Frame	Operator	Output/Result
1. Field survey (Aerial and surface) data collection and processing	As per the requirement and watershed area	Designated officials	<ul style="list-style-type: none"> - Field survey report is issued - DEM, river cross section and flow data, etc. generated

2. Setup, run and simulate Hydrological and hydro-dynamic model services for hazard mapping	As per the requirement and watershed area	Designated officials	Model is setup and simulated/calibrated
3. Prepare and provide flood hazard maps services	As per the requirement and watershed area	Designated officials	Flood hazard map is prepared and disseminated

6. SOP for Functions of Hydrological Data Management Section (HDMS)

6.1 National Hydrological Database Management Services			
Actions of HIMS	Time Frame	Operator	Outcome/result
1. Receive raw data from manual stations from site <ul style="list-style-type: none"> ● Verify and cross check raw data ● Data processing, analysis, and quality check ● Archival of data to database (Hy-data). 	Daily	Data manager	Manual station hydrological data is updated and available for users.
2. Verify and quality check of real time station data (AWLS)	Daily	Data manager and designated officials	AWLS data are quality checked and available.

<p>3. Reporting to chief for any AWLS data transmission failed and non-reception of manual station data and maintaining of the failure record</p>	<p>Daily.</p>	<p>Data manager and designated officials</p>	<p>AWLS and manual data problem are resolved</p>
<p>4. Receive sediment data from sediment station via Sediment Lab</p> <ul style="list-style-type: none"> ● Data processing, analysis and archival of data to database (CDAT). 		<p>Data manager</p>	<p>Sediment data is updated and available for users</p>
<p>5. Report on non-reception of sediment data</p>	<p>Report non-reception of Monthly data to Division head</p>	<p>Data manager</p>	<p>Resolved the issues of non-reception of data</p>

6.2. Publication of Hydrological, Sediment Data and River Basin Information

Actions of HIMS	Time Frame	Operator	Output/Result
1. Prepare and issue monthly flow monitoring of selected station	Monthly	Designated official	Monthly flow status issued (website)
2. Publication of hydrological data book	Yearly	Data Manager and designated official	Yearly hydrological data book is published

6.3. Dissemination of Hydrological, Sediment Data and River Basin Information

Actions of HIMS	Time Frame	Operator	Output/Result
1. Prepare and issue ad-hoc historical data analysis report	As per the request	Data manager and designated official	Historical data analysis Report is issued
2. Provide historical hydrological, sediment data and river basin information to user	Within 5 days after the receipt of data requisition	Data manager	Historical data disseminated to users

7. SOP for Functions of Research and Analysis Services (RAS)

3.1 Hydrological & Water Resources related research and Analysis Services			
Actions of RAS	Time Frame	Operator	Result/Remarks
1. Historical hydrological flow data analysis and report publication including (flow duration curves, statistical distribution and trend analysis, extreme value analysis (floods and droughts)).	Station wise	RAS	Analyzed time series data available
2. Study on the Automatic Station vs the manual station reading	Station wise	RAS	Data compared and report is issued.
3. Conduct research/collaborative studies on hydrology and water related with other sectors and user agencies	Annually / as and when required	Designated official	- Report printed/published - Collaborated studies done with other sectors
4. Carry out research on the hydrological modelling and verification	As per the requirement	Designated official	- Hydrological model is validated

8. Office of Technical Maintenance Officer (TMO) (GoI Program)

Functions of Flood Warning Section (GoI Programm/TMO Office are:

- a. Overall administration and management of Flood Warning Program funded by GoI;
- b. Timely transmission of flood warning data/information to designated contact points in India and HQ in Thimphu;

- c. Up-gradation and modernization of Flood Warning Stations and required equipment for data collection and storage in coordination with the division;
- d. Rehabilitation/renovation of existing infrastructure at various field stations as well as construction of new facilities in coordination with division;
- e. Management of GoI budget as per the RGoB procedures;
- f. Coordinate Joint Expert Team (JET) meeting between Bhutan and India on a comprehensive scheme for setting up flood forecasting (FF) systems on rivers common to India and Bhutan.

9. Hydro-met Regional Offices

Action	Time Frame	Operators	Output/ Result
A. Water Level			
1. Water level Observation and data collection from Principal Hydrological manual observation site	Hourly /Daily	Technician	Collect data from the observation site as per schedule/Predetermined time in the prescribed format at: - 0900 and 1500 hours and - hourly during the monsoon Lean Water Level: Principal:0900 and 1500 Secondary: 0900 and 1500 FWS: 0900, 1300,1500
2. Water level Observation and data collection from Secondary	Hourly /Daily	Technician	

Hydrological manual Observation Site			
Water level Observation and data	Hourly/ Daily	Technician	

<u>River Discharge/Flow Measurement</u>			
River discharge/Flow measurement for Principal Hydrological Sites	Weekly	Technician	Collect river flow data from the observation site as per schedule/Predetermined time in the prescribed format at once in a week using the Bank Operated Cableway system.
River discharge/Flow measurement for Secondary Hydrological Sites	Daily	Technician	Collect river flow data from the observation site as per schedule/Predetermined time in the prescribed format daily using the traditional float method.
River discharge/Flow measurement for Flood Warning Site(GoI)	Daily	Technician	Collect river flow data from the observation site as per schedule/ Predetermined time in the prescribed format daily using traditional float method

<u>C.Sediment Sampling</u>			
Sediment data collection form Hydrological Observation site	Daily	Technician	Sediment Sampling collected per schedule/Predetermined time in the prescribed format using the cableway system
Sediment data collection form Flood Warning Site (GoI)	Daily	Technician	Sediment Sampling collected per schedule/ predetermined time in the prescribed format using the cableway system

Data Transmission

Action	Time Frame	Operators	Output/ Result
A.WATER LEVEL DATA			
Transmission of River Water level data from sites	Hourly/ Daily	Technician	Hydrological River level Data to Flood Monitoring and Command Room (FMCR), NFWFC <i>Monsoon Period (May-October):</i> -Principal: Hourly data to
			NFWFC -Secondary: - Hourly data to NFWFC -FWS: As per the schedule <i>[Instantaneous and hourly water</i>

			<p><i>level data shall be transmitted directly to NFWFC based on need Non-Monsoon Period (Nov-April;</i></p> <ul style="list-style-type: none"> -Principal: 0900 and 1500 -Secondary: 0900 and 1500 -FWS: 0900, 1300 and 1500 <p><i>Report emergency conditions to Chief</i></p>
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B. RIVER DISCHARGE/FLOW DATA

1 River discharge data transmission from Principal and Secondary Hydrological Station	Monthly	Technician	<p>Computed discharge data in prescribed format is transmitted to HQ monthly by post:</p> <p><i>[Instantaneous and hourly discharge, velocity data shall be transmitted directly to NFWFC based on need</i></p> <p>FWS: 0900</p> <p>Monthly report submitted to HWRSD through post.</p> <p><i>Report emergency conditions to Chief</i></p>
2 River discharge data	Monthly	Technician	Computed discharge

transmission from Flood Warning Site (GoI)			data in prescribed format is transmitted to FWC, HQ by HF wireless at 0900 daily: <i>[Instantaneous and hourly discharge, velocity data shall be transmitted directly to NWFWC based on need with copy with Chief, HWRSD]</i> Report emergency conditions to Chief
C SEDIMENT SAMPLES ANALYSIS DATA			
1 Sediment transmission	Monthly	Technician	Monthly report of computed sediment samples analysis data transmitted

10. SOP for Common Services under the HWRSD.

4.1 Budget, Five Year Plan, APT and others.			
Action	Time Frame	Operator	Outcome/result
a) Division budget works (proposal, monitoring and follow ups)	Yearly	Budget focal	Budget status is maintained up to date

b) Plan and prepare APT for division in coordination with program officer.	1-2 weeks	APT focal	Division APT is on track
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10.2. Tendering and procurements (e-government procurement)

Action	Time Frame	Operator	Outcome/result
a. Procurement of works in consultation with Procurement officer, NCHM - Preparation of design and estimation of the work - Tendering and awarding the contract	As per the need	Designated official	Procurement of work is done

b. Procurement of goods in consultation with Procurement Officer, NCHM - Preparation of specification and estimation of the goods - Tendering and awarding the contract	As per the procurement rules	Designated official	Procurement of goods is done
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10.3. Maintain stocks, scientific equipment and goods under HWRSD

Action	Time Frame	Operator	Outcome/result
a) Maintain stock ledger for consumable & fixed assets for delivered stocks and issue good receipt notes for further payments(s).	Routine work	Designated official	Stock ledger and good receipt note maintained up to date in coordination with center's store incharge

b) Maintain inventory for HWRSD equipment, gear, survey tools and machineries.	Routine work	Designated official	Maintained inventories up to date.
c) Issue requested equipment with proper hand-taking upon approval for hiring of equipment.	As and when required	Designated official	Equipment issued with proper hand-taking.
d) Check and charge rechargeable batteries (9V & 12 V)	Regularly	Designated official	Keep batteries healthy.

11. Amendment and Revision

TSRD in consultation with the Division will review and update this SOP from time to time and submit to the management for approval



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