

Internal Audit Unit

Performance Audit on the Plant Operation and management on water supply Services

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Glossary Priority ratings have been assigned to issues raised in this report as follows:

Rating scale for individual findings	
Critical	Active management attention required as an extreme priority. Controls are not adequate to address the associated risk.
High	Active management attention required as a high priority. Controls are not adequate to address the associated risk.
Medium	Active management attention required as a moderate priority. Controls are not adequate to address the associated risk.
Low	Active management attention not required on priority. Controls are more or less adequate to address the associated risk.

Rating scale for overall report

Control is inadequate			Control is adequate	
E	H	M	L	CC
Extreme Priority	High Priority	Moderate Priority	Low Priority	Control Critical Test controls regularly

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Executive summary

The review on the water services under plant operation and management section is carried out in accordance with the approved annual internal audit work plan. During the risk-based evaluation of the internal audit annual work plan, this audit universe was rated as high risk. The main goals of the audit are to review the economic, efficient, and effective services provided by Thromde; the audit is carried out on the broad three goals;

- ✓ Is drinking water provided in Thimphu Municipality safe for Human Consumption
- ✓ To test check robust system to monitor and supervise the water distribution network
- ✓ To test check whether there is revenue Leakage/cost leakage or not.

The audit periods cover the financial year (FY) July 2019- June 2020 and July 2020- April 2021.

The Internal Audit Unit (IAU) claims that during the audit we had neither yielded to pressure nor dispensed any favors or resorted to any unethical means that would be considered as violation of the Internal Auditors Code of Ethics

The study reviewed the past audit paras, internal control system/process in place in the agency and the lapses on the systems/corrective measure to mitigate the risks are raised in this report.

Background

Water management and distribution system

Until May 2021, the Infrastructure division functioned under five sections namely water section, road and bridge section, sewer section, electrical section and building section. With an excessive amount of pressure and observations on openness, accountability, and the smooth execution of services, internal arrangements under the division were made whereby the division's sections were restructured namely Infrastructure Planning and Design Section (IPDS), Infrastructure Development Section (IDS), Infrastructure Maintenance Section (IMS) and Plant operation and Management Section (POMS). With this all the data collection, planning, estimates and design, as well as tendering, evaluation and awards of work were done by IPDS. Following that, IDS was responsible for development of urban infrastructure, planning of construction work, coordination with the stakeholders, supervision and monitoring of construction works, processing of contractor bills, taking over of completed works, and rating of APS of contractors. Daily operation, attending to 4 complaints and maintenance of water, road, electrical, drains, footpaths, and sewerage were looked after by IMS. POMS were in charge of works related to water and sewer treatment plants. With the growing attention to the maintenance of assets under Thromde, the management realized the need to institute a separate division which would solely focus on the maintenance part of infrastructure services. Thus, the 5th management came to a decision to bifurcate the infrastructure division into maintenance division and infrastructure division

The plant operation and management section of the Maintenance Division, Thimphu Thromde is responsible for the Municipality's water distribution system as well as providing services on the operation and management of water and waste water treatment plants.

Water supply is one of the main services provided by Thimphu Thromde to its residents. Water supplied by the Thromde is intended for consumption, food preparation, bathing and laundry. The quality of the drinking water provided in accordance with World Health Organization's (WHO) Guidelines for Drinking water Quality (4th Edition) and Bhutan Drinking Water Quality Standard 2016. At present drinking water is supplied to the residents of Thimphu Municipality from the five established water treatment plants located at Motithang, Jungshina, Dechencholing, Taba and Chamgang or Megaypang and distributed from service tanks. The details on the water treatment plants and their distribution areas are tabulated in **Annexure A**.

Water services offered by Thimphu Thromde include water connections, disconnection, reconnection, up gradation, downsizing and replacement. Besides these services, the Thromde also attend to water complaints. The system introduced for the water billing and its related technical issues is looked by the ICT section, all the meter readers directly report to ICT officer.

Objectives and Scope

The main objectives of the review were:

- ✓ Is drinking water provided in Thimphu Municipality safe for Human Consumption
- ✓ To test check robust system to monitor and supervise the water distribution network
- ✓ To test check whether there is revenue Leakage/cost leakage or not.

Sub Objectives

1. Is there any irregularities in Water Network System like any illegal tapping, water connection bypassing water meter, approval of water connection from transmission lines, water supply diverted to community water tank
2. How the database on building and water meters are maintained and test check the effectiveness and efficiency
3. Test checks internal control for the service delivery? Be it in a distribution, connection, disconnection, reconnection, up gradation, downsizing and replacement. How effective the services on the water compliant are handled. Is there TAT on the services?
4. Test check how effectively TT maintains and safeguards water distribution networks and water meter.
5. How effective water meter is functioning and what interval new meter is change and installed? How the records/inventories are maintained?
6. Evaluate how the job responsibilities are distributed?

Scope

Audit Period from July 2019 to April 2021. Review controls relating to:

- 5 WTP operation and water Network distribution
- Billing system and water metering
- Objectives linked with of Annual Performance Agreement (APA) on the safe drinking water distribution
- Human resource management at operation and maintenance of water supply section

Methodology

The review was conducted in pursuant with the Internal Audit charter and Internal Audit standard of Royal Government of Bhutan. The review entailed the followings approaches:

1. Interviewing responsible staff on the audit questionnaire
2. Collecting evidence through tests and review of files and documents
3. Evaluating evidence to determine risk
4. Visit sites and observe operation
5. Carry out Physical verification if necessary
6. Used telephonic method to acquire the information from the consumer/customer

Limitation

The audit is limited to the information provided by concerned official of the agency, employees and the documents referred for the analysis. The audit analysis is more focused on the strengthening of internal control system agency. IAU did not carried out comprehensive study on the objective three on the analysis in the Non- Revenue Water since agency currently have consultant carrying out the study on the NRW.

Observations

The chapter is divided into two parts; part 1 highlights the positive achievement and part 2 the shortcomings and deficiencies.

Part 1: initiatives and Positive developments

There were good practices and initiatives undertaken by the agency to strengthen the internal control system and improve the water services delivery to the public. The initiatives and good practices are as mentioned below:

1. Water quality criteria for safe drinking water adoption and implementation.

The Thromde has established numerical "guideline values" for each parameter of water quality testing based on the World Health Organization (WHO) Guidelines for Drinking Water Quality, as indicated in Table No.1. Thromde now has 5 water treatment plants, all of which treat water according to the ambient water quality, water quality standards 2018 established by the WHO.

2. Creating Geo-database for utility Network

The survey and mapping of the water supply network, sewer network, and street light in the Changzamtog region has been completed, and the GIS section is collecting data for the entire area of Thromde pocket by pocket, data collection for the Dechencholling LAP is almost complete. These programs are aimed at improving data and information.

Such information will be used in decision-making processes such as succession planning, network maintenance, security, and monitoring.

3. Thromde metered all water production outlets

To monitor and take remedial measures to reduce non-revenue water (NRW), Thromde metered all water production outlets from the Water Treatment Plants and service tanks. Total 5875 commercial 1445 and institutional 331, residential 4099 household units are metered as of November 30th, 2021.

4. MoWHS in collaboration with Thimphu Thromde, is conducting a study on the NRW

MoWHS in collaboration with Thimphu Thromde, is conducting a study on the NRW in the core region as a pilot project, which is being funded by Water Management International. This will provide insight into the difficulties as well as a plan for resolving them on the NRW. By December 2021, a project will be completed, and authorities will be trained in lowering NRW and doable recommendation for the improvement.

5. Development of a smartphone app for paying water bills and property tax

Thromde management has developed five mobile applications for both service providers and service users, namely Thromde payment app, Spot water billing app, Project Information management app, BI (Building Inspector) reporting app, and Complaint Management app, in order to avoid human to human contact, minimize cash handling, and make the transition to digitalization, with the goal of providing efficient and effective services to the public and officials. The first two apps, however, are already in use, and the updated versions will be launched on 17/12/2022.

6. Initiative for the development of water master plan for Thromde

With the importance felt by management of having Water Master Plan for the agency, deliberated water team of Thromde to look for the possibilities of developing one. The water team notified the management at the 5th management meeting on October 29th that the water master development for TT has been incorporated under the Water Flagship Program in partnership with MoWHS, and that the plan will be developed either by Thromde or MoWHS, with discussions ongoing. This plan will detail current water usage and set a course for water efficiency improvements, conservation efforts, and water reduction targets. A strategic plan creates priorities and aids a site or agency in allocating funds to the most effective water-efficiency projects.

Part 2 Shortcomings and Deficiencies

1. Water quality

1.1 The Water Test Report is Unreliable.

As per WHO guidelines for drinking water quality 2014, Drinking water suppliers are accountable for the quality and safety of the water they produce at all times.

Thimphu Thromde is the water supplier, and as a safety measure and objective to provide the Thimphu municipal with safe drinking water, raw water is treated (Microbial water quality) in terms of pH, conductivity, Hardness, turbidity, and fecal coli as per the Manual and requirement of water quality standards 2018

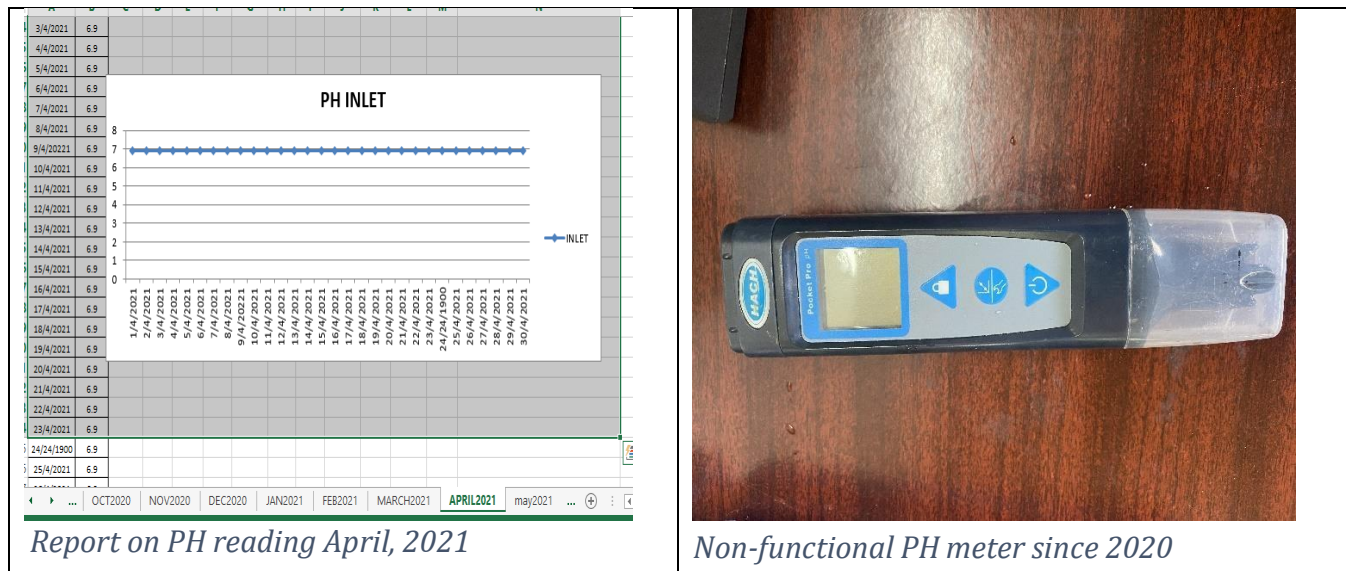
The Thromde has established numerical "guideline values" for each parameter of water quality testing based on the World Health Organization (WHO) Guidelines for Drinking Water Quality, as indicated in Table No 1: Water quality Test

Where	What	When	Who	Critical limits (or range target)
Source chamber (intake)	E-coli	Monthly	Technician	0 CFU/100ml
	Turbidity	Daily		Turbidity<1000 NTU
	PH			PH: 6.5-8.5
	Conductivity			
	Hardness	Weekly		<500
Clear Water Tank at WTP (outlet)	PH	Daily		PH:6.5-8.5
	Turbidity			<5NTU
	Cl2			0.6-0.8mg/L
	Conductivity			
	Hardness			<500
	Temperature			

During the physical verification, IAU discovered that, despite the fact that the water is treated every day, the water test report's reliability is in doubt since, with the exception of the Motithang WTP, the technicians who treat the water are untrained. Furthermore, because technician is familiar with the typical range of numerical values for each parameter of water quality assessment, report can be recorded without carrying out the actual testing. As a result, the provided report may be deceptive. For instance, the non-reliability of the technician's water test report is demonstrated in the case of the

Dechencholling WTP, where the PH meter has been out of service since 2020 but daily readings are displayed in the report submitted to the IAU office until April 2021. Figure no 1

Figure no 1



1.2 No training or refresher courses are provided to technicians.

According to the water safety plan (WSP), para 10; supporting program, technicians must be trained whenever opportunities arise. They will receive refresher training every year and whenever there is a staff turnover. Once the training is successfully completed, the WSP chairman shall issue a certificate of competency; however, it was discovered that, with the exception of the Motithang water treatment plan, none of the other technicians are trained or provided with refresher courses to those joining the treatment plan for the first time. The technician follows the manual's instructions for dosing chlorine, alum, and polymer in water, and conducts water quality testing without any prior experience. They are responsible for the lives of those who drink water, and their reliability on their profession is in doubt without sufficient training.

Recommendation

Adoption of Collaborative multiagency approach

It is essential that a collaborative multiagency approach need to be adopted to ensure that agencies with responsibility for specific areas within the water cycle are involved in the management of water quality. For example developing partnership with RCDC to act as a surveillance and quality control agency with appropriate mechanisms and documentation for stakeholder commitment and involvement. Developing a partnership with RCDC will

aid in the resolution of the water quality monitoring problem, as well as the development of our technician's competency.

1.3 Inconsistency in documenting test and production report

Despite being part of the same agency, each of the five water treatment plants in Thimphu Thromde records water test and production reports in a different format, showing a lack of standardization or reporting format (Annexure B). The water test report is not disseminated and is kept in silos until the supervisor requires it; it is not made public, despite the fact that the water Act of 2011 stipulates that all citizens have access to water-related information (article 11). Because there are no internet facilities, such an act occurred, lack of standard format will lead to difficulty in analyzing overall report resulting in inefficiency.

Recommendation

- ✓ Standardize the reporting format;
- ✓ As a public awareness mechanism, the analysis of the water test report should be made available on the website once a quarter as information to the general public during the fiscal year. Such a mechanism will increase the visibility of the agency's activities and performance; people will be made aware of the costs incurred for water treatment, and the water tariff will be transparent.

1.4 Absence of proper storage for water treatment chemical

With an objective to provide safe drinking water to the public, annually Thromde is spending Nu. 2 million (figure: expenditure statement for the financial year 2019-2020) for the procurement of water treatment chemical for the four water treatment plant. However, during the field visits, it was discovered that the Thromde lacked sufficient and safe liquid chlorine storage. For instance, liquid chlorine jerry cans were kept outside at the Dechencholing water treatment plant and Thromde store (lungtenzampa) as shown in Figure no 2

Figure No 2



To guarantee optimal stability, liquid chlorine should be stored in a cold, dry, and well-ventilated area away from direct sunlight. Sodium hypochlorite, sometimes known as chlorine bleach, is a rather unstable form of chlorine. Chlorine loses some efficacy each year: it can lose up to 50% of its potency in 6 months and up to 90% in a year. The stability of chlorine is affected by how it is stored. When exposed to extremes of heat or cold, as well as direct sunshine, its disinfection capacity will rapidly deteriorate.

In this aspects, IAU is view that improper handling of chlorine will not serve the purpose.

Recommendation

In view of the aforementioned, Thromde management need to create or seek an alternative for suitable water treatment chemicals storage.

1.5 E-coli test not conducted

The e-coli test must be performed at least once a month, according to water quality standards and the parameter adopted by the Thimphu Thromde. The presence of E. coli in a drinking water sample usually indicates recent fecal contamination. That means pathogens are more likely to be present.

A defined parameter of water test must be performed to remove contaminants and undesirable components, destroy pathogenic microorganisms or reduce their concentration, and make the water fit for its intended end-use through water treatment process. However, during the analysis of the test report, it was discovered that, aside from Taba WTP, none of the other WTPs perform the e-coli test. Whereas, a contrary report

from the RCDC indicates that the treated drinking water supplied by Thromde contains e-coli in water. (See Annexure C) one reason could be chlorine losing its disinfectant function or seepage into our drinking water.

Failure to detect such microorganisms as a result of not conducting e-coli tests increases the risk of outbreak of water-related diseases, and in the worst-case scenario, the agency may face legal liability. This occurred as a result of insufficient monitoring.

Recommendation

The operational monitoring of control measures in the drinking water supply is critical to ensuring drinking water safety. As a result, it is critical to set parameters limits, monitor those limits, and take corrective action in the event of a detected deviation before the water becomes unsafe. The WSP specifies the parameters for water quality testing as well as the frequency with which tests must be performed. Strict compliance must be implemented.

1.6 No Safety gears and equipment

According to the Occupational Health, Safety, and Welfare Regulations, Chapter 8: Personal Protective Equipment Clause 65, at no cost to employees, the employer shall provide employees with protective equipment for the eyes, face, hands, and feet, protective shields and barriers whenever necessary due to the hazardous nature of the process or environment, chemical, radiological, or other mechanical irritants or hazards capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

However, during the site visit to the water treatment plants, IAU discovered that chemical dosing (chlorine, polymer) was carried out without use of required safety equipment.

Chlorine and polymer are toxic and corrosive chemicals. It can cause severe irritation and chemical burns to human tissues like the skin, as well as damage material such as metal pipes and can also cause fires and explosions. Chlorine must be handled and stored with extreme caution. People handling it must wear the necessary personal protection equipment.

Safety clothing is crucial in the workplace, and it is the employer's obligation and responsibility to provide safety gear for workers who perform demanding tasks. It safeguards users from any potential health and safety hazards at work. Such precautions can reduce the risk of injury, illness, and legal issues. Such failures occurred since no safety amenities were established and a person in charge of overseeing such requirements.

Recommendation

Each worker who performs demanding work is entitled to safety equipment, and the person in charge of the concern must set safety amenities and the frequency with which safety gears must be provided to the worker, as well as see the requirement and propose a budget for the procurement of safety equipment every financial year.

1.7 Water safety plan in Thromde needs to be reviewed

As per water regulation 2014, chapter vi, functions of Thromde administrative, clause 88 states, For the purpose of determining risk factors and their management, the Thromde Administration will develop a Water Safety Plan and implement it.

Water Safety Plan (WSP): means effective ways of consistently ensuring safe drinking water supply through a risk assessment and risk management approach to a water supply chain, beginning from its catchment to the consumer point.

During the performance audit conducted by the external auditor in the year 2017, it was reflected as a positive accomplishment whereby an agency in collaboration with MoWHS and MoH, has developed the WSP as required by the water regulation of Bhutan 2014. But the irony is concerned implementing section is unaware on the existence of such documents. System of archiving the important documents, hand and taking, lack of communication is the weakness of internal control.

IAU retrieved WSP documents from MoWHS for audit purposes, and during the review it was discovered that the documents needed to be reviewed because all of the responsible persons in the Water Safety Team (WST) changed, and this documents is dynamic, requiring constant review for the forecasting of new risks and their mitigation.

Recommendation

As per the water regulation 2016, chapter VI clause 86, besides technical supports and issuance of guideline(s), the MoWHS will monitor and assist Thromde in developing and implementing water infrastructure, water safety plans and review their efficiency, from time to time. Therefore, appoint a focal person and collaborate with the relevant agency and review the WSP and implement it.

2. Water distribution monitoring and supervision system.

Water is a scarce resource, and with global warming, it appears to be much scarcer. People believe that because water is a natural resource, it is free. However, there are expenditures associated with clean drinking water: collection, filtering, and delivery. Thus, metering production, distribution, and domestic/commercial consumers is one of the controls utilized by Thromde to monitor and manage the water distribution. Metering provides information on how much clean water is generated, how much is consumed by consumers, and how much is wasted as NRW. With this information, the decision maker can devise a strategy for improvement. However, the following are some observations that have an impact on internal control.

2.1 Bulk meter not functioning

The bulk meters were installed in water treatment plants to track actual drinking water production from the water treatment plants to the service tanks.

The bulk meters facilitate in calculating water revenue and water loss including non-revenue water. However, on site verification of water treatment plants, it was noted that the bulk meters at Motithang, and one bulk meter in Jungshina were not working and the production at Motithang and Jungshina were measured manually. What good is metering if it doesn't work? It's as good as not having one if the purpose isn't realized.

Similarly, since the electromagnetic flow meter at Megapang water treatment plant was not working, the water output data presented till April 2021 is based on assumptions. As a result, the IA is unable to obtain accurate statistics on water production and consumption, making it difficult to determine whether revenue gains or losses have occurred.

The non-functional bulk meters are presented in Figure No 3

Figure No 3



Recommendation

Upgrade non-functional bulk water meter at production facilities so that the actual production records on the water is realized. This report will help in identifying the NRW similarly data will be accurate and can be used to develop the strategy plan for the decision maker.

2.2 Inappropriate installation of water meter

Water meters are devices that are used to measure the flow of water consumed by the customer; Once you learn more about the amount of water that you consume every month, it become to reduce wastage because you know that the more water you waste, the more you are going to pay thus you will be able to conserve water just as needed. This device will also prove to be very useful when it comes to detecting leaking pipes and tanks. If at one point you notice that the meter is running after you have turned off all taps, it will give you an indication that there is a possible leak somewhere that should be fixed. However, as a water supplier installing water meter rightly is foremost while delivery services and charging them.

2.2.1 Improper mounting of water meter

During the joint physical verification of water distribution network in Changzamtog, the IA discovered some water meter were not installed properly; some are installed vertically, whereas the preferred mounting position is horizontal with the dial facing upwards according to water meter installation guideline. Water meters should never be mounted vertically, and they should never be turned upside down or canted on their side since they will not function properly.

Improper installations of water meters are mainly due to lack of guidelines and standards on water meter installation.

Figure no 4: Vertical mounting of water meter



location: Changzamtog



Location: Norzin (MKTS Building)

Recommendation

- ✓ Aforementioned issues were raised due to a lack of guidelines for the water meter installation, getting it right from the beginning is one of best approach. Plumbers are currently installing water meters based on their knowledge and experience therefore, it is recommended to have one.
- ✓ Improper mounting/meter location should be rectify with working in collaboration with meter reader, and plumbing section in their respective zone.
- ✓ Regular consultative stakeholder meeting with the intra division; water meters, plumber, relevant engineer, concerned official needs to conducted.

2.2.2 Water billed based on taking average consumption

Customers that used Thomde's water meter replacement services between 2019 and 2021 were randomly questioned, and the one common complaint was that meter readers were billing the residence without actually reading the meter. This statement may be genuine, but IA was unable to verify it; however, when the water meter reader was questioned, they accepted the act of invoicing the customer based on average use, which occurred in the following instances:

2.2.2.1 Meter reading display

As per chapter 6 of water regulation 2014, Pipe-Work and Water Meter clause 91 states that the water connection pipe from the municipal main to the water meter point, water meter and associated fittings are the property of the Thomde. The care and safety of the water connection beyond the water meter and other associated fittings are the responsibility of the building owner. Maintenance of meters must ensure that the meter display can be read clearly by the billing officials but during physical verification, it was discovered that a water meter was installed but the meter reading display was not visible as shown in Figure no 5, making it difficult for the water meter readers to read. They advised the owners to change the meter, but when they returned for the next round of reading, the same problem remained, and the water meter reader invoiced the customer based on average use.

Such a situation is more likely to arise if dual reporting is not implemented; in this case, the water meter reader just informed the consumer and did not alert Thomde officials.

Figure No 5: Unclear water reading display



Recommendation

- ✓ Monthly defective water meter reports need to be compile and send it to the respective concern site engineer for work ratification. Such TAT must be developed. One of the reasons why people are reluctant to replace the water meter is that it is costly. Don't charge them all at once; adjust the from water bills from water bills until the meter cost is repaid.
- ✓ **Alert notification system** need to be integrated in the current system so that the information on the defective meter detected by the meter readers will be informed to concerned user and official for the rectification.

2.2.2.2 Meter installed at location not easily accessible to meter readers

During physical verification, IA discovered that the meter was located in an area that was inaccessible to the water meter reader, such as within the store and in some area inside the toilet, as depicted in the figure no 6, thus, water meter reader bill the customer based on average use.

Thromde officials did the initial installation of the water meter, therefore why is it in such an inconvenient location? Why hasn't the relocation of water meters been made easier if the setback was constructed later?

It is inappropriate to bill on the average consumption when the water meter is installed. Because average consumption may not reflect real usage, customers may be paid more or less as a result agency might be losing revenue as well as customer confidence on the system institute for the monitoring water consumption. When it's metered, the metering purpose should be accomplished. The problems are primarily due to a lack of guidelines and standards for water meter installation, as well as a lack of ToR and accountability.

Figure no 6: improper location of meter



Recommendation

- ✓ Develop, implement and sensitize the guideline of water meter installation to concerned official and the consumer.
- ✓ In collaboration with the consumer, relocation of the water meter work needs to be rectified and make it easily accessible to the water meter.
- ✓ ToR for the water billing services cycles needs to be developed
- ✓ Accountability needs to be instituted
- ✓ SOP needs to be developed.

3. Water meter test bench left idle

The water meter testing bench is a necessary measuring instrument for water meter testing and repair in metrological services. In the year 2019, Thromde spent Nu. Twenty three lakh sixty eight thousand nine hundred eighty seven (23, 68, 987.00) on a water meter test bench. During the physical verification, it was discovered that the machine had been left idle for an extended period of time without being properly cared for, as illustrated in Figure 7.

The machine is not accounted for in either the asset management or the government inventory systems.

Figure No 7: Water meter test bench



4. No strategy plan documents for any kind services provided by Thomde

Thromde is moving toward financial independence and agency autonomy in its function serving its citizens; it is past time for management to develop a strategy plan for all services that generate revenue for Thromde. There is currently no such plan. Furthermore, as a service-oriented agency, Thromde has not conducted a customer/ stakeholder survey for the services provided by Thromde to determine whether or not the clients are satisfied. Such strategy planning measures will improve the internal control mechanism for revenue generation sources. For instance, IAU is in view that, private sewer operators should pay minimal or certain fee to Thromde for its operation because the sewer waste is deposited in the manholes and sewer treatment work is carried out by Thromde. Similarly, with other services also. A plan needs to be develop and should be dynamic, for instance, in case of water bill payment defaulters, what, how and when need to be done needs to look upon as a priority.

It is also recommended that management conduct a customer/stakeholder survey to learn about customer perceptions of Thomde's services, which can aid in improving the services from the end user's perspective.

Summary of the overall findings based on the rating scale provided in the glossary

Sl.No	Findings	Priority/impact level
1	Quality	
	1.1 The Water Test Report is Unreliable.	High
	1.2 No training or refresher courses are provided to technicians.	High
	1.3 Inconsistency in documenting test and production report	Low
	1.4 Absence of proper storage for water treatment chemical	High
	1.5 E-coli test not conducted	High
	1.6 No Safety gears and equipment	High
	1.7 Water safety plan in Thomde needs to be reviewed	High
2	Water distribution monitoring and supervision system.	
	2.1 Bulk meter not functioning	High
	2.2 Inappropriate installation of water meter 2.2.1 Improper mounting of water meter 2.2.2 Water billed based on taking average consumption	High
3	Water meter test bench left idle	High
4	No strategy plan documents for any kind services provided by Thomde	Medium

Conclusion

The internal audit concludes that the control processes governing the water and metering service were generally established and functional to a reasonable extent, but that further strengthening is required, as the supervisory and monitoring controls were insufficient. As a result, the deficiencies and lapses listed above were identified. It is time for a systemic as well as a procedural intervention.

Part 3: Management Response

As per the signed minutes of meeting (annexure attached), following are the management responses to the observations:

1. Observation on water quality are from Para 1.1 to 1.7,
 - 1.1. The Water Test Report is Unreliable
 - 1.2. No training or refresher courses are provided to technicians.
 - 1.3. Inconsistency in documenting test and production report
 - 1.4. Absence of proper storage for water treatment chemical
 - 1.5. E-coli test not conducted
 - 1.6. No Safety gears and equipment
 - 1.7. Water safety plan in Thromde needs to be reviewed

Decision: The Management accepted the observation on water quality and directed the Operation and Maintenance Division to implement the recommendation in the time frame as proposed in the annexure: Management response

In addition, the management also directed the HRS to propose a budget in collaboration with the O and MD and plan and provide refresher courses for Treatment Plant Technicians from time to time.

Action: Operation and Maintenance Division

2. Water distribution monitoring and supervision system para 2.1 and 2.2
 - 2.1 Bulk meter not functioning
 - 2.2 Inappropriate installation of water meter
 - 2.2.1 Improper mounting of water meter
 - 2.2.2 Water billed based on taking average consumption

Decision: The management commented that it is not the responsibility of the ICT section to look after the metering part but only on the system issues. Therefore, the water metering part of the infrastructure division should be taken over by the operation and maintenance division from the ICT section because it has been long overdue, and now that the infrastructure division has been bifurcated into O and MD. Furthermore, a new unit/section can be instituted that can be attended to by the existing staff under O and MD or recruit a competent official who is well aware of the know-how of the water metering system. And this section should implement the recommendation on the above lapses as stated in the annexure.

Action: Chief, O and MD

3. Water meter test bench left idle

Decision: The Management directed the operation and maintenance division to take responsibility for the water test bench.

4. No strategy plan documents for any kind services provided by Thromde

Decision: The management informed that the Finance division is developing a Financial Strategy Plan for the Thimphu Thromde.

Management Response

Sl. No	Observation	Recommendation	Management Response	Responsibility	Timeline Dec 2021-30 June 2022
1.	Water Quality				
1.1	The Water Test Report is Unreliable.	Adoption of Collaborative multi agency approach It is essential that a collaborative multi agency approach need to be adopted to ensure that agencies with responsibility for specific areas within the water cycle are involved in the management of water quality. For example developing partnership with RCDC to act as a surveillance and quality control agency with appropriate mechanisms and documentation for stakeholder commitment and involvement. Developing a partnership with RCDC will aid in the resolution of the water quality monitoring problem, as well as the development of our technician's competency.	Accept	Maintenance division	•
1.2	No training or refresher courses are provided to technicians.		Accept	Chief Maintenance Division and HRD	•
1.3	Inconsistency in	✓ Standardize the reporting format;	Accept	Maintenance	•

	documenting test and production report	✓ As a public awareness mechanism, the analysis of the water test report should be made available on the website once a quarter as information to the general public during the fiscal year. Such a mechanism will increase the visibility of the agency's activities and performance; people will be made aware of the costs incurred for water treatment, and the water tariff will be transparent.		division	
1.4	Absence of proper storage for water treatment chemical	In view of the aforementioned, Thromde management needs to create or seek an alternative for suitable water treatment chemicals storage.	Accept	Maintenance division	•
1.5	E-coli test not conducted	The operational monitoring of control measures in the drinking water supply is critical to ensuring drinking water safety. As a result, it is critical to set parameters limits, monitor those limits, and take corrective action in the event of a detected deviation before the water becomes unsafe. The WSP specifies the parameters for water quality testing as well as the frequency with which tests must be performed. Strict compliance must be	Accept	Maintenance division	•

		implemented.			
1.6	No Safety gears and equipment	Each worker who performs demanding work is entitled to safety equipment, and the person in charge of the concern must set safety amenities and the frequency with which safety gears must be provided to the worker, as well as see the requirement and propose a budget for the procurement of safety equipment every financial year.	Accept	Maintenance division	•
1.7	Water safety plan in Thromde needs to be reviewed	As per the water regulation 2016, chapter VI clause 86, besides technical support and issuance of guideline(s), the MoWHS will monitor and assist Thromde in developing and implementing water infrastructure, water safety plans and review their efficiency, from time to time. Therefore, appoint a focal person and collaborate with the relevant agency and review the WSP and implement it.	Accept	Maintenance division	•
2	Water distribution monitoring and supervision system.				
2.1	Bulk meter not	Upgrade non-functional bulk water meters at production facilities so that the actual	Accept	Maintenance	•

	functioning	production records on the water is realized. This report will help in identifying the NRW similarly data will be accurate and can be used to develop the strategy plan for the decision maker.		division	
2.2	Inappropriate installation of water meter				
2.2.1	Improper mounting of water meter	<ul style="list-style-type: none"> ✓ Aforementioned issues were raised due to a lack of guidelines for the water meter installation, getting it right from the beginning is one of the best approaches. Plumbers are currently installing water meters based on their knowledge and experience therefore, it is recommended to have one. ✓ Improper mounting/meter location should be rectified with working in collaboration with meter reader, and plumbing section in their respective zone. ✓ Regular consultative stakeholder meeting with the intra division; water meters, plumber, relevant engineer, concerned official needs to conduct. 	Accept	Maintenance division	•

2.2.2	<p>Water billed based on taking average consumption</p> <p>1. Meter reading display</p>	<p>✓ Monthly defective water meter reports need to be compiled and sent to the respective concern site engineer for work ratification. Such TAT must be developed. One of the reasons why people are reluctant to replace the water meter is that it is costly. Don't charge them all at once; adjust the water bills from water bills until the meter cost is repaid.</p> <p>✓ Alert notification systems need to be integrated in the current system so that the information on the defective meter detected by the meter readers will be informed to concerned user and official for the rectification.</p>	Accept	ICT and Maintenance Division	•
	<p>2. Meter installed at location not easily accessible to meter readers</p>	<p>✓ Develop, implement and sensitize the guideline of water meter installation to concerned officials and the consumer.</p> <p>✓ In collaboration with the consumer, relocation of the water meter work needs to be rectified and make it easily accessible to the water meter.</p> <p>✓ ToR for the water billing services cycles needs to developed</p>	Accept	Maintenance Division	•

		✓ Accountability needs to be institute ✓ SOP needs to be developed.			
3	Water meter test bench left idle		Accept	Maintenance Division	•
4	No strategy plan documents for any kind services provided by Thromde		Accept	Financial strategy document, Finance Division	•

References

1. Water Act 2011
2. Water regulation, 2014
3. Water quality standard 2018
4. Water test and production report of 5 WTP
5. Water consumption report 2019,2020, and April 2021
6. Water test report from RCDC
7. City cooperation service guide
8. WHO Guidelines for drinking water quality
9. RAA performance audit report of water, 2016
10. Water meter installation guideline, Delta Flowtech
11. Protocol for the chlorination of drinking water, Government of Sudan
12. Water safety plan of Thimphu Thromde, 2015.

Annexures:

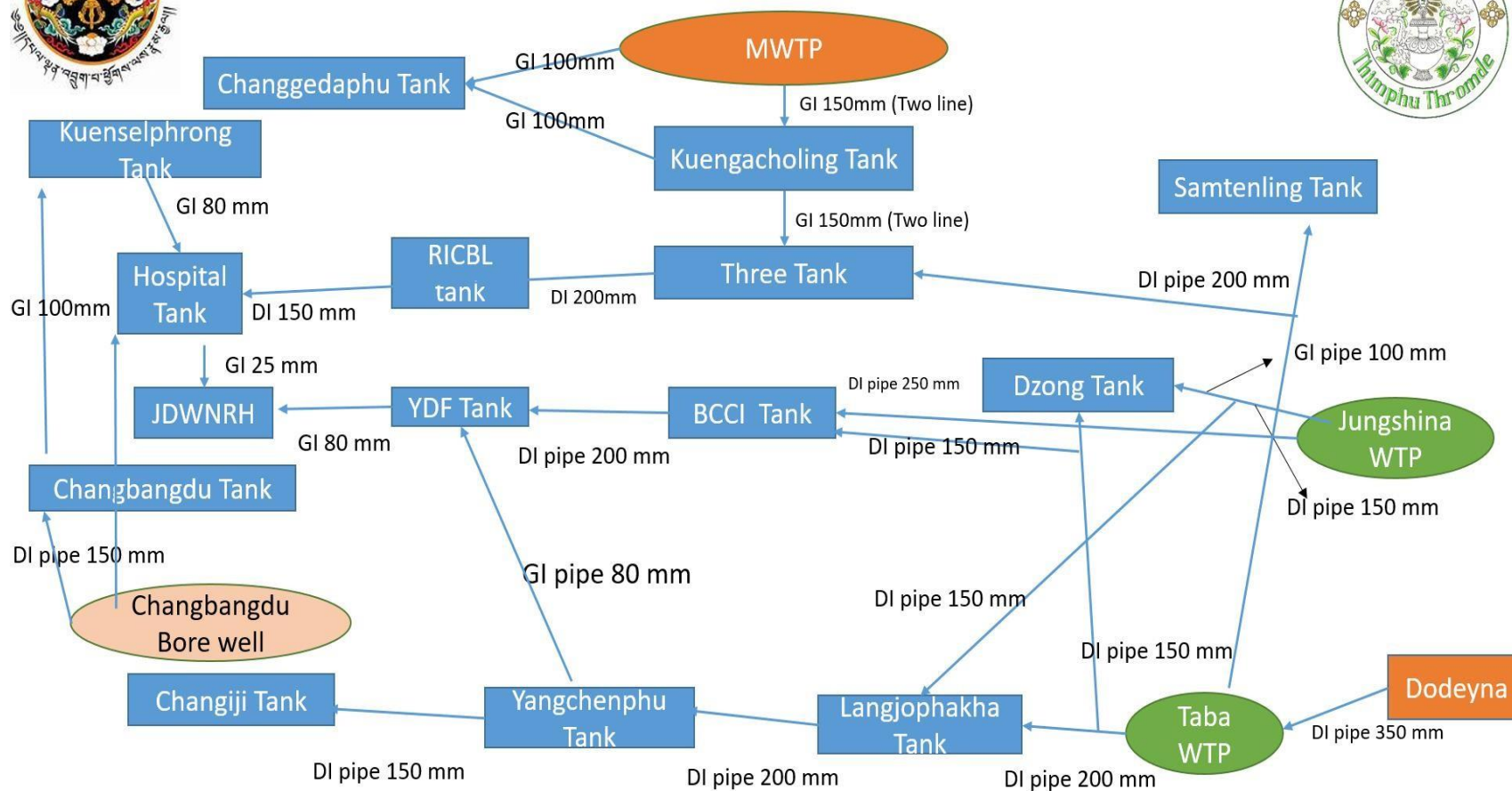
1. Annexure A: The details on the water treatment plants and their distribution areas
2. Annexure B: The report format of 5 WTP on the production and test.
3. Annexure C: Presence of E-coli in water
4. Annexure D: Total number of meter replaced during FY 2019-April 2021
5. Annexure E: Signed minutes of the meeting of audit exit meetings

Annexure A: Water treatment plants and areas receiving water supplies from Thimphu Thromde

Sl.No	Name of the water treatment plant & its capacity	No. of service tanks *capacity (m3)	Total capacity of service tanks (m3)	Location of service Tank	Areas of water distribution
<u>1</u>	Chamgang WTP 6.5MLD	1x360	720	Gabjakha	Babesa Tag
		1x360		Babesa Back to Statue	Babesa Lamwog
		1x735	735	Simtokha below Dantak	Tshalu Brap & Tshalu Maphay
		1x450	810	Lungthenphu	Olakha, Lungtenphu, Changjalu
		1x360			
		2X270	540	Changbangdu	Changbangdu
<u>2</u>	Changzatog Bore well, 2MLD	1x100	100	Changbangdu	Lower Changzamtog and Changbangdu
		1x100	330	Kuenselphrong Tank	Upper Changzamtog
		1x230			
		Directly supplying to Gyaltsuen Jetsun Pema Wangchuck Mother and Child Hospital			
<u>4</u>	Motithang WTP 6.5 MLD	2X320	640	Kuengacholing	Upper Motitang, Kawajungsa, Changgangkha, Zilukha, above Momorial Chorten, above NPPF Colony
		1x100	330	Changigaphu	Changigaphu and upper Changzamtog
		1x230			
		3x320	960	Motithang Three Tank	Core area below Three tanks
<u>5</u>	Jungshina WTP 6.5MLD	1x320	320	BCCI	Norzin, Changlam and CFM area
-		2x230	460	Swimming pool (YDF)	Core area, Honkong Market Area, Lower Changzamtog, Hospital

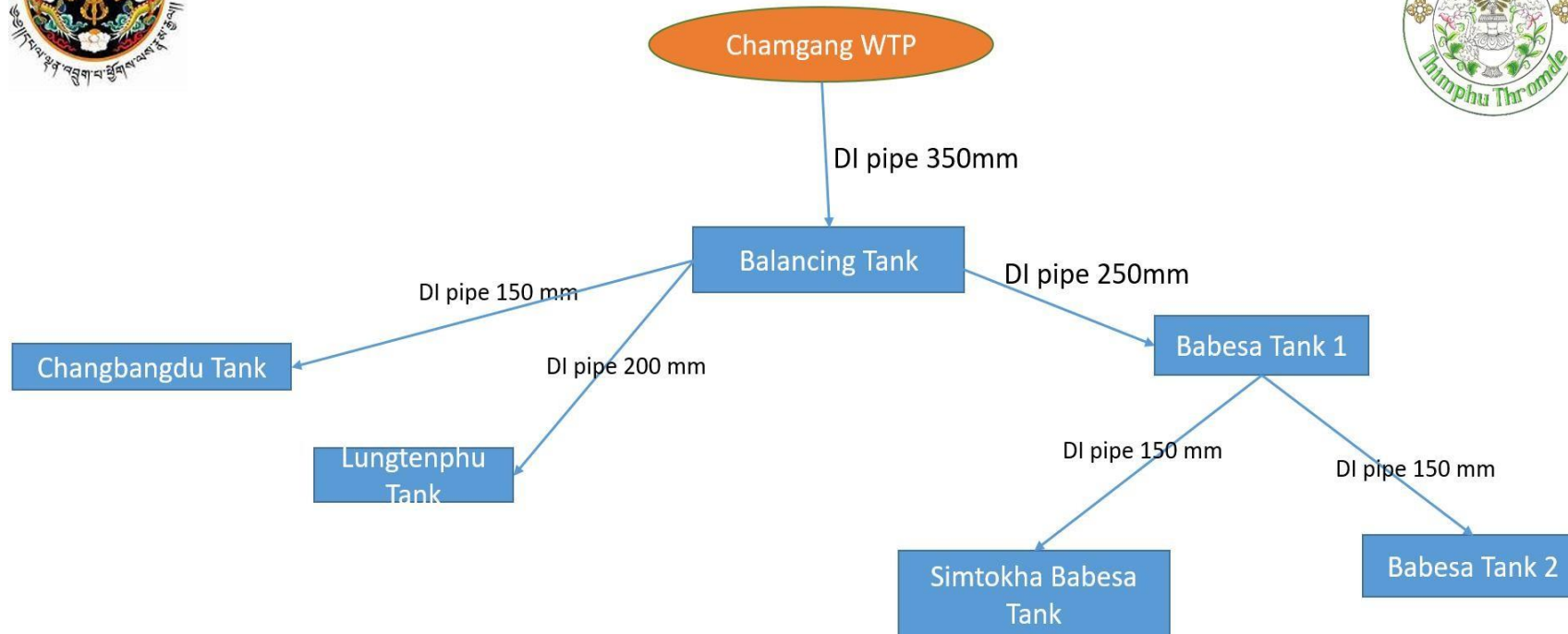
-		1x250	250	Dzong Tank	Kawajungsa, Zilukha, Hejo, Dzong
<u>6</u>	Taba WTP 10MLD	1X230	230	Taba	Lower Taba
-		2x230	460	Langjophakha	Langjophakha
-		1x320	320	Yangchenphu	Yangchenphu
-		3x230	690	Changjiji	Changjiji
-		1x250	250	Dzong Tank	Kawajungsa, Zilukha, Hejo, Dzong
-		1x320	320	BCCI	Norzin, Changlam and CFM area
-		3x320	960	Motithang Three Tank	Core area below Three tanks
-		1x320	320	RICBL above NPPF Colony	NPPF Colony, PED Colony, Core area, Changzamtog
-		1x320	445	Above Hospital	Changzamtog, JDWNRH
-		1x125			
7	Dechencholing WTP 1.4MLD	2X230	460	Dechencholing	Dechencholing

Water Distribution Network (Core)





Water Distribution Network, South Thimphu



Annexure B: Sample of report format for the 5 WTP

1. Meygapang: production and test report

Meygapang water treatment plant (6.5MLD)

Thimphu Thromdue

Production report for the month: APRIL : 2020

Date	Time	Daily production(m3)	Monthly production(m3)	REMARKS
1/4/20	8:00 am-8:00 am			
2/4/20	"			
3/4/20	"			
4/4/20	"			
5/4/20	"			
6/4/20	"			
7/4/20	"			
8/4/20	"			
9/4/20	"			
10/4/20	"			
11/4/20	"			
12/4/20	"			
13/4/20	"			
14/4/20	"			
15/4/20	"			
16/4/20	"			
17/4/20	"			
18/4/20	"			

Megaypang water treatment plant (6.5 MLD) chamgang.

Thimphu Thromdue

Daily water quality test report for the month of: April : 2020



Laboratory Test Parameter and frequency		PH 6.5-8.5 Mg/l (Daily)		<u>Cl,Residual</u> 0.5-1.00 mg/l (Daily)		PAC 4.00m g/l (Daily)	Hardness 50.00 mg/l (Yearly).		Total coliform 0.0-1.0MPN (Weekly)		Turbidity 0.00-1.0NTU (Daily)		Conductivity 330.00 MS/cm (Weekly)	
Time:	Date:	R/W	T/W	R/W	T/W	R/W	R/W	T/W	R/W	T/W	R/w	T/W	R/W	T/W
9:00 am	1/4/20			0.00	0.	4.00	-	-		0.00		0.00		
"	2/4/20			0.00	0.	4.00	-	-	-	-			-	-
"	3/4/20			0.00	0.	4.00	-	-	-	-			-	-
"	4/4/20			0.00	0.	4.00	-	-	-	-			-	-
"	5/4/20			0.00	0	4.00	-	-	-	-			-	-
"	6/4/20			0.00	0.	4.00	-	-	-	-		0.0	-	-
"	7/4/20			0.00	0.	4.00	-	-		0.00		0.00		
"	8/4/20			0.00	0.	4.00	-	-	-	-		0.1	-	-
"	9/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	10/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	11/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	12/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	13/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	14/4/20			0.00	0.	4.00	-	-		0.00		0.00	-	-
"	15/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-
"	16/4/20			0.00	0.	4.00	-	-	-	-		0.00	-	-

2. Dechencholling WTP: Production and test report

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	DAILY REPORT FOR THE MONTH OF FEBRUARY 2020													
2	Parameters	TURBIDITY				PH				Conductivity		Residual Chlorine		Remarks
3	BDWQS, Guideline	(5 NTU)				6.5-8.5				(µs/cm)		(mg/L)		
4	DATE	INLET	Filtration	R1	R2	INLET	Filtration	R1	R2	INLET	TEMP°C	R1	R2	
5	1/2/2020	0.12	0.08	0.09	0.02	6.7	6.5	6.5	6.7	16.8	3.5	0.68	0.5	
6	2/2/2020	0.07	0.05	0.06	0.01	7.0	7.1	6.6	6.6	16.7	2.3	0.52	0.42	
7	3/2/2020	0.15	0.06	0.04	0.05	7.5	7.6	6.5	6.6	16.2	3.4	0.6	0.52	
8	4/2/2020	0.14	0.06	0.10	0.05	7.4	7.5	6.5	6.5	19.8	2.1	0.58	0.4	Clean lamella settler tank
9	5/2/2020	0.10	0.07	0.07	0.02	7.5	7.6	6.5	6.5	16.9	2.8	0.6	0.48	
10	6/2/2020	0.15	0.01	0.02	0.01	7.6	7.6	6.5	6.6	16.9	2.5	0.70	0.62	Back Wash
11	7/2/2020	0.12	0.02	0.01	0.01	7.5	7.6	6.5	6.7	17.1	2.1	0.68	0.52	change grease and coupling
12	8/2/2020	0.14	0.07	0.04	0.02	7.6	7.6	6.6	6.5	17.0	2.2	0.70	0.64	
13	9/2/2020	0.13	0.01	0.01	0.01	7.6	7.6	6.5	6.4	16.9	2.3	0.8	0.72	
14	10/2/2020	0.15	0.06	0.05	0.02	7.5	7.6	6.6	6.5	17.1	2.2	0.82	0.75	
15	11/2/2020	0.14	0.08	0.04	0.01	7.6	7.5	6.5	6.6	17.2	2.3	0.70	0.68	
16	12/2/2020	0.12	0.06	0.05	0.02	7.5	7.6	6.6	6.5	17.1	3.8	0.68	0.55	
17	13/2/2020	0.11	0.03	0.02	0.01	7.6	7.7	7.0	7.0	16.8	4.0	0.79	0.68	
18	14/2/2020	0.12	0.04	0.03	0.01	7.5	7.6	7.6	7.6	16.7	4.9	0.73	0.65	
19	15/2/2020	0.14	0.03	0.02	0.01	7.6	7.7	7.6	7.5	17.2	4.3	0.80	0.75	
20	16/2/2020	0.10	0.05	0.01	0.00	7.6	7.6	7.6	7.6	16.8	6.1	0.76	0.69	replaced chlorine pipe line
21	17/2/2020	0.16	0.05	0.02	0.01	7.5	7.6	7.6	7.6	17.7	6.8	0.89	0.71	
22	18/2/2020	0.14	0.06	0.03	0.01	7.6	7.7	7.6	7.6	17.5	4.1	0.91	0.82	
23														

< > ... SEPTEMBER 19 OCTOMBER 19 NOVEMBER 19 DECEMBER 19 JANUARY 2020 **FEBRUARY20** ... + : < >

READY

	A	B	C	D	E	F	G	H	I
1	Production for june 2021								
2	Date	Time	Previous reading	Present reading	Total	Previous reading	Present reading	Total	Remarks
3			Meter -1	Meter-1	Flow	Meter-2	Meter-2	Flow	
4					In 24hrs			In 24hrs	
5	1/6/2021	9.30Am	28880007	2882923	2916	424317	425312	995	
6	2/6/2021	9.30Am	2882923	2886056	3133	425312	426475	1163	
7	3/6/2021	9.30Am	2886056	2888594	2538	426475	427510	1035	
8	4/6/2021	9.30Am	2888594	2891378	2784	427510	428669	1159	
9	5/6/2021	9.30Am	2891378	2893977	2599	428669	429712	1043	
10	6/6/2021	9.30Am	2893977	2897150	3173	429712	430770	1058	
11	7/6/2021	9:30AM	2897150	2900301	3151	430770	431795	1025	
12	8/6/2021	9:30AM	2900301	2903433	3132	431795	432864	1069	
13	9/6/2021	9:30AM	2903433	2906165	2732	432864	433922	1058	
14	10/6/2021	9:30AM	2906165	2908660	2495	433922	434992	1070	
15	11/6/2021	9:30AM	2908660	2911775	3115	434992	436073	1081	
16	12/6/2021	9:30AM	2911775	2914743	2968	436073	437194	1121	
17	13/6/2021	9:30AM	2914743	2917748	3005	437194	438204	1010	
18	14/6/2021	9:30AM	2917748	2920852	3104	438204	439288	1084	
19	15/6/2021	9:30AM	2920852	2923831	2979	439288	440332	1044	
20			2923831			440332			
21									
22									
23									

< > sept2020 oct2020 Nov2020 DEc2020 Jan2021 Feb2021 march 2021

3. Jungshina WTP: Production and Test report

	A	B	C	D	E	F
1	Date	High Pressure	Medium Pressure		Total Discharge	Remarks
2		Flow (m3/Day)	Flow (m3/Day)	Other	Flow (m3/Day)	
3	01/06/2019	2186	3801	12	5999	
4	02/06/2019	2239	3439	10	5688	
5	03/06/2019	2121	3620	20	5761	
6	04/06/2019	2196	3780	50	6026	
7	05/06/2019	2223	3493	30	5746	
8	06/06/2019	2292	1638	48	3978	MP line damaged
9	07/06/2019	2041	2770	39	4850	
10	08/06/2019	2190	3493	26	5709	
11	09/06/2019	2200	3620	30	5850	
12	10/06/2019	1828	3621	4	5453	
13	11/06/2019	2190	3439		5629	
14	12/06/2019	2198	3656	8	5862	
15	13/06/2019	2144	3470		5614	
16	14/06/2019	1617	1991		3608	line damaged
18	16/06/2019	2206	3439		5645	
19	17/06/2019	2250	3622		5872	
20	18/06/2019	458	2226		2684	inter connection.
21	19/06/2019	1390	3623		5013	

2				Jungshina Water Treatment Plant										
4				Water Quality Assessment.										
5				PHYSIOCHEMICAL ANALYSIS										
7	Point of Sampling: JWTP													
8	Sampled by: Passang													
9	Sampled Analysed by: Passang													
11	Parameters		Flowrate	Turbidity (NTU)			PH			Conductivity (µS/cm)	Temperature (°C)	Residual Chlorine (mg/L)	Remarks	
12	As Per BDWQS		(m³/Hr)	5 NTU			6.5 -8.5				15	1-2ppm		
13	Date	Time	Inlet	Raw	Filtration	Treated	Raw	Filtration	Treated	Raw	Raw	Treated		
14	01-12-2019	11:00AM	230	0.3	0.12	0.02	6.9	6.9	7.2			1.02		
15	02-12-2019	11:00AM	230	0.35	0.21	0.04	6.9	6.9	7.2	10.24	6.8	1.1		
16	03-12-2019	11:00AM	230	0.4	0.31	0	6.9	6.9	7.2			1.13		
17	04-12-2019	11:00AM	230	0.42	0.32	0	6.9	6.9	7.2			1.15		
18	05-12-2019	11:00AM	230	0.32	0.2	0	6.9	6.9	7.2			0.98		
19	06-12-2019	11:00AM	230	0.29	0.15	0	6.9	6.9	7.2			1.05		
20	07-12-2019	11:00AM	230	0.41	0.3	0.05	6.9	6.9	7.2			1.17		
21	08-12-2019	11:00AM	230	0.5	0.39	0.08	6.9	6.9	7.2			1.09		
22	09-12-2019	11:00AM	230	0.45	0.32	0.1	6.9	6.9	7.2	11.32	4.5	1.06		
23	10-12-2019	11:00AM	230	0.58	0.41	0.13	6.9	6.9	7.2			1.11		
24	11-12-2019	11:00AM	230	0.61	0.5	0.2	6.9	6.9	7.2			1.14		
25	12-12-2019	11:00AM	230	0.2	0.11	0	6.9	6.9	7.2			1.07		
26	13-12-2019	11:00AM	230	0.1	0.07	0	6.9	6.9	7.2			1		
<div><div><div>◀▶</div><div>December 2019</div></div><div><div>November 2019</div><div>October 2019</div><div>September 2019</div><div>August 2019</div><div>July 201 ...</div></div><div><div>⊕</div><div>:</div><div>◀</div></div></div>														

4. Motithang WTP: Production and Test report

Production for the month of April, 2021				
Date	Inlet, Raw water	outlet 1, Treated	outlet 2, Treated	Total, cum3/day
1/4/2021	9600.32	4425	4692	9117
2/4/2021	8457.05	4250	3696	7946
3/4/2021	8095.17	4151	3490	7641
4/4/2021	8095.17	4127	3490	7617
5/4/2021	7976.65	4007	3490	7497
6/4/2021	7800.83	3838	3490	7328
7/4/2021	7399.68	3790	3211	7001
8/4/2021	7456.21	3814	3234	7048
9/4/2021	7513.00	3814	3372	7186
10/4/2021	8703.59	4300	3934	8234
11/4/2021	7800.83	3838	3490	7328
12/4/2021	7742.74	3814	3466	7280
13/4/2021	7456.21	3624	3286	6910
14/4/2021	7343.41	3601	3237	6838
15/4/2021	7343.41	3601	3214	6815
16/4/2021	7231.64	3578	3196	6774
17/4/2021	8095.17	3982	3580	7562
18/4/2021	7513.00	3766	3239	7005
19/4/2021	8214.74	4102	3635	7737
20/4/2021	7800.83	3934	3401	7335
21/4/2021	7742.74	3814	3413	7227
22/4/2021	7513.00	3766	3239	7005
Daily production, July 2019-2021		D.T.Report, 2019-		D.T.Report, 2020-21.

	A	B	C	D	E	F	G	H	I
2352	SL N	Time	Date	Parameters	Inlet	Outlet 1	Outlet 2	R1 Cl2	(BDWQS)
2353		10.00am	27/12/2019		Raw	Filtration	Filtration		Guideline
2354									(Max Allowed)
2355	1			PH	7.0	7.2	7.0		6.5-8.5
2356	2			Turbidity(NTU)	1.33	1.03	0.85		5
2357	3			Residual Chlorine (ppm)		1.31	1.28	0.87	0.2-1
2358	4			Conductivity (us/cm)					0-1000
2359	5			Hardness (mg/l Caco3)					30-500
2360									
2361		Sample collected by: Dawa							
2362		Sample Analysis by: Dawa							
2363									
2364		Daily water quality Report sheet & weekly, month of December, 2019.							
2365	SL N	Time	Date	Parameters	Inlet	Outlet 1	Outlet 2	R1 Cl2	(BDWQS)
2366		10.00am	28/12/2019		Raw	Filtration	Filtration		Guideline
2367									(Max Allowed)
2368	1			PH	7.0	7.2	7.0		6.5-8.5
2369	2			Turbidity(NTU)	2.84	1.14	1.12		5
2370	3			Residual Chlorine (ppm)		1.31	1.14	0.89	0.2-1
2371	4			Conductivity (us/cm)					0-1000
2372	5			Hardness (mg/l Caco3)					30-500
2373									
2374		Sample collected by: Dawa							
2375		Sample Analysis by: Dawa							

5. Taba WTP: Production and test report

	A	B	C	D	E	F	G	H	I
2352	SLN	Time	Date	Parameters	Inlet	Outlet 1	Outlet 2	R1 Cl2	(BDWQS)
2353		10.00am	27/12/2019		Raw	Filtration	Filtration		Guideline
2354									(Max Allowed)
2355	1			PH	7.0	7.2	7.0		6.5-8.5
2356	2			Turbidity(NTU)	1.33	1.03	0.85		5
2357	3			Residual Chlorine (ppm)		1.31	1.28	0.87	0.2-1
2358	4			Conductivity (us/cm)					0-1000
2359	5			Hardness (mg/l Caco3)					30-500
2360									
2361		Sample collected by: Dawa							
2362		Sample Analysis by: Dawa							
2363									
2364		Daily water quality Report sheet & weekly, month of December,2019.							
2365	SLN	Time	Date	Parameters	Inlet	Outlet 1	Outlet 2	R1 Cl2	(BDWQS)
2366		10.00am	28/12/2019		Raw	Filtration	Filtration		Guideline
2367									(Max Allowed)
2368	1			PH	7.0	7.2	7.0		6.5-8.5
2369	2			Turbidity(NTU)	2.84	1.14	1.12		5
2370	3			Residual Chlorine (ppm)		1.31	1.14	0.89	0.2-1
2371	4			Conductivity (us/cm)					0-1000
2372	5			Hardness (mg/l Caco3)					30-500
2373									
2374		Sample collected by: Dawa							
2375		Sample Analysis by: Dawa							

Annexure C: presence of E-coli in the water					
Sl.No	Year	Month	WTP	Thermotolerant (RCDC)	Remarks
1	2019		Jungsina Treatment Plant	200	Relevant data extracted from the RCDC water test report.
		January	Reservoir Tank BCCI	4	
		April		7	
		July		8	
		November		37	
		December		1	
			Reservoir Tank near swimming pool		
		April		16	
	2020		Jungsina Treatment Plant		
		October		21	
		November		27	
		December		72	
			Reservoir Tank BCCI		
		January		65	
		February		6	
		October		23	
		December		64	
			Reservoir Tank near swimming pool		
		October		27	
		December		1	
2	2019	January	Motithang WTP	23	
	2020	February		5	
3	2019	January	Tank above hospital colony	57	
		February		3	
4	2019	January	Three Tank	23	
5	2019	February	Changjiji Colony Reservoir Tank (Treated)	45	
		March		1	
		April		25	
		May		15	
		June		2	
	2020	January		3	
		October		4	

Annexure D: Total Meter replaced during FY 2019-April 2021

Annexure D Meter replacement		
year	month	Total
2019	July	73
	August	105
	September	82
	October	52
	November	41
	December	36
2020	January	39
	February	53
	March	82
	April	68
	May	142
	June	106
	July	138
	August	25
	September	163
	October	72
	November	35
	December	15
2021	January	
	February	17
	March	34
	April	21
	Total	1399

Annexure E : comparison of production unit and the billing consumption record										
1.Chamgang WTP			2. Jungshina WTP		3. Taba WTP		4. Motithang WTP		5. Dechholing WTP	
2019			2019				2019		2019	
Jan	1,98,047		Jan	168565	Jan		Jan		Jan	
Feb	1,41,724		Feb	151650	Feb		Feb		Feb	
March	1,86,385		March	166234	March		March		March	
April	1,79,358		April	160034	April		April		April	
May	1,94,673		May	165296	May		May		May	
June	60,180,400		June	163417	June		June		June	
July			July	164980	July	237729	July	282596	July	5158
August	202,460		August	163194	August	300857	August	301419	August	6772
Sept	202,631		Sept	143900	Sept	283622	Sept	293592	Sept	8005
Oct	193,896		Oct	144756	Oct	284170	Oct	305622	Oct	7904
Nov	1,84,765		Nov	134684	Nov	284942	Nov	295763	Nov	4485
Dec	1,67,052		Dec	131674	Dec	306948	Dec	303564	Dec	6544
	60779387			1858384						
2020			2020		2020		2020		2020	
Jan	55,821	Plant shut down from the date 21/1/2020 till date 31/1/2020 due low incoming raw water.	Jan	131480	Jan	306091	Jan	294649	Jan	8511
Feb		Plant shutdown from 21january till 20 th April due	Feb	130364	Feb	291319	Feb	262859	Feb	8082
March			March	132742	March	313252	March	257176	March	9007

		to low incoming raw water								
April	53,594	21/04/2020- 30/04/2020	April	145366	April	298454	April	234778	April	8347
May	1,69,774		May	153350	May	313591	May	243431	May	5987
June	1,83,442		June	136529	June	278523	June	267795	June	30351
July			July	159247	July	309329	July	299873	July	47765
August	1,91,520		August	156052	August	312735	August	299643	August	46301
Sept	1,81,799		Sept	164146	Sept	241651	Sept	293301	Sept	36605
Oct	1,80,305		Oct	178933	Oct	313051	Oct	302908	Oct	12683
Nov	1,60,171		Nov	146453	Nov	302881	Nov	290939	Nov	10008
Dec	1,20,734		Dec	138266	Dec	322134	Dec	296149	Dec	14744
	109,415			1772928		3603011		3343501		238391
2021			2021		2021		2021		2021	
Jan	Plant Shut down	181799	Jan	143420.5	Jan	318950	Jan	291032	Jan	11260
Feb		180305	Feb	102882.5	Feb	282961	Feb	240754	Feb	15988
March		160171	March	118807.8	March	314860	March	248589	March	55592
April		120734	April	111600	April	291207	April	221996	April	36422
		643009		476710.8		1207978		1002371		119262

2020	9067246		
2021	3449330.8		
	Data Base	Plant	Difference (NRW)
Year	water consumption (Kilo liter)		
2020	6345200	9067246	-2722046
2021	25214323	3449330.8	-21764992.2

Minutes of Performance Audit Exit Meeting

Date: 9/12/2021

Venue: Thromde Conference Hall

Time: 10.30 AM

Member Present

Sl.no	Name	Designation
1	Mr. Ugyen Dorji	Thrompon
2	Mr. Karma Namgyel	Executive Secretary
3	Mr. Sonam Dorjee	Chief ADM Officer
4	Mr. Yeshe Wangdi	Chief Engineer
5	Mr. Tashi Dorji	Executive Engineer
6	Mr. Penjor Dukpa	Executive Engineer
7	Mr. Pema Thekcho	Asst. Engineer
8	Mr. Omapati Luitel	Sr. ICT officer
9	Mrs. Cheki Yangzom	Asst. HRO
10	Mr. Karma Dorji	Planning Officer
11	Mrs. Phub Dema	Asst. Internal Auditor

The Internal Auditor presented the performance audit report on the water supply services of Thimphu Thromde based on following objectives:

1. Is drinking water provided in Thimphu Municipality safe for Human Consumption (water Quality)
2. To test check robust system to monitor and supervise the water distribution network (Water distribution monitoring and supervision system)
3. To test check whether there is revenue Leakage/cost leakage or not.

However, the Internal Auditor informed the management that a comprehensive study on the objective three on the analysis in the Non- Revenue Water was not carried out since the agency currently has a consultant carrying out the study on the NRW.

Therefore, the discussion and decisions on audit observation was focused on the first two objectives; water quality and Water distribution monitoring and supervision system and the committee discussed on the following observations;

1. Observation on water quality are from Para 1.1 to 1.7,
 - 1.1. The Water Test Report is Unreliable
 - 1.2. No training or refresher courses are provided to technicians.
 - 1.3. Inconsistency in documenting test and production report
 - 1.4. Absence of proper storage for water treatment chemical
 - 1.5. E-coli test not conducted
 - 1.6. No Safety gears and equipment

1.7. Water safety plan in Thromde needs to be reviewed

Decision: The Management accepted the observation on water quality and directed the Operation and Maintenance Division to implement the recommendation in the time frame as proposed in the annexure: Management response

In addition, the management also directed the HRS to propose a budget in collaboration with the O and MD and plan and provide refresher courses for Treatment Plant Technicians from time to time.

Action: Operation and Maintenance Division

2. Water distribution monitoring and supervision system para 2.1 and 2.2

2.1 Bulk meter not functioning

2.2 Inappropriate installation of water meter

2.2.1 Improper mounting of water meter

2.2.2 Water billed based on taking average consumption

Decision: The management commented that it is not the responsibility of the ICT section to look after the metering part but only on the system issues. Therefore, the water metering part of the infrastructure division should be taken over by the operation and maintenance division from the ICT section because it has been long overdue, and now that the infrastructure division has been bifurcated into O and MD. Furthermore, a new unit/section can be instituted that can be attended to by the existing staff under O and MD or recruit a competent official who is well aware of the know-how of the water metering system. And this section should implement the recommendation on the above lapses as stated in the annexure.

Action: Chief, O and MD

3. Water meter test bench left idle

Decision: The Management directed the operation and maintenance division to take responsibility for the water test bench.

4. No strategy plan documents for any kind services provided by Thromde


Decision: The management informed that the Finance division is developing a Financial Strategy Plan for the Thimphu Thromde.

Handwritten signatures and marks at the bottom of the page, including a large checkmark and several initials.

Annexure: Management Response



Sl. No	Observation	Recommendation	Management Response	Responsibility	Timeline
1.	Water Quality				
1.1	The Water Test Report is Unreliable.	Adoption of Collaborative multi agency approach It is essential that a collaborative multi agency approach need to be adopted to ensure that agencies with responsibility for specific areas within the water cycle are involved in the management of water quality. For example developing partnership with RCDC to act as a surveillance and quality control agency with appropriate mechanisms and documentation for stakeholder commitment and involvement. Developing a partnership with RCDC will aid in the resolution of the water quality monitoring problem, as well as the development of our technician's competency.	Accept	Maintenance division	✓
1.2	No training or refresher courses are provided to technicians.		Accept	Chief Maintenance Division and HRD	✓

1.3	Inconsistency in documenting test and production report	<p>✓ Standardize the reporting format;</p> <p>✓ As a public awareness mechanism, the analysis of the water test report should be made available on the website once a quarter as information to the general public during the fiscal year. Such a mechanism will increase the visibility of the agency's activities and performance; people will be made aware of the costs incurred for water treatment, and the water tariff will be transparent.</p>	Accept	Maintenance division	✓
1.4	Absence of proper storage for water treatment chemical	In view of the aforementioned, Thromde management needs to create or seek an alternative for suitable water treatment chemicals storage.	Accept	Maintenance division	✓
1.5	E-coli test not conducted	The operational monitoring of control measures in the drinking water supply is critical to ensuring drinking water safety. As a result, it is critical to set parameters limits, monitor those limits, and take corrective action in the event of a detected deviation before the water becomes unsafe. The WSP specifies the parameters for water quality testing as well as the frequency with which tests must be performed. Strict compliance must be implemented.	Accept	Maintenance division	✓



3

4



1.6	No Safety gears and equipment	Each worker who performs demanding work is entitled to safety equipment, and the person in charge of the concern must set safety amenities and the frequency with which safety gears must be provided to the worker, as well as see the requirement and propose a budget for the procurement of safety equipment every financial year.	Accept	Maintenance division	✓
1.7	Water safety plan in Thromde needs to be reviewed	As per the water regulation 2016, chapter VI clause 86, besides technical support and issuance of guideline(s), the MoWHS will monitor and assist Thromde in developing and implementing water infrastructure, water safety plans and review their efficiency, from time to time. Therefore, appoint a focal person and collaborate with the relevant agency and review the WSP and implement it.	Accept	Maintenance division	✓
2	Water distribution monitoring and supervision system.				
2.1	Bulk meter not functioning	Upgrade non-functional bulk water meters at production facilities so that the actual production records on the water is realized. This report will help in identifying the NRW similarly data will be accurate and can be used to develop the strategy plan for the decision maker.	Accept	Maintenance division	✓

2.2	Inappropriate installation of water meter				
2.2.1	Improper mounting of water meter	<p>✓ Aforementioned issues were raised due to a lack of guidelines for the water meter installation, getting it right from the beginning is one of the best approaches. Plumbers are currently installing water meters based on their knowledge and experience therefore, it is recommended to have one.</p> <p>✓ Improper mounting/meter location should be rectified with working in collaboration with meter reader, and plumbing section in their respective zone.</p> <p>✓ Regular consultative stakeholder meeting with the intra division; water meters, plumber, relevant engineer, concerned official needs to conduct.</p>	Accept	Maintenance division	✓
2.2.2	Water billed based on taking average consumption 1. Meter reading display	<p>✓ Monthly defective water meter reports need to be compiled and sent to the respective concern site engineer for work ratification. Such TAT must be developed. One of the reasons why people are reluctant to replace the water meter is that it is costly. Don't</p>	Accept	ICT and Maintenance Division	✓

		<p>charge them all at once; adjust the water bills from water bills until the meter cost is repaid.</p> <p>✓ Alert notification systems need to be integrated in the current system so that the information on the defective meter detected by the meter readers will be informed to concerned user and official for the rectification.</p>			
	<p>2. Meter installed at location not easily accessible to meter readers</p>	<p>✓ Develop, implement and sensitize the guideline of water meter installation to concerned officials and the consumer.</p> <p>✓ In collaboration with the consumer, relocation of the water meter work needs to be rectified and make it easily accessible to the water meter.</p> <p>✓ ToR for the water billing services cycles needs to be developed</p> <p>✓ Accountability needs to be institute</p> <p>✓ SOP needs to be developed.</p>	Accept	Maintenance Division	✓
3	Water meter test bench left idle		Accept	Maintenance Division	✓

4	No strategy plan documents for any kind services provided by Thromde	Accept	Financial strategy document, Finance Division	✓
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Members

1. Dasho Ugyen Dorji, Thrompon
2. Mr. Karma Nangyel, Executive Secretary
3. Mr. Yeshi Wangdi, Chief Engineer
4. Mr. Tashi Dorji, Executive Engineer
5. Mr. Penjor Dukpa, Executive Engineer
6. Mr. Pema Thekcho, Asst. Engineer
7. Mr. Sonam Dorjee, CAO
8. Mr. Karma Dorji, Planning Officer
9. Mrs. Cheki Yangzom, Asst. HRO
10. Mrs. Phub Dema, Asst. Internal Auditor