JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE REPUBLIC OF THE UNION OF MYANMAR
YANGON CITY DEVELOPMENT COMMITTEE (YCDC)

REPORT ON BASELINE SURVEY & CAPACITY ASSESSMENT

(Period during July and December 2015)

24TH DECEMBER 2015

PROJECT FOR IMPROVEMENT OF WATER SUPPLY MANAGEMENT OF YCDC

YCDC TECHNICAL COOPERATION COUNTERPARTS TEAM
AND
JICA EXPERT TEAM

Note:

This is a first draft version of the Report on Baseline Survey & Capacity Assessment for the Project for Improvement of Water Supply Management of YCDC which has been prepared by YCDC Technical Cooperation Counterparts Team assisted by JICA Expert Team.

Through preparation of this Report, the existing baseline conditions have been discussed and shared between YCDC Counterparts Team and JICA Expert Team. Based on this Report, further discussions will be made and necessary revisions will be carried out by the YCDC Counterparts Team assisted by JICA Expert Team in the course of the Project.

At the final version, a proof reading will be made by both Counterparts Team and JICA Expert Team.

This report was prepared during the period between July and December 2015. The successive report may be prepared for the year 2017.

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ABBREVIATION

ACE	Assistant Chief Engineer
AE	Assistant Engineer
CE	Chief Engineer = Head of Department
DYCE	Deputy Chief Engineer
EE	Executive Engineer
HRD	Human Resource Development
MGD	Million Gallons per Day
M&E	Mechanical & Electrical
OJT	On-the-Job training
NRW	Non-Revenue Water
O&M	Operation & Maintenance
PCM	Project Cycle Management
PDM	Project Design Matrix
P/S, PS	Pumping Station
SAE	Sub-Assistant Engineer
SOP	Standard Operation Procedures
UCSB	Union of Civil Service Board
T/S, TS	Township
WA	Work Authority (temporary staff of YCDC)
WSD	Water and Sanitation Department
WTP	Water Treatment Plant

Abbreviation for the Relevant Studies

The Preparatory Study for Urban Development Programme in the Greater Yangon (JICA), 2012	JICA Urban Plan Study, 2012
Household Interview Survey (JICA), 2012	2012 JICA-HIS
The Study on Improvement of Water Supply System in Yangon City, 2002	2002 JICA-M/P
Preparatory Survey Report on the Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City in the Republic Of The Union Of Myanmar, March 2014	JICA M/P

Unit

1 Gallon (British Gallon) = 4.546 liter
1 Acre = 4,047 m^2

CHAPTER 1 BASIC UNDERSTANDS OF WATER SUPPLY IN YANGON

1.1 PRESENT CONDITIONS OF WATER SUPPLY SERVICE

Water supply is largely categorized into two systems; YCDC water supply system and Non-YCDC water supply system.

1.1.1 Service Area

The service area is extended to parts of 30 townships out of 33 townships in YCDC area. The water source for various purposes other than drinking is private tube well (37%), followed by YCDC piped water (34%) and neighbor's well/tap (free of charge) (9%). The main sources of drinking water are categorized in three: bottled water (45%) followed by private tube well (17%) and YCDC piped water (12%).

1.1.2 Service Population and Served Coverage

Percentages of population getting water from the YCDC water supply system is 39% in YCDC area and 34% in the study area (according to 2012 JICA-HIS). Water service coverage rate has increased slightly from 37% in 2000 (according to 2002 JICA- M/P).

The population of Yangon city is developed by 1,250,000 between 1998 and 2011 with the corresponding growth rate of 2.58%. During the period of 11 years, the water supply service population increased by 480,000 (1,920,000 -1,440,000). This show that about 45,000 service population increased in yearly. According to the census for the whole country Myanmar in 2014, the population of Yangon is adopted about 5.2 million. The estimated served population for drinking water is about 1.7 million at present.

1.1.3 Sources of Water for Yangon City (YCDC and Non-YCDC)

Current water supply sources are classified as surface water source stored in reservoirs, tube wells from groundwater, and others. The current water capacity is at 933,000 m3/day (205 MGD).The present water sources are mainly reservoirs of Gyobyu, Phugyi, Hlawga and Ngamoeyeik. YCDC has 645 tube well pumps with maximum yield amount of 20 MGD which of these, 414 pumps are in order.

(1) YCDC Water Supply System

This system gets raw water mostly from reservoirs, enhanced by tube wells. Some raw water is treated and some is not treated. Then water is distributed through pipes to customers. The service area is extended to parts of 30 townships out of 33 townships in YCDC area. In some areas which are far away from YCDC pipe line network system, the customers from these areas depend on YCDC owned tube-wells, lakes and ponds for their daily water demand.

(2) Non-YCDC Water Supply System
In the areas excluded by YCDC service and in peripheral 6 townships, people use water by various means; including tube wells, rain water storage, streams, ponds, neighbors' piped water supply system/tube wells, bottled water, water vendors, public tube wells, and public taps. There are small-sized public water supply systems in Thanlyin and Kyauktan townships and Thilawa SEZ, all located outside of YCDC service area.

1.1.4 Service Conditions (2012 JICA-HIS survey)

(1) Service hours
Households with less than 3 hours water supply constitute the largest share of 36% while those with

water supply duration between 19 and 24 hours are 24%, indicating wide difference.

The service area covers most of the Central Business District (CBD), Inner Ring Zone, Outer Ring Zone, and Older Suburb (see Figure 1.2); and a small part of new suburbs. The service hours varies widely between 24 hours and 6 hours a day depending on areas.

Average supply duration is estimated as 9.1 hours per day.

(2) Water pressure
Townships with relatively high pressures are Bahan, Hlaing, Insein, Mayangone, Tarmwe and Yankin. Townships in the downtown had booster pumps and tanks to cope with low pressures.

(3) Consumed amount
Concerning domestic water consumption amount, households with 51 to 100 gallons (230 to 454 liters) per day are the largest, 40%, those with 101 to 200 gallons (459 to 900 liters) are 18% and those with less than 50 gallons are 17%. Average per household consumption is 24 gallons (110 liters) assuming 4.3 persons per household.

On the other hand, per capita domestic consumption is 94 liters per day according to the YCDC data. It is high, 138 liters in northern suburbs where service condition (water pressure and supply hours) is good due to these locations being near to water sources.

Areas with low water consumption are south of CBD where supply amount is not sufficient. Other areas with low consumption exist in New Suburbs zone.

(4) Water for drinking
More than half households drink YCDC water after treatment such as filtering and boiling. About 60% use bottled water for drinking purposes. Only a few households drink YCDC water directly.

(5) Water tariff system and water meter
Households that pay tariff based on volumetric consumption set up 53% and those with fixed tariff are 31%. Households having water meter connected are 63%, out of which 6% responded that water meter is not in operation.

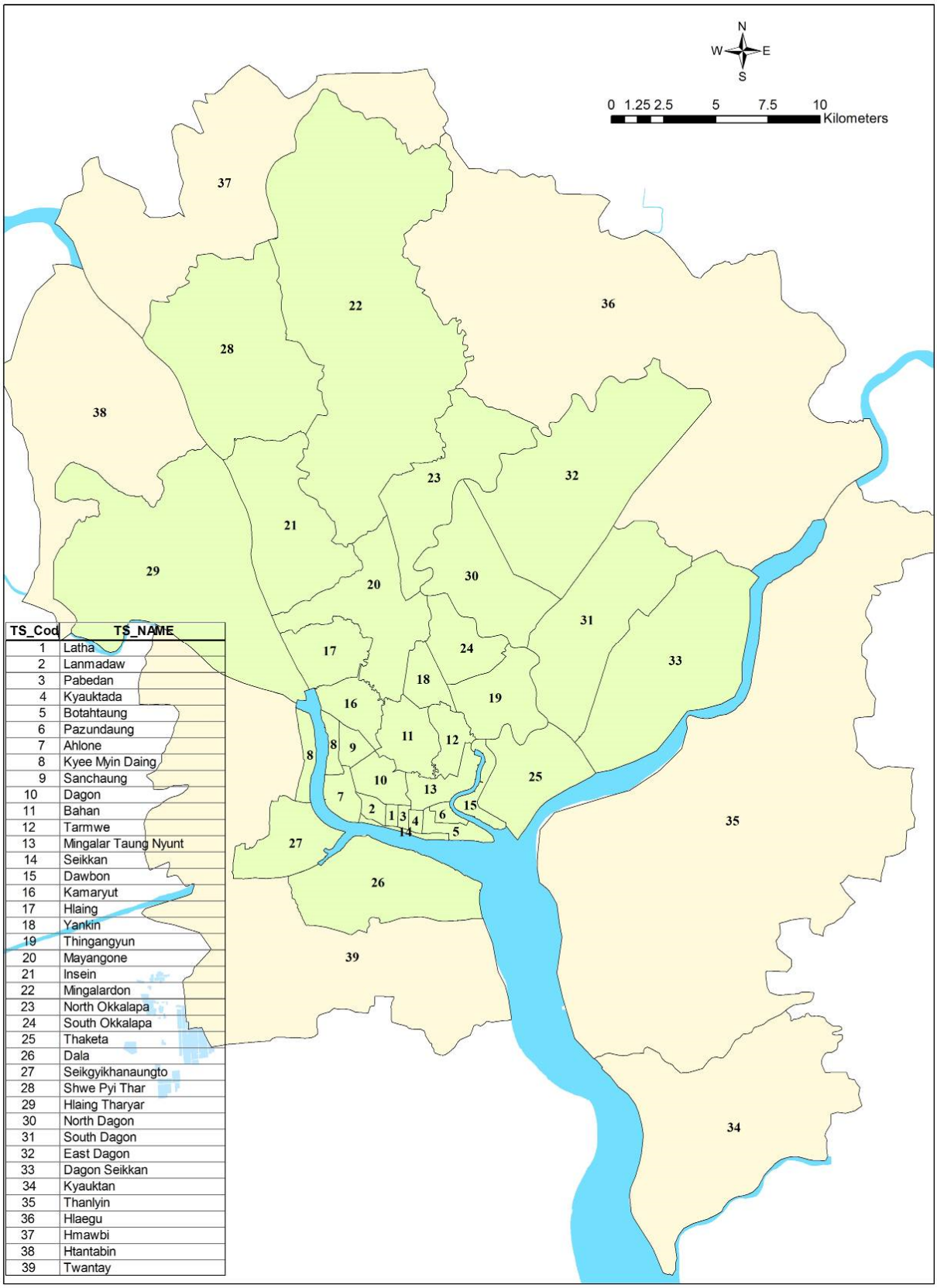
(6) Number of connections
Number of connections for various water use categories is domestic, commerce, department and Foreign. Out of 205 thousand connections, 90% is for domestic, 6.7 % is for commerce and 0.6% is for department. Metered connections are about 70%.

1.1.5 Water Costs

The average costs for drinking water is 5,600 kyat per month and 4,400 kyat for other use. Some commodities charged high cost (such as 150,000 and 270,000 kyats). The average is the 1,200 kyat for drinking water and 700 kyat for other use. It is estimated that the general public spends 1,900 kyat per month for water supply.

1.1.6 Summary and Issues of Water Supply Services

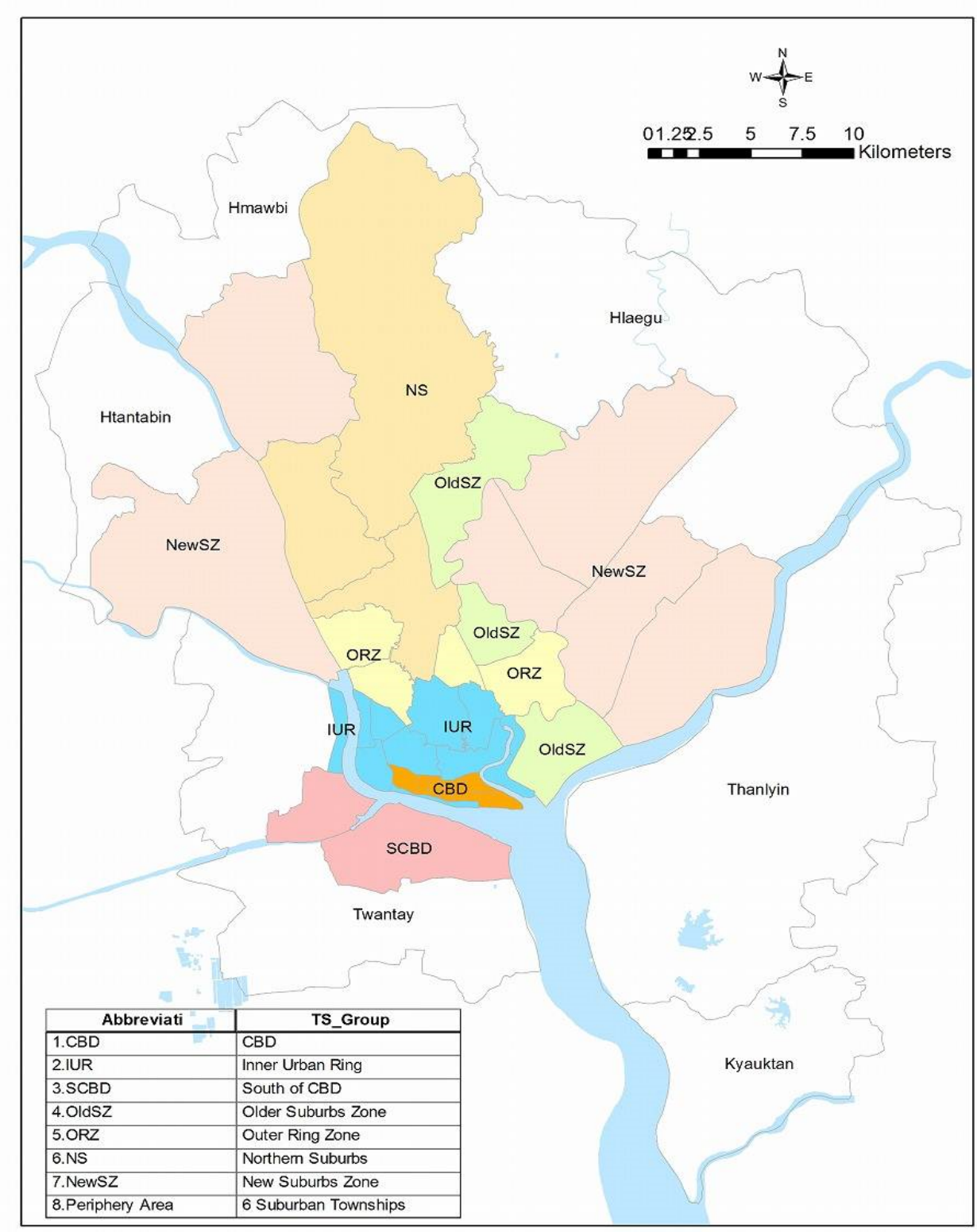
Major issues of water supply system are low water coverage, high non-revenue water rate, poor water quality, ageing of facilities, inappropriate layout of facilities, weakness in database on facilities, operation and maintenance of facilities and database on tariff collection.



TS_Cod	TS_NAME
1	Latha
2	Lanmadaw
3	Pabedan
4	Kyauktada
5	Botahtaung
6	Pazundaung
7	Ahlone
8	Kyee Myin Daing
9	Sanchaung
10	Dagon
11	Bahan
12	Tarmwe
13	Mingalar Taung Nyunt
14	Seikkan
15	Dawbon
16	Kamaryut
17	Hlaing
18	Yankin
19	Thingangyun
20	Mayangone
21	Insein
22	Mingalardon
23	North Okkalapa
24	South Okkalapa
25	Thaketa
26	Dala
27	Seikgyikhanaungto
28	Shwe Pyi Thar
29	Hlaing Tharyar
30	North Dagon
31	South Dagon
32	East Dagon
33	Dagon Seikkan
34	Kyauktan
35	Thanlyin
36	Hlaegu
37	Hmawbi
38	Htantabin
39	Twantay

(Source: JICA M/P)

Figure 1.1 33 Townships in Yangon City and the Part of Surrounding 6 Townships



Abbreviati	TS_Group
1.CBD	CBD
2.IUR	Inner Urban Ring
3.SCBD	South of CBD
4.OldSZ	Older Suburbs Zone
5.ORZ	Outer Ring Zone
6.NS	Northern Suburbs
7.NewSZ	New Suburbs Zone
8.Periphery Area	6 Suburban Townships

Source: JICA M/P

Figure 1.2 Grouping (33 Townships) and Surrounding Area of YCDC

1.2 EXISTING WATER SUPPLY SYSTEM AND OPERATION & MAINTENANCE

1.2.1 Water Sources and Conveyance

The major intake towers and intake P/Ss which are available currently are composed of Gyobyu intake tower and P/S, Hlawga P/S, Phugyi intake tower and P/S, Nagmoeyeik reservoir and Aungtagon P/S.

(1) Gyobyu intake tower and pumping station
The capacity of this reservoir is 123,000 m^3/day (27 MGD) constructed in 1940. Raw water taken by intake pipe is transmitted to Yegu pumping station through transmission steel pipe with diameter of 1400 mm, and distributed to downtown by booster pumps.

(2) Phugyi intake tower and pumping station
The capacity of this reservoir is 245,000 m^3/day (54 MGD) constructed in 1992. Raw water taken by intake pipe is transmitted to Hlawga reservoir through transmission concrete pipe having diameter of 1500 mm.

(3) Hlawga reservoir and pumping station
The capacity of this reservoir is 63,600 m^3/day (14 MGD) constructed in 1906. Capacity of pumping station is 309,000 m^3/day, which is capable of handling 245,000m^3/day from Phugyi reservoir and 64,000 m^3/day from Hlawga itself. Raw water is transmitted and distributed by No. 1 and No. 2 pumping station.

In No.1 pumping station, the number of distribution pumps with the capacity of 4,980 m^3/hr is two, and pumps are regularly operated. The maximum distribution capacity is 239,000 m^3/day. Raw water taken by intake gate is directly distributed to northeast area and east area through the distribution pipe (concrete pipe) having diameter of 1650 mm from this pump station.

No.2 pumping statation is being shut down. The transmission water amount is the remaining water after deduction of distribution amount from No. 1 pump station (same as capacity of 64,000 m^3/day in Hlawga reservoir). Raw water taken from intake tower is transmitted to Yegu pumping station through transmission pipe (cast iron pipe with diameter of 1,050 mm) by gravity flow.

(4) Ngamoeyeik reservoir
This reservoir was constructed by MOAI in 1995 and is located at upstream of Pazundaung creek where Ngamoeyeik creek and Mahoe creek meet about 48 kilometers (30 miles) north of Yangon city. Raw water from intake tower of Ngamoeyeik reservoir is transmitted to Nyaunghnapin WTP through irrigation canal. The water right of this reservoir for drinking water at the existing phase-1 and phase-2 is 204,500 m^3/day (45 MGD) each; 409,00 m^3/day (90 MGD) in total.

(5) Aungtagon water supply station
Aungtagon P/S was constructed in 2010, where reserve water from Ngamoeyeik reservoir is stored temporarily, and water is transmitted to Hlawga reservoir in case of emergency in order to recover water level in Hlawga reservoir.

(6) Pyawbwesu Pumping Station
This pumping station is also one of the main pumping stations in water supply system in Yangon city. Because in the former time, the supplied water from Phugyi reservoir is added to Gyobyu main pipe line near pyawbwe pumping station and this water entered to this pumping station and pumped to Kokkine reservoir through Yegu pumping station. At present, we change the former system a little to use the more water from Phugyi reservoir and want to keep the stored water at Gyobyu reservoir for the purpose of keeping water for summer time. So, the water from Phugyi reservoir is delivered to Pyawbwesu pumping station instead of taking from Gyobyu pipe line and pumped again to Gyobyu pipe line.

1.2.2 Water Treatment Plant

There are six WTPs in the existing water supply systems. It includes Gyobyu WTP with a capacity of about 123,000 m^3/day along with Gyobyu intake pumping station, Thaephyu and Yangonpauk WTPs with capacity of about 4,500 m^3/d established by YCDC, Nyaunghnapin WTP having capacity of about 409,000 m^3/day (phase I & II) constructed by YCDC in 2005, and 2013. South Dagon No. 1 in 2008 and 2 WTP in 2009 with capacity of about 4.500 m^3/day each.

In the oldest Gyobyu WTP, water is treated by sedimentation process without coagulant, whereas in Nyaunghnapin WTP, water is treated by flocculation, sedimentation, and filtration process. At WTPs, which uses groundwater as raw water, aerated cascade and filtration process for Fe removal is applied for water treatment. Currently, chlorination system is not used in any of the WTPs.

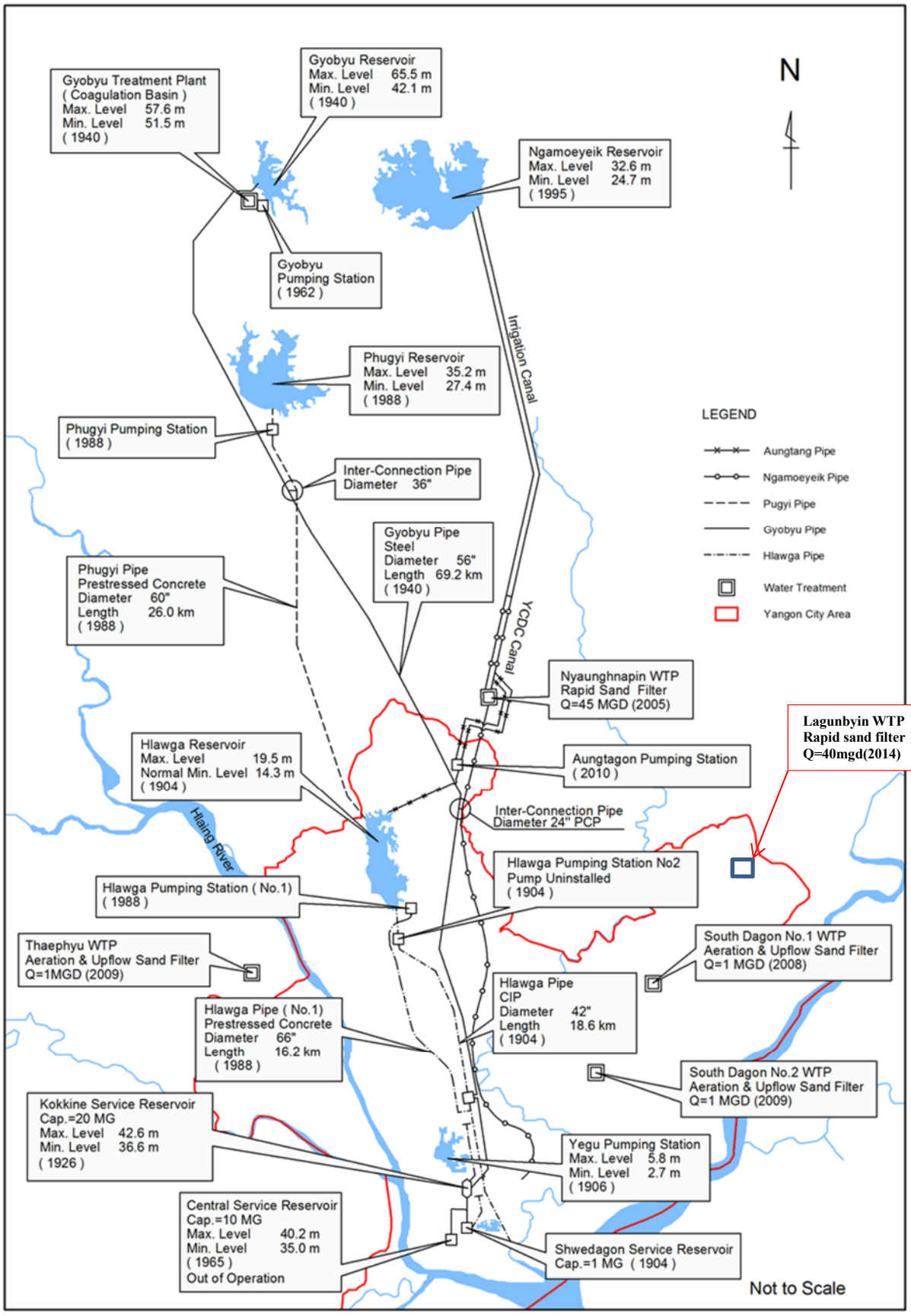


Figure 1.3 Water Supply System (2015)

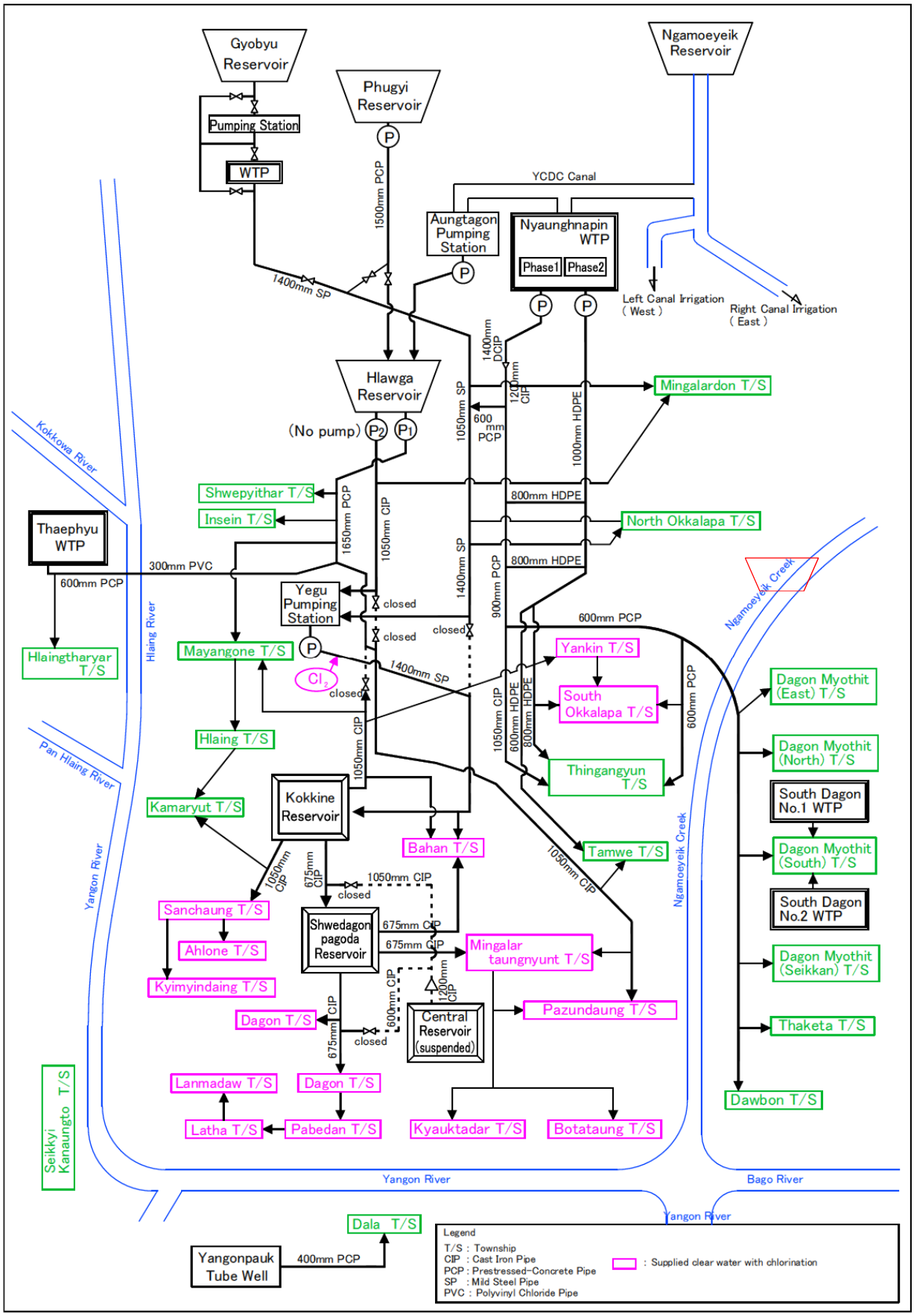


Figure 1.4 Detailed Flow Diagram of Water Supply System (2015)

1.2.3 Transmission system

Presently, Yegu booster P/S is operated as one of major transmission/ distribution facility. Yegu P/S is composed of No. 1 old booster station installed in 1990 and No. 2 new booster station installed in 2007.

Pumps with total capacity of 187,000 m^3/day are regularly operated handling Gyobyu reservoir water amounting 123,000 m^3/day and Hlawga No. 2 P/S with 64,000 m^3/day of water from Hlawga reservoir. Water is distributed to the 3 townships (Yankin, South Okkalapa and Bahan) directly after boosting transmission pressure and chlorination (currently shut down), and is also transmitted to Kokkine reservoir.

No. 2 booster station is constructed since enough transmission head is not secured by only No. 1 booster station, and pumps in No. 1 station is not able to transmit water to Kokkine S/R. Normally only 2 duty booster pumps in No. 2 station are operated. However, in case when suction water level of tank decreases, 1 pump in No. 2 station and 2 pumps in No. 1 station are operated.

1.2.4 Distribution system

The existing service reservoirs are located at three (3) places downstream of Yegu P/S, such as Kokkine, Shwedagon and Central. However, Central S/R has been out of operation.

Currently, Kokkine and Shwedagon S/R have function to supply water to southern townships including neighborhood and old town. The detention time of each S/R compared to daily maximum supply water of 148 MGD (673,000$m^{3/}$day) in 2011 is mentioned below. At least 8 hours of detention time is required for stable water supply. The detention time mentioned above is insufficient from the view point of stable water supply. Short detention time cannot respond to the peak time requirements of water uses such as in morning or evening, therefore short supply duration areas exist in the city. Capacity of two S/Rs being operated has not been utilized effectively since sediment has accumulated at the bottoms due to untreated water.

(1) Distribution pipeline
In water supply networks, there are pipelines that are more than 100 year old and/or pipelines choked by scaling, and such pipelines do not have enough flow capacity. Also, the distribution network have been expanded year by year due to population growth in the city and development activities, thus, new and old pipe are mixed.

The total length of distribution pipe owned by YCDC is estimated to be 1,455 km. Cast iron pipes have been widely used since old times, consisting of about 80% of the total length. The cast iron pipes without internal and external coatings are susceptible to corrosion, resulting in great chances of leakage. Recently, PVC pipe which has resistance to corrosion has started to use for particularly small-sized diameter pipe. For the new distribution network and the other grant aid projects from Japanese government, pipe materials of high density polyethylene and ductile iron pipes are used instead of cast iron and Poly vinyl chloride pipes. And also, in some project, pipe jacking method is introduced instead of usual open-cut method to avoid the problem of traffic congestion.

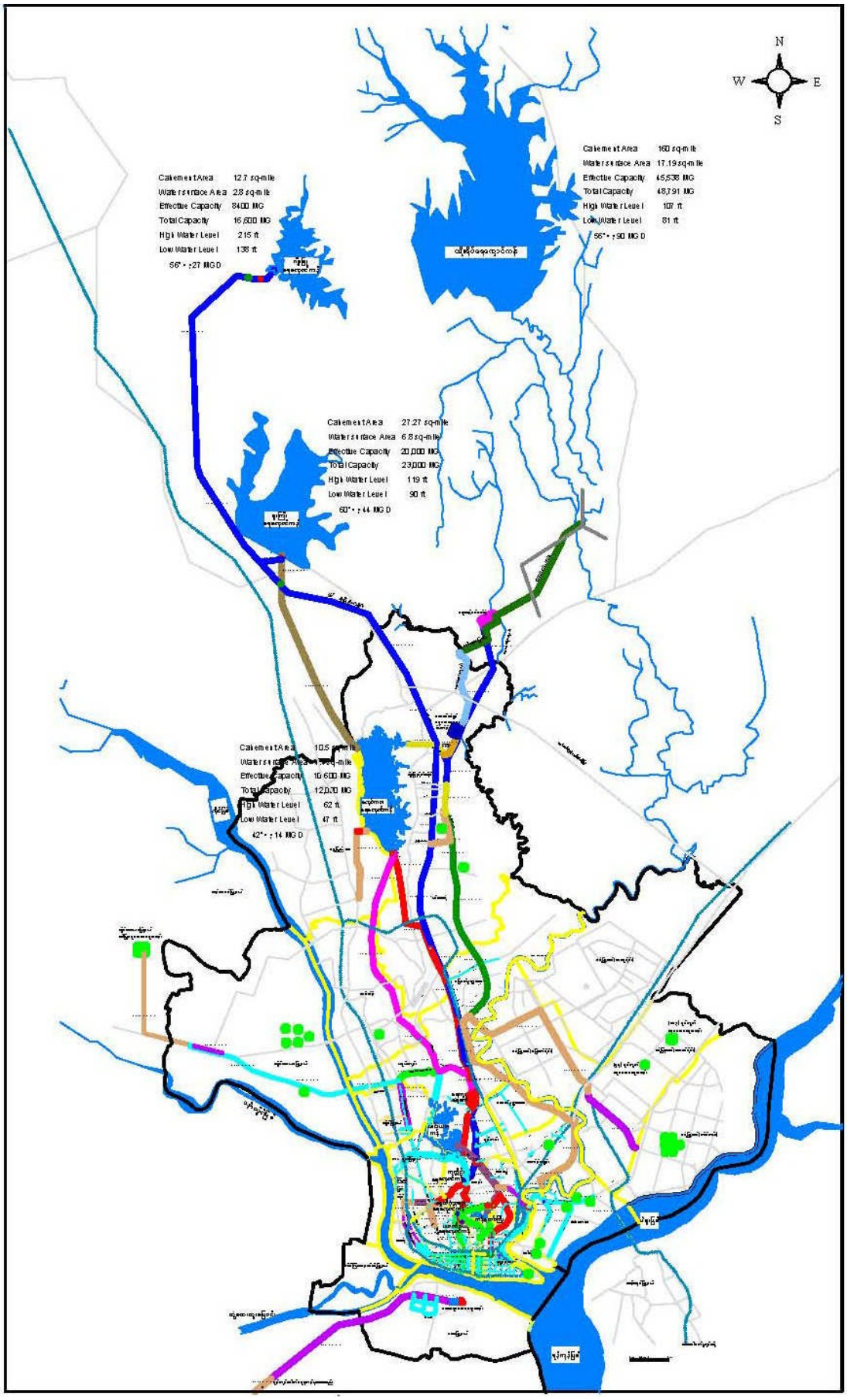


Figure 1.5 Water Supply System in Yangon City

(2) Booster pump
In many poor supply areas, the water supply pressure is low, and 150 booster pumps for maintaining pressure are installed in distribution network. In some booster pump stations, there have small underground storage tanks but some have no tanks and directly boost to the existing main lines. Since a large number of booster pump exists in the distribution network, O&M is troublesome.

1.2.5 Water Production and Transmission Flow

It is now being estimated by the counterpart.

1.2.6 Summary of Problems of Facilities and Operation and Maintenance

Major problems about operation and maintenance of water supply facilities are technical issues, organizational and institutional issues, and financial and management issues.
Current problems and issues are listed below.

- Raw water quality is not so bad, but occasionally blue-green algae occur in the reservoir.
- All pump facilities have become older.
- Pumps in Gyobyu reservoir have not been operated since May 2011, and water generally has been transmitted by gravity.
- Absence of water level gauges, water flow meters and pressure gauges which are required for pump operation.
- Transmission pipeline between Gyobyu reservoir and Yegu pump station was installed in 1940 and is very old cast iron pipe. Air valves and its maintenance valves installed in the pipeline are not able to open and close.
- Aged pipe (>100 year)in downtown area caused the degradation of water quality.
- Saline water intrusion occured along Yangon and Bago river bank
- Direct ingestion of groundwater into the surface water distribution network at low pressure area.
- Unadequate and unequalized water pressure
- Degradation of drinking Water quality for customers
- Higher % of NRW (Non Revenue Water)

CHAPTER 2 PLANNING AND MONITORING

2.1 BASELINE SURVEY

2.1.1 Objectives of YCDC Water and Sanitation Department

Engineering Department (Water and Sanitation) have already had five main objectives. These are as below;

(1) To distribute the adequate, safe and wholesome water for city dwellers.
(2) To collect the water tariff completely.
(3) To prevent water leakage and control the reduction of non-revenue water.
(4) To manage for systematic sewage disposal.
(5) To upgrade water distribution facilities and sewerage system.

2.1.2 Vision and Mission of YCDC WSD

Water vision of Yangon city (prepared with assistance of the JICA M/P study)

(1) Safety and health
(2) Environmental conservation
(3) Sustainable development
(4) Security and convenience for use

Water mission for vision

(6) Safety and Health

- Development of water supply pipelines
- Thorough chlorination disinfection
- Development of WTP
- Development of WWTP
- Development and improvement of septic tanks
- Development of drainage system

(7) Environmental Conservation

- Preservation of forest
- Establishment of development prohibition areas
- Achieve introduction of storage and infiltration facilities
- Limit and regulation of inflow to sewerage
- Purification of rivers and lakes, etc.

(8) Sustainable Development

- Reuse of treated wastewater
- Construction of energy-saving system
- Implementation of services in planned manner
- Promotion of understanding to collection of charges
- Promotion of understanding to investment of services

(9) Security and Convenience for use

- Securement of water source.
- Decrease of water leakage.
- Decrease of other Non-Revenue Water.
- Proper partitioning of distribution areas.

2.1.3 Existing plans and reports

There are seven divisions under control of water and sanitation engineering department in YCDC. To formulate the five years implementation plan, firstly, all of the responsible officials who are relevant to each division need to formulate their implementation projects of water supply facilities for five years, such as big projects, water supply works, preservation of water resources and so on. After formulating the projects, they need to report and discuss with their head of relevant division and revise again if it is necessary. Especially for water supply division, all of township engineers need to show their implementation works for five years plan.

In the second, all of heads, assistant chief engineers, from seven divisions, Deputy Chief Engineers and head of department from water and sanitation engineering department discuss again and select the priority items to implement for future five years plan. The other departments also have the same procedure to formulate their priority implementation projects for five years.

In the third, all of the priority lists selected from each department is reported and discussed in the meeting in which Mayor, secretary, joint-secretary, all of committee members and the other relevant head of departments participate and adopted for this five year plan.

In the fourth, all of these adopted plans are reported to the Budget department of Ministry of Finance in Yangon regional government as a first step through the department of Budget under YCDC.

Finally, this five year plan is reported to union cabinet and to take the approval from central government.

2.1.4 Existing reporting system

The existing data or information are daily/ weekly/ monthly reported to the top management of WSD or even to the regional government in some cases. The existing reporting system is shown as the following Figure.

No	Facilities	Data	daily	weekly	monthly	Submission processess				
						ACE	DYCE	CE	C/O	R/G
1	Reservoir	water level	√		√	→	→	→	→	→
		precipitation	√		√	→	→	→	→	→
		storage capacity	√		√	→	→	→	→	→
		electricity shortage		√	√	→	→	→	→	→
		Operating Hours		√	√	→	→	→	→	→
		water supplied amount		√		→	→	→	→	→
2	WTP	ACH dosing rate	√		√	→	→	→		
		water supplied amount		√		→	→	→	→	→
		electricity shortage	√			→	→	→	→	→
		Operating Hours	√			→	→	→	→	→
3	Pumping Station	electric consumption	√			→	→	→		
		Operating Hours	√			→	→	→	→	→
		electricity shortage	√			→	→	→	→	→
4	M & E Section	Maintenance Records			√	→	→	→		
		New installation			√	→	→	→		
		water supplied amount	√			→	→	→	→	→
5	Service Reservoir	Water level			√	→	→	→		
6	Water supply	Maintenance Records on transmission lines		√		→	→	→		
		patrol records on transmission lines		√		→	→	→		
7	Customer service	Numbers of customers				→	→	→	→	
		water quality parameter				→	→	→		

Figure 2.1 Existing Reporting System

(1) M and E Section

Water supplied amount from all YCDC tube wells is reported to the Regional government through the head of department as a daily report. All of these data as shown in below are also reported to the committee office of YCDC through the head of department as monthly report.

These are;

(1) Water supplied amount from all YCDC tube well
(2) Installation of new tube wells
(3) Maintenance for cleaning to the old tube well
(4) Maintenance for the submersible pumps and meter used in tube wells
(5) Reinstallation of the tube well facilities after maintenance
    - maintenance to pumps
    - maintenance to motors
    - maintenance to submersible pumps
    - maintenance to engine

(2) Water Quality

In 2014, the laboratory room for water quality can be established in WSD of YCDC. So far, these are sixteen parameters related to the drinking water to be tested in their laboratory. These parameters are;

- Arsenic (As)
- Calcium (Ca)
- Chloride (CL)
- E Coli
- Electrical Conductivity
- Lead
- Magnesium (Mg)
- Manganese (Mn)
- Nitrate (NO3)
- pH value
- Total Alkalinity
- Fecal Coliform
- Total Dissolve Solid
- Total Hardness
- Iron (Fe)
- Turbidity

As a reporting system concerning with water quality results testing in this laboratory, all of the water samples for testing according to the weekly and monthly schedule and other samples occasionally instructed by head of department and committee members are needed to test for water quality in time. After that all of these water quality results are listed as a weekly report and submit to the head of department through Assistant Chief Engineer, Head of supporting branch.

Finally, all of these monthly reports are listed again and submit to the head of department through Assistant Chief Engineer as a monthly report.

(3) Reservoir

There are four main reservoirs, named Hlawga, Phugyi, Gyobyu and Ngamoeyeik, as a surface water resources for the purpose of drinking water to Yangon city dwellers. All are situated in the northern parts of Yangon city.

In these reservoirs, the storage capacities, water levels and rainfall amounts are listed daily and submit as a daily report to Yangon region government through Assistant Chief Engineer, Head of Reservoir Section, and Head of Department.

All of the activities working in all reservoirs within one week are reported as a weekly report to Head

of Department through Deputy Head of Department. Especially in Hlawga reservoir, electricity shortage, operating hours and water supplied amounts are reported to the Head of Department through Deputy Head of Department as a weekly report.

Water level, water supplied amount and precipitation amount are also recorded daily and then reported as a monthly report to committee office through the Head of Department.

(4) Water Treatment Plan
Nyaunghnapin water treatment plant is the only one treatment plant in Yangon City water supply under operating for drinking water. It was started to construct in 2004 and completed in 2005.

In this treatment plant, Aluminum Chlorohydrate, water supplied amount, operating hours are recorded daily and submitted as a monthly report to the head of department through Assistant Chief Engineer, section Head of Reservoir Division.

(5) Service Reservoir
There are service reservoirs in Yangon. Among them, two service reservoir, namely two Kokkine service reservoirs, can be operated and the other one is central S/R, cannot be operated since 1965.
Only in Kokkine reservoir, water level of this reservoir can be recorded daily and submit again to the Head of Department.

(6) Pumping Station
Yegu pumping station is located near Kabaraye Pagoda Road. This station is very important for our water supply system of YCDC, because all of inlet water from Gyobyu, Phugyi and Hlawgha reservoirs are collected in this station and pumped again to Kokkine service reservoir and to downtown area. In this station, water levels, operating hours, electricity shortage are recorded as a daily record and submit as a daily report to the Head of Department through the head of reservoir division (Assistant chief engineer) and Deputy Chief engineer No-1 and No-2.

Operating hours, electricity shortage and maintenance of machineries are also reported as weekly report to the head of department through section head of reservoir division.

All of these data mentioned above are reported again as a monthly report to the Head of department through the head of reservoir division.

2.1.5 Existing data and performance indicators (PIs)

(1) Existing data of counterpart's section/ facility
Prior to monitoring PIs, we firstly tried to clarify what kind of data is existed in the counterpart's section/ facility. Although these data could not cover all of existing data, these were useful information for considering the present available and developing datasheets for PIs. Based on the information, datasheets for monitoring PIs was prepared which is described in the next section.
The existing data is shown as the following Table.

Table 2.1 Existing Data of Counterpart's Section/ Facility in WSD

	Existing	
	Data	Monitoring Data
Reservoir	Storage Capacity of each reservoir	Water level and depth
	Storage curve	Precipitation
		Pump operation hour (PS)
		Electrical Breakdown records (PS)
WTP	Back washing time	ACH Dosing rate
		Electricity Power Consumption
		Water Quality
		- Turbidity (raw, treated), PH, temp., Alkalinity
Pumping		Operation Hours
		Electricity Consumption
		Flow - inflow, out flow
		Pump and Mortor
		- Ampere meter reading
		- voltage reading
		- frequency
		Transformer
		- temperature
		- voltage (inlet, outlet)
		Pressure
Service Reservoir	Storage capacity	Water level
	Age	Valve Control
Underground Water		Pumping Hours
		Electricity Consumption
		Ground Water Quality (three times per year)
		- 15 parameters
Distribution	Pipe size	Pressure (some pts)
	Pipe length	Leakage repair record of main transmission pipe
	Pipe materials	

2.2 RESULTS OF PCM WORKSHOP

2.2.1 Problem Analysis

At the beginning of September 2015, we started our activities by discussing about the problems and obstacles currently exist in water supply system to reach the target of 2040 Master Plan. There are two portions to discuss about the improvement of current water supply management in Yangon. In this portion of planning and monitoring system, we considered and discussed how to reach the target of 2040 master plan based on the current situation and system of water supply system. After that we made the group discussion and workshop with JICA responsible experts and assigned counterparts from YCDC and formulated the problem analysis and objective analysis about Planning and monitoring sector. The main factors to face the problems of disturbing to reach the master plan target are as follow;

- Limitation of data information to understand the current waterworks
- Key performance indicators have not set up
- Data record systems are not sufficient to be satisfied
- Lack of planning section to consider for future
- Lack of mid-term and long –term plans to meet the target of master plan

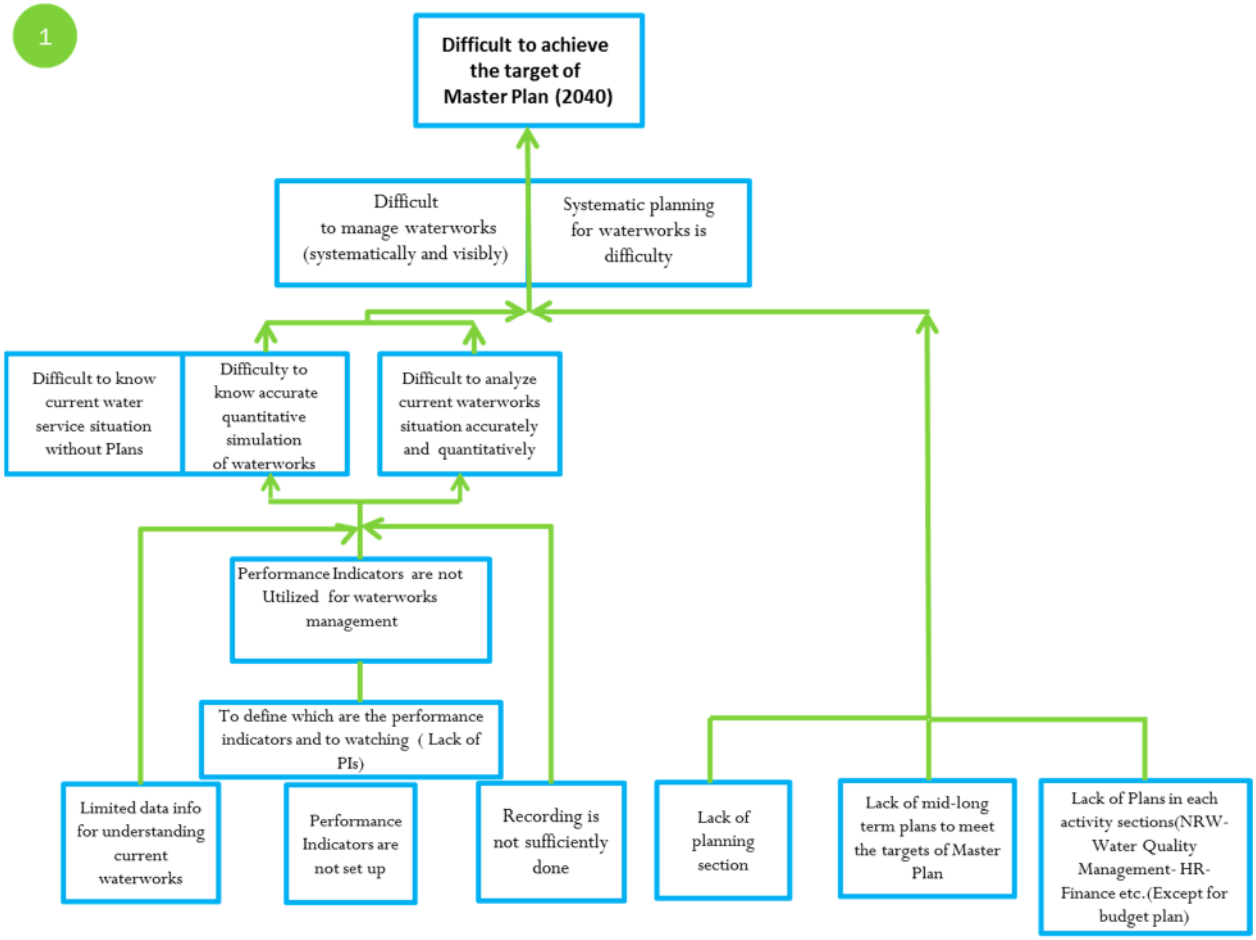


Figure 2.2 Problem Tree (Planning Sub-Group)

2.2.2 Objective analysis

Based on the problem analysis, we formulated again the problem solution to meet the target of 2040 master plan for Yangon City. The result of objective analysis tree is as follow;

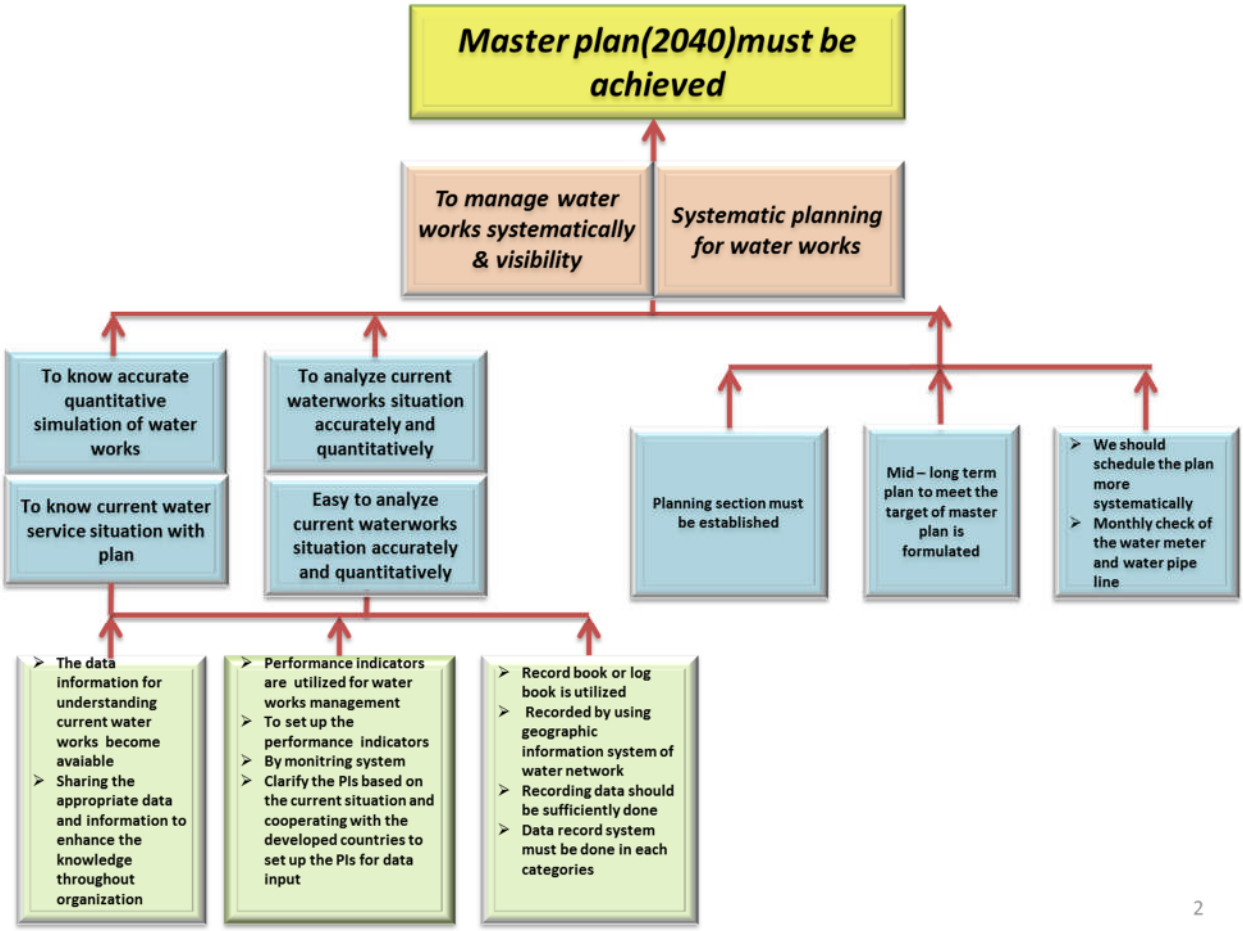


Figure 2.3 Objective Tree (Planning Sub-Group)

Photo 2.1 Workshop Scene for Objective Tree

2.3 CAPACITY ASSESSMENT

2.3.1 Results of Assessment

Capacity assessment was conducted targeting only on the assessment of organizational capacity, not of individual capacity.
The reasons for this are:

- The counterpart members for planning sub-group are composed of the staffs from a variety of sections such as reservoir division, pumping station, service reservoir, electrical and mechanical section, etc.
- And there is presently no specialized section on this issue in WSD,
- A proposal for the establishment of Planning Section was submitted, while the detail staffing of members cannot be assumed, and it will take time

The preliminary results of capacity assessment are described as follows.

(1) 5 years plan and annual activity plan are developed
(2) The progress of annual activity is monitored by the meeting in some extent
(3) The contents are basically composed of the project title and the budget, hence the more detail activity information should be included
(4) PIs and clear targets are more indicated in the plan to understand the progress and the outcome clearly
(5) The systematic monitoring and evaluation function need to be established
(6) Plans are evaluated and revised periodically according to PDCA (Plan-Do-Check-Action) Cycle
(7) The evaluation results need to be analyzed and be reflected on the plans
(8) There is no responsible section for planning, thus one section to comprehensively cover the planning function
(9) A process for development and approval of plans need to be defined clearly

2.3.2 Achievement state/ Expected outcomes in capacity development (Phase 1 & 2)

(1) Summary of achievement state/ expected outcomes
Future achievement state and expected outcome were discussed in the PCM workshop and the separate meeting. The counterparts tried to image and envisage the state after the Project and the state in the more long-term.

Based on the results, the future achievement state and expected outcome has been prepared as shown in the following Table.

Output1-1 Planning

Long-term	**Achievement state/ Expected outcome**
	• Waterworks situation is monitored and analyzed quantitatively and accurately • Waterworks is appropriately managed in a planned manner
After 5 years	**Achievement state/ Expected outcome**
(PDM Activity) (1-1) Establish the Planning Section (1-2) Develop and Monitor Performance Indicators (PIs)	• Planning section is established • Waterworks management is monitored by PIs periodically • Monitoring information on waterworks management is shared among staffs • Systematic planning process for waterworks is established with clear targets and PIs • Plans are evaluated and revised periodically according to PDCA

	(Plan-Do-Check-Action) Cycle • A comprehensive mid- and long-term plan (including facility development plan, financial plan, institutional plan) is developed

(2) Achievement state/ expected outcomes considered by the counterparts

Some of image on achievement state and expected outcome considered by the counterparts are shown as below.

1) To get more better plan for future period by establishing planning section
2) Able to manage water supply facilities based on the proper collection of data, short-term plans performed regularly
3) To get more acknowledgement to understanding of current water supply system data, info and sharing
4) To set, manage and monitor of PIs in which basic depend on local condition
5) To collect the data related to the water supply system and identify the key PIs
6) To install the monitoring instrument in main pumping station, branch pumping station, tube wells, then we know water distribution amount per day or per month, pump operation time, electrical consumption
7) To enhance recording system more such as GIS
8) Based on the accurate data and information, we are able to make a future plan
9) To achieve the development of potable water supply system for our citizens

2.3.3 Training plan/Implementation plan

Preliminary training plans/ implementation plans are shown as the following table.
These training plans/ implementation plans will be finalized until the end of January 2016, through a discussion with the relevant staffs and the advisory committee in Japan.

Item	Contents/Topics	Type
Planning	• Planning function on water utility • Duty and responsibility of Planning section • Strategic planning process for waterworks • Sustainable planning by PDCA • Review of existing activity plans • Establishment of an institutional development plan for mid- and long-term, etc.	OJT/ Seminar
Performance indicators	• Monitoring system of PIs • Data management/transfer system • Calculation of PIs • Analysis of PIs • Target setting for planning with PIs, etc.	OJT
Good practice of neighboring countries	• Study tour to Phnom Penh Water Supply Authority (PPWSA) in Cambodia • Study tour to Metropolitan Waterworks Authority (MWA) in Thailand	Study tour

2.4 PROGRESS OF THE PROJECT

(1) Present position

PCM workshop, a baseline survey and organizational capacity assessment have been conducted since the launching of the project activities. The existing plans, monitoring and reporting system related to the

activities of WSD are largely identified working together with the counterparts. The outline of existing plan, monitoring and reporting system is also described in the previous sections of this Chapter 2.

The first next step is 1) to continuously enhance the establishment of the Planning Section in WSD, and 2) follow-up monitoring system and reporting system of PIs. The detail of the project activities are mentioned in the following sections.

The present position of "Activity 1-1 Establishment of the Planning Section" and "Develop and monitor PIs" in the project PDM is shown as the following Figure.

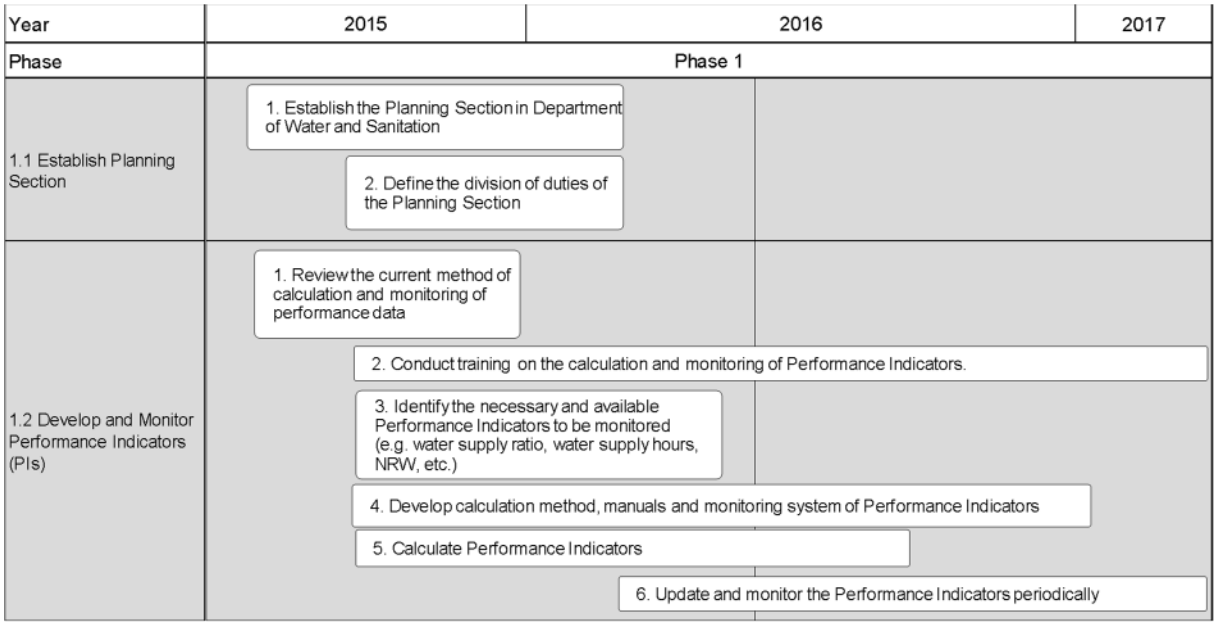


Figure 2.4 Present Position of Activity 1-1, 1-2 in PDM

2.4.1 Establishment of planning section

A proposal for establishment of planning section was submitted to WSD.
The proposal includes and organogram, and duty and responsibility of the section and the subsidiary units. The proposed Planning Section consists of two subsidiary units such as management planning and facility planning.

(1) Organogram
The proposed organogram of the Planning Section is shown as the following Figure.
The number of brackets indicates the proposed number of staffs.

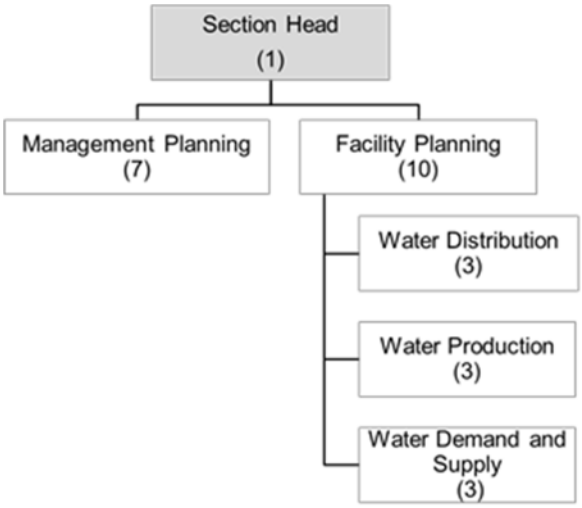


Figure 2.5 Organogram of Planning Section

(2) Duty and responsibility

Duty and responsibility of Planning section, and the subsidiary 2 units are shown as the following Table.

Table 2.2 Duty and Responsibility of New Planning Section

Planning Section Overall
• Formulating overall vision, policy and strategy of WSD • Making comprehensive management planning and development of operation • Periodic Monitoring and evaluating the performance of WSD's waterworks • Providing timely feedback to the management class of the operational areas • Enhancing the continuous improvement of WSD's waterworks from a comprehensive viewpoint • Preparing guidelines • Maintaining a database on key operating indicators for computation of trends and performance history

Management Planning Unit
• Planning of overall management plan (non-technical) of waterworks • Identifying problematic areas in the operations • Study, analysis and data collection on management plan • Overall coordination with other sections and units • Continuous assessment of the management plans and playing a leading role in strengthening/ developing improvement programes • Developing and implementing performance bench marking systems comparable to good international standards • Preparing Admin. & Financial guidelines • Preparing non- technical database system

Facility Planning Unit
• Planning of water supply and demand plan • Planning of reservoir, intake, conveyance, production, transmission development • Planning of distribution facilities development

Facility Planning Unit
• Overall coordination with other sections and units • Control of technologies to be adopted • Evaluation of materials (pipe, accessories, etc.) and water supply technologies • Preparation of technical guidelines and standards • Study and research on water supply technologies • Safety measure of construction • IT for technical database system

2.4.2 Establishment of performance monitoring system

(1) Responsibility of preparation of datasheet

The responsibility of preparation of datasheets was determined in the following Table.
Some division/ section such as planning, NRW management, water distribution management, commercial are newly proposed in the project activity, and are not yet established. In that case, therefore, counterpart groups for the JICA project are assigned to the datasheet collection.

We can classify seven areas of datasheets to fill up the data; Production data, Distribution and NRW data, Water Quality, Nyaunghnapin Water Treatment Plant data, Sale and collection data, Finance data, Administration and Human Resources Development data.

Table 2.3 Responsibility of Preparation of Datasheet in WSD

Category of Datasheet	Responsible Section for Preparation of Datasheet		Symbol
	YCDC Department	JICA Counterparts	
1. Water Supply Service	(Proposed Planning & Monitoring Section)	Team 1 Sub-group 1 (Planning)	S
2. Production & Transmission	Reservoir Division (Proposed Water Distribution Management Section)	Team 1 Sub-group 1 (Planning) Team 2 (NRW)	P
3. Distribution & NRW	(Proposed NRW management section)	Team 2 (NRW)	D
4. Water Quality	Water Quality Monitoring Section Nyaughnapin WTP	Team 3 (Water Quality)	Q
5. Sales & Collection	(Proposed Commercial Division) converted from Computer Section	Team 1 Sub-group 1 (Planning)	C
6. Finance	Finance Section	Team 1 Sub-group 3 (Finance)	F
7. Administration & Human Resource	Administration Section	Team 1 Sub-group 4 (HRD)	H

(2) Data management system and collection system

Original data will be monthly collected and be filled in the datasheet by each township, WTP, pumping station, reservoir and service reservoir, pipe maintenance and installation office etc. These data will be planned to transfer to that relevant division/ section of the head quarter, eventually to the Planning Section. The Planning section compiles the information as monthly report and report to the top management such as CE and DYCE.
Main flow of data management is assumed to be the following.

1. Electric datasheet will be prepared at T/S (31) and site offices by computer
2. Datasheet will be transferred to District Office (4) and be compiled as division summary

datasheet

3. Datasheet will be transferred to specific division of HQ and compiled and confirmed
4. All datasheet will be transferred to Planning Section for compilation and make summary report
5. Summary datasheet will be submitted to the top management

A conceptual diagram for data management system can be shown as the following Figure.

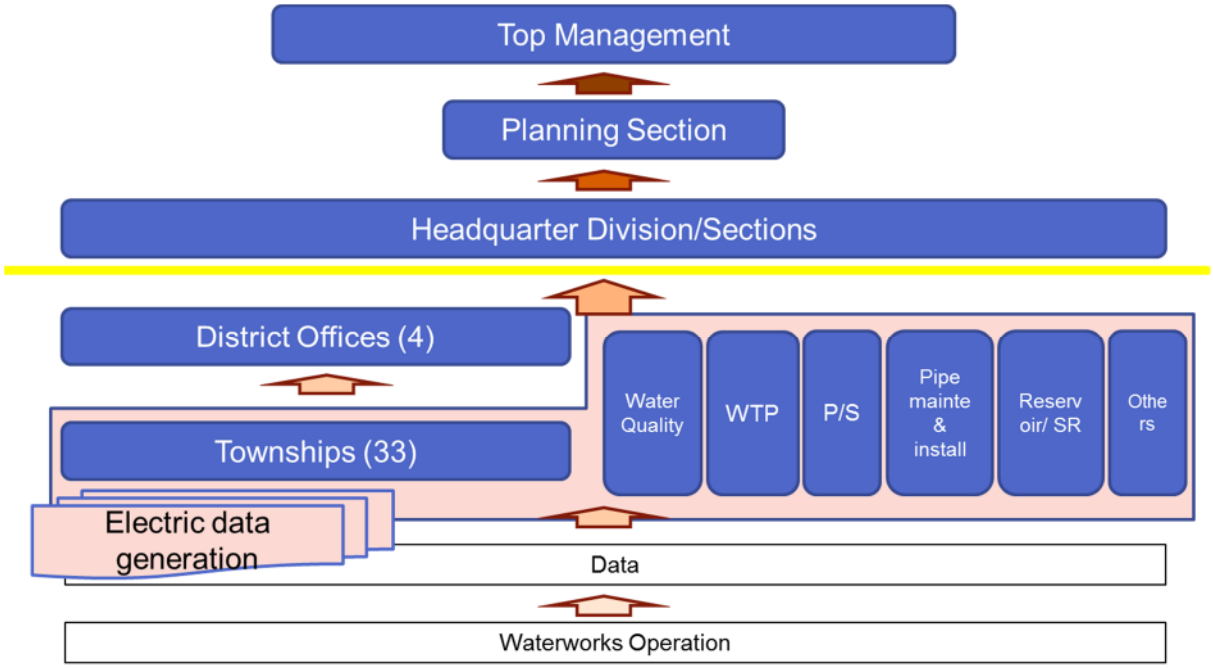


Figure 2.6 Conceptual Diagram of Data Management System in WSD

A data collection and transfer system can be shown as the following Figure.

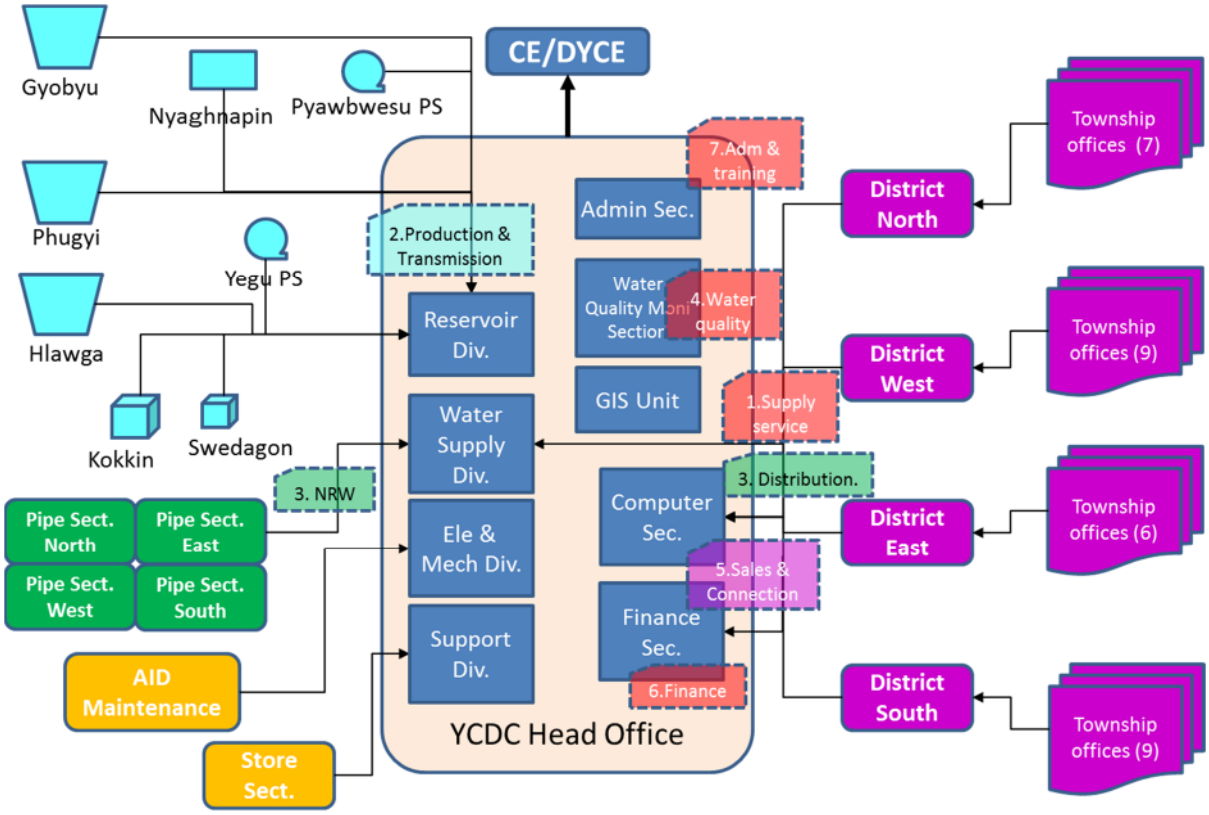


Figure 2.7 Data Collection and Transfer System for PIs in WSD

2.4.3 Key performance indicators (overall outputs)

Key PIs were selected from each datasheet and proposed to WSD. These KPIs will be monthly summarized and submitted to the top management of WSD. Since this monitoring system for PIs is just commenced, the continuous follow-up needs to be done.

KPIs also need to be considered according to the importance and the results of data monitoring situation, and be modified as necessary. The initial KPIs are shown as the following Table and datasheet and PI Sheets are attached as Annex.

Table 2.4 Key Performance Indicators (PIs)

Key Performance Indicators (KPI)

Summary Seet

Sq.N	Symbol	Indicators	Unit	Jan	Dec	Total	Average
1. Water Supply Service							
1	S1	Service population	'000 inhabitants				
2	S2	Total connections	Nb.				
3	S28	Service coverage rate	%				
4	D5-1	Average hours of water supply per day	hr/day				
5	C23	Unit (average) water consumption per connection per day	L/conn/d				
6	Q7-2	Compliance ratio of monthly water test at tap water in TS (turbidity)	%				
7	Q7-5	Compliance ratio of monthly water test for tbe well (TDS)	%				
8	C25-2	Average tariff per connection (billed connection)	Kyat/conn				
9	C26	Unit (Average) tariff per unit water consumption	Kyat/m^3				
2. Production & Transmission							
10	PT4-1	Daily average total production (untreated)	m3/day				
11	PT4-2	Daily average total production (treated)	m3/day				
12	PT4-3	Daily average total production (groundwater)	m3/day				
13	PT4-4	Daily average total production	m3/day				
14	PT4-5	Percentage of actual production (surfcewater) of total capacity	%				
15	PT4-6	Achievement ratio of water production of the planned production	%				
	Nyaghnapin WTP						
16	P4-1	Achievement ratio of WTP water production of the planned production	%				
17	P4-2	Operation ratio of WTP water production	%				
18	P4-3	Production efficiency (balance between inflow and outflow)	%				
19	P4-4	Transmission efficiency (transmitted water / produced water)	%				
20	P4-5	Overall production-transmission efficiency (transmitted water / raw water volume)	%				
21	P4-7	Alum sulfate consumption per unit treated water volume (m3)	g/m3				
3. Distribution & NRW							
22	D3-2	The number of leakage repaired (distribution network)	Nb./month				
23	D3-4	The number of pipe breaks (distribution network)	Nb./month				
24	D17	NRW	%				
25	D22	Operating metering level	%				
26	D24	The number of repaired pipe breaks per 1,000 connections	Nb./ 1,000 conn.				
4. Water Quality							
27	Q7-1	Compliance ratio of monthly water test in water facilities (turbidity)	%				
28	Q7-2	Compliance ratio of monthly water test at tap water in TS (turbidity)	%				
29	Q7-5	Compliance ratio of monthly water test for tube well (TDS)	%				
5. Sales & Collection							
30	C4-1	Number of connections -Metered (end of the month)	Nb.				
31	C4-3	Number of total connections (Metered+Flat) (end of the month)	Nb.				
32	C5-3	Number of bills delivered (Metered+Flat)	Nb.				
33	C6-3	Amount of bills delivered (Metered+Flat)	Kyat/month				
34	C7-3	Number of bills collected (Metered+Flat)	Nb.				
35	C8-3	Amount of bills collected (Metered+Flat)	Kyat/month				
36	C9-3	Number of bills outstanding (Metered+Flat)	Nb.				
37	C10-3	Amount of bills outstanding (Metered+Flat)	Kyat/month				
38	C12	Number of new connection	Nb.				
39	C15-1	Metering ratio (by total connection)	%				
40	C15-3	Operating metering ratio (by total connection)	%				
41	C19	Billing ratio in number	%				
42	C20-2	Collection ratio in amount	%				
43	C21-2	Outstanding ratio in amount	%				
44	C22-2	Daily average water consumption (metered)	m3/d(MGD)				
45	C27	Collection period of account receivable (Outstanding bill amount)	days				
46	C28	Service coverage rate	%				
6. Finance							
47	F1	Total operating revenue for water	Kyat/month				
48	F2	Total operational expenses for water	Kyat/month				
49	F3	Accounts receivable	Kyat//month				
50	F4	Financial balance	Kyat/month				
51	F5	Operating ratio (Operating cost coverage)	%				
52	F8	Average revenue per m3 produced	Kyat/m3 water produced				
53	F9	Average revenue per m3 sold	Kyat/m3 water sold				
54	F10	Average revenue per connection	Kyat/month/conn				
55	F11	Unit operational cost for water produced	Kyat/m3 water produced				
56	F12	Unit operational cost for water sold	Kyat/m3 water sold				
7. Administration & Human Resource							
57	H8	Training period*number of trainee/Total staff	Person*day				
58	H9	Ratio of trainers to trainees	Person				
59	H10	Ratio of practice sessions	%				
60	H11	Total staffs number/1000 connections	person				

Prepared by:
Date:

Checked by:
Date:

Received by (Division ACE)
Date:

2.4.4 Procurement of equipment for performance monitoring

For the monitoring of PIs, the following procurement of equipment is planned.

Out put	Area	Purpose	Main equipment	Progress
1	**Distribution flow monitoring (tentative)**	• To collect data on water flow volume for transmission and distribution • To utilize flow data for NRW management • To make water flow management plan for transmission and distribution for equitable water supply	• Ultrasonic flow meter • Panel, logger	• Detail plan under preparation
2	**Digitalization of billing & collection works**	• To digitalize hand-writing data at T/S, P/S, field offices, etc. for more efficient management	• Computer • Printer • MS Office etc.	• Asked YCDC to prepare the plan
3	**Water quality monitoring**	• To measure all prioritized water quality parameters in Myanmar • To level up the quality test from simple testing kit to standard method	• UV- vis Spectrometer • Jar tester • Sieving test equipment	• Procurement list mostly completed

CHAPTER 3 Regulations, Standards, Guidelines, and Manuals

3.1 BASELINE SURVEY

3.1.1 Legal system of water supply in Myanmar

(1) Myanmar national water law

National water law is not existed in Myanmar as of December 2015. However, Myanmar national water law is under preparation by National Water Resources Committee (NWRC). YCDC is not a member of the Committee, so that the tentative information on the contents is not appeared. YCDC is told that the committee will invite a seminar if they prepare the draft of Myanmar national water law.

(2) National water policy

1) Table of Contents

Myanmar National Water policy was published in 2014 under the authority of Advisory group of the National Water Resources Committee (NWRC). In this book, all of the chapters are related to the water usage and water management in Myanmar. All of persons related to the will need to follow and know the information expressed in this book. The titles included in this book are as follow;

Table 3.1 Table of Contents Myanmar National Water Policy

In these all chapters mentioned above, only chapter 12 is related to water and sanitation management. We would like to express the detail information and how to utilize and relate to water supply and sanitation system,

2) Chapter 12 Water Supply and Sanitation

In these all chapters mentioned above, only chapter 12 is related to water and sanitation management. We would like to express the detail information and how to utilize and relate to water supply and sanitation system,

12.1. There is a need to remove the large disparity between stipulations for water supply in urban

areas and in rural areas. Efforts should be made to provide improved water supply in rural areas with proper sewerage facilities. Least water intensive sanitation and sewerage systems with decentralized sewage treatment plants should be incentivized.

12.2. Urban domestic water supplies should preferably be from surface water. Where alternate supplies are available, a source with better reliability and quality needs to be assigned to domestic water supply. Exchange of sources between uses, giving preference to domestic water supply should be possible. Also, reuse of urban water effluents from kitchens and bath rooms, after primary treatment, in flush toilets should be encouraged.

12.3. Urban domestic water systems need to collect and publish water accounts and water audit reports indicating leakages and pilferages, which should be reduced taking into due consideration social issues.

12.4. In urban and industrial areas, rainwater harvesting and desalinization, wherever techno economically feasible, should be encouraged to increase availability of utilizable water. Implementation of rainwater harvesting should include scientific monitoring of parameters like hydrogeology, ground water contaminations, and growth of vectors, pollution and spring discharges.

12.5. Urban water supply and sewage treatment schemes should be integrated and executed simultaneously. Water supply bills should include sewerage charges.

12.6. Industries in water short regions may be allowed to either withdraw only the makeup water or should have an obligation to return treated effluent to a specified standard back to the hydrologic system. Tendencies to unnecessarily use more water within the plant to avoid treatment or to pollute groundwater need to be prevented.

12.7. Subsidies and incentives should be implemented to encourage recovery of industrial pollutants and recycling/ reuse, which are otherwise capital intensive.

3.1.2 Existing Regulations, Standards, Guidelines and Manuals

Current regulations, laws, standards, guidelines and manuals complying in YCDC are listed up by the YCDC counterpart members of Output 1 Sub-group2. Some books are related to government service affairs and the others are related to the engineering sectors. From each books, the relevant parts about water supply and sanitation works are picked up and summarized. The existing regulation, standards, guideline and manuals are shown as below.

Table 3.2 List of Existing Regulations, Standards, Guideline, Manuals

No	Title	Institution responsible
1	YCDC Law (2013) (2014 updated)	YCDC
2	YCDC Regulations related to water and sanitation (1999,december-17)	YCDC
3	New YCDC Regulation related to water and sanitation (under drafting)	YCDC
4	Analysis of rate for Roads,bridges,buildings,electrical,airfield,research laboratory,water supply and sanitation (2014)	Ministry of Construction
5	Guidelines for water and sanitation (1996)	Ministry of Construction
6	Reinforced concrete design by Professor U Nyi Hla Ngae	Yangon Technological University
7	Guidelines for High-rise building construction projects (Sanitary)	Committee for Quality Control of High-Rise
8	Guidelines for civil engineers (Including material standards)(2001)	Ministry of Construction
9	National drinking water quality standard Myanmar by Ministry of Health (2014)	Ministry of Health
10	Myanmar National Water Policy (2015)	NWRC

(1) Law

1) No.1: YCDC Law (2013) (updated to 2014, YCDC)

This book was established by YCDC in 2013 based on the book of YCDC regulations established in 1997, December -17. This book is effective for government service affairs and the agreements and laws and regulation between YCDC and the dwellers in Yangon city. Some of the items are revised and added based on the new constitution of new democratic government.

(2) Regulation

1) No2: YCDC regulation related to water and sanitation (December-17, 1999, YCDC)

This book was established by YCDC in 1997, December-17. Some items are the old versions regarded in 1990, 1996, and 1997. This book is also very effective like as the new versioned one, established in 2013.

(3) Guidelines and Manuals

1) No.5: Guidelines for water and sanitation (1996, Ministry of Construction)

This book was translated from one of the reference book and established by U Slaine Myo Myint worked in ministry of construction. This book is also very effective to use not only for water supply system but also for sanitation system. The main contents of this book are related to the general knowledges and essential information and guidelines concerning with water supply and sanitation.

2) No.7: Guidelines for high-rise building construction projects (2005, Committee for quality control of CQHP)

This book was established by committee for quality control of High-Rise Building construction projects in 2005.It is necessary and effective to control the quality and can inspect in the same format and guidelines for High-Rise Buildings.

3) No.9: National drinking water quality standard in Myanmar (2014, Ministry of Health)

This book was established by ministry of Health in 2014 and got the approval from National Government. Before 2014, water quality standard was referred and followed to the water quality guidelines established by World Health Organization. In this book, there contains the water quality standards relevant to the geographical situation of Myanmar, sampling methods and general requirements.

4) No.10: Myanmar national water policy (2015)

This book, Myanmar National Water policy was published in 2014 under the authority of Advisory group of the National Water Resources Committee(NWRC). This book is very effective not only for water supply system but also for other sector related to the water resources, disaster, environmental conservation and so on. The other detail information are mentioned in 3.1.1.

3.1.3 Main Contents and Utilization of Existing Standards, Guidelines and Manuals

(1) Law

1) No.1: YCDC Law (2013) (Updated to 2014)

Duties and Responsibilities

- Water supply and water tariff collection are done by water and sanitation engineering department in YCDC or other appropriate system such as contract or tender or auction by some organization and someone

Authorities

- Even if there have complaints from neighbourhood near the project related to water supply, it can be done to be continue by approval and permission from government if it is necessary and suitable for effectiveness for public.

Duties and Responsibilities

- Construction, operation and maintenance of existing water sources (Dams, reservoirs, tube-wells and lakes), identification of new water sources
- Construction of transmission main pipes and distribution networks, installation and

maintenance of booster pumps
- Permission for domestic water supply connection and water usages
- Prohibition of pollution to YCDC owned water sources of lakes and reservoirs
- Prohibition of water supply works which may have water borne diseases related to the health
- Drinking water supply works are done according to the WHO drinking water quality standard
- Land acquisition (rent and purchase) and required facilities can be rented or purchased for water supply
- New water sources and water supply facilities can be done by contract or tender or auction system
- Prohibition to the obstacles for water supply, such as building construction and dumping sites
- Prohibition and restriction to prevent the illegal intrusion into the prohibited areas and building which are related to water supply facilities.

Prohibitions
- Do not permit for illegal connection and usages
- Do not permit to extend the accessories related to the water supply unit that are permitted originally
- Do not permit for connection without water meter
- Do not allow illegal maintenance, destructions, taking out, changing, destroying, delaying
- Do not make the pollution to the water sources owned by YCDC
- Do not waste water and do not allow to sale the YCDC owned water without permission
- Do not allow dumping goods, excavation and the other earthworks on the area owned by YCDC
- Do not disturb the watershed area and forest surrounded from dams and reservoirs
- Do not make the valves open, close, dismantle, install, operation and maintenance without permission
- Do not construct any buildings, roads, bridges on the water supply transmission pipes without permission

(2) Regulations

1) No.2: YCDC Regulations related to water supply and sanitation (December,1997)

Duties and Responsibilities
- Carry out of water supply
- Operation and maintenance of pipe lines and reservoirs

Authorities
- If someone will committed the regulations regarded according to this law ,this person can be convicted by cash or jail ,or both
- If it is necessary, the new laws, regulations, instructions and manuals can be promulgated

Water Supply Works
- Implementation of water works
- Purchasing and borrowing of lands, construction tools and machineries for water supply works
- It can be done by contractors or tender system and auction system for water supply works and new water resources
- It can be carried out by negotiation with owner of building, road and land in advance for water supply work
- It can be permitted for individual meter connection by rental houses
- It can be permitted to construct the storage tank for domestic usages.
- It can be regarded the sizes and kinds of materials for water supply connection
- It must be allowed to license plumbers for connecting of water supply works
- Any licensed plumbers can be inspected
- It can be allowed to inspect for any houses regarding to the water supply connection
- If the customers can not obey the instructions related to the water usages, this connection

can be cut out. If the customers implemented according to the instructions, the customers can get the permission again.
- If there have some problems or damages in the pipe line and water supply utilities, it must be maintained according to the instructions.
- If there want to construct and extend the buildings, roads and bridges on the transmission pipe lines, there need to negotiate with committee in advance
- We should use the standard guidelines of WHO for drinking water
- If someone would like to use YCDC supplied water, the customer need to pay the water charges.

Prohibition
- Same as the prohibitions mentioned I YCDC Law (2013) (Updated to 2014)

(3) Guidelines and Manuals

1) Analysis of rates for roads, bridges, buildings, electrical, airfield, research, laboratory, water supply and sanitation (2014, Ministry of Construction)

The rate for water and sanitation works is indicated in this book. This is used in calculation and checking of cost estimation of water supply and sanitation projects especially for the following purposes.

1. To calculate the quantities of sanitary appliances and fittings in internal installation (supplying and fixing IWC pan, EWC pan, basin, urinal, fountain etc…)
2. To calculate labour charges in internal installation
3. To calculate materials and labour charges in fixing and joining CI Soil pipe, GI pipe, PVC pipes and fittings, valves, cock, showers, hydrants etc. for internal and external installation
4. To calculate materials and labour charges in fixing and joining sewers
5. To calculate materials and labour charges in fixing and joining HDPE pipes and fittings, valves
6. To calculate the quantities of materials and labour charges in boring and drilling of tube wells
7. To calculate the quantities of materials and labour charges for installation of water pumps

2) No.5: Guidelines for Water and Sanitation (1996, Ministry of Construction)

This book was established by U Saline Myo Myint who is official working as a water supply and sanitation engineer in Ministry of construction, but now he had already retired. Actually, this book was published in English version by foreign author, but he translated and published again to share these information and knowledge in Myanmar. There have two portions in this book; one part is for water supply system and the other portion is for sanitation system.

There includes information and knowledge about water supply system. All of these are very effective and useful for water supply engineers. These can be utilized in these related purposes shown as below;
- To calculate the quantities of sanitary appliances and fittings in internal installation (supplying and fixing IWC pan, EWC pan, basin, urinal, fountain etc…)
- To calculate labour charges in internal installation
- To calculate materials and labour charges in fixing and joining CI Soil pipe, GI pipe, PVC pipes and fittings, valves, cock, showers, hydrants etc.. for internal and external installation
- To calculate materials and labour charges in fixing and joining sewers
- To calculate materials and labour charges in fixing and joining HDPE pipes and fittings, valves
- To calculate the quantities of materials and labour charges in boring and drilling of tube wells
- To calculate the quantities of materials and labour charges for installation of water pumps

In the second part, there includes information and knowledge about sanitation system. All of these are very effective and useful for sanitation engineers. These can be utilized in these related purposes shown as below;
- To understand general knowledge and basic requirements related to Water Supply and Sanitation

- To estimate water demand by using per capital consumption, consumption for varies uses, fire demand, fluctuation in rate of consumption
- To know water resources managements, rainfall and runoff, impounding reservoirs
- To identify types of spring and wells and nature of tube well
- To study water quality analysis and management and purification methods
- To know the structures of various kinds of intakes
- To recognize methods related to transportation of water
- To understand about pipe materials, pipe joints, special fittings, pressure tests, and pipe corrosion
- To see installation and operation of various kinds of pumps
- To study water treatment facilities
- To understand water supply system and water meter management
- To know Sewage, sewer and sewerage and its treatment and disposal system

3) No.7: Guidelines for High-Rise Building Construction projects (2005, Committee for quality control of CQHP)

This book is especially for High-rise building over eight and half stories to follow and obey the standards and guidelines in the same format. There include the ten guidelines, six tables and five figures in this book. In guideline-1, there must have the definite project organization chart for high rise buildings and all these positions in this organization chart are also fixed according to the relevant personal requirements and qualification. The other guidelines are also prepared to follow guidelines and requirements regarding to the related portions to be sure in the same format. Table 1 to 5 are regarded for estimation and design for water supply and sanitation system for High-rise buildings. Figure 1 to 5 are also regarded to use for calculation of detail assembly in interior pipe line installation. The following table shows the brief explanations how to utilize this book for design and calculation of High-rise buildings.

Table 3.3 Table of Contents

1	Guide line -1	(A) Project Organization Chart
		(B) Minimum Qualification Requirement for various position
2	Guide line -2	Site Inspection
3	Guide line -3	geotechnical Investigation Related to Sanitary Work
4	Guide line -4	Cold and Hot water supply
5	Guide line -5	Sanitation
6	Guide line -6	Garbage Collection and Disposal
7	Guide line -7	Fire Protection system
8	Guide line -8	Design Concept and Calculation
9	Guide line -9	Water, Sanitation and plumbing related drawing
10	Guide line -10	Operation and maintenance
11	Table-1	Population Equivalent
12	Table-2	Recommended Drinking water quality
13	Table-3	Storage tank requirement
14	Table-4	Water storage capacity for extra light hazard class system (for sprinkler system)
15	Table-5	Symbols and Abbreviation
16	Table-6	Colour scheme for painting work
17	Figure-1	Typical cold water distribution system
18	Figure-2	Typical soil, waste and vent piping system
19	Figure-3	Typical arrangement of Hose Reel System
20	Figure-4	Typical arrangement of Dry Riser System
21	Figure-5	Typical arrangement of Wet Riser System

4) No.9: Drinking Water Quality Standard Myanmar (2014, Ministry of Health)

This book was established by ministry of Health in 2014.Before the establishment of this book, we measured and analyzed the parameters of drinking water quality in Myanmar, based on the WHO standard guideline. Now we have the national standard to control the water quality not only for drinking

water but also for the other utilities related to water, based on this book. The main contents included in this book are very effective and useful for the drinking water quality standards, the priority parameters, the sampling methods, general requirements and so on.

As for our department, we can plot the sampling points on our water coverage areas based on the information included in Myanmar drinking water quality standards (MDWQS). The analytical methods of MDWQS help to develop the Standard Operation Procedure (SOP) For the analytical methods of our water quality monitoring system. This book shows that we need to analysis 50 parameters for drinking water supply, but according to the current capacity of existing water quality section, we decided to monitor the sixteen parameters first. Later we will try to improve our analytical parameters according to MDWQS.

From this book, we can know clearly about analytical monitoring which can identify how to control the measurements in our water supply system. It is the good and effective book for our water quality system because it guides us to make a good water quality monitoring system for Yangon City.

3.2 PCM WORKSHOP RESULTS

3.2.1 Problem Analysis

At the beginning of September 2015, we started our activities by discussing about the problems and obstacles currently exist in water supply system to reach the target of 2040 Master Plan. There are two portions to discuss about the improvement of current water supply management in Yangon. In this portion of planning and monitoring system, we considered and discussed how to reach the target of 2040 master plan based on the current situation and system of water supply system. After that we made the group discussion and workshop with JICA responsible experts and assigned counterparts from YCDC and formulated the problem analysis and objective analysis about Planning and monitoring sector. The main factors to face the problems of disturbing to reach the master plan target are as follow;

- Existing agreement between YCDC and customers is not appropriately defined
- No maintenance guideline
- No guideline of water meter, pump replacement
- Design standard water supply system need to be established (Lack of Design Standards)
- Lack of material standards
- No standard and guideline of construction project and management
- Insufficient understanding on roles and task of works

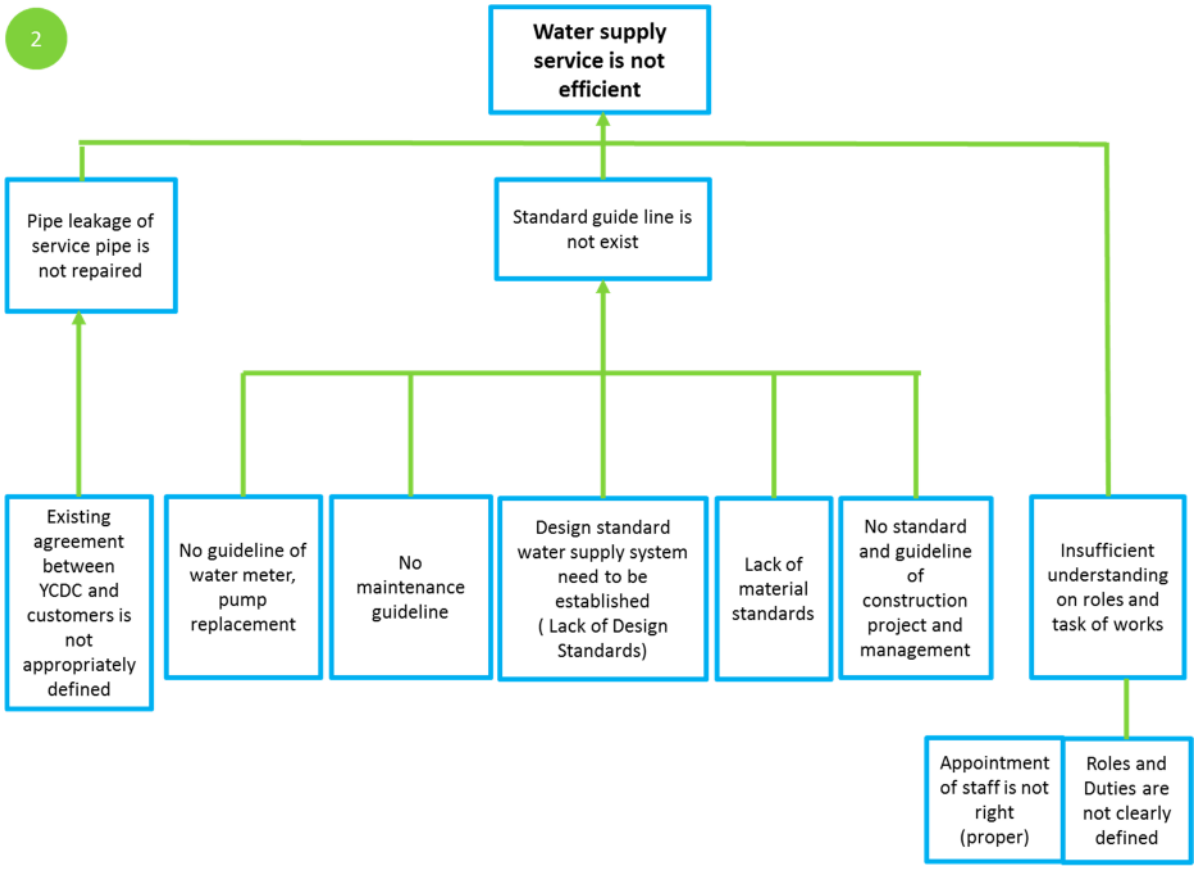


Figure 3.1 Problem Analysis (CHAPTER 3 Regulations, Standards, Guidelines, and Manuals)

3.2.2 Objective analysis

Based on the problem analysis, we formulated again the problem solution to meet the target of efficient water supply service to city dwellers in Yangon. Problem analysis tree is as follow;

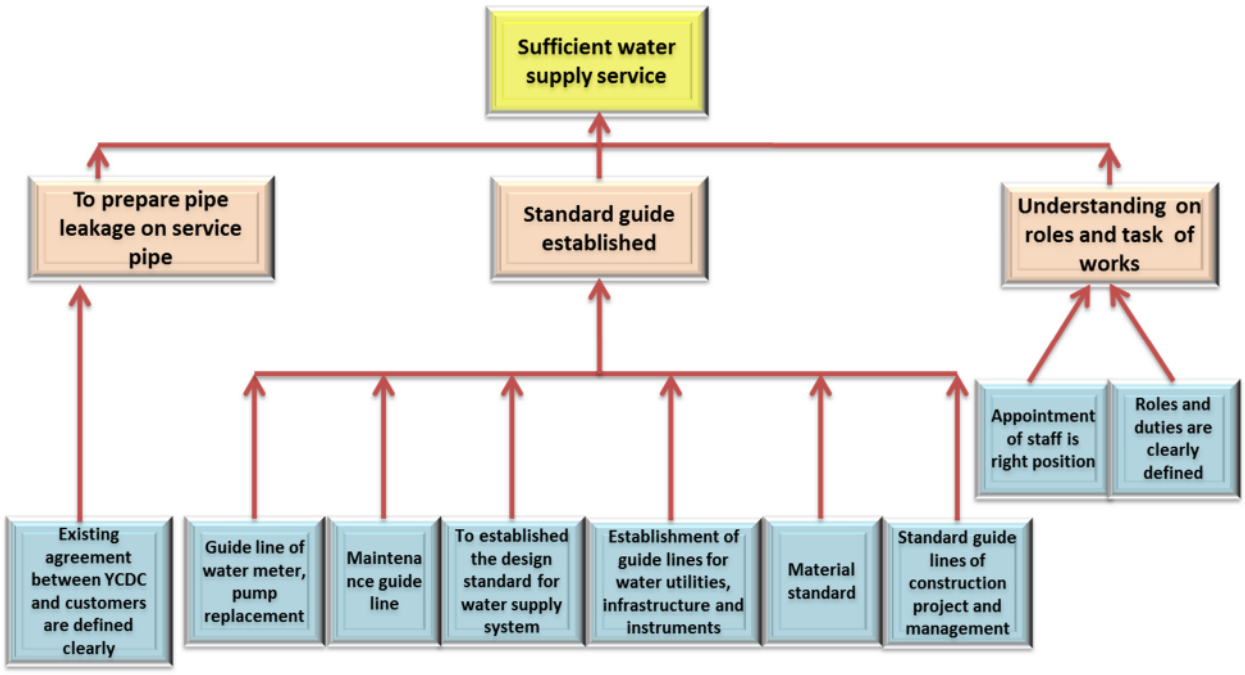


Figure 3.2 Objective Analysis (Regulations, Standards, Guidelines, and Manuals)

Photo 3.1 Objective Tree Workshop Scene

3.3 CAPACITY ASSESSMENT

3.3.1 Results of assessment

Capacity assessment was conducted targeting only on the assessment of organizational capacity, not of individual capacity.
The reasons for this are:

- The counterpart members for regulation, standards, guidelines and manuals sub-group are composed of the staffs from a variety of sections such as research section, house connection section and others.
- And there is no specialized section on this issue in WSD, and no plan for new establishment of the section
- The succeeding project activities are assumed to be carried out by the working group, which will be organized by the relevant members to the specified issues

- The preliminary results of capacity assessment are described as follows.
- The existing regulation, standards, guidelines and manuals are understood and utilized by the staffs in some extent
- Some staffs who is familiar to the specified issues know the information because they may use it in daily works
- However, it can be seen that other staffs tends to know the very limited extent or no information
- These information is not comprehensively compiled, managed and shared among the all staffs
- A process for development, of necessary standards, regulation and manuals, is not necessarily clear
- Similar to the above, an approval process is expected to be defined clearly
- Some of exiting regulation and guidelines are revised some extent
- Apart from law and regulation which may be mostly formulated by the higher governmental authorities, guidelines, rules and manuals which may more related to daily waterworks are a quite few
- It would be said that a lack of guidelines, rules and manuals contributes not to uniform the quality of water supply services in overall

3.3.2 Achievement state/ Expected outcomes in capacity development (Phase 1 & 2)

(1) Summary of achievement state/ expected outcomes

Output1-2 Regulation, Standards, Guideline, Manuals

Long-term	Achievement state/ Expected outcome

	• All necessary standards, guideline and manuals are developed and enforced • All standards, guideline and manuals are understood by staffs • Waterworks is appropriately managed based on the existing standards, guideline and manuals

After 5 years	**Achievement state/ Expected outcome**
(PDM Activity) (1-3) Formulate regulations, standards, guidelines and manuals	• The draft of standards, guideline and manuals with high priority are newly prepared • The prepared standards, guidelines and manuals are shared and understood by staffs • Daily activity of waterworks (design, civil works, billing and collection, NRW mitigation and management etc.) is done according to the prepared standards, guidelines and manuals

Achievement state/ expected outcomes considered by the counterparts

Some of image on achievement state and expected outcome considered by the counterparts are shown as below.

- To reach the situation which all officers and staffs in all departments know and understand the laws, rules and regulations concerning with their respective department
- After 5 years, our expected outcome is to develop pragmatic standards or guidelines same as other ASEAN countries
- Able to update and revise the existing standards, guideline and manuals
- Making standard and guideline to the international level
- To apply their understanding on regulations, standards, guidelines and manuals in the actual daily works while performing their duties and responsibilities

3.3.3 Training plan/Implementation plan

It was appeared that the existing standards, guideline and manuals on YCDC's waterworks are limited apart from the formulation of law and regulation responsible for the national government. Hence the first step is to select and prioritize the necessary standards, guidelines and manuals through a discussion with the counterparts and the advisory committee in Japan. Some manuals and guidelines are planned to be developed through the project activities of other output groups, so that careful coordination will be done for the selection.

Once the topic is determined, then the working group will be organized for the respective topics. The working group will hold a series of meeting and will developed the contents of new standards, guidelines and manuals. During the development process, seminars by the Experts or the advisory committee in Japan, study tours will be effectively organized as necessary.
The detail will be determined until the end of January 2016, through a discussion with the relevant staffs and the advisory committee in Japan.

The preliminary standards, guidelines, manuals are shown as below.

Item	Contents/Topics
Rules/ Standards/ Specification	• Design standards (distribution pipeline, service pipeline, water meter) • Work standards (distribution pipeline, service pipeline, water meter) • Material standards (distribution pipe, service pipe, water meter, pump, etc.) • General specification (pipe laying works, water meter installation, service pipe

	connection, etc)
Guideline/ Manuals	• O&M manual (WTP, pump, deep tube well,) • Guideline for water tariff setting • Guideline for water meter installation • Guideline for pump/ water meter replacement • Asset management guideline • Billing manual • Collection manual

3.4 PROGRESS OF THE PROJECT

(1) Present position

PCM workshop, a baseline survey and organizational capacity assessment have been conducted since the launching of the project activities. The existing regulation, standards, guideline and manuals related to the activities of WSD are largely identified working together with the counterparts. The outline contents are also described in the previous sections of this Chapter 2.

The present position of "Activity 1-3 Formulation of regulation, standards, guidelines and manuals" in the project PDM is shown as the following Figure.

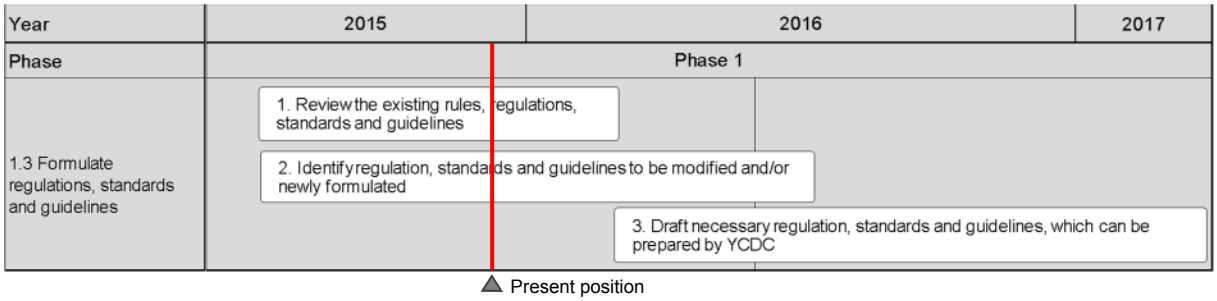


Figure 3.3 Present Position of Activity 1-3 in PDM

(2) Next activity

The first next step is to make a list of necessary regulation, standards, guideline and manuals with putting priority. Since there are various needs to formulate standards, guideline and manuals in the different fields according to the results of the project activities until December 2015, the further discussion and the coordination with other project activities will be held in January 2016.

CHAPTER 4 FINANCE AND UTILITY MANAGEMENT

4.1 BASELINE SURVEY

4.1.1 Budgetary Situation on Water Supply

Yangon City Development Committee (YCDC) is operating the budgetary affairs according to the Union Revenue Fund Program since 1.10.2011. The estimated revenue of the plans which will be implemented by WSD is submitted to Finance Department of Yangon Region through Y.C.D.C (Budget and Accounting Department). Yangon Regional Government analyses it and submits to the Ministry of Finance and Finance Commission. After the budget allocation is approved in the Parliament (Pyithu Hluttaw), Yangon Regional Government issues the revenue and expenditure law and the plans are implemented according to the budget allocation. During the fiscal year, if there are the cases which budget is not enough or needs more budget, they can submit budget proposal again as Revise Estimate (RE). The estimated revenue (including income) and expenditure of the current fiscal year was calculated and planned in the previous year and, Revise Estimate (RE) can be submitted in the middle of the current fiscal year if necessary or need. At the same time, the estimated revenue for the next fiscal year has to be submitted.

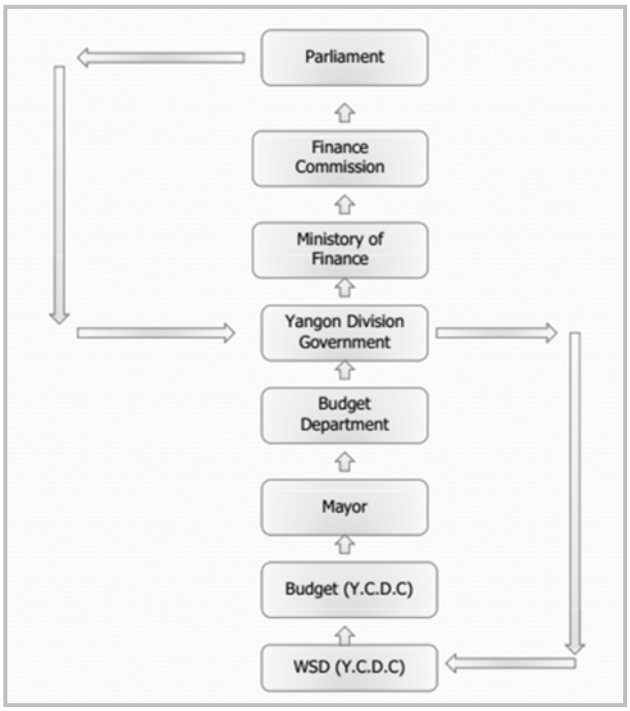


Figure 4.1 Annual Budget Estimation Process

As for financial plan, now, we are making the estimated Budget list for middle-term plan (5 years) and long-term plan (20 Years) and submit it to parliament step by step. Currently we are implementing a long-term plan (20 years) from 2011/12 to 2030/31.
(Expert comments) How about expenditure?

4.1.2 Financial conditions

WSD is collecting the charges in two types as the operating income and capital income and give the charges in to the Budget and Accounting Department of YCDC in two types. Those revenues are checked and analyzed by CE (Chief Engineer: Head of Department) and it is approved by the Mayor. They are giving the operating income in to the Budget and Accounting Department of YCDC in five categories: (1) service charge, (2) rental charges, (3) license fees, (4) general income and (5) others income. The main income of WSD is water charges (tariffs) and it is over 90% of the total income which are included in the service charge category. The operating income from 2006/07 to 2010/11 (for five fiscal years) is shown in the table 4.1. The operating income from 2011/12 to 2015/16 (for five fiscal years) is shown in the table 4.2. The estimated operating income from 2016/17 to 2020/21 (for five fiscal years) is shown in the table 4.3 and the capital income is shown in the table 4.5. Those “five years” is correspond to Union Government’s five-year plan.

The fundamental policies for income and expenditure and financial disciplines have already been pronounced. We are using sixteen forms of departmental account system. Among those sixteen forms, WSD is mainly complying form 5,6,7,8 and 9. Sixteen forms are as follow:

1. Order to establish departmental account

2. Account for estimated three-month cash
3. Establishing cash account of three-month period
4. Registration book for keeping cheque
5. Cash Book
6. Balance sheet of cash book
7. Book of Account for received money from Bank
8. Book of Account for paid money to Bank
9. Table of cash account title
10. Monthly Cash Report
11. Table of monthly cash balance between department and Bank
12. Account table of debt and deposit
13. Cash Book for Sundry expenditure
14. Registration Book for Prepayment
15. Registration Book for Prepayment
16. Registration Book for current account

The regular expenditure of WSD from 2011/12 to 2015/16 is shown in table 4 and the capital expenditure is shown in table 4.6.

(1) Annual operating income

The operating income during 2014/15 accounted for 9.00 billion Kyat indicating a steady annual growth of 2-6%. About 90-95% of income is shared by water sales every year. Other income such as connection fee, rental fees for shop and tenant, and license fee for plumber shares only few percentage of the total.

Operating income of water supply and sanitation department and the trend is shown in the following table.

Estimation for the new financial plan of 2016/17-2020/21 is shown in Table 4. 3. Water charge revenue in 2017/18 and 2018/19 are estimated to increase more than 30 % comparing the previous year. On the other hand, in 2016/17, 2017/18 and 2020/21 its increase are 9%, 3% and 0% respectively.

Table 4.1 Annual Operating Income (2006/07~2010/11)

Account items	2006/07		2007/08		2008/09	
	Million Kyat	(%)	Million Kyat	(%)	Million Kyat	(%)
Water Charge	3849.22	90.1	3966.30	92.1	4065.80	94.2
- Departmental Water Charges	1367.56	32.1	1236.50	28.7	1171.10	27.2
- Public Water Charges	2481.66	58.1	2729.80	63.4	2894.70	67.1
Water Connection	208.44	4.9	198.60	4.7	148.30	3.5
Sales of Water Meters	145.99	3.5	88.90	2.1	43.20	1.1
Rental of Shops and Sites	31.27	0.8	33.50	0.8	34.70	0.9
Plumber Licenses Fees	0.77	0.1	0.70	0.1	0.80	0.1
Road Crossing Charges (Ngamoyeik Toll gate)		0	0.40	0.1		
Other Revenue	37.90	0.9	20.20	0.5	26.70	0.7
Re-pay						
Total	**4,273.59**	100	**4,308.60**	100	**4,319.50**	100

Account items	2009/10		2010/11	
	Million Kyat	(%)	Million Kyat	(%)
Water Charge	4185.90	94.5	4345.80	95.1
- Departmental Water Charges	1117.50	25.3	1094.80	24

- Public Water Charges	3068.40	69.3	3251.00	71.2
Water Connection	122.30	2.8	139.10	3.1
Sales of Water Meters	38.90	0.9	26.41	0.6
Rental of Shops and Sites	33.50	0.8	35.30	0.8
Plumber Licenses Fees	0.70	0.1	0.60	0.1
Road Crossing Charges (Ngamoyeik Toll gate)			1.20	0.1
Other Revenue	52.10	1.2	23.40	0.6
Re-pay				
Total	**4,433.40**	100	**4,571.81**	100

Table 4.2 Annual Operating Income (2011/12~2015/16)

Account items	2011/12		2012/13		2013/14	
	Million Kyat	(%)	Million Kyat	(%)	(%)	Million Kyat
Water Charge	4382.40	93.1	6345.25	95.6	7083.99	93.3
- Departmental Water Charges	1081.91	23	1073.25	16.2	1110.96	14.7
- Public Water Charges	3300.49	70.1	5272.01	79.4	5973.02	78.7
Water Connection	185.76	4	144.61	2.2	217.76	2.9
Sales of Water Meters	16.19	0.4	53.94	0.9	130.00	1.8
Rental of Shops and Sites	44.32	1	29.88	0.5	80.17	1.1
Plumber Licenses Fees	1.34	0.1	1.68	0.1	1.33	0.1
Road Crossing Charges (Ngamoyeik Toll gate)			0.02			
Other Revenue	79.10	1.7	64.87	1	85.38	1.2
Re-pay						
Total	**4,709.12**	100	**6,640.25**	100	**7,598.61**	100

Account items	2014/15		2015/16 (Est.)	
	Million Kyat	(%)	Million Kyat	(%)
Water Charge	8514.79	94.6	8570.70	94.2
- Departmental Water Charges	1608.37	17.9	1500.00	16.5
- Public Water Charges	6906.42	76.7	7070.70	77.7
Water Connection	296.32	3.3	400.00	4.4
Sales of Water Meters				
Rental of Shops and Sites	65.08	0.8	68.00	0.8
Plumber Licenses Fees	1.46	0.1	1.40	0.1
Road Crossing Charges (Ngamoyeik Toll gate)				
Other Revenue	130.19	1.5	59.90	0.7
Re-pay				
Total	**9,007.84**	100	**9,100.00**	100

Table 4.3 Annual Operating Income (Estimate for 5 year plan) (2016/17~2020/21)

Account items	2016/17		2017/18		2018/19	
	Million Kyat	(%)	Million Kyat	Million Kyat	(%)	Million Kyat
Water Charge	9370.70	93.8	9720.70	94	13570.70	95.3
- Departmental Water Charges	1500.00	15	1600.00	15.5	1600.00	11.3
- Public Water Charges	7870.70	78.8	8120.70	78.5	11970.70	84.1
Water Connection	500.00	5	500.00	4.9	550.00	3.9
Sales of Water Meters						
Rental of Shops and Sites	68.00	0.7	68.00	0.7	68.00	0.5
Plumber Licenses Fees	1.30	0.1	1.30	0.1	1.30	0.1
Road Crossing Charges (Ngamoyeik Toll gate)	0.10	0.1				
Other Revenue	60.00	0.6	60.10	0.6	60.10	0.5
Re-pay	(0.10)		(0.10)		(0.10)	
Total	**10,000.00**	100	**10,350.00**	100	**14,250.00**	100

Account items	2019/20		2020/21	
	Million Kyat	(%)	Million Kyat	(%)
Water Charge	17970.70	95.1	17970.70	95.1
- Departmental Water Charges	1600.00	8.5	1600.00	8.5
- Public Water Charges	16370.70	86.7	16370.70	86.7
Water Connection	800.00	4.3	800.00	4.3
Sales of Water Meters				
Rental of Shops and Sites	68.00	0.4	68.00	0.4
Plumber Licenses Fees	1.30	0.1	1.30	0.1
Road Crossing Charges (Ngamoyeik Toll gate)				
Other Revenue	60.10	0.4	60.10	0.4
Re-pay	(0.10)		(0.10)	
Total	**18,900.00**	100	**18,900.00**	100

(2) Annual operating expenditure

Operating expenditure of WSD during recent 5 years is shown in the following table. The operating expenditure of WSD for the period 2014/15 totaled about 13.6 billion Kyat, which has increased by more than 50% in the recent 3 years.

Expenditure mainly consists of material costs/ labor and service costs amounting about 70%, personnel costs amounting 10% and maintenance and repair costs sharing about 17%. The largest costs within the material costs/ labor and service costs is electricity costs amounting 47%, followed by material costs amounting 18%. Electricity cost is approximately equivalent to water tariff revenue.

The sum of labor costs and personnel costs contribute approximately 25% of the total expenditure, which is not at dominant level in comparison to the average level of other developing countries.

Table 4.4 Annual Operation Expenditure (2011/12-2015/16)

Cost Items	2011/12		2012/13		2013/14	
	Million Kyat	(%)	Million Kyat	(%)	Million Kyat	(%)
Salary	740.81	16.50	805.68	11.90	1079.34	11.60
Allowance Salary		0.00	445.93	6.60	433.14	4.70
Labor Charges	393.20	8.80	699.97	10.40	951.33	10.20
Travelling Allowance		0.00		0.00		0.00
Electricity Charges	1832.31	40.80	2528.12	37.40	2864.92	30.60
Petrol & Lubricant	119.71	2.70	114.61	1.70	120.86	1.30
Operating Material	800.00	17.80	746.73	11.10	1603.49	17.10
Printing & Publishing	53.97	1.30	51.27	0.80	56.00	0.60
Materials, repair, maintenance and spare-parts	544.61	12.20	1350.03	20.00	2234.20	23.90
Other	11.59	0.30	34.63	0.60	33.95	0.40
Total	**4496.20**	100	**6776.97**	100	**9377.23**	100

Cost Items	2014/15		2015/16 (Est.)	
	Million Kyat	(%)	Million Kyat	(%)
Salary	1313.61	9.7	1313.61	11.90
Allowance Salary	415.57	3.1	415.57	6.60
Labor Charges	1055.15	7.8	1055.15	10.40
Travelling Allowance				0.00
Electricity Charges	6374.30	46.8	6374.30	37.40
Petrol & Lubricant	72.39	0.6	72.39	1.70
Operating Material	1942.71	14.3	1942.71	11.10
Printing & Publishing	69.97	0.6	69.97	0.80
Materials, repair, maintenance and spare-parts	2342.59	17.2	2342.59	20.00
Other	37.52	0.3	37.52	0.60
Total	**13623.81**	100	**13623.81**	100

(3) Annual capital revenue

Account item of sales of water meters had been categorized as operating income and was altered to categorize as capital revenue in 2011-2012 which is globally accepted accounting practice. Sales of water meters are only one item of capital revenue for WSD. It is estimated to increase more than double in 2020/21.

Table 4.5 Annual Capital Revenue (2014/15~2020/21)

Account items	2014/15		2015/16 (Est.)		2016/17 (Est.)		2017/18 (Est.)	
	Million Kyat	(%)	Million Kyat	(%)	Million Kyat	(%)	Million Kyat	(%)
Sales of Water Meters	296.32	100	400.00	100	500.00	100	500.00	100
Total	**296.32**	100	**400.00**	100	**500.00**	100	**500.00**	100

(Expert Comments) Why is it categorized to different table?

Account items	2018/19 (Est.)		2019/20 (Est.)		2020/21 (Est.)	
	Million	(%)	Million	(%)	Million	(%)

	Kyat		Kyat		Kyat	
Sales of Water Meters	550.00	100	800.00	100	1100.00	100
Total	**550.00**	100	**800.00**	100	**1,100.00**	100

(4) Annual capital expenditure

Capital expenditure such as construction investment costs was financed by internal financial sources of YCDC until September 2011; however, the budget has been allocated from special account of the central government since October 2011. The budget for 2011/12 totaled about 4.47 billion Kyat comprising approximately 97 % for water supply sector and approximately 3 % for sewerage sector. The investment is dominantly allocated to water supply sector.

The budget amount has increased more than 2.3 times during the recent 5 years, the investment in the development of Ngamoeyeik-Hlawga has increased.

The trend of capital expenditure during recent 5 years is shown in the following table.

Table 4.6 Annual Capital Expenditure (2011/12 – 2015/16)

Account items	2011/12	2012/13	2013/14	2014/15	2015/16(Est.)
	Million Kyat	Million Kyat	Million Kyat	Million Kyat	Million Kyat
Extension of Water Supply Pipes	**49.7**	**98.1**	**189.9**	**2243.2**	**4871.7**
Water Supply	**3737.1**	**16273.0**	**32153.4**	**38859.8**	**83367.5**
-Ngamoeyeik-Hlawga	2962.7	14724.4	13299.1	11570.6	31344.7
▪Ngamoeyeik-Hlawga(Commitee)		14724.4	12664.8	9185.5	16419.0
▪Ngamoeyeik-Hlawga(Grants)			634.4	2385.1	14925.7
-Water Supply from Ngamoeyeik Chaung	195.0				
-La Gone Pyin Water Supply			12833.7	22328.2	23651.5
▪La Gone Pyin Water upply(MaSo)(Committee)			12833.7	22328.2	18348.0
▪La Gone Pyin Water upply(MaSo)ODA(Loans)					5303.5
-Water Supply for New Township	40.9	201.9	3350.0	930.4	303.8
-Lakes and Tube Wells	262.5	1096.7	2555.9	3527.2	5257.0
-Hlawga-Yangon (Aung Da Gon)	276.0	249.9	114.6	4.9	183.0
-Ko ko wa River Water Supply				498.4	14327.5
-Phugyee-Yangon Water Supply					8300.0
Sufficient Water Supplles	**790.2**	**956.3**	**1843.5**	**7949.9**	**3564.9**
-Sufficient Water Supply for Downtown	483.9	637.0	732.4	4922.3	2994.9
-Water Service for Upgrading	18.6				
-Production of Water Pipes	287.7	300.0	327.0		
-City High Grade Water Service		19.3	784.1	3027.6	570.0
Sewerage	**138.0**	**199.9**	**166.7**	**241.0**	**227.0**
Waste Water Treatment Plant	**15.7**	**58.5**	**48.8**	**68.5**	**40.0**
Machine			**954.9**	**4.1**	**2.0**
Total	**4730.7**	**17585.9**	**35357.1**	**49366.4**	**92073.0**

(5) Debt services (loan/bond, annual interest payment and re-payment)

- ODA (Grant) JPY 1,900 Million

According to the "Grand Aid Agreement", Myanmar will receive JPY 1,900 million from the Government of Japan for "The Project for Improvement of Water Supply System in Yangon City" which will be implemented by YCDC and JICA. It has been implementing since 2013/14 fiscal year and the

project will finish in 2016/17 fiscal year.

- ODA (Loan) JPY 23,683 million

In 23th July 2015, Myanmar Government signed MOU with the Government of Japan to borrow JPY 23,683 million from the Government of Japan for "Greater Yangon Water Supply Project". The situation of loan which Myanmar government will receive in every fiscal year is as follow:

Year	Amount of Loan
2015/16	319.65 JPY million
2016/17	4253.63
2017/18	9891.67
2018/19	6214.75
2019/20	1373.29
2020/21	922.47
2021/22	194.04
2022/23	513.50
Total	23683.00

For that loan, the interest rate is 0.01% and the interest will be started to pay from 2015/16 fiscal year which begins the loan. After 10 years suspended period, the invested loan will have to be repaid during 30 years – two times in one year. Borrowing loan and repayment of interest/principle is the first experience for WSD.

(Expert Comment) The loan is the first experience in WSD and the payment of interest this year (2015/16) should imply YCDC's water supply management enters the new era of holding huge loan that is normal management in water utilities.

4.1.3 Financial process

(1) Annual financial report making process

Annual report is made by the Budget and Account Department, YCDC and got approval of Yangon Regional Government and submitted to Union Government and Parliament. WSD makes monthly and annual report to the Budget and Account department, but does not much concern about making the annual financial report.

(2) Each expenditure decision process

The respective representatives of each division of WSD submit the estimated calculation of expenditure for pipe maintenance in every township, pipe replacement, pipe extension, pumping machines changing and repairing in pumping machines stations, reservoir maintenance, implementation of La Gun Pyin Projects, performing to supply enough water and water supply from tube-well and the officers of the Financial section analyze the estimated expenditure. Then CE approves it and submits it to the Committee of YCDC.

After receiving the permission from the Committee, the Budget & Account Department disburses 50% prepayment to start the work and the Coordination Department give out the work order. After 50% of work has finished, the Inspection Department checks the work accomplishment and gives out the Completion Certificate (CC), and the Committee office (YCDC) gives out the Administrative Authority (AA). With those AA and CC, the work representatives have to do financial statement with Budget & Account Department and bring out the rest 50% amount for expenditure from Budget and Account Department.

In implementing the projects, the financial authorities are set for more effective performance as the expenditure is very high. For work implementation, CE has the authority to allow up to 2 million of expenditure, the committee members has the authority to allow up to 2.5 million, Joint Secretary has the authority to allow up to 3 million and the Secretary has the authority for 5 million. For over 5 million expenditure, the approval of Committee Chairman (Mayor) and EC (YCDC) is needed.

To buy equipment and materials, CE has the authority to allow up to 0.5 million, the committee members have authority up to 1 million, Joint Secretary has authority up to 1.5 million, Secretary has authority up to 2 million. For buying equipment over 2 million, the approval of Committee Chairman (Mayor) and EC (YCDC) is needed. To buy equipment which costs over 5 million, it has established the procurement group and the procurement group is responsible to buy the equipment in tender system.

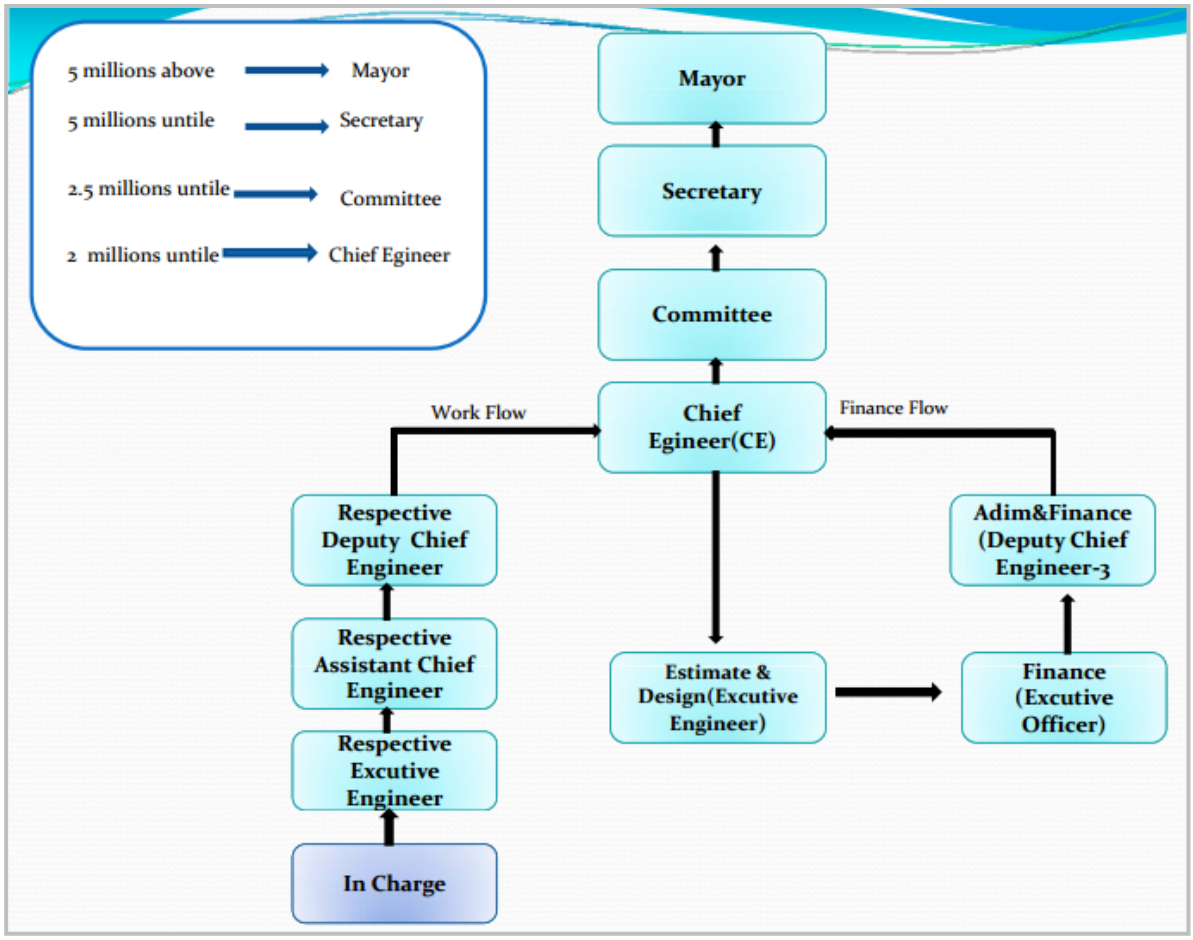


Figure 4.2 Each Expenditure decision process

(3) Expenditure register process

WSD has 7 Sections and is now working with its 7 Divisions. Those 7 Divisions are –

1. Reservoir Division
2. Water Supply Division
3. Mechanical and Electrical Division
4. Supporting Branch Division
5. Finance and Administrative Division
6. Sewerage Division
7. Pipe Factory Division

Buying materials & equipment for each Division is done according to the fundamental disciplines of expenditure of Budget and Accounting Department (Expenditure Section). The accounts are systematically recorded in its titles and every accounts of expenditure for each work is kept in relevant systems.

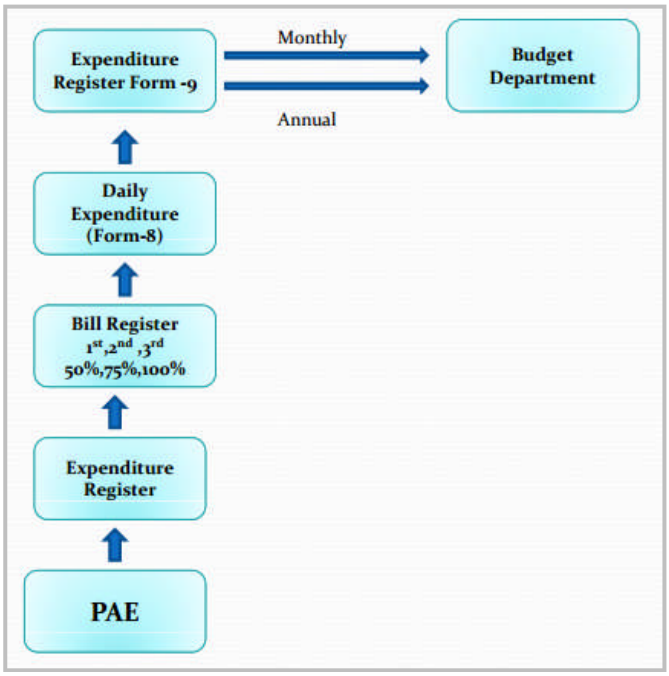


Figure 4.3 Expenditure Register Process

(4) Water tariff rate (Draft) making process

According to the permission of Yangon Regional Government in 2012/13, WSD increased the water tariff rates. For Domestics Flat Rate, WSD increased from 1125 kyats per month to 1800 kyats. For higher class (wide yards), WSD increased from 1875 Kyats to 3000 Kyats. For water meter, domestics is 88 Kyats per one unit and commercial is 110 Kyats per one unit. For water meters used by foreigners, domestics is 440 Kyats per one unit and commercial is 880 Kyats per unit.

(5) Financial plan making process

For the expenditure, the respective officers calculate the estimate cost for the project/work and then it is submitted to CE step by step. CE analyzes the proposal and submits the proposal to Mayor through Budget and Account Department. After getting the approval of Mayor, the proposal is submitted to "Estimate Account of Income and Expenditure Department" of Yangon Regional Government and requests the fund from the Yangon Regional Government.

4.1.4 Water tariff structure (present rate structure)

(1) Tariff Collection Policy

The YCDC directive describes that water tariffs on water supply service shall be basically charged to all customers except customers such as monastery.

In existing practices, the frequency of meter reading and issuing of water bill varies with customer types. For metered customers, meter reading and billing is carried out every month for domestic, and commercial and industries type of customer, once a year for governmental building and factories, and quarterly for foreign exchange customers.

For flat rate customers, as e-Government has introduced and the billing system has changed. Administrative Department and its Township office collect flat rate charges together with Land tax, Land rental Fees. Property tax, waste collection fees are being planned to be integrated to its combined bill. Flat rate billing is conducted quarterly for domestic, and commercial and industries, and once a year for governmental building and factories, and also quarterly for foreign exchange customers.

(2) Current Tariff Structure and Tariff System

YCDC has applied 2 types of tariff structure, namely metered rate system and flat rate system by customer types, ant has intention to expand metered system to whole customers. Flat rate system defines monthly fixed water tariff by customer types. The metered system in YCDC has adapted a simple and clear uniform rate in practice. Main part of current tariff rates have been adopted since April 2012, and a little altered in 2014.

Kyats

No.	Category	1 Unit
1	Domestic (Meter)	88
2	Commercial (Meter)	110
3	FE(House) (Meter)	440
4	FE(Commercial)(Meter)	880
5	Y.C.D.C Staff (Meter)	88
6	Department (Domestic) (Meter)	88
7	Department (Commercial) (Meter)	110
8	Domestic (Flat)	1800
9	department (Flat)	3000
10	FE (Flat)	270,000(for 1 month)

Customers are categorized into 7 groups in metered rate and 3 groups in Flat rate. Department means government residence (No.6) and building & factory (No.7) FE (No.3,4,10) means foreign customers or offices and buildings targeting foreigners. Water tariff of FE used to be collected in US dollars and in 2014 its system has altered to collect in Myanmar Kyat. However, the rate level is set up at rather higher than that of general customers such as domestic, departmental and commercial, etc.

If unit rate for domestic customer between flat rate and metered rate is compared, the tariff rate in case of metered customer is less than 10 yen/ m^3 and flat rate is less than 200 yen/ month for general house and apartment. If we calculate monthly tariff by using this metered rate at the volume of 20 m^3/month, the monthly charge is 1760 Kyat which is still less than flat rate. In the past, the preferential tariff rate was given to governmental customers which is lower than the domestic rates but now it was set at the same level.

(3) Revision of Water Tariff and the Transition

Transition of tariff rates during 12 years, after 2001, is shown in the following Figure. It is observed that tariff rates was raised in 2012 and in 2014 the rates was simplified and understandable for the public as (a) integrated to basic unit price of 88 Kyat/ m3 and 110 kyat/ m3 and (b) unit price of foreigners was set in Myanmar Kyat instead of US$.

Type	Customer		2001	2002	2005	2006	2012	2013	2014	2015	Unit
Metered	General	Household		13.2						88	Kyat / ㎥
		Commercial Commercial		20		77		110		110	Kyat / ㎥
		Construction		13.2		77		110		110	Kyat / ㎥
		Department Building		3.3		55			88	88	Kyat / ㎥
		Factory		3.3		77			110	110	Kyat / ㎥
	FE	Household		0.44 (US$)				440		440	Kyat / ㎥
		Commercial Hotel, Motel, inn, etc		0.88 (US$)				880		880	Kyat / ㎥
Flat	General	Household Ordinary		120		1125		1875		1800	Kyat / month
		High class		120		1875		3000		3000	Kyat / month
		Commercial		135		1575 ~ 57,068		2250 ~ 81,525			Kyat / month
	FE	Household		25							US$ / month
		Commercial		35~ 1,440					27000	27000	Kyat / month
		Hotel, Motel, inn, etc		0.5							US$ / guest /day
		Construction		83.6		155	217	309.6			Kat / sq-m

Figure 4.4 Revision of Water Tariff (2001~2015)

4.1.5 Water tariff billing and collection process

The water tariff income is collected in two types – Departmental Water Charges (DWC) and Pubic Water Charges (PWC). "Department" means governmental organization including governmental factory and corporation. "Public" means general domestic use and general commercial use which is not relating to governmental organization.

In DWC, the domestics are charged 88 kyats for one unit (220 Gallons x 4.546 liter = 1m3). e.g., schools under the Ministry of Education and staff housings and offices under the Ministry of Health. The commercials (factories & industries) are charged 110 Kyats for one unit. e.g., energy distributions under the Ministry of Energy. Now WSD is trying to collect the Departmental water charges in meter system.

For PWC, the water tariffs are collected in Water Metered Rate and Flat Rate. For water metered rate, Township staffs read meters, calculate water tariffs and send the data to Computer Section of WSD. Computer Section print bills and get the approval of issuing bills, bills are given out to Township. In that bill, it includes two parts – notice letter and receipt bill. WSD (township offices) transfer the collected water tariffs into the income section of WSD and WSD give out the receipt (MEMO). The

detailed accounts of water tariffs from all townships are sent to the Budget and Account Department and the department keeps the account of commercial water tariffs and domestic water tariffs month by month.

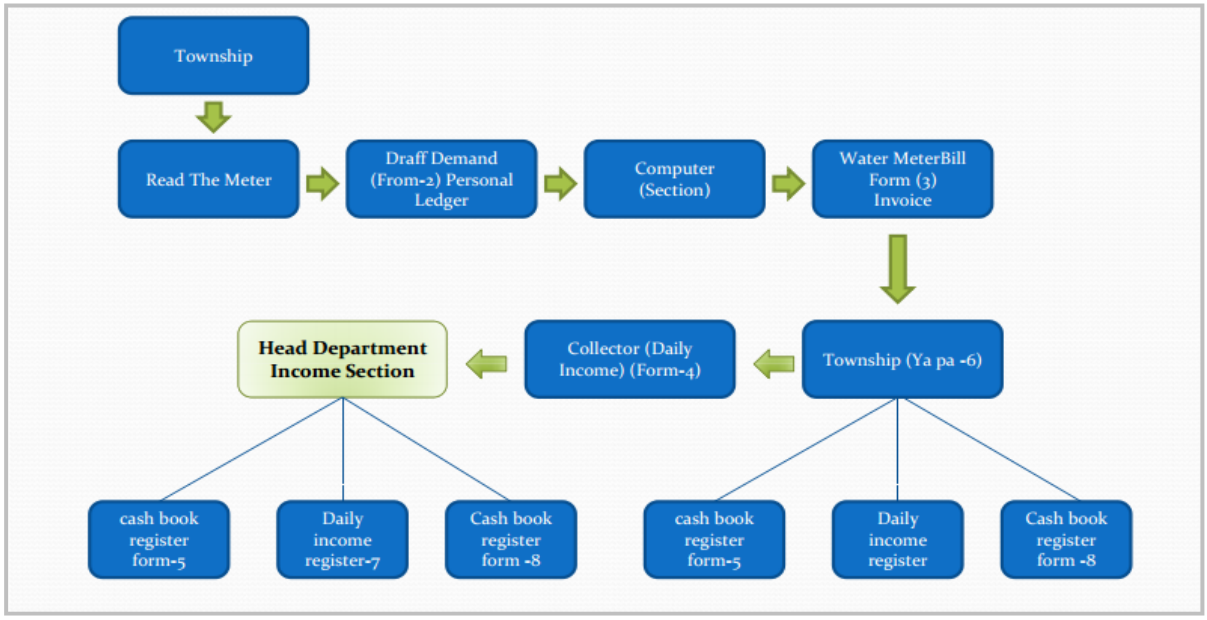


Figure 4.5 Metered Water Tariff Collection and Registration Process

The Flat Rate is charged 1800 kyats. The wide yards & houses (higher class) are charged 3000 kyats per month and the water tariffs are collected once in three-month (quarterly). Flat Rate are collected under the system of e-Government. Combined Bills including Land tax, fees and water flat rate is issued at Administration Department and delivered to Township offices. All payments of water charges are accepted in each Township office of Administration Department and every township office transfers the water charges into the income of WSD under Budget and Accounts Department (YCDC). The water tariff incomes are kept in the detail account of daily income and the account ledger of domestic water charges, and the account of WSD (Township offices), the account in Budget and Account Department (YCDC) and the account of Bill section are checked out whether all accounts are the same or not.

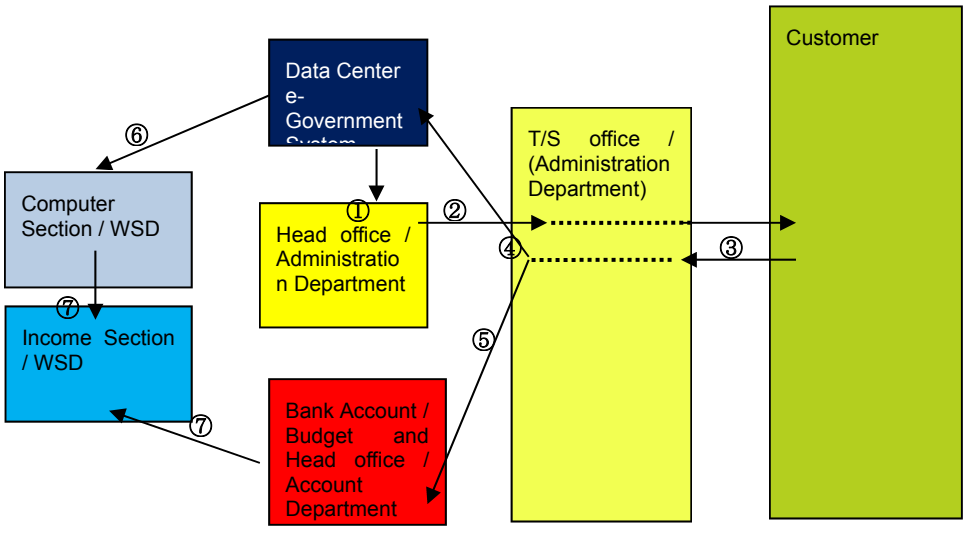


Figure 4.6 Flat Rate Tariff Collection and Registration Process

1. Administration Dep. staff print out water bills (Flat rate customer) by PC terminal using the customer information of Data Center

2. Administration Dep. staff distribute them to T/S office (Adm. Dep).

3. T/S staff (Adm. Dep.) visit customers with water bills and collect money.

4. T/S staff (Adm. Dep.) input receipt information in PC terminal at T/S office.

5. T/S staff (Adm. Dep.) deposit received money to a bank account of Budget and Account Dep. every day.

6. WSD staff of Computer Section confirm tariff revenue contents information by PC terminal at Computer Section and send it to Income section.

7. WSD staff of Income Section get the information of cash revenue from Budget and Account Dep. and confirm the accordance with tariff revenue information.

Main works of Income Section of WSD is to confirm revenue of water tariff which is collected at Township offices.

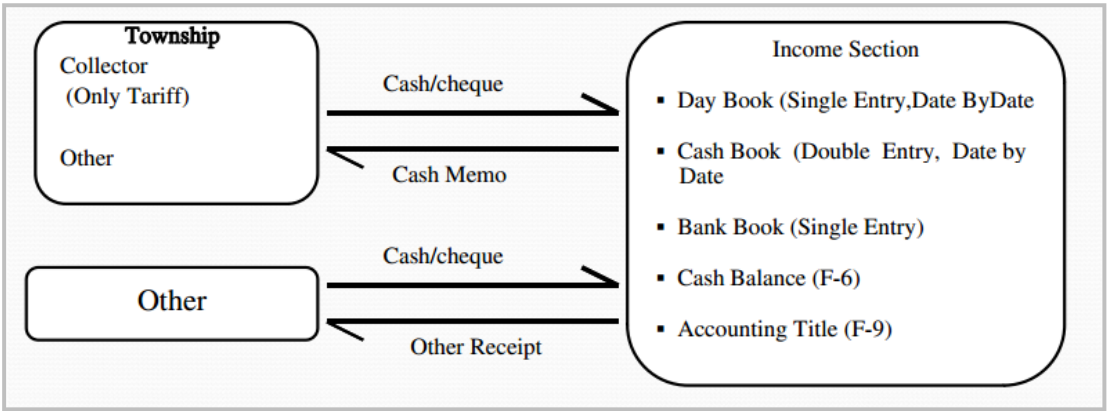


Figure 4.7 Tariff Collection and Registration of Cash Balance

4.2 PCM WORKSHOP RESULT

4.2.1 Problem Analysis

WSD does not receive full charges from the customers because, in the water supply of WSD (YCDC), WSD cannot distribute water full time and daily and WSD's water distribution cannot cover the demand of the customers' need. WSD's water tariff rate is so low if compares with other countries' rate. WSD has weak points in controlling NRW systematically and also faces difficulties to increase water rate. Thus, the imbalance exists between Revenue and Expenditure of WSD and WSD is facing the problem that the expenditure is more than income.

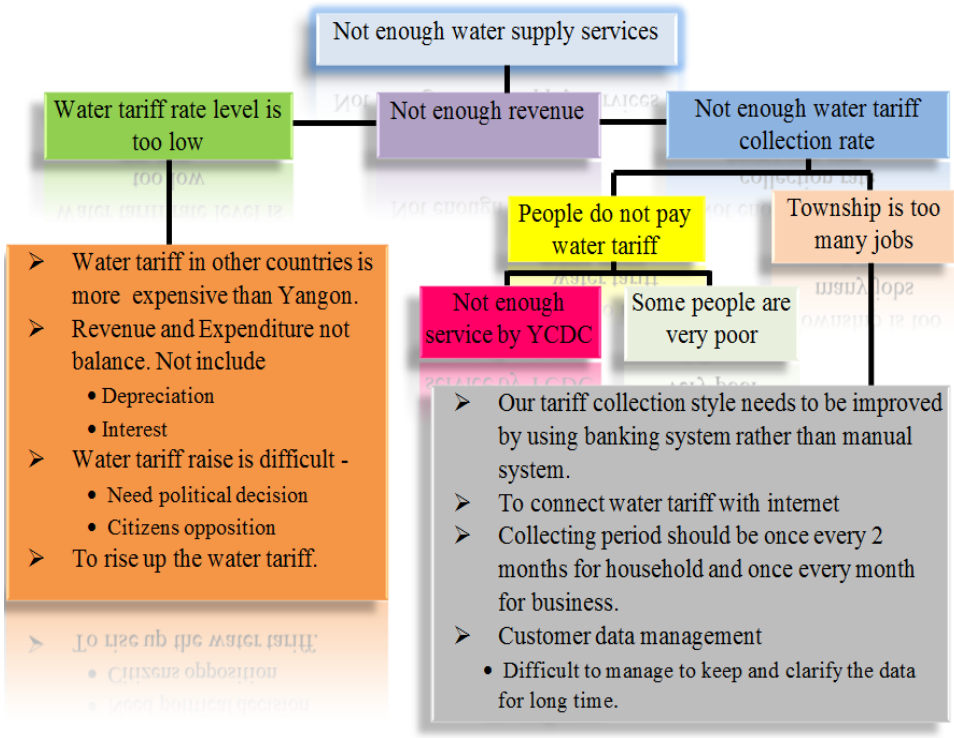


Figure 4.8 Problem Analysis

4.2.2 Objective analysis

WSD could set a little bit higher rate or could increase water rate if WSD can establish a better water supply system for the public and can distribute purified water enough. To receive full water charges, the water connection with flat rate should be transformed into water meter and collected water tariffs. The laws, rules and regulations concerning with used water and collecting water charges needs to be adapted in accordance with time and circumstance. The awareness activities should be done so that the public can understand the value of water, waterworks/ water supply and wasting water, and also recognize the increase of water rate. If do so, it will be a support to increase water rate.

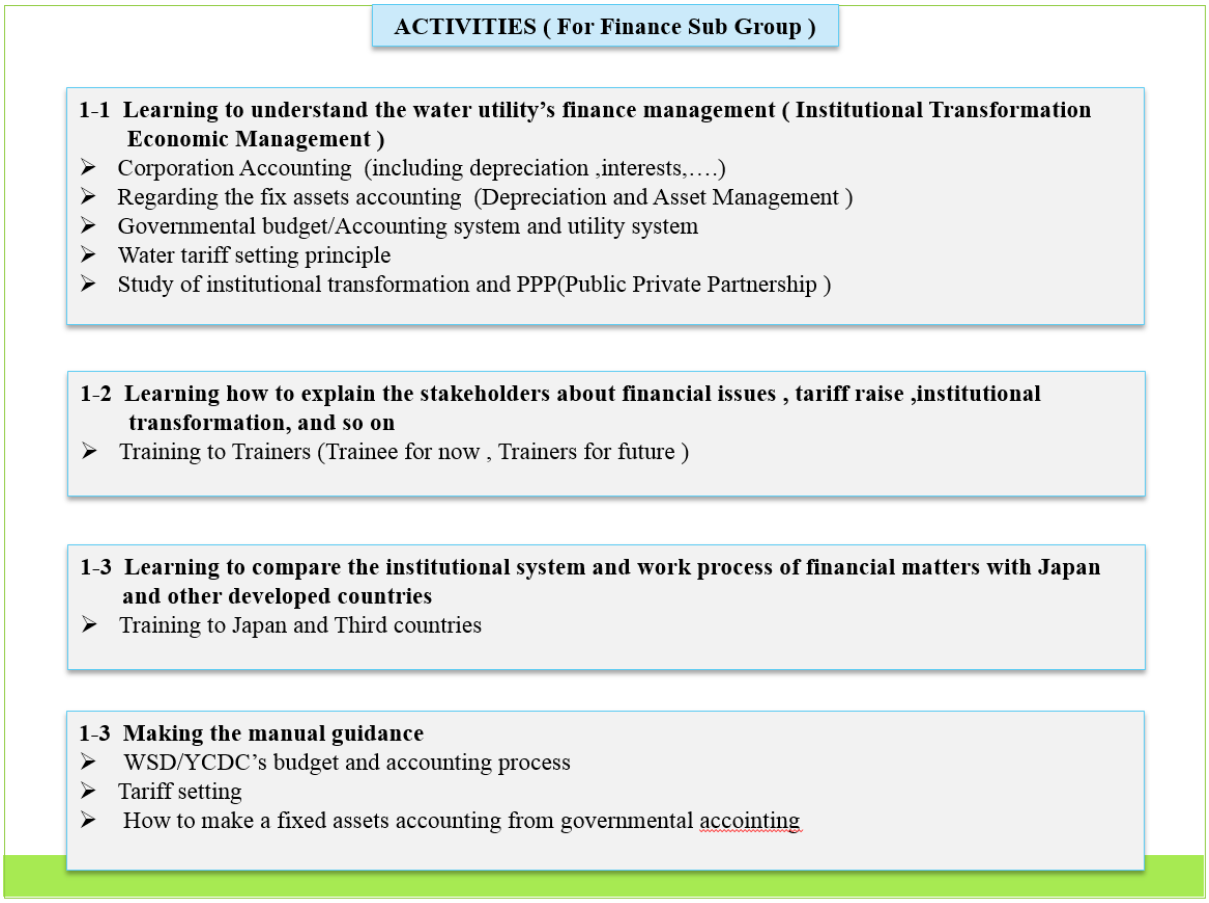


Figure 4.9 Objective Analysis

4.3 CAPACITY ASSESSMENT

4.3.1 Result of assessment

(1) Technical capacity Assessment (Organizational Level)

The result of technical assessment on organizational level revealed that Financial Section of WSD has rather weak point on institutional affairs of water utility, water tariff setting, corporate accounting system and Budget management. Financial plan and Capital finance and office management look average level.

As water supply is managed as a "public works" in YCDC, and its account is not independent but is involved in the general account of YCDC, its management is ambiguous regarding financially self-sufficient. Staff members of WSD are not familiar with water utility management that is managed under independent account and self-sufficient tariff setting.

The assessment result shows the typical situation of YCDC's water supply management. When YCDC' water supply is managed as independent and self-sufficient utility, then staff member may get familiar with all these items and get more higher point.

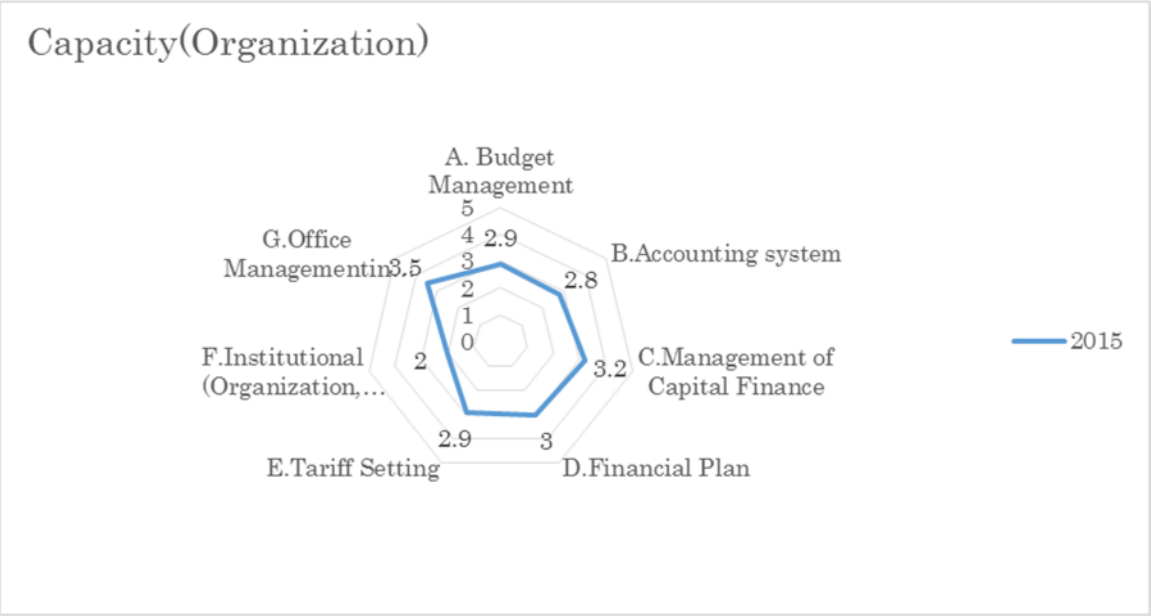


Figure 4.10 Result of Technical Capacity Assessment (Organizational Level)

Table 4.7 Technical Capacity Assessment Questionnaire (Organizational Level)

Category	Items
A. Budget Management **- Is the existing budget system (process) suitable for enhancing water supply situation in Yangon city?**	A1: Does WSD/YCDC have manuals and/or SOPs and they work (function) well at the workplace? (in Budget system)
	A2: To what degree WSD/YCDC is interested in independent management (separate from general budget of YCDC), and has already implemented some measures towards such directions? (in Budget system)
	A3: To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions?
	A4: To what degree WSD/YCDC is interested in overall financial balance which includes capital costs like depreciation (or repayment of loans/bonds) and interest, and has already implemented some measures towards such directions?
	A5: Does WSD/YCDC have a good budget control system to be an efficient and effective water supply utility?
	A6: Does WSD/YCDC have any improvement program for budget management system and does it functions (works) efficiently?
	A7: To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?
B. Accounting system **- Is the existing accounting system suitable for enhancing water supply situation in Yangon city?**	B1: Does WSD/YCDC have manuals and/or SOPs and they work (function) well at the workplace? (in Accounting system)
	B2: To what degree WSD/YCDC is interested in independent accounting system of water supply, and has already implemented some measures towards such directions? (in Accounting system)
	B3: To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions? (in Accounting system)
	B4: Now WSD/YCDC implement government style accounting (single-entry bookkeeping), and to what degree WSD/YCDC is interested in double-entry bookkeeping system, and has already implemented some measures towards such directions? (in Bookkeeping system)
	B5: To what degree WSD/YCDC is interested in introduction of depreciation and fixed asset accounting, and has already implemented some measures towards such directions?
	B6: To what degree WSD/YCDC is interested in overall financial balance (including interest and repayment of loan/bond), and has already implemented some measures towards such directions?

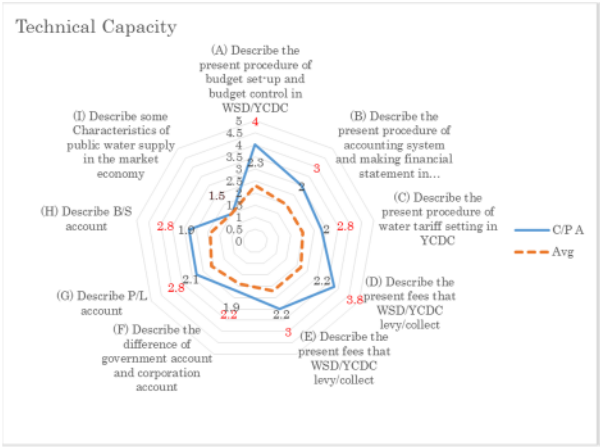
	B7: To what degree WSD/YCDC is interested in overall cash management, and has already implemented some measures towards such directions?
	B8: To what degree WSD/YCDC gets information about revenues relating water services? (water tariff, connection fee, …..?)
	B9: To what degree WSD/YCDC gets information about expenses relating water services? (salary, electricity fee, chemicals, stationery, pipes, valves, meters, …..?)
	B10: To what degree WSD/YCDC is interested in independent annual financial report of water supply, and implements some measures towards such directions? (in Annual report)
	B11: Does WSD/YCD have any improvement program for accounting system already and does it functions (works) efficiently?
	B12: To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement improvement program?
C. Management of Capital Finance **- Is the existing capital finance system suitable for enhancing water supply situation in Yangon city?**	C1: Does WSD/YCDC have manuals and/or SOPs and they work (functions) well at the workplace? (in Management of Capital Finance)
	C2: To what degree WSD/YCDC is interested in independent capital investment budget of water supply (which includes both capital investment and its financial resources), and has implemented some measures already towards such directions? (in Budget system)
	C3: To what degree WSD/YCDC is interested in independent capital investment account of water supply (which includes both capital investment and its financial resources), and has implemented already some measures towards such directions? (in accounting system)
	C4: To what degree WSD/YCDC gets information about capital investment expenses relating water services? (construction costs for replacement/rehabilitation, expanding, upgrading facilities, salary, electricity fee, stationery, pipes, valves, meters …..?)
	C5: Does WSD/YCDC gets all information regarding self savings, Government's subsidy, Loan from domestic bank, foreign/international grant aid, foreign/international loan, PFI
	C6: Does WSD/YCDC gets all information regarding debt services (repayment and interest for loan and/or bond) and including it on the capital finance management
	C7: Does WSD/YCDC have a capital improvement program which includes capital investment and their financial resources, and forecast of middle-term and long-term balance of expense and income. The program shall include not only new construction for expanding area but also include construction of replacement, rehabilitation, and upgrading existing facilities.
	C8: Does WSD/YCDC have any improvement program for management of capital finance system already and does it functions (works) efficiently?
	C9: To what degree the management cycle (Plan -Do-Check-Act) has been introduced already to implement improvement program?
D. Financial Plan **- Is the existing financial planning system suitable for enhancing water supply situation in Yangon city?**	D1: Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Financial Plan)
	D2: To what degree WSD/YCDC is interested in independent and self-sufficient in finance, or WSD has implemented already some measures towards such directions? (in financial plan)
	D3: Does WSD/YCDC have annual, mid-term plan and long-term financial plan already and they work (functions) well at the workplace?
	D4: Does WSD/YCDC's financial plan includes various plans (Construction plan, Replacement plan, O&M plan, Personnel plan (staff position plan), Cost efficiency plan (costs-cut, save energy, etc.)) which concerns expenditures and incomes, Those plan forecast of middle-term and long term balance of expense and income.
	D5: Does WSD/YCDC have monitoring system for assessing the result of financial plan using Performance indicators.
	D6: Does WSD/YCDC have public and customer communication tools and implement such activities?
	D7: To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement financial plan?
E. Tariff Setting **- Is the existing**	E1: Does WSD/YCDC have manuals and/or SOPs and they work (functions) well at the workplace? (in Tariff setting)
	E2: To what degree WSD/YCDC is interested in beneficiary pay principle or WSD has implemented already some measures towards such directions?

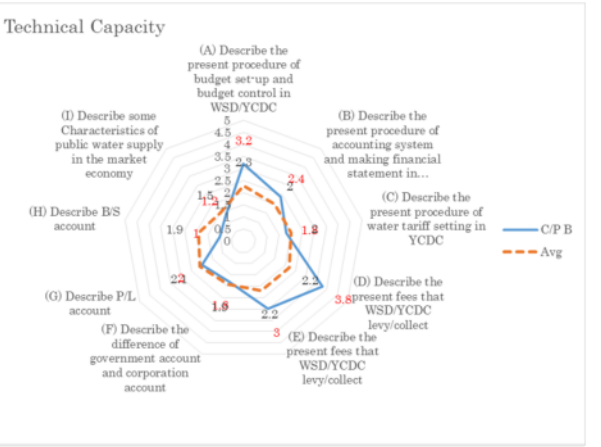
tariff setting system suitable for enhancing water supply situation in Yangon city?	E3: To what degree WSD/YCDC know that each customer pay all costs which used to supply water (provide service) to the customer (individual cost of service principle) or to each customer pay more/less costs which used to supply water (provide service) to the customer (cross-subsidies)
	E4: To what degree WSD/YCDC recover full costs; recover depreciation expenditure, recover interests?
	E5: To what degree WSD/YCDC is interested in customers' affordability to water tariff, or WSD/YCDC has implemented already some measures towards such directions?
	E6: To what degree the management cycle (Plan -Do-Check-Act) has been introduced to implement in tariff setting?
F. Institutional (Organization, Governance) Arrangement- Is the existing institutional (organizational, governance) system of YCDC suitable for enhancing water supply services in Yangon city?	F1: To what degree WSD/YCDC has been interested in independent and/or self-sufficient utility, or WSD/YCDC has implemented already some measures towards such directions?
	F2: To what degree WSD/YCDC is interested in the management style such as government style, corporation style etc, or WSD/YCDC has already implemented some discussion/survey about management style?
	F3: To what degree WSD/YCDC is interested in private sector involvement, or WSD has implemented already some measures towards such directions?
	F4: To what degree WSD/YCDC is interested in organization structure such as centralized or de-centralized, or WSD/YCDC has already implemented some discussion/survey about this topic?
	F5: To what degree WSD/YCDC is interested in separation of policy and operation in water supply organization, or WSD/YCDC has already implemented some discussion/survey about this topic?
	F6: To what degree WSD/YCDC is interested in vertical separation (separate distribution from production and make an independent department) and/or horizontal integration (merge outside YCDC area) of water utility, or WSD/YCDC has already implemented some discussion/survey about this topic
G. Office Management in Finance section and relating section **- Is the existing office management is suitable for enhancing efficiency of office**	G1: Does WSD/YCDC have the clear job description of individual members in Financial Division/Section and does it functions (works) efficiently?
	G2: Does WSD/YCDC have reference documents (Law, Regulation, By-law Guideline, Standards) and all staff members can easily find around their desks, and efficiently functions (works)?
	G3: Does WSD/YCDC have manuals and/or SOPs and staff members can find them easily around their desks, and efficiently function (work)?
	G4: Does WSD/YCDC have the-state-of-the-art IT equipment and does it functions (works) efficiently?
	G5: Does WSD/YCDC have any improvement program for office management for Financial Division/section and does it functions (works) efficiently?
	G6: To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?
	G7: Does WSD/YCDC have the improvement plan of office management in accordance with WSD office moving to the new building in 2016

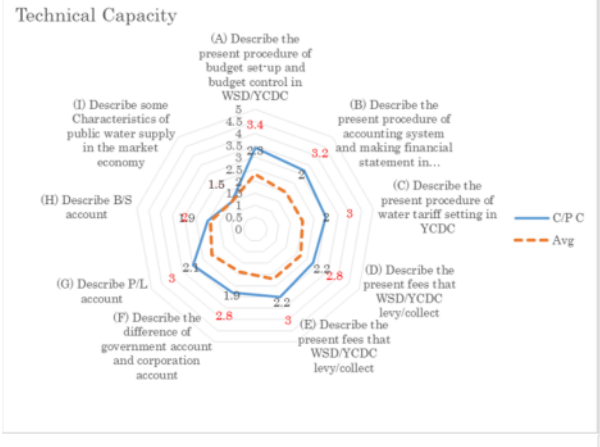
(2) Technical capacity Assessment (Individual Level)

The result of individual staff of Financial Section assessment revealed the same tendency of the result of organization level. The reason may be the same as mentioned there.

To look into the variance of each staff member, some are young and have less experience and small round results is typical, that means all items marks low scores. Some have longer experience and marks rather higher scores but some weak points are revealed same as organization's tendency.


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in WSD/YCDC
(B) Describe the present procedure of accounting system and making financial statement in...
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation account
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
C/P A
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in WSD/YCDC
(B) Describe the present procedure of accounting system and making financial statement in...
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation account
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
C/P B
Avg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(G) Describe P/L account
(H) Describe B/S account
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C/P C
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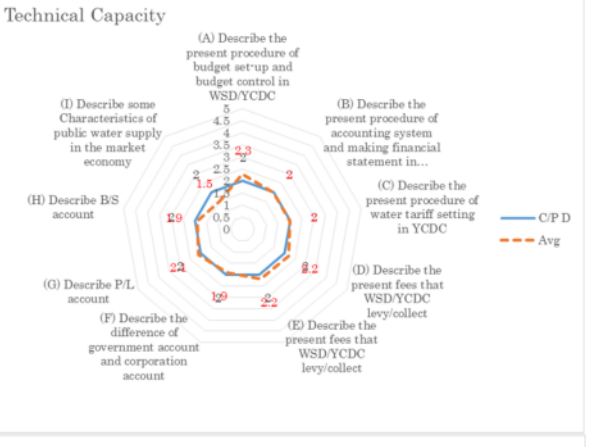
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(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
C/P D
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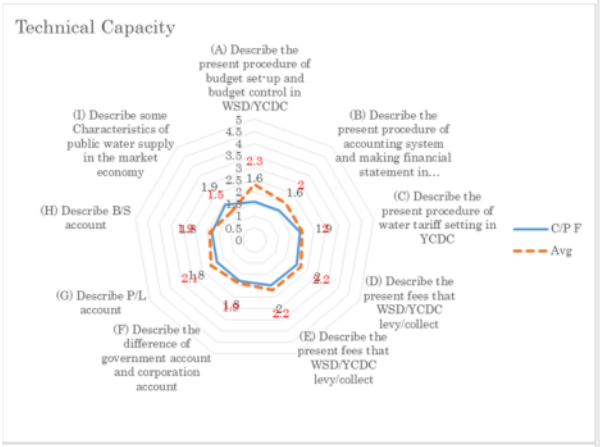
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C/P F
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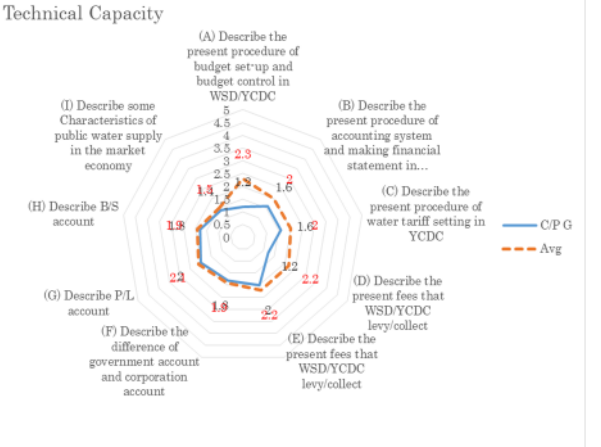
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(I) Describe some Characteristics of public water supply in the market economy
C/P G
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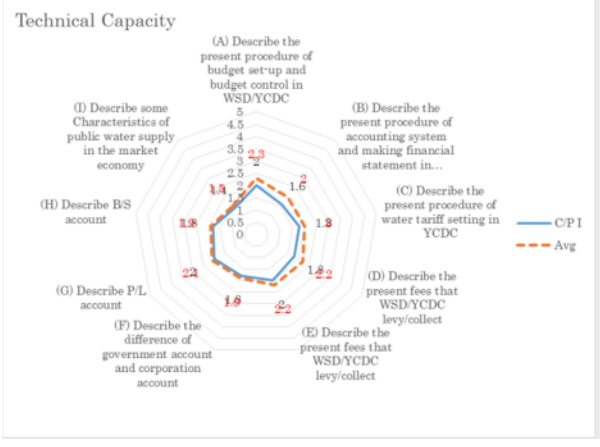
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(G) Describe P/L account
(H) Describe B/S account
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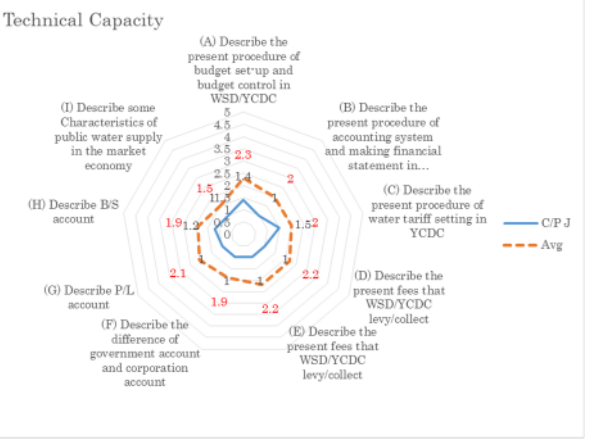
C/P I
Avg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C/P J
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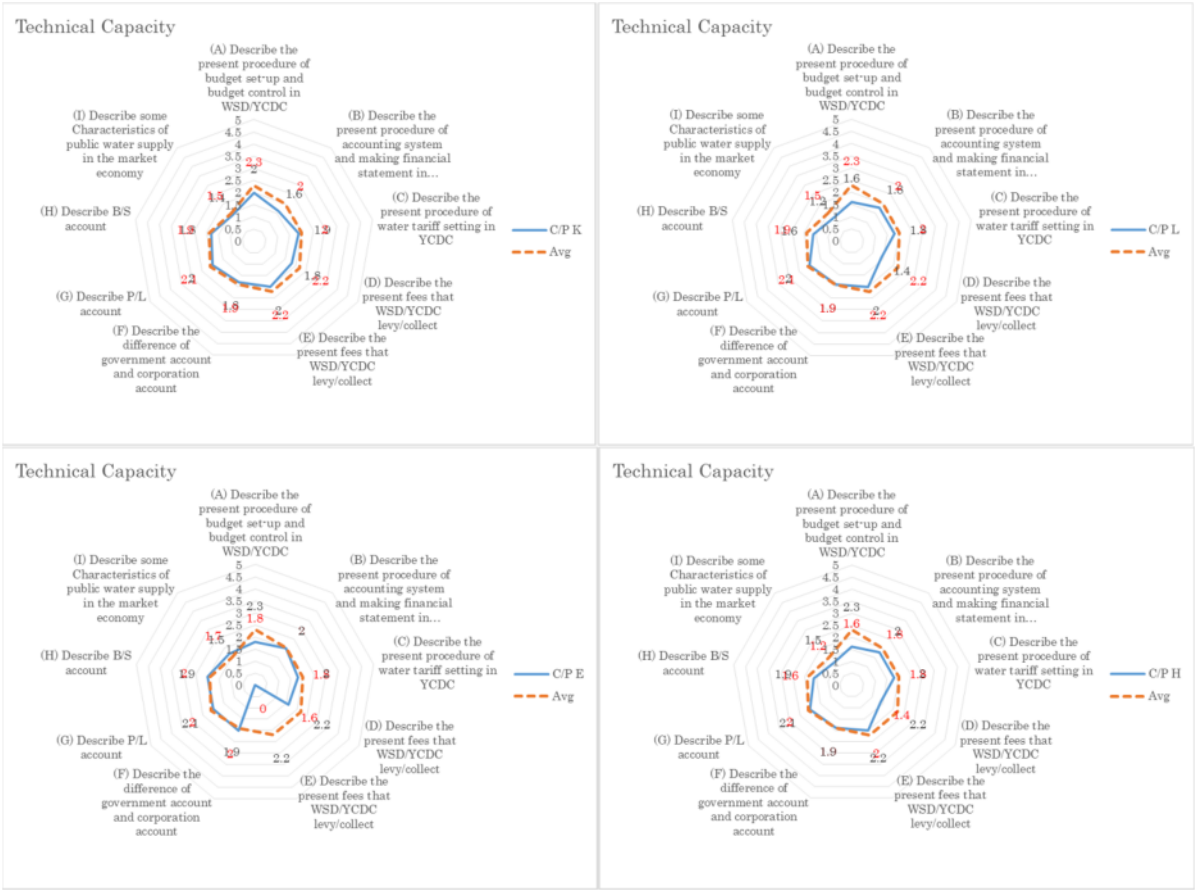


Figure 4.11 Result of Technical Capacity Assessment Questionnaire (Individual Level)

Table 4.8 Technical Capacity Assessment Questionnaire (Individual Level)

Category	Items
A. Describe the present procedure of budget set-up and budget control in WSD/YCDC	A1: Can you describe the procedure of annual budget set up and budget control on expenditure in WSD/YCDC? It may include all sections of WSD and Budget Department of YCDC, the Regional Government and the Central Government.
	A2: Can you describe the legal and regulatory background of budget set up and budget control in WSD/YCDC and do you know the decision makers about budget at each step clearly?
	A3: Can you describe how and why the system of budget has been changed for these 10, 20 or 30 years?
	A4: Can you describe some characteristics about budget system in YCDC comparing other governmental budget system or private organization's budget system?
	A5: Can you describe on-going renovation/reform plan/scheme(s) of budget system in YCDC, and/or do you have any idea to improve budget system in WSD/YCDC in the future?
B. Describe the present procedure of accounting system and making financial statement in WSD/YCDC	B1: Can you describe the procedure of accounting and making financial statements at the end of fiscal year in WSD/YCDC? It may include all sections of WSD and other Department of YCDC, the Regional Government and the Central Government.
	B2: Can you describe about legal and regulatory background of accounting and making financial statements of WSD/YCDC and do you know the decision makers about accounting and making financial statements?
	B3: Can you describe how and why the system of accounting and making financial statements has been changed for these 10, 20 or 30 years?
	B4: Can you describe some characteristics about accounting and making financial statements system in YCDC comparing other governmental system or private organization's system?

Category	Items
	B5: Can you describe on-going renovation/reform plan/scheme of accounting system and making financial statements in YCDC, and/or do you have any idea to improve them in WSD/YCDC in the future?
C. Describe the present procedure of water tariff setting in YCDC	C1: Can you describe the procedure of tariff setting (both metered rate and flat rate) in YCDC? It may include all sections of WSD and other Department of YCDC, the Regional Government and the Central Government.
	C2: Can you describe the difference between metered rate customers and flat rate customers regarding customer services provided by YCDC.
	C3: Can you describe the difference between customers who get the 24/7 water supply and customers who get the intermittent water supply in the aspect of water tariff?
	C4: Can you describe the legal and regulatory background of tariff setting, and do you know the decision makers about tariff setting clearly?
	C5: Can you describe how and why the system of tariff setting has been changed for these 10, 20 or 30 years?
	C6: Can you describe some characteristics about tariff (price) setting system in YCDC comparing other governmental system or private organization's system?
	C7: Can you describe on-going renovation/reform plan/scheme of tariff setting system in YCDC, and/or do you have any idea to improve it in YCDC in the future?
D. Describe the present fees that WSD/YCDC levy/collect	D1: Can you describe fees that WSD/YCDC levy/collect from customers/ plumbing companies/ owners of land or building/ citizens regarding water supply services?
	D2: Can you describe the legal and regulatory background of such fees, and do you know the decision makers about fees setting clearly?
	D3: Can you describe how and why the system of such fees have been changed for these 10, 20 or 30 years?
	D4: Can you describe some characteristics about fees in WSD/YCDC comparing other governmental system or private organization's system?
	D5: Can you describe on-going renovation/reform plan/scheme of fee system in YCDC, and/or do you have any idea to improve it in YCDC in the future?
E. Describe the present fees that WSD/YCDC levy/collect	E1: Can you describe the meaning of the following figure/illustration which appears in the web-site of YCDC (English version) as "Facts about YCDC"?
	E2: Can you describe how YCDC can move to "Desirable Circle"? Have you ever think about it?
F. Describe the difference of government account and corporation account	F1: Can you describe the difference of government account and corporation account especially on Double-Entry bookkeeping and Single-Entry bookkeeping?
	F2: Can you describe the difference of government account and corporation account especially on concept of depreciation of fixed (capital) assets?
	F3: Can you describe the difference of government account and corporation account especially on the separation of expenditures for fixed assets (capital) account and expenditures for P/L account?
	F4: Can you describe the difference of government account and corporation account especially on the accrual versus cash account? (When expenditures and revenues are recorded? Cash move or contracts are signed?)
	F5: Can you describe the difference of government account and corporation account especially on the separation of expenditures for fixed assets (capital) account and expenditures for P/L account?
	F6: Can you describe the difference of government account and corporation account especially about the cash flow account? Can you describe why cash flow account is required in corporation account and can describe what is it?
	F7: Can you describe the main purpose of government account and that of corporation account? Can you describe the difference of purpose and the reason?
G. Describe P/L account	G1: Can you describe what abbreviation of P/L stands for and describe some items P/L account includes?
	G2: Can you describe how to put P/L account items in order to calculate profit?
	G3: Can you describe what kind of information we get from P/L account statement?
	G4: Can you describe some differences between governmental enterprise's P/L account and private corporation's?

Category	Items
	G5: Can you describe some methods of depreciation that are used in P/L account?
H. Describe B/S account	H1: Can you describe what abbreviation of B/S stands for and describe some items B/S account includes?
	H2: Can you describe how to put B/S account items in order to make B/S account statement?
	H3: Can you describe what kind of information we get from B/S account statement?
	H4: Can you describe how to write down on the B/S account when you construct a purification plant?
	H5: Can you describe if a government institution like YCDC introduce B/S account what kind of difficulties they encounter?
I. Describe some Characteristics of public water supply in the market economy	I1: Can you describe how price of bottled water is fixed in the competitive market economy?
	I2: Can you describe how efficient allocation of goods and services is achieved in market economy? Have you ever learned the meaning of marginal cost?
	I3: Can you describe how price of goods or services in monopolistic industries like public water supply services should be fixed or decided?
	I4: Can you describe the meaning and concept of "cost of service" which is introduced in monopolistic industry like public water supply services?
	I5: Can you describe the meaning and concept of "self supporting system (self sufficient system)" which is introduced in the governmental enterprise such as governmental water supply enterprise, governmental electricity supply, governmental transportation system, governmental city gas supply, so on.
	I6: Can you describe the meaning and concept of "beneficiary pay principle (polluter pay principle)" which is introduced in the governmental services such as

4.3.2 Achievement state/Expected outcomes in capacity development (phase 1&2)

<u>To keep the following long term targets in mind both Experts and Counterpart and implement the project of phase 1 & 2</u>

- A road to sifting to an independent and financially self-sufficient utility is developed.
- Water tariff rates are set at full cost principle (total revenues = total costs) and cost of service principle (each unit price = each unit costs).
- The waterworks introduce P/L (profit and loss) account and B/S (balance sheet) account.
- The system of water billing, collection and customer services is efficient and effective enough comparing with waterworks in surrounding countries based on ICT (information and communication technology).

<u>Achievement stare of the project (phase 1 & 2)</u>

1. Independent and financially self-sufficient utility
   - Water utilities' management concept and principle are understood and other water utilities' management style is learned.
   - What YCDC should do in utilities' management is understood by top management.
   - An appropriate budget and financial plan is developed and improvement of business is initiated.
   - The utilities management and plan is shared with the staff.
2. Water tariff rates
   - Water utilities' financial management theory is understood.
   - What YCDC should do in financial management is understood.
   - These are shared with the staff through training course.
3. P/L and B/S account
   - Water utilities' account system is learned.
   - The financial conditions are understood.

- What YCDC should do in account system is understood.
- These are shared with the staff through training course.
- Preparation of assets account (assets ledger) for B/S starts

New activities proposal (request for a new Expert)

4. Establish efficient and effective billing and collection system
   - Commercial Division is established.
   - The improvement of billing and collection system is carried out in a pilot township.
   - An expansion plan of the pilot project to 31 townships is prepared.
   - The expansion plan is implemented through IT training to staff members of 31 townships.

4.4 SUMMARY OF MAJOR ISSUES

(1) Water supply in Yangon shall be self-sufficient water supply utility.
At present, water supply by YCDC is managed as public work. As the market economic in Myanmar has been progressing, water supply also shall be transformed to be self-sufficient in accordance with economic transition. It is the principle of efficient and effective management of water supply.

(2) Water supply management shall have an independent account in YCDC
YCDC should have an independent account of water supply management. It is the big step for self-sufficient water utility management.

(3) Asset account shall be established
To introduce independent account, making asset account is the beginning. Water supply utility has a lot of facilities, and to maintain them in good condition efficiently is the key of water utility management. Asset management is required.

(4) Clear rate making method on water tariff shall be established
In the market economy, water tariff shall be set in economical principle. Clear rate making method shall be introduced.

(5) Decentralization of authority is required for faster and precise decision making
Water supply is managed by municipal responsibility in the most of countries. In accordance with the progress of market economy, central government's role shall be to make policy, laws/regulation and support instead of direct orders/approvals. Also inside of the local entity, more responsibility shall be put on the head of utility for its independent and efficient management. In YCDC, decision authority of each officer is rather small. Bigger authority shall be delegated to lower officer.

(6) Customer Division shall be established and more efficient work process in water tariff billing and collecting shall be introduced
Working procedure of water tariff billing, collecting and customer information system in YDCD is rather inefficient comparing with other countries. Especially, most of works have done manually in YCDC which is uncommon in such a big water utility like YCDC. It shall be done more efficiently and effectively by using IT technology. In order to make the works smoothly Customer Division shall be established.

<Supplement by Counterparts >

(1) The fixed assets lists of the YCDC are requested at the end of the financial year in March. WSD also send/submit the lists. To specify the depreciation rate for those fixed assets, some of the used facilities have no depreciation rate. WSD keep the record of asset registrations but it doesn't include depreciation. Thus, the Asset Account cannot express the current situation. The true and accurate accounts can help the future to be benefit. Therefore, all Finance staffs and officers under WSD

should be given the training of Asset Account.

(2) It is difficult to calculate costs and rates because there is no meter in some free water connections and there are a lot of wasting water as it is free. If all houses are set with meters, WSD could calculate all accounts concerning with water supply and could plan the projects for better water supply and could receive more water tariffs income.

(3) In the current situation, WSD's expenditure is more than the income. The expenditure exceeded more than the income of WSD has to depend on the income of other departments of YCDC.

(4) For better situation and improvement on Water Tariff Billing and Collecting Procedure, the current producer is needed to be analyzed and we should plan the trainings for capacity improvement of staffs and applying what they learnt in job.

4.5 PROGRESS OF THE PROJECT

4.5.1 Performance indicators

The purpose of performance indicators (PIs) is to monitor the activities which shall be implemented according to a plan. To find PIs is one step of using "Management cycle, Plan-Do-Check-Act".

So far, in WSD/YCDC, there is not the systematic financial PIs. As water supply of YCDC is managed as public works and its account is included in the governmental general account, then its PIs' characteristics shall be different of other water utilities. However, some PIs may be useful by formulating systematically and monitoring the activities of water supply. Such PIs shall be looked for and be used. To challenge it for searching more efficient management.

Counterparts pointed out some point as followings.

- Expenditure is more than the income.
- At present,we must spend the money,that's why we have to make more income.
- To get more income,there are **two main point** that we have to perform.
  1. The first one is to increase the water tariff rate.
  2. To get the water charges.
- To reduce the expenditure and try to find the way to get more income

Toward Finance Monitoring

- For the Finance Section ,account receivables are the basic one.
- Old year account receivables are found mostly.
- To check and make the bill printout for the household which don't pay the water charge.
- Need a good management for the staff.

Engineering Department (Water& Sanitation) (June /2015-2016)

(kyat -Millions)

No	Performance Indicators(Pls)	Amount	Amount
1	2	3	4
	Total Operating (Billed)Revenues for water(LC/year)		
1	**Water Revenue**		**775.249**
	Departmental Water Charges		108.080
	Public Water Charges		667.170
	- Residential(Flate)	115.741	
	- Residential(Meter)	286.998	
	-Industrial & Commercial	175.731	
	-FE	88.700	
2	**New/reconnection**		**93.352**
3	**Deposit**		-
4	**Other**		**55.472**
	-Sales of Water meters		42.689
	-Rental of Shops and Sites		6.127
	-Plumber Licenes Fees		
	-Road Crossing Cherges		0.014
	-Other income		6.642
	Total (Revenue)		**924.074**
	Total Operational expenses for water (L/C year)		
1	**Salary**		**188.346**
2	**Labour Charges**		**86.607**
3	**Electricity Charges**		**499.539**
4	**Pertrol& Lubricant**		**2.226**
5	**Printing& Publishing**		
6	**Maintenance & Repairs**		**253.366**
7	**other**		**6.371**
	-Stamp& Telecommunication		0.061
	- Operating Material		6.310
	Total(Expenses)		**1036.455**
	Financial Balance		**-112.380**

Sales

No.	Performance Indication
1	**Number of connections (end of the month)**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
2	**Number of Metered connections**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
3	**Number of non-metered connections**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
4	**Number of Bills Delivered**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others

Sales

No.	Performance Indication
5	**Amount of bills delivered**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
6	**Nunber of Bills Paid**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
7	**Outstanding amount**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others
8	**Metered Consumption**
	Residential
	Commerical&industrial sector
	Departmental
	FE
	Others

CHAPTER 5 ORGANIZATION AND HUMAN RESOURCES MANAGEMENT

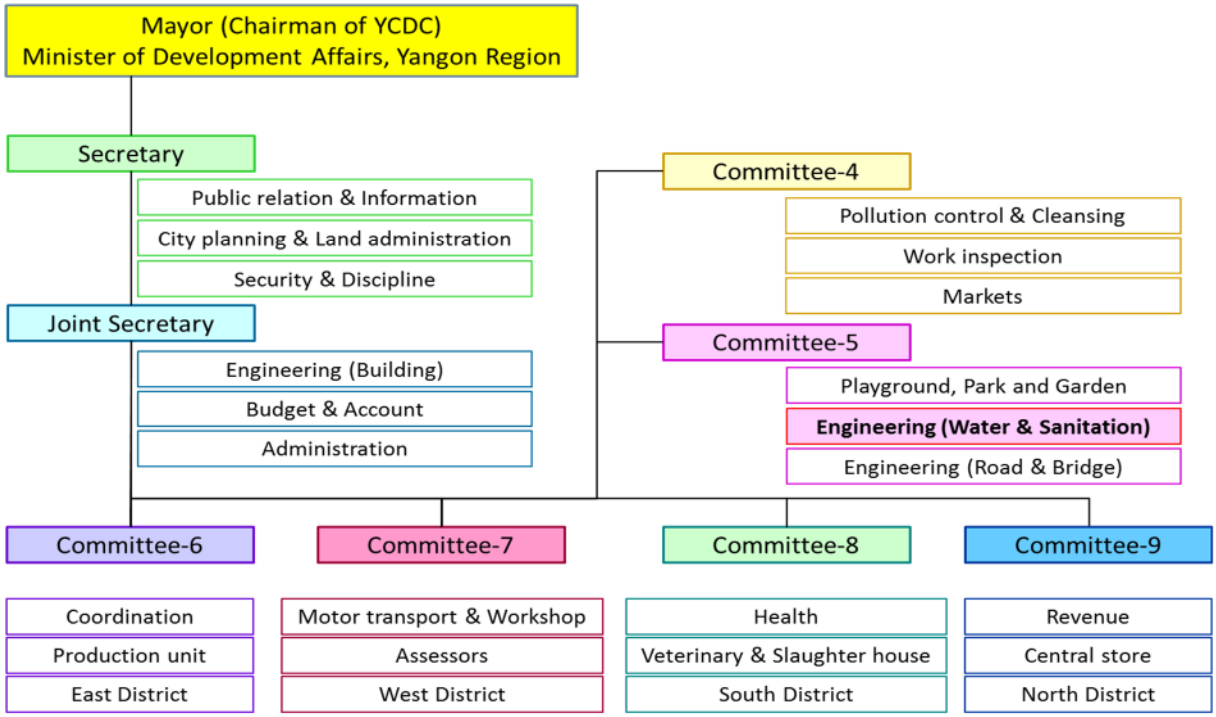
5.1 BASELINE SURVEY

5.1.1 Organization, Duties and Responsibilities of WSD

5.1.1.1 Yangon City Development Committee (YCDC)

Yangon City Development Committee (YCDC) is formed based on the Yangon City Development Committee Law (revised from old version in 2013, amended in 2014) aiming to serve to the Yangon city citizens for fulfilling the needs of the citizens under leadership of the mayor who is appointed from the regional government, and committee members.

The motto of YCDC is "Clean, green and fair Yangon City". The Council of YCDC consists of only one mayor and eight committee members, among which the secretary and the joint secretary are also included. One committee member is responsible to manage three of posts, departments or districts concurrently. The assigned districts and departments of YCDC of each committee member are shown in YCDC organization chart.



Source: YCDC

Figure 5.1 Organization Chart of YCDC

5.1.1.2 Department of Engineering (Water Supply and Sanitation)

Among the departments under YCDC, Department of Engineering (Water and Sanitation) (WSD) is the one which performs to supply water for 33 T/S out of 45, and sewage system within the downtown area. The 5 visions of the WSD is as follows:

- To distribute the adequate, safe and wholesome water for citizens.
- To collect the water tariff completely.
- To prevent water leakage and control the reduction of non-revenue water.
- To manage for systematic sewage disposal.
- To upgrade water distribution facilities and sewerage system.

The department is administered by one Chief Engineer (head of department) and three Deputy Chief Engineers. And for seven divisions, there are seven Assistant Chief Engineers to take the respective responsibilities to perform the above duties.

Under finalization

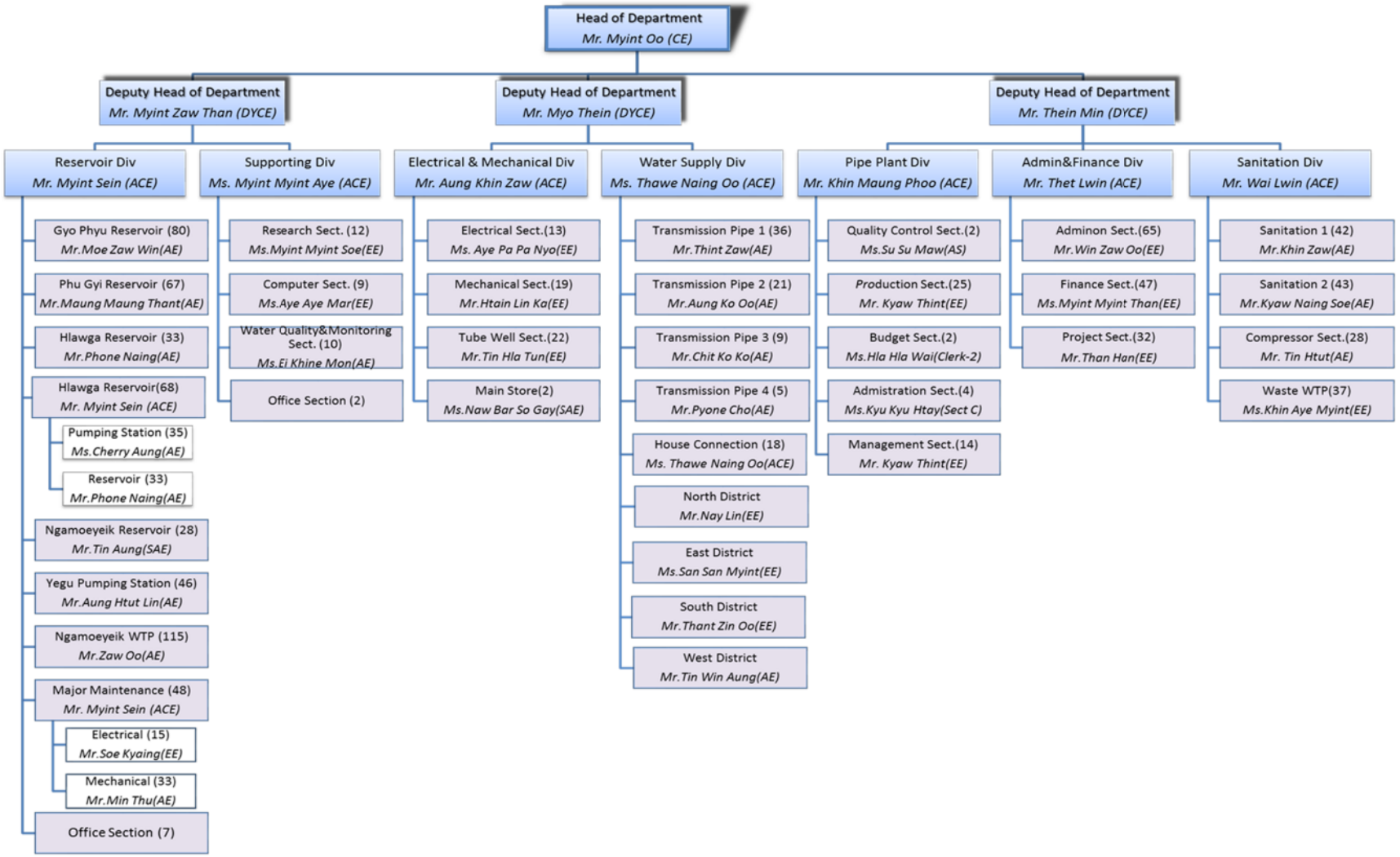


Figure 5.2 Organization Chart of WSD

To implement the visions of WSD, we form the organization of WSD into 7 divisions. The responsibilities of each division are regulated by "Orders to be obeyed by YCDC staff" as shown below. Since the order was set in 2004 by the Mayor, the actual duties have differed from the regulation.

Table 5.1 Duties and Responsibilities of Each Division of WSD

Division	Duties and Responsivities
1. Reservoir Division	• Maintenance and preservation to be sustainable. • Protection of catchment area and forest cover. • Disinfection as chlorination, coagulation and chemical dosing for water purification. • Daily measurements for water levels and precipitations in reservoirs and the amount of delivered water • Operation of the main pumps in reservoirs and maintenance of main pumps, transformers and other electrical and mechanical equipment. • Cleaning and screening of rubbishes on the surface of reservoirs • Upgrading of roads, bridges and infrastructures for water supply in reservoirs.
2. Water Supply Division	• To maintain the main transmission pipes, the additional pipe lines and the distribution ones and to install the extension of new pipe lines. • To operate the booster pumping stations in all T/Ss. • To distribute the water from tube wells to the T/Ss which have no direct distribution lines from the reservoirs. • To facilitate for safe and clean water by dosing chlorine, alum and appropriate chemicals. • To prevent the non-revenue water caused by leakages. • To maintain and guard the communal tanks and fire hydrants. • To prevent illegal connections. • To manage the permission for construction of septic tank, connection of sewer lines and installation of service connection. • To arrange water supply to the new satellite towns and the T/Ss on the other sides of Yangon river.
3. Electrical and Mechanical Division	• To operate and maintain the booster pumping stations. • To implement the major repairs and maintenance of main pumps, transformers and electrical and mechanical equipment. • To maintain the old tube wells and to construct the new ones. • To maintain and install the mechanical and electrical equipment. • To maintain and assemble the submersible pumps for tube wells. • To maintain the vehicles and machines. • To upgrade the existing machines and equipment with the modernized ones and the auxiliary ones.
4. Supporting Branch	• Issuing, keeping the instrument necessary for the sites and the auxiliary ones. • To undertake collection of water sample, monitoring and analysis for water quality. • To estimate and workout for bill of quantity and preparation of engineering design for water supply facilities. • Documentation for designs, drawings, mapping and official assistance. • Planning of the projects and allocation of new water resources. • Sustainable development for the job training and preparation for the local and oversea training program.
5. Finance and Administration Division	• Making for documentation and collecting of the water charges. • Receiving the incomes and managing the expenditures. • Making for short term plans and long term plans, and the estimation of current, capital and expenditures. • To service for the liens. • To arrange the staffs to follow the disciplines. • To support the staffs for their good living.
6. Sanitation Division	• Maintenance for the sewer lines. • Operation and maintenance for the air compressor and ejector station.

Division	Duties and Responsivities
	• Project planning for extension of sewerage system and desludging of septic tank system. • Implementation for the improvement of sewerage system. • Upgrading the existing facilities by replacing the modernized machines and equipment
7. Pipe Production Factory	• Production of concrete pipes and special pipes for water supply purposes. • Production of other products for improvement of income. • Maintenance of electrical and mechanical equipment. • Supplying and purchasing the products used in manufacturing process, spare parts and modernized machineries.

The total number of the staff in WSD, and the allocation number of staff is defined as 2,425 by YCDC Development Law (updated in 2013); consisting of 88 officers and 2,377 other levels staff. The current situation is as shown below. The YCDC Law also regulates that labor expenditure shall not exceed 30% of the annual revenue of YCDC, and the number of staffs shall not exceed two third of the assignment numbers.

	Officers	Other levels	Total
(1) Allowed numbers	88	2,337	2,425
(2) Current permanent staff	75	1,039	1,114
(3) Vacancy	**13**	**1,298**	**1,311**
(4) Numbers of temporary staff			
a. Flat		102	
b. Daily Wage		88	
c. WA (Work Authority)		859	
(5) Number of staffs need to be recruited more		**249**	

The list of the assigned personnel and vacancies according to the positions is as follows.

Table 5.2 List of the Number of Permanent Staff by Position in WSD

(As of 30 October, 2015)

	Position	Allowance	Assignment	Vacant Position
1	Head of Department (Chief Engineer: CE)	1	1	-
2	Deputy Chief Engineer (DYCE)	2	2	-
3	Assistant Chief Engineer (ACE)	5	5	-
4	Factory Manager	1	1	-
5	Executive Engineer (EE)	21	20	1
6	Deputy Factory manager	2	1	1
7	Assistant Engineer (AE)	49	39	10
8	Chief Officer	4	3	1
9	Chief Officer (Account)	3	3	-
10	Office Manager (Suprin Tendant)	2	2	-
11	Accountant-1	9	7	2
12	Supervisor	58	36	22
13	Electronic Expert-1	1	-	1
14	Sub-Assistant Engineer-2 (SAE)	111	110	1
15	Computer Planner	5	2	3
16	Deputy Supervisor	81	61	20
17	Deputy Supervisor (Drawing)	2	-	2
18	Accountant 2	11	11	-
19	Branch Clerk	7	7	-
20	Store Keeper 2	1	-	1
21	Junior Steno	1	-	1
22	Assistant Supervisor	252	189	63
23	Assistant Supervisor (Drawing)	4	-	4

	Position	Allowance	Assignment	Vacant Position
24	Assistant Computer Planner	5	3	2
25	Senior Clerk	37	31	6
26	Accountant 3	3	2	1
27	Senior Typist	2	-	2
28	Skillful worker 4	530	324	206
29	Skillful worker 4 (measurement)	6	-	6
30	Deputy Assistant Computer Planner	8	-	8
31	Junior Clerk	59	54	5
32	Junior Typist	13	-	13
33	Filing & Copying	4	-	4
34	Accountant 4	2	1	1
35	Skillful worker	559	1	558
36	Labor	469	198	271
37	Security	89	-	89
38	Cleaner	6	-	6
	Total	2,425	1,114	1,311

Staff are categorized by employment type into the following 5 types: (1) Officer, (2) Permanent, (3) Flat, (4) Work Authority, (5) Daily Wages. The characteristics of each type are as follows:

Staff: Staff is the one who is assigned to work in the department, division, organization of the country with various position from officer level to the basic level.

Officer: Assistant Engineer Level and above, who past the unified examination for officer conducted by Administration Department of YCDC (Admin Dept.) and were appointed by UCSB.

Permanent Staff: According to the organization chart of YCDC, the staff who is assigned to work full time in certain position is called permanent staff.

Flat: The staff who is assigned in each financial year with flat pay system is called Flat. In the Council, this position is assigned from April 1 to March 31 every year. To be Flat, there is a prerequisite to have working experience as WA prior to assignment as Flat.

WA: The staff who is paid for every month is called WA. Head of Department has authority to employ WA staff.

Daily Wages: The staff who is paid daily for his work is called daily wages.

5.1.2 Personnel Management Related to HRD

5.1.2.1 New Recruitment

Each department is not authorized to recruit new permanent staff. Each department applies for candidate of new staff to Council of YCDC, held weekly, consisting of the mayor, the committee members and each department. Then a final approval is made by the Council.

(1) Procedures

In recruiting staff of WSD, each section makes request to Head of Department. Head of Department collects necessary information and select the nominate person from the candidates. The nominate persons are selected upon the relevant degree, diplomas and experiences. The head of department makes request for new recruitment with list of posts and the nominated name to submit to the Council. The Council has final approval of list of new recruitment posts and candidate persons. The decision is announced in public by Admin Dept. The procedures can be shown as the chart below.

There are two channels to be employed in YCDC.

The first channel is to be employed as WA, shifted to Flat, and then Permanent staff, through which most of WSD staff employed. No staff can be employed starting from Permanent staff. Promotion from WA to Flat level is decided by the Council meeting according to the presentation of the department or T/Ss.

The other way to enter YCDC is to be employed as an officer level. The officer level is recruited from other national ministries and inside of YCDC. For the officer positions (Assistant Engineer and upper), after decision of the Council, UCSB is responsible to announce the vacancies in public, select and recruit officially. Candidates have to sit for written test and interview regardless of whether s/he is staff of WSD or not.

Figure 5.3 Process of Staff Recruitment

(2) Criteria

In case of new recruitment of engineers related to water and sanitation of WSD, applicants who successfully past the engineer examination is newly employed. The prerequisite of applicants are to graduate from one of the following schools, universities or engineering universities in foreign countries. Diploma from private university is not accepted even if it is on engineering.

- Yangon Institute of Technology
- Technical University
- Universities in Yangon city (Hmawbi, Hlaing Thar Yar, Thanlyin)
- Government Technical Institute (currently closed)

WSD/YCDC does not have specific staff employment plan from longer view for management aspect. New staff is recruited when many big project starts such as pipe line extension, or rehabilitation of facilities.

(3) Issues

The allocation of new staff often does not satisfy the required qualification. It is difficult for WSD/YCDC to employ qualified staff. In particular, some job positions require specific background such as accountant, electric/mechanical engineers, which seems partially because the working conditions including salary cannot be competitive with private company.

5.1.2.2 Staff Transfer

Most staff does not move among Departments once staff allocated. Basically, staff transfer occurs only when needed. Though there is no clear standard for staff transfer, staff may transfer between departments mainly based on their own willing.

Even within WSD, staff transfer occurs rarely, mainly when staff promotion, or substitute of staff retiring. The table below shows the number of staff who was transferred within WSD without promotion. When staff is transferred, relevance of the jobs and the staff's experiences are considered.

Table 5.3 The Number of Staff transferred in WSD (not including promotion

Year	2010	2011	2012	2013	2014	2015
Staff transferred	23	18	17	14	21	24

In terms of the procedures of staff transfer, transfer needs to be submitted by the respective supervisor to CE like recruitment. The staff can be transferred within the department with the permission of CE so that the staffs can be in the suitable place. In case of staff transfer beyond the department boundary, the request is submitted to the Council meeting to be approved as same as staff recruitment.

5.1.2.3 Retirement/Turnover

Retirement age is defined as 60 years old for all job titles of YCDC. After the retirement age, some staff are requested to continue working as Flat status.

Average working period of WSD staff before retirement/turnover is 32 years, which means most staff tend to work at YCDC until their retirement age. The rate of intermediary turnover of YCDC staffs is assumed to be low although there are some turnover of staff by the reasons attributed to working environment and family environment. In particular, engineers and technicians sometimes leave WSD/YCDC for private companies because of poor working conditions (especially salary).

YCDC staff, equivalent to national civil servant, has right to receive pension. The pension system and the requirement of the pension is as shown in Table 5.4.

Table 5.4 Type of Pension for Staff of YCDC

Type of pension	Minimum requirement to receive pension	
	Age at retirement	Period of working
(A) Retirement Pension	at age 60 years	N/A
(B) Tenure Pension	55 years old	30 years' service
(C) Reduce Pension	55 years old	20 years' service
(D) Reduce Pension	50 years old	25 years' service
(E) Health Pension	40 years old	10 years' service
	(Need the approval of Ministry of Health)	
(F) Family Pension	If die, the rest family members (Spouse, husband, parents and siblings) are allowed to receive the pension of the dead staff. But the staff needs to have at least 10 years' service.	

5.1.2.4 Personnel Evaluation, Promotion

In present, WSD/YCDC does not have periodical personnel evaluation system. The supervisor observes daily performance of their subordinates for personnel evaluation. On the occasion of selecting staff for promotion, transfer, study in abroad, trainings or assignment to the new projects, section leaders are consulted by head of division on the personnel evaluation.

Promotion is to substitute the retiring staff within the department. The procedures of the promotion is as the same as the staff recruitment.

There are two types of promotion; one is promotion from staff level to officer level, the other is the all promotions in other levels from temporary staff till the one below officer level.

For the general promotion, the following factors are evaluated. The nomination documents are prepared on these items, and the performance is endorsed by head of department's recommendation letter.

- The experience and service years

- The performance
- Degree, diploma
- Training participation

There are many job positions in WSD as shown in Table 5.2. In case of engineer, staff starts working in WSD as WA, then is expected to promote step by step to Flat, Skillful Worker, Assistant Supervisor, Supervisor, and Sub Assistant Engineer. There is no official examination until sub assistant engineer level. The next position of Sub Assistant Engineer is Assistant Engineer, officer level, which requires official promotion procedures taken.

For promotion to officer level (Assistant Engineer and above), the candidate needs to have at least 3 years working experience as Sub Assistant Engineer to sit for the examination conducted by Admin Dept. In addition, educational background and training participation record is evaluated. The primary examination is written test, and the person who passes it can proceed to the interview exam. The final result of the examination is sent to UCSB for making necessary procedures to promotion and assignment as officer.

Promotion and the next position are differently determined by the elements of type of jobs and educational background. In case of engineer, it normally takes 1.5 – 2.0 years to get promoted to the position of SAE, however the reality depends on the actual vacancy of the position in addition to capability and educational background. Also it will necessarily take 5-7 years at least to get promoted from SAE to ACE. In case of a non-technical staff and a lower staff with education qualification lower than high school level, the final stage of carrier path is department supervisor and manager respectively.

The promotion posts are not necessarily many, thus the number of posts becomes smaller at higher position levels. Also personnel appointment from other governmental institutions is commonly exercised.

5.1.2.5 Salary, Allowance

The salary level is 250,000 – 270,000 Kyat for Assistant Engineer, 150,000-160,000 Kyat for permanent staff as shown in Table 5.5. "Increment" is added according to the accumulated service period of the position. After promotion, the staff is paid only the basic amount, and is added by "increment" according to the number of year in the position. The table, updated on 31/10/2015 by the National Parliament, originally indicating entire salary table of all positions including non-permanent staff. Since YCDC employees are equivalent to national public servants, the employment system such as the salary, allowance and pension follows according to the standards of the central government. Hence YCDC are not allowed to change this salary system by itself.

Table 5.5 Salary Table of YCDC (Extracted)

Position	Basic	Increment	Maximum
Assistant Chief Engineer	310,000	4,000	330,000
Executive Engineer	280,000	4,000	300,000
Assistant Engineer	250,000	4,000	270,000
Supervisor	195,000	2,000	205,000
Sub-Assistant Engineer-2	180,000	2,000	190,000
Assistant Supervisor	165,000	2,000	175,000
Skillful worker 4	150,000	2,000	160,000
Labor	120,000	2,000	130,000

5.1.2.6 Incentives

There is no specific financial incentive measures based on staff performance. Salary and additional

allowance system is unified as public servant as described in 5.1.2.5, which cannot be arranged by WSD.

Apart from promotion, there is a reward event to appraise good performance staff of YCDC once a year organized by Admin Dept. About 20 staff of WSD is awarded. There are some incentive systems as follows:

- Promotion
- Opportunity for studying abroad
- Excursion trips
- Arrangement for accommodation of staffs

In terms of incentives for capacity development, employee's accomplishment and results of training are directly not reflected to their salary. However, if an employee graduate from a national university of public servants, which allows only permanent governmental staffs to enter and participate in, the achievement is reflected to salary.

In spite of these incentive system, WSD/YCDC faces difficulties to motivate staff because of low salary and less relevance between the performance and treatment.

5.1.3 Frame of HRD

5.1.3.1 Related institution

There are some concerned institutions and organizations for HRD of staff of WSD/YCDC as follows:

(1) Union Civil Service Board (UCSB)
- To conduct the recruiting and selection process for officials to be appointed at the entry point of public organizations.
- To undertake and organize induction training courses for all levels of service personnel and provide arrangements for middle and senior level officials to participate in training programmes, conferences, workshops and seminars.
- To conduct training and educational programmes aimed at capacity enhancement of civil service personnel.
- To administer the existing rules and regulations relating to the civil service personnel and provide advisory and consultancy service to other public organizations in matters relating to civil service affairs. (website)

(2) Administration Department of YCDC (Admin Dept.)
- To plan the organizational structure based on duties and form the staff organization after getting the approval of the Government.
- Can discuss and negotiate with the respective departments to recruit the following staff who can support the committee and can put in the organizational structure;
  - i) the person/staff who can take the responsibilities for disease prevention and public health,
  - ii) the person/staff who can take the responsibilities for the prevention of fire/burn, and
  - iii) YCDC police and other staffs who can take the responsibilities for security and disciplinary duties.
- To recruit new staff according to the vacancies based on the organization structure.
- To transfer a staff from one department to another with the agreement of respective department or organization.
- To pay salary, allowance, pension and compensation.

(3) WSD
- To work to train the staffs and staff affairs.

(4) Head of Department
- To supervise the disciplinary and staff affairs of the current staff.
- To arrange staff assignment within the department.
- To supervise the number of staff of the department and make request to the Council for recruit, promotion, staff transfer beyond department.

(5) Administration Section of WSD
- To perform for the privilege of staff, for the disciplinary of staff and relief.
- To make arrange for necessary procedures as focal point for WSD staff to join outside courses of WSD and vice versa.
- To keep individual staff profile record including training participation.

5.1.3.2 Regulations, Plans Related to HRD

There is no specific plan of HRD neither in YCDC nor WSD. Though YCDC has its own development plan, it does not include policy, strategy or plan related to human resource development. For personnel management, YCDC Development Law regulates the number of staff of each department, and some working regulations is set as in Table 5.6.

Table 5.6 Major Regulations Related to HRD

	Issued Date	Name	Issued by	Purpose	Main contents
1.	08/10/ 2013	YCDC Development Law	Regional Government of Yangon	Updating the older law (issued in 14/05/1990), to regulate organization, authority, duties and responsibilities of YCDC	Organizational structure of the committee and salary and other expenditures for staffs, action, budget of YCDC.
2.	10/12/ 1991	Ethics of Civil Service (government staffs)	Government of Myanmar (Issued by UCSB)	To regulate exactly his/her duties, ethics to adhere, rules to obey and the allowance to receive.	Duty to be performed, ethics to be adhere, Discipline to be obeyed
3.	26/03/ 2014	Regulation for Civil Services (Government Staffs)	Government of Myanmar (Issued by UCSB)	To update the No. 3 above, regulate basic roles of national civil servants.	Staff recruitment process, duty time, salary, leave salary and the punishment for breaking disciplines.
4.	30/09/ 1993	Handbook for Government staffs	Myate Aung (Retired; T/S Education Administrator)	To make all government staff understand more concerned laws, regulation and disciplines by Q&A style.	Q&A on; Recruitment, Salaries and allowance, financial rules, Travel allowance, Leaves, Prosecution, Pension.
5.	09/04/ 2014	Standing order; all of YCDC staff must follow	YCDC	All of YCDC staff can follow the current Committees order	To control the qualification of the committee members, officers such as loyalty, hardworking, conscientiousness, morality, improvement healthy, education and to support the staffs for their good living.

5.1.4 Training

5.1.4.1 Type of Trainings and Records

There are five types of training courses for staff of WSD/YCDC. YCDC is formed with 20 departments and all YCDC staff are being trained by YCDC internal trainers and guest trainers at the following training venues according to the type of training. For detail information of each training center and venue is described in 5.1.6.1.

Table 5.7 Training Institutes for WSD Staff

	Training courses	Organizer	Characteristics
1	Unified training courses for all civil servant	Union Civil Service Board	Hierarecal based training courses fro engineers, supervisors, clerks, accountants
2.	General training courses of YCDC	Admin Dept of YCDC	Hierarecal based training course for Engineers, Supervisors, clerks, accountants.
3	Technicians training	Each department of YCDC	Specific courses for technicians, workers; pipe connection, welding, electrical works, civil works, and driving.
4	Specific training	Each division of WSD	Each division of WSD made request for training courses to CE's approval. AutoCAD, Epanet, GIS, English, and NRW have been conducted recently for young engineers, Flat, WA (engineers)
5	Trainings abroad	Other institutes	Mostly foregin donors invite engineers and officers on specific subject related to water supply and waste water.

(1) Unified training courses for all national civil servants

All staff (from clerk level to Deputy Chief Engineer level) of YCDC have to attend this type of training courses according to the position. These training courses focus on general affaires what officers and staff have to understand as a national civil servant. The following six training courses are conducted annually.

The training courses are organized by University of Central Government Staff (at Phaung Gyi, outskirt of Yangon City) under UCSB and by other relevant Ministries related with YCDC. For example, Engineer Training Course includes some sessions by Ministry of Environmental Conservation and Forestry.

Table 5.8 Training Courses Organized by UCSB

No.	Types of Trainings	Target of trainees	Duration (day)	No. of WSD staff joined
1	Training of Management for high level Officers and Fresh (fresher) Officer	DYCE, ACE, Branch Officer	4 weeks	22
2	Basic Training for Fresh (fresher) Officers	Administrator, Assistant Engineer, Executive Officer (Law)	15 weeks	27
3	Basic Training for non-gazette Officers	Deputy Supervisor, SAE, Assistant Administrator	15 weeks	11
4	Training for Junior officers	Accountant 2, Assistant Supervisor	15 weeks	4
5	Training of Supervision of clerks	Branch Clerk, Supervisors	15 weeks	8
6	Training for clerks	Senior Clerk, Junior Clerk	15 weeks	4

Note: The number of the training participants is accumulated number since the training center has established.

(2) General training courses of YCDC (organized by Admin Dept.)

The staff of YCDC have to attend these training conducted in YCDC Training Center organized by Admin Dept. The training course targets all departments of YCDC in principle. The participants of engineering training are limited to the department relevant to engineering. As the same as the training courses organized by Central Government described above, target of each training course target is set by position respectively from general staff till management class. The approximate ceiling number of trainees is 100 persons per course. This is determined by the capacity of a training room of the training center. Training subjects on water and sanitation are integrated into engineering training as a part.

For the last two years (FY 2014, 2015), the number of the participants from WSD in this type of training courses is 73 as shown in Table 5.9.

Table 5.9 Training Courses Organized by Admin Dept.

	Name of Training Courses	Target Level	Month/year	Duration (day)	Participants from WSD
	Refresher Course of engineering (3 times)	Flat and Upper levels	12/2014, 01/2015, 02/2015,	28	26 25 18
	Refresher Course of Clerk Training (2 times)	Junior Clerk, Senior clerk, Flat	10/2014, 04/2015	28	10
	Basic Accounting Training Course (2 times)	Other Ranks of Accounting (3,4), Auditors (3,4), Cashers (3,4)	06/2014 & 11/2014	28	15
	Refresher Course of engineering	Flat to Upper level	06/2015 &	28	14
	Refresher Course of Clerk Training	Junior Clerk, Senior clerk, Flat	08/2015	28	10
	Training of Supervision of clerks	Supervisor, office head, section head, supreme talent	12/2015	28	2
	Basic Accounting Training Course	Other Ranks of Accounting (3,4), Auditors (3,4), Cashers (3,4)	10/2015	28	8

The Administration Section of WSD (Admin Section) made a list of candidate participants who have never joined the certain training courses. In present, 225 staff's names are left in this waiting list. In case of Flat, among 102 Flat staff in total, the staff who have already join the training courses is 16 engineers out of 29, and 24 clerks and accountants out of 73.

(3) Training Courses for Workers

This type of training courses are conducted by related department of YCDC as listed below. These courses are not closed to the participants of the department, but open to the participants of the other concerned departments. Although these training courses were conducted eight times repeatedly for the period from 2012 to 2014, no training course has been conducted in this year.

Table 5.10 Training Courses Organized by Departments of YCDC during 2012-2014

Name of Training Courses	Target Level	Month/year	Duration (day)	No. Trainees of WSD	Organizer	Place
Pipe Connection and Plumbing	Flat, WA, labor, skillful worker 4	10/2012, 12/2012, 02/2013, 05/2013, 07/2013, 02/2014, 06/2014, 10.2014	30	23	WSD	Yegu Pumping Station
Welding			30	38	WSD	Hlawga Pumping Station
Electrical works			30	14	Department of Engineering (Building)	YCDC Training Center
Civil works			30	9	Ditto	Ditto
Driving			30	25	Department of Motor Transport & Workshop	The Department (at South Dagon T/S)

The training courses are composed of theoretical sessions and practical sessions. In most courses, almost half of the training period is accounted for practical sessions such as practice at working sites or site-visit. The main subjects of training courses organized by WSD are as follows:

Table 5.11 Major Subjects of Training Courses for Workers

Training Course	Main subjects	Period allocated
Welding	1. Melting Welding 4 ways of welding, Oxygen-Fuel Gas Welding, Thermal Welding	2 Weeks
	2. Welding using Pressure Forge Welding, Gas-pressure Welding, Seam Welding	1 Week
	3. Five Types of Welding joints	1 Week
	4. Welding Position	1 Week
	5. Equipment used in Gas welding	1Week
Pipe Connection and Plumbing	1. House Connection (internal connection, meter installation)	2 Weeks
	2. Pipe connection and Plumbing	2 Week
	3. Sewage System & Pump installation	2 Week

(4) Each division of WSD

As WSD under the Committee, in order to implement the Department's plans successfully and efficiently, WSD conducts internal training focusing on specific technical subjects such as NRW, GIS, with the cooperation of Japanese ODA project or outside lecturers.

Table 5.12 Training Courses Organized within WSD

	Name of Training Courses	Target Level	Year	Duration (day)	No. trainees (WSD)	Organizer (Division of WSD)
1	Auto Cad drawing	Engineers	2015	Under going	-	Reservoir
2	Speaking English	Engineers, accountants, clerks	2015	Under going	-	DYCE 1
3	NRW reduction	Engineers	2015	36	36	Japanese ODA Project
4	GIS operation & drawing	Engineers	2015	10	10	DYCE 1
5	E.Panet operation	Engineers	2015	Under going	10	DYCE 1

(5) Overseas Training

The staffs are sent abroad to attend the long/short seminars and training courses concerning with Water & Sanitation, including Japan, Korea, Thailand, Germany and Singapore.

As shown in Table 5.13 recently, the occasions of foreign training increases rapidly. Noteworthily, most of the all foreign training courses are specific subject on duties of WSD. Considering the domestic training course cannot satisfy the training needs especially on subjects related to water supply, it is necessary to utilize occasions such foreign training courses as much as possible.

Table 5.13 Summary of Participations of Training Courses in Abroad

	~2001	2003	2005	2006	2007	2010	2011	2012	2013	2014	2015	Total
Number of course	5	1	2	2	1	3	4	6	9	11	6	50
Number of staff	5	1	2	2	1	3	4	10	10	21	7	66

Table 5.14 Training Courses Conducted Abroad

Name of course	Schedule	Number participants	Country/donors
1) Perfectionnement Aux Techniques D.E.L.E AU AL Institut Superievr Des Techniques DELEAU Cycle B	29.8.1995 -24.11.1996	1	Belgian
2) Water Supply Engineering Course	29.7.1996 -28.10.1996	1	Singapore
3) Exploitation and Management Of Ground Water Resource	1.3.1999 -18.6.1999	1	Israel
4) Special Training Course In Lake Water Quality Management	4.1.2001 -18.3.2001	1	Japan
5) Water Supply and Environment Sanitation	29.8.2001 -27.9.2001	1	Japan/Philippines
6) Technology and Innovation Management	31.3.2003 -3.10.2003	1	Germany
7) Promotion Environmentally Sound Waste Management and Resources Recycling	20.2.2005 -26.2.2005	1	Japan
8) Integrated Environmental Planning and Management	28.7.2005 -26.8.2005	1	Malaysia
9) Water Work Engineering 2	6.6.2006 -26.8.2006	1	Japan
10) Restoration of fresh Water Environment by ECO sound Technology	15.10.2006 -11.11.2006	1	Japan/Korea
11) Management and project proposal writing for rural development (Basic needs -Building)	5.2.2007 -23.2.2007	1	Thai
12) Integrated Water Resource and Environment Management Policy In Water Scare Regions	30.8.2010 -11.9.2010	1	Japan
13) Water Supply Administration for better Management of Water Supply Services	5.9.2010 -18.9.2010	1	Japan
14) Management of Water Supply Business	8.11.2010 -26.11.2010	1	Thai
15) Fifth Asia Pacific Urban Forum APUF-5	22.6.2011 -24.6.2011	1	Indonesia
16) Course on Executive Workshop on Urban Waste Management In South East Asia	4.7.2011 -7.7.2011	1	Singapore
17) Integrated Water Resource and Environment Management Policy In Water Scare Regions	25.7.2011- 29.7.2011	1	Singapore
18) Sewerage Works, Engineering and Strom Water Drainage Technology	25.9.2011 -10.12.2011	1	Japan
19) Design operation and Management of Decentralized Waste Water treatment System	23.4.2012 -4.5.2012	1	Thai
20) Urban Water Supply Planning and Management	20.6.2012 -30.6.2012	1	Thai
21) Water Resources Environmental Management	6.8.2012 -30.9.2014	1	Germany
22) Seminar Program on 2012 EACAP Water Management	8.10.2012	1	Korea

Name of course	Schedule	Number participants	Country/donors
	-17.10.2012		
23) Municipal Officials of Foreign Cities	9.10.2012 -17.10.2012	1	Korea
24) Water distribution and reducing leakage water	2.12.2012 -23.12.2012	1	Japan
25) Water Distribution and NRW Reduction	3.12.2012 -21.12.2012	5	Japan
26) The PPI Council for overseas Water Infrastructure	27.1.2013 -2.2.2013	1	Japan
27) Water Management In tropical and Subtropical regions	6.4.2013 -6.10.2015	1	Germany
28) Operation and Maintenance of Ortan Water Supply System (Water Distribution and Service)	3.6.2013 -6.7.2013	2	Japan
29) Water Supply System (Water Quality and Purification)	3.6.2013 -6.7.2013	1	Japan
30) Industrial Waste Water Treatment Technique	16.6.2013 -7.9.2013	1	Japan
31) Operation & Maintenance of Sewerage System and Waste Water Treatment Technique	18.8.2013 -28.9.2013	1	Japan
32) Technical Exchange Programme on Waste Water Management	1.9.2013 -8.9.2013	1	Japan
33) Project management to establish urban reduced carbon dioxide production	19.10.2013 -2.11.2013	1	Korea
34) Water Supply and Sewage System Training Program for Senior Officials	22.10.2013 -29.10.2013	1	Japan
35) Daejean Seminar Program on KOICA Singapore Joint Training Program on Drinking Water Management	10.11.2013 -23.11.2013	1	Korea
36) Planning Design and Operation of Water Treatment Plant and Water Quality Management	14.1.2014 -29.1.2014	6	Japan
37) Training Program on Water Environment Administration	11.6.2014 -5.7.2014	1	Japan
38) Training Program on Comprehensive Engineering and Water Supply System	2.7.2014 -17.9.2014	1	Japan
39) Operation and Maintenance of Sewerage System And Waste Water Treatment Technique	17.8.2014 -2.10.2014	1	Japan
40) Sewage Works Engineering and Storm Water Drainage Technology	23.9.2014 -6.12.2014	1	Japan
41) Water Supply Sector Seminar	18.10.2014 -20.11.2014	1	Lao
42) Training Program on Non-Revenue Water Distribution Management Leakage Control C	2.11.2014 -3.12.2014	1	Japan
43) Sophisticated Water Work System	23.11.2014 -29.11.2014	6	Thai
44) Water Supply Administration for better Management of Water Supply Services B	30.11.2014 -13.12.3014	1	Japan
45) Master Science	2.2015 -2.2016	1	Korea
46) Advance Certificate Course on Water Quality Analysis Laboratory Practices	4.2.2014 -31.3.2014	1	Korea
47) Capacity Development of Sewer Pipes O & M and Rehabilitation Project in Yangon City	21.6.2015 -28.6.2015	1	Japan
48) Locals Government Official Training Program	17..5.2015 -19.12.15	1	Japan
49) Operation and Maintenance of Urban Water Supply System	18.5.2015 -16.6.2015	1	Japan
50) Water Environment Monitoring	6.9.2015 -17.10.2015	2	Japan
51) Non-Revenue Water Management (leakage Control) D	29.11.2015 -19.12.2015	1	Belgian

Source: YCDC

(6) Remarks

Presently, 5 – 7 % of permanent staff receives training courses a year in average. WSD staff can have opportunity to receive the training course in their early stage of working in WSD such as Flat. However, after employed as permanent staff, there are little chance to join any training course for refreshing except for advanced training courses designated for staff promoted.

Most training courses are on general subjects of engineering, clerk, accounting; there are few training courses on specific subject in water supply.

Some training courses are rather long period (30 – 45 days); hence it is difficult for staff to participate in training course especially in the small offices and T/S office. They cannot find their substitute during their absence from their worksite.

5.1.4.2 Training Management

Training courses is managed within WSD as follows.

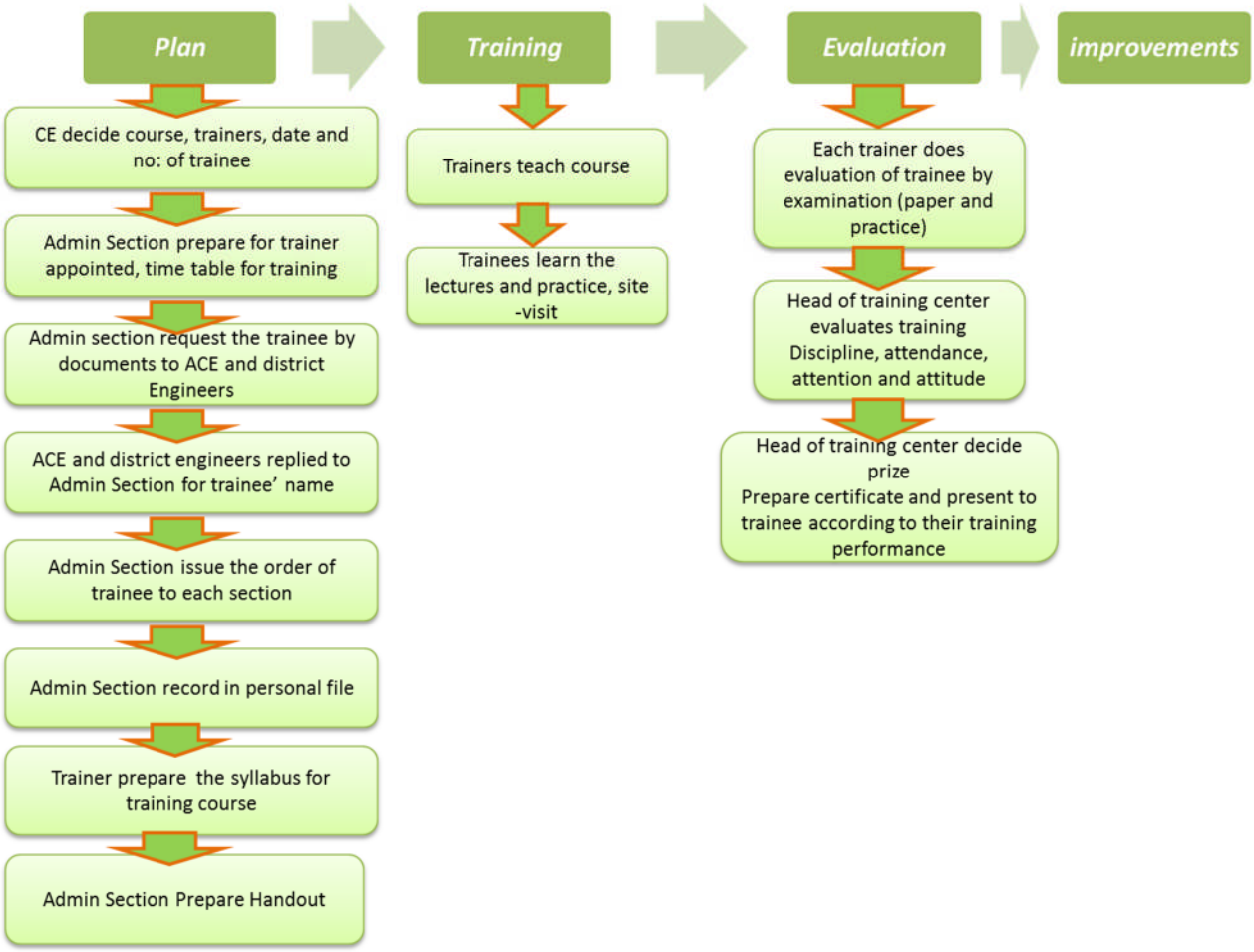


Figure 5.4 Process of Training Management

(1) Plan

Training courses organized by Admin Dept. of YCDC is implemented periodically, and repeated annually, while other training courses are conducted on an ad hoc basis. In WSD, there is no specific plan of training. When Top management of WSD makes decision to conduct a specific training course, the following items are specified at the same time.

- Course Title and Series Number of course
- Training Period

- Numbers of trainees
- Deadline to submit name list of trainees
- Date & time to submit the official registration in the training Center after trainees receive invitation from Training Center.
- Materials to bring together (e.g. photo, uniform, stationaries)

[Preparation procedures of training courses organized by Admin Dept.]
For training courses organized by departments, the Training Center prepares annual (FY) training plan and with approval of EC committee, consisting of committee members and heads of department, distributes it to the other department in May annually. For each training course, Admin Dept. issues invitation with the allocated number of trainees from each department; 10 persons from each district office and 60 persons from all departments. Then the Training Center collects the list of nominated staff from 21 departments of YCDC and 4 district offices, which is submitted to Joint Secretary through Head of Department of Admin Dept. to ask for approval. With getting approval of list of trainees, Admin Dept. sends the final name lists of eligible staff to the training center.

Selection of trainees within WSD is basically conducted by ACE with related section leaders' suggestions as shown in Figure 5.4.

For training courses organized by Admin Dept. and each department, Admin Section of WSD keeps records of training participation in the staff individual profile book. However, the information of other training courses are not reported to Admin Section, and thus these training courses are not recorded in staff profile book, even though training records are referred for selection of promotion.

(2) Implementation
There is no manual or SOP for training management in the Training Center. Because training implementation is responsibility of the training center, Admin Section of WSD is not involved in training management even in the training courses within WSD. The detail information on training centers, trainees and budget is described in 5.1.6.

For training materials, no handout and textbook is distributed to the participants. The trainees have to take note what they heard in their notebooks. The appointed trainers are responsible to prepare the only presentation slide by their own. The materials are sometimes modified for kept up-to-dated.

(3) Evaluation
There are two ways of evaluation after a training course: The evaluation of participants' achievement and the evaluation of training itself by participants.
The first evaluation is examinations on achievement of participants prepared by the lecturers. During the training period, participants have to sit for test at every week end for all subjects taught in the week. Moreover, attendance of the training and notes taken is also evaluated by training organizer. The score is converted to 4 grade; Excellence (3 persons), Qualified (more than 80 marks; about 30%- 35%), Fair (40 marks< 80 marks; about 50%), Under normal (less than 40 marks; 10-15%). The grade is written in the training certificate, which is presented by the Principle to each trainee on the last day of the training course. The evaluation criteria are as follows:

Obeying discipline	(50 Points)
Notetaking	(10 Points)
Assignments	(10 Points)
Points on each subject	(430 Points)
Total	(500 Points)

The other evaluation is done by training participants to assess the training course by questionnaire on the items shown below. These suggestions from training participants are sent to the Admin Dept. as the feedback.

Training program or styles of the trainers
Training subjects

Training disciplines
Training arrangement (on meals and accommodation)
Individual teaching style

The training center compiles training reports to submit to Joint Secretary of YCDC. The report, including a list of trainees, attendance results, achievement of trainees, has not been shared with the departments which sent the participants.

5.1.5 OJT & Self-learning

5.1.5.1 Situations of OJT

There is no systematic OJT system in WSD. According to the results of interview, many managers of WSD understand the importance of OJT in each workplace. However, OJT is not assumed to work actively and effectively enough. Many managers pointed that is because the supervisors are too busy to conduct OJT for their younger staff. Many managers of WSD utilize the internal regular meeting as occasion of OJT. Senior staff encourages their junior staff to learn new knowledge actively. In particular, when staff is newly assigned to an office, senior staff tend to teach basic WSD knowledge for 3-4 days. However, the main OJT in WSD is still limited to learning by staff himself through doing job.

Difficulties of OJT are found especially in small offices, and offices working individually such as meter readers, clerks in T/S offices because younger staff has less opportunities to work closely with their seniors. In T/S office, WA staff in T/S office tends to turn over the office easily, and their qualifications are not enough to absorb what senior staff instructs effectively. This is also difficulties to conduct OJT which requires rather longer time to train the staffs.

In addition, recently rich-experienced staff is getting to the retirement age. There are also one of difficulties to promote OJT.

5.1.5.2 Situations of Self-learning

Currently, there is not specific system for encouraging self-learning by staff.
In terms of resource for self-learning, there is only one library in YCDC managed by Admin Dept. However, the documents of there are out of date, and limited only to the general affairs, not including specific ones related to jobs of WSD.

Moreover, internet access at workplace is limited to staff in higher position (ACE level and above).
Some sections such as an access internet fully. However, ordinary staff has little chance to access to resources such as technical books, catalogs, case study in other utilities.

5.1.6 Resource for HRD

5.1.6.1 Training Centers

Among overall training activities undertaken by YCDC or each department, there are four institutes related to training courses related to WSD.

(1) College of Central Government Staff
This training institute is located at Phaung Gyi, outskirt of Yangon City, as one of educational institutes for national civil servants of the Cooperative Department of Ministry of Cooperative, which was originated to the Central School of Civil Service in 1965 under the Ministry of Home Affairs, and transferred to the Civil Service Training and Selection Commission (present UCSB) renamed as Cooperative College in 2004. The objectives of the College is defined as follows:

- To conduct induction courses for potential civil servants at managerial and technical levels
- To conduct refresher courses for middle level management officials

- To conduct workshops and seminars for senior level managers as well as members of central and local government organs

To focus on research concerned with the training of managerial techniques for civil servants
The training organizer is UCSB, which is responsible for recruiting, selecting and training civil servants, belongs to the national level central organizations.
This college conducts two types of HRD schemes; one is 2-years long training course as college, and the other is short term training courses. To the short-term training courses, WSD has sent its staff for training.

(2) YCDC Training Center

The central training center was opened in March 1996 in Mingala Taung Nyunt T/S under Admin Dept., and the director of the center is concurrently serving as a deputy director of Admin Dept. The staff of the training center is assigned from Admin Dept, the number is 14 in total, and its composition is as follows:

- Mr. Tin Phay Win (Head master)
- Mr. Myint Myint Soe (Second Principal)
- Mr. Phay Win (lecturer in charge of training related to Management and good governance)
- Mr. Khin Kyaw Soe (Training officer)

And addition to the further four permanent staffs, there are two flat staffs, one WA, three general workers and one driver.

1) Purposes of the training center

The central training has organized trainings with the following purposes.

- Improvements for operational works
- Enhancement of understanding on operational works of committee and other departments
- Having experience of mutual cooperation
- Enhancement of understanding on national development and legal and regulatory framework etc.
- Human resource development of resourceful staffs.

2) Responsibilities of the training center (from interview)

Duties and responsibilities of the training center is as follows:

- to decide annual plan with budgetary plan of the training activities, and submit it to Head of Dep. to announce it to others department,
- to prepare training program for each training course, with consideration of request from other departments,
- to consult with trainers to improve training materials (presentation material)
- to organize training courses, and
- to evaluate each trainee at the end of the training course and issue certificate with the result of the evaluation

3) Training Courses

The YCDC training centers conducts many types of training courses. In terms of related to WSD, the training center conducts two types of the training courses; 1) training courses organized by Admin Dept. (see 5.1.4.1 (2)), and 2) training courses organized by other department (see 5.1.4.1 (3)). The details of each course is described in 5.1.4.

The training courses organized by Admin Dept. are conducted annually, which has no changed for last several years. The TC has authorization to change the program of training courses. All training courses last 4 weeks. The following 4 weeks period is for preparation for the next training course.

Table 5.15 Training Courses Organized by Admin Dept. and Numbers of Attendants during 1996-2015

No	Training course	Number of all YCDC staff trained	Period (Month)
1	Refresh Training for Clerks (35 times)	3,346	1
2	Training of Basic Accounting (9 times)	670	1
3	Refresh Training of Accounting (Officer level) (2 times)	100	1
4	Refresh Training for Engineers (13 times)	751	1
5	Assistant Executive Officer Training of Staff affair (1 time)	70	1
6	Training of Supervision of clerks (1 time)	50	1

There are other training courses managed by other departments as listed below. These courses are not closed to the participants of the department, but open to the participants of the other concerned departments. According to the interview with Principal of the Training Center, the Training Center can cooperate with any department if department makes request to held training courses there.

Table 5.16 Training Courses Organized by Departments

Training course	Organizer	Place
Pipe connection	WSD	Yegu Pumping Station
Welding	WSD	Hlawga Pumping Station
Electrical works	Department of Engineering (Building)	YCDC Training Center
Civil works	Department of Engineering (Building)	YCDC Training Center
Driving;	Department of Motor Transport & Workshop	The Department (at South Dagon T/S)

4) Facilities and Equipment

The training center has some facilities for general training courses; one training classroom can accommodate more than 100 trainees equipped with projector and screen (no air-conditioned), office rooms, dining room for lunch space. The building was constructed inside of the compound of Admin Dept. in December of 1996 for training purpose.

The other specific training equipment, for example for practice of civil work course, is brought by trainers during the training period.

(3) WSD training venue in Yegu Pumping Station

Training courses organized within WSD are mainly conducted in rooms in Head office of YCDC, Yegu pumping station located in Yankin T/S, or seminar room in AID compound located close by the head office. In Yegu pumping station, some training courses, mainly requiring large space for training, have been conducted. From 2012, “Plumbing and installation of large pipeline” course was repeatedly conducted 8 times as shown in 5.1.4.1.(3).Recently, “NRW reduction” training course was conducted there with 36 participants of WSD for 22 days in October 2015 with support of Japanese ODA project.

Previously, the Yegu Pumping Station is equipped with some training facilities for the plumbing training. However, the training room was closed and changed to warehouse after the series of the training course was finished.

(4) Hlawga Pumping Station

In the Hlawga Pumping Station, “Welding” training courses were conducted. The Hlawga Pumping station is a station of Maintenance Section of Reservoir Division with equipment of full facility for welding as follows:

- 6 Welding machines,
- Maintenance section, 1 oxygen cylinder
- 1 Acetylene generator

- Cylinder Regulator
- Welding torch
- Meeting room without projector

During the Welding training course, these facilities can be temporarily utilized for training.

5.1.6.2 Trainers

In WSD, there are many staff of WSD have experience to teach in training courses as follows.
For Central Training Center of YCDC, there is no specialized trainer as a regular lecturer, the center asks the necessary trainers for chief engineer, deputy chief engineer of each dept. in accordance with the training subjects. Also they invite a lecturer from the union/ regional government, each ministry, a central university of civil servant and other university etc.

Table 5.17 Staff of WSD with Trainees' Experience and Their Concerned Subjects

	Trainer	Subjects
1.	CE/DYCE	About WSD
2.	Mr. Thein Min (DYCE)	Sewerage System
3.	Mr. Wai Lwin (ACE)	Management of sewerage System
4.	Ms. Khin Aye Myint (EE)	Waste Water Treatment Plant
5.	Mr. Phoe Lone (EE)	The construction of Septic Tanks
6.	Mr. Myint Sein (ACE)	Water Reservoirs
7.	Mr. Zaw Oo (AE)	Water Treatment Plant
8.	Ms. Thawe Naing Oo (ACE)	Water Distribution
9.	Mr. Khin Maung Phoo (ACE)	The Production of Concrete Pipes
10.	Mr. Aung Khin Zaw (ACE)	Underground Water
11.	Ms. Ei Khin Mon (AE)	Conservation of Water Quality
12.	Mr. Kyaw Kyaw Oo (AE)	Water supply systems, House Connection, Pipe Maintenance, Sewerage System, Plumbing
13.	Mr. Min Thu (AE)	Welding
14.	Mr. Ohm Win	Pipe & Accessories
15.	Mr. Tint Zaw(AE)	Transmission pipe & Accessories, Transmission Pipe Connection
16.	Mr. Aung Ko Oo	Distribution pipe Connection and Maintenance
17.	Mr. Nay Lin	Distribution pipe Connection and Maintenance
18.	Mr. Aung Win	Water Resource
19.	Mr. San Myint	Water Resource
20.	Mr. Ohm Win	Sewerage System
21.	Mr. Thant Zin Oo	Sewerage System
22.	Mr. Chit Ko Ko	Distribution Pipe Connection and Repair
23.	Mr. Tin Win Aung	Distribution Pipe Connection and Repair

For Department level training courses, the trainers are SAE, EE or other persons of management class in WSD responsible for the lectures and practical field training.
For technical training courses, some experienced workers have joined as instructors to training courses under cooperation with main engineer lecturers.

5.1.6.3 Budget

The budget for activities for human resource development of Admin Dept. is 40 million kyats for 2014-2015 financial year. And for 2015-2016 Financial year, the budget is supposed to be 65 million kyats. There is no specific budget allocated to training activities. The budget for one training course in training center is about 1 million kyat. The overall budget for six training courses cost about six million. This budget includes honorarium to lecturers who are invited from outside of YCDC.

- Open/closing ceremony

- Material; paper, printing for examination, certificate
- Present for internal trainer
- Fees for outside trainer

For WSD, there is no budget specifically allocated for human resource development.

5.2 PCM WORKSHOP RESULTS

5.2.1 Problem Analysis

The members discussed on problems related to HRD of WSD as Figure 5.5. The core problem is "We can't finish the work very well in time for sustainable water supply". And the following two items are reasons; 1) Ability of the staff are not high enough, and 2) Not enough qualified staff.

(1) Ability of the staff are not high enough
This problem focuses on the aspect of capacity of each staff. It seems to be caused by three main problems.

The first is "Sharing experiences isn't often to juniors". This is because 1) younger staff has small chances to work together with senior staff, 2) some younger staff's capacity is not enough especially academic background, and 3) senior staff is too busy for their assigned job.

The second is "not enough training to improve the skills and knowledge". This is because 1) staff is too busy to join training courses, 2) training in Japan is limited, and 3) no full time trainers and equipment for trainings including training center.

The third is "there is a gap between what staff can do and what they need to do". The current capacity of staff is not enough to perform well what he/she are expected to do.

(2) Not enough qualified staff
This problem focuses on the aspect of the number of the staff. It seems to be caused by four main reasons.

The first is "there is a gap between the planned staff number and the actual allocated number of staff". This is because too many temporary staffs, hence the number of temporary staff is more than one of permanent staff.

The second is "Technicians and engineers are leaving abroad". This is because 1) salary is not enough for living, and 2) budget of YCDC is not enough for personnel salary because of regulation limiting.

The third is "WSD has difficulties to recruit qualified staff". This is also because 1) salary is not enough, and 2) budget for personal salary is limited.

The fourth is "there is no plan for HRD of WSD". This is also because WSD has not been responsible for HRD.

5.2.2 Objective Analysis

The main purpose which WSD (water & sanitation) is implementing now is to supply enough purified water full time to the public in Yangon City. In current situation, WSD cannot provide enough but WSD is trying to fulfill the demand of the public.

In implementing the aims of WSD, HRD plays a main role. (1) To improve the capacity of current staff and (2) to have enough qualified staff are the most important factors as Figure 5.1Figure 5.6.

(1) To improve the capacity of current staff

As the department, it should manage for 1) sharing or teaching in the workplace by seniors to juniors by applying experience, 2) sending staff to the trainings, and 3) preparing incentives and bonus for the staff to concentrate more on the job.

Seniors should teach or instruct juniors clearly and should prepare and utilize Standard Operation Procedures (SOP). Juniors can get experience and knowledge by working together with seniors. Junior staff **should have more time** to work together with seniors to learn their experiences. Section Head should encourage the staff. And more technicians with proficiency should be allocated in computer technical sections for improving working efficiency.

For promoting training participation, it is necessary to expand training subjects such as GIS drawing and computer operation. Trainers and training facilities are also in need. Officers of WSD can become trainers. Training centers are necessary to be established.

For incentives, it is important to motivate staff actively for performing better. To do so, it is needed to improve salary system and incentive system. Especially, performance based incentives is supposed to function well.

(2) To have enough qualified staff

In parallel of improving the capacity of each staff, it is necessary to take measures to improve the number of staff of WSD.

The number of staffs in the personnel assignment plan must be the same with the number of appointed staffs (i.e. number of current working staffs). WSD should select the qualified staffs (systematically and carefully). WSD must establish the HRD plan to show staff allocation for longer term. By doing this, the department will get qualified staffs enough.

If we can implement the staff capacity improvement program, and the plan to get enough qualified staffs, we (WSD) could achieve the successful implementation of the aim of WSD; to supply enough purified water full time to the public in Yangon City.

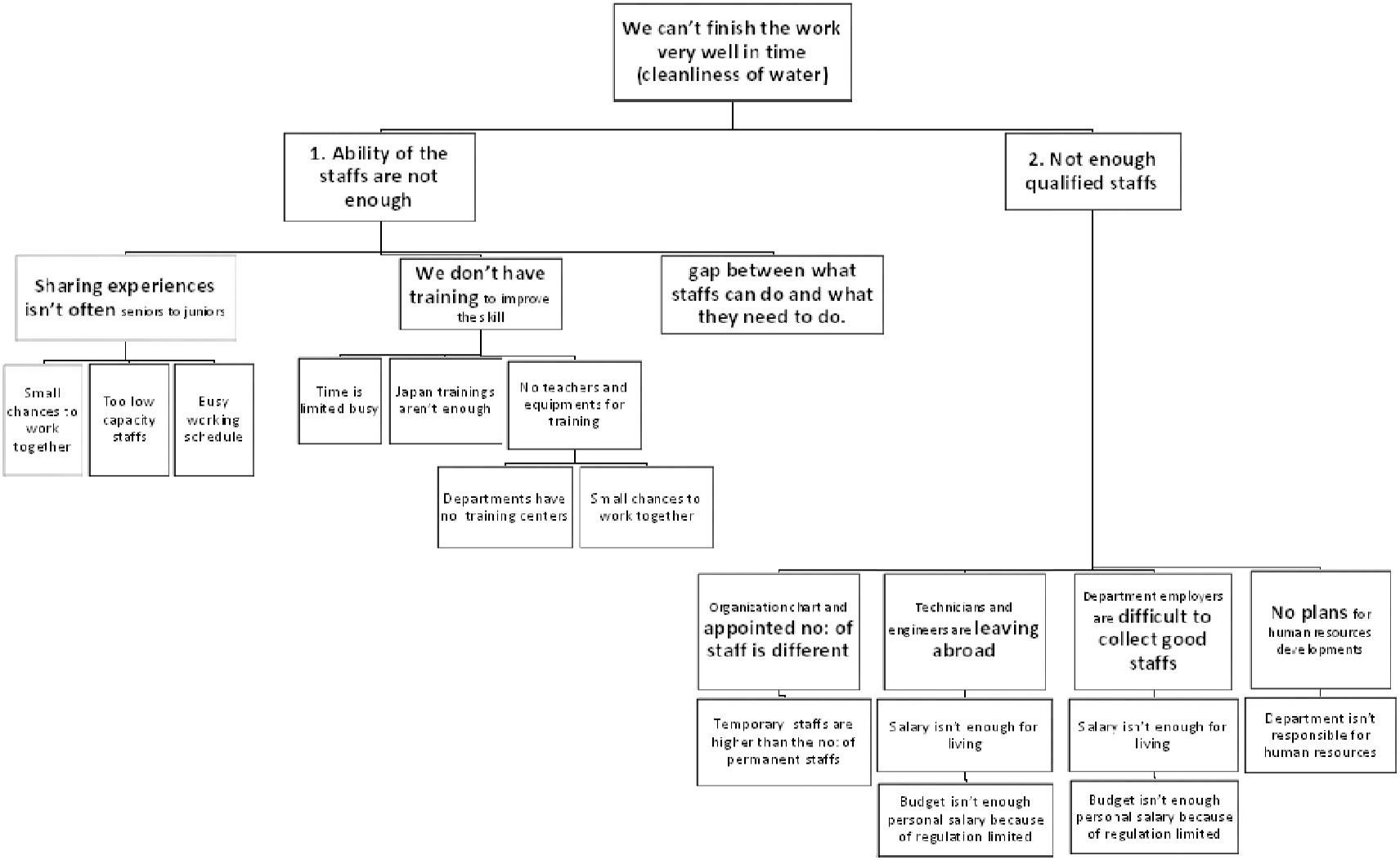


Figure 5.5 Problem Tree of HRD

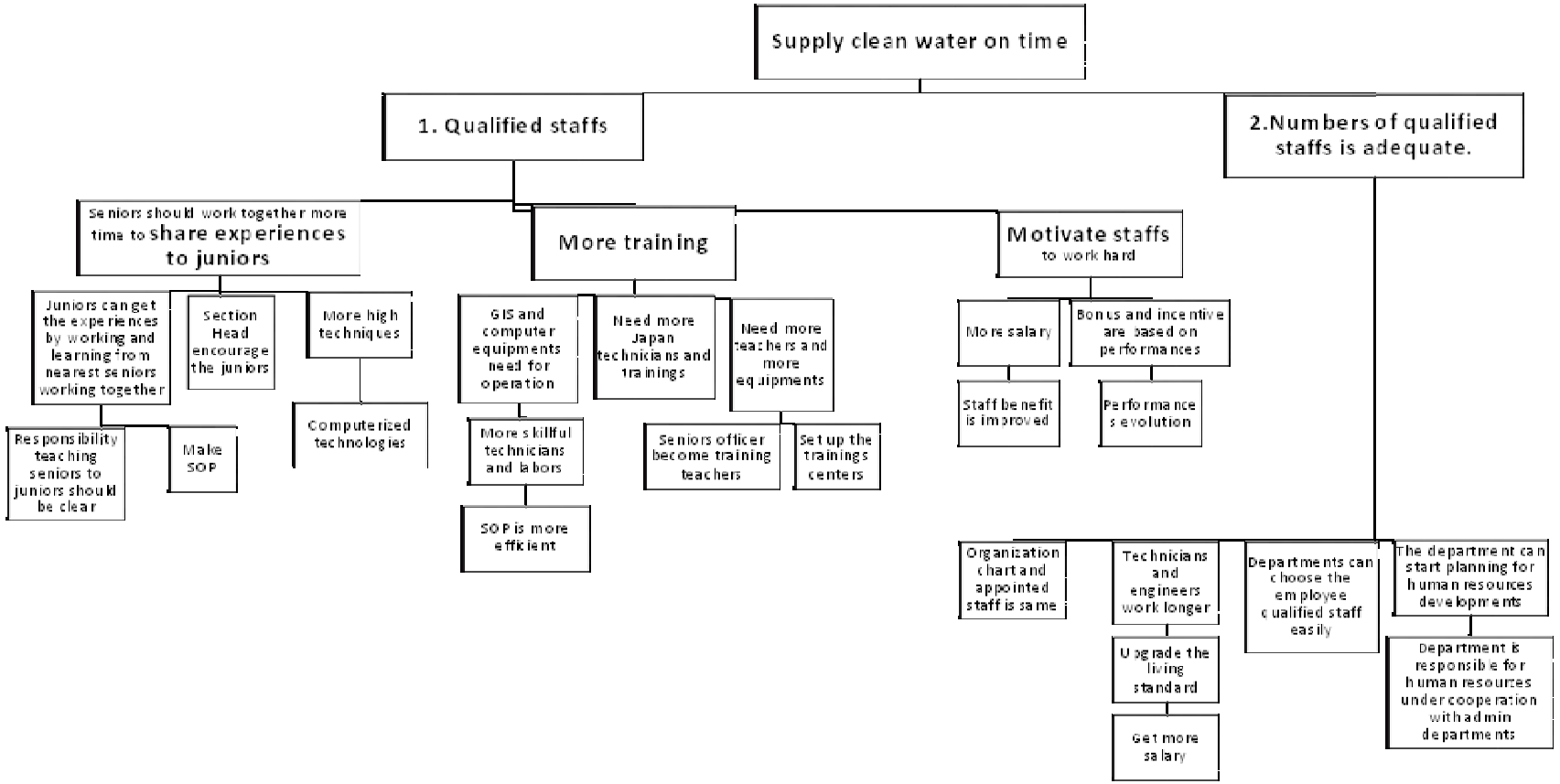


Figure 5.6 Objective Tree of HRD

5.3 CAPACITY ASSESSMENT

5.3.1 Results of Assessment

5.3.1.1 Technical Capacity

(1) Organization Level

The detailed results of assessment is as shown in table 5.18. Based on the results of the baseline survey and the collected information related to the questionnaire of CA, here, the main point of the assessment on each field are summarized below.

(2) Organization, duties and responsibilities

Since the discretion is centralized and not well delegated to lower level, decision-making takes longer time, and it is difficult to take account actual situation into making decision. While duties and responsibilities of division level is clearly defined, ones of section level is not in writing. Job seems to be assigned not to the position/section, but to the personnel.

(3) Personnel management related to HRD

Many personnel systems are regulated as unified as national civil servant, which cannot be changed by WSD. In particular, there are no encouragement system to improve performance such as performance related salary system or incentives; hence it is difficult for staff to be motivated to improve their workings and efficiency.

(4) Frame of HRD

The responsible section for HRD in WSD had not been defined before project starts. Thus, WSD has neither strategy nor plan of HRD from longer term of view. Recruitment, staff transfer and training are not planned but on ad hoc bases.

(5) Training

WSD has sent its staff to the training courses organized by other departments and foreign donors responding to their invitation. On the other hand, there is no system to collect training needs in WSD for reflecting to training plan and few training courses specified to water supply. To utilize the training results, there are few support or monitoring system to encourage training participants to apply in their working place.

(6) OJT & Self-learning

Although many managers agree with the importance of OJT, OJT is not work well in many workplaces. Mainly because there is no system to support OJT. Senior staff does not recognize their important role as instructor of OJT. Some offices face difficulties to promote OJT such as too busy daily work, or jobs working individually like meter reader, younger staff turnover easily. For self-learning, there is no official support system, and little incentives for staff to learn now. It seems to be little practices of self-learning of staff.

(7) Resources for HRD

Training centers are available for other department training courses. On the other hand, WSD does not have any specific training center or venue now. Some staff of WSD has experiences of trainers, however, it seems to have some rooms to improve teaching skills more. There are no budget and full-time staff for HRD of WSD.

Table 5.18 Results of Capacity Assessment of Technical Capacity – Organization Level-

Items	Mark	Summary of the results
A. Recruitment, transfer, retirement		
A1: Does WSD/YCDC have any **plan or regulation to control the number of staff** recruited or assigned in each office?	2	There is only one regulation on official number of permanent staff in each level (from CE to labor) defined annually by UCSB (Union Civil Service Board). On the other hand, since labor cost of YCDC is regulated as within 30 % of total revenue of YCDC, the number of permanent staff is limited only to about half of the allocated number. The remaining workforce is supplemented by temporary staff such as Flat, WA, and Daily Wages.
A2: Does WSD/YCDC have clear regulation on procedures of staff recruitment? (Is transparency secured?)	2	Procedures are set as regulation but not transparent enough. For only AE level, the recruiting announcement is in public through newspaper. For ordinary staff is recruited as WA level. There is no recruiting announcement in public for ordinary staff. WSD receives applications from students graduated anytime, and selects from them when needed. There are many cases that staff or ex-staff introduces their relatives.
A3: Does the **frequency and fields** of staff transfers in WDS/YCDC linked with developing staff capabilities?	2	In principle, staff continue working in WSD without transferring beyond department boundary. Within WSD, staff is sometimes transferred mainly when the vacancies occur due to retirement or promotion. There is no regular staff rotation aiming at HRD. The selection of staff to be transferred is based on his/her experience.
A4. Is there any measure to retain staff of WDC/YCDC?	1	Not in particular. Salary is correlated only to position not to working period of each staff.
B. Job description, performance evaluation, incentives		
B1: Are **responsibilities and duties divided** clearly defined for each office?	4	There is clear definition of duties and responsibilities of WSD and 7 divisions consisting of WSD, prescribed in YCDC Law (amended in 2014). However, duties of each section under division level is not defined clearly and often have minor changes of organization such as newly establishment of GIS section under Supporting Division due to technology advance.
B2: Are **job description**s clearly defined for each staff position? (including managers, engineers, technicians, unskilled workers, administration staff of different kinds, etc.)?	4	Budget execution authority is clearly defined to CE, T/S Officer. Responsibilities of each level within department is set by CE, but not in writing. Some staff has clear individual job description such as meter reader, operator in WTP and P/S.
B3: Does WSD/YCDC have a fair **evaluation system** for section/team performance?	3	There is not official evaluation system of performance of each division/section. Head of division, and head of section have responsibilities for the progress of the annual plan, and have to report the progress at regular meeting held every two weeks. At the end of the financial year, the achievement is evaluated to correspond to the annual plan.
B4: Does WSD/YCDC have an **annual appraisal and target setting** system for staff/managers?	1	No regular evaluation system. For promotion, the supervisor is requested to make comment on the person's performance.
B5: Are **individual performance based incentives** working in WDS/YCDC (e.g. pay rises, promotions and bonuses based on individual performance)?	3	There is few incentive system such as welfare (staff accommodation, commuter bus), chance for joining training abroad. For financial incentives, there is no additional allowance, overtime, bonus nor reword. The salary is unified among all civil servants regulated by UCSB.
B6: Is there any linkage between **capacity development of individual staff and improvement of his/her salary** or benefits?	1	No. Salary is fixed based on job level.

Items	Mark	Summary of the results
B7: Does WSD/YCDC have a **reward and recognition program** for all staff?	3	Annually Admin Dept. organizes staff rewarding. About 20 staff of WSD is selected based on their performance and recommended by CE and rewarded by the Minister annually.
B8: Are there **any active criteria for promotion** to a management position? (such as promotion tests, professional qualification requirements, achievement of target performance level, etc.)	4	The Council has authority for the promotion of all YCDC staff. 1) For promoting to AE (officer level), there is unified examination of YCDC, 2) Lower level than AE (ordinary staff level), CE's recommendation for promotion on performance evaluation is taken consideration, 3) from temporary staff (Flat) to permanent staff, performance (evaluated by head of division) and academic qualification is evaluated. Although there is not clear and objective criteria for promotion, working performance (recommendation of head of department), academic qualification, training record, job attendance are evaluated.
C. General HRD		
C1: Does WSD/YCDC have any **HRD strategy / plan** for staff?	2	There is no policy/strategy or plan for HRD. Since duties and responsibilities of WSD do not include HRD so far, WSD never has such plan. For training organized by Admin Dept., EC meeting (attended by committee members and heads of department) approves the annual training plan prepared by Admin Dept.
C2: Does your **human resources development plan meet the current needs** of the utility?	1	No system because HRD is not clearly assigned to any section in WSD.
C3: Are the **duties and responsibilities related to HRD of each office** clearly defined and regulated?	2	Mainly Admin Dept. For training courses in WSD, CE/DYCE rise idea for training course and make decision to implement. Admin Section of WSD is a focal section to contact related section to select/send trainees to each training course. These procedures are fixed, but not in writing. No section is assigned to examine HRD based on plan of WSD.
C4: Is **the supervisor responsible** for bringing up and training of the subordinates?	3	Management staff has understood the importance of OJT but not actively promote OJT in the workplace.
C5: Is there any occasion for each staff to think of their **career path** in YCDC?	4	For job vacancy, there are some cases that staff raises their will to move there. For most cases, job transfer is occurred only when promotion or substitute of retired person.
C6: Does the utility have **any Incentives** for lecturers, participants in training courses?	3	There is no additional allowance for internal trainers and trainees. But most trainees are gladly join training courses because training records can be advantage for promotion.
D. Training Management		
D1: Does WSD/YCDC provide any training courses?	3	Yes. Until 2014, WSD organized 2 training courses; 1) plumbing, 2) welding targeting not only staff of WSD, but staff from other department of YCDC, private companies. Some training courses such as GIS drawing, speaking English are also under implementation based on request by each division.
D2: Are training activities (planning, implementation, evaluation, making report) managed properly?	3	Top management of WSD makes decisions to implement training courses ad-hoc base. There are no annual plan. For training course organized by Admin Dept., there is no system to make request for training subject, nor feedback of the results of conducted training.
D3: Is the procedures for implementing trainings defined?	2	No. The procedures are fixed but not in writing.
D4: Are the procedures appropriate to select proper participants of training responding to the contents of the training.	3	Mostly trainees are initially appointed in each work place responding to training invitation prepared by Admin Section of WSD. For training course organized Amin Dep., Admin Section keeps long list for the target trainees so as to send all entitled staff to the training.

Items	Mark	Summary of the results
D5: Are the procedures appropriate to ensure the **programs and materials meet the training needs**	3	Not in system. For individual training courses, lecturer has all responsibilities to prepare training materials. No stage to hear trainees' request or concerns before and after the training course. In the all training courses, trainees give suggestions for improvement in questionnaire, but the results are not conveyed to each trainer.
D6: Are the results of the exam which is taken by the trainee after training course referred and utilized?	4	Participation of training is recorded in Admin Section of WSD in Staff Personal Record. Trainees who perform well in training evaluation will have advantage for promotion.
E. OJT &Self-learning		
E1: Is **OJT** carried out effectively, in terms of the number of experienced staff who can provide OJT, recognition of the importance of OJT, an organized approach for OJT, etc.?	2	Though many managers understand importance of OJT, OJT in workplace is not promoted actively enough. OJT is not conducted systematically.
E2: Does WSD/YCDC have a **culture of knowledge-sharing**?	3	There is no culture to hinder knowledge sharing. But information and experience is not well conveyed among staff.
E3: Does WSD/YCDC provide a supportive environment for the staff to undertake **self-learning** (e.g. access to learning materials, equipment, information, communication with other utilities, financial support, etc.)?	1	No. YCDC has library but the documents are not updated and few documents related to water supply.
F. Resource		
F1: Does WSD/YCDC have a **training center** for staff?	3	Yegu pumping station and Hlawga pumping station has been utilized for training courses. They equip necessary equipment for training on welding or pipe connection. Training materials (textbooks) are not enough.
F2: Is WSD/YCDC's **budget** for human resource development adequate?	2	No fixed budget. Since HRD activities are not planned in annual schedule, there is not specified budget is secured.
F3: Does WSD/YCDC incorporate with **external training** (including those provided by private companies, development partners, and other authorities)?	3	During training courses for Engineer organized by Admin Dept., there are some site visit to private factories. Some sessions are taught by the outside lecturers such as HRD, computer.
F4: Are there enough number of staff with teaching experiences in YCDC?	3	Enough trainers for technical courses; 16 trainers for plumbing, 10 for electrical course, 10 for welding, 10 for connecting.
F5: Are internal trainers capable enough of technical and/or communications skills.	2	Necessary to improve especially presentation skills. In present, one way lecture dominates a training course; no discussion session.

(8) Individual Level

For HRD fields, the following members were assessed as counterparts of the Project.

Table 5.19 Project Members of HRD Group

	Name	Position	Section/Division	Working years in WSD (as of August 2015)
	Mr. Kyaw Kyaw Oo	Assistant Engineer	Leader of Other Lakes Section, Water Supply Division	13
	Mr. Aung Moe Kyaw	Sub Assistant Engineer	Office Section, Reservoir Division	28
	Ms. Su Nandar Linn	Assistant Engineer	House Connection Section, Water Supply Division	31
	Ms. Mya Mya Aye	Supervisor,	Admin Section, Admin & Finance Division	15
	Ms. Khin Zin Mar Myint	Programmer	Admin Section, Admin & Finance Division	19
	Ms. Moh Moh San	W.A	Computer Section, Reservoir Division	3 months
	Ms. May Htoo Aung	W.A	Office Section, Reservoir Division	1 month

Presently, WSD has not assigned any section to be responsible for HRD. Therefore C/Ps have little experience and knowledge on HRD. Some C/Ps who are in a managing position have some experience to manage their staff and made efforts to improve staff capacity. For organization levels HRD, it is necessary to conduct TOT.

5.3.1.2 Core Capacity

(1) Organization Level

The project conducted capacity assessment on core capacity of existing sections of WSD, which is closely related to the project activities as listed in Table 5.20. Core capacity is common regardless of the duties of each section, thus, all targeted sections are assessed with the same assessment items as shown in Table 5.21.

Table 5.20 Sections Related to the Project

	Division	Section	Main Duties
	Reservoir	Yegu Pumping Station	Operation and maintenance of Yegu Pumping station
		Ngamoeyeik WTP	Operation and maintenance of Nyaunghnapin WTP
		Major Maintenance Section	Major maintenance of electric and mechanical facilities of WTP, and transmission pumping stations
		-Electrical group	
		- Mechanical group	
	Supporting	Research Section.	Check cost estimation for construction, rehabilitation.
		Computer Section.	Input and print water bills
		Water Quality & Monitoring Section	Check water quality of water from WTP till tap
	Water Supply	Transmission Pipe 1	Maintenance of transmission pipe from reservoirs till Yegu PS
		House Connection Section	Supervise house connection
		GIS Section	Manage GIS data
		North District	Supervise branch offices including T/S offices
		East District	
		South District	
		West District	
	Admin & Finance	Admin Section	Manage administrative issues
		Finance Section	Manage financial issues including

(1) Planning, Monitoring

In WSD, annual implementation plan and budget plan are set annually, but these not well shared with each branch, sections after the approval. In present situation, annual plan is prepared mainly in division level. Each section needs more capacity to make annual plan by themselves.

For monitoring the progress of the plan, monthly and biweekly meeting is held with attendance with section head and upper level to share all WSD's achievement. However, section level does not know how the report is reflected to the plan. Moreover, quality of the report is need to be improved on the manner to show and analyze the data.

(2) Budget management

Budgeting, and monitoring of its execution is done regularly, and procedures are set firmly. According to the score, these category marks the highest. Although discretion of budget execution is clear, the power is concentrated to the higher position. At the section level, few activities can be managed without top management' decision.

Budget execution is monitored but requires so complicated documents that staff should consumes much time for documentation.

(3) Staffing

Most sections have problems to secure qualified staff; the number of staff is insufficient to implement the assigned duties, staff has not enough knowledge related to the duties, skilled labor is retiring, or WA and Flat turnover easily. Moreover, most sections do not have clear job descriptions of the both of section level and staff level.

(4) Communication

Hierarchal communication: Regular meeting is held biweekly to monitor activities of each section with attendance of section heads and upper level. Important information is shared in the meeting but the annual plan is not distributed in writing but reported orally to each section.

Communication within section: While small sections tend to have close communications among section members, In larger sections, information cannot be conveyed properly to lower staff than SAE level.

Communication with related sections: information is shared only in the regular meeting. Without it, information sharing is not officially established.

Table 5.21 Results of Capacity Assessment of Core Capacity – Organization Level-

Category	Items	Criteria	Average (5-scale)
A. Planning, Monitoring	1. There is annual action plan of section	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	2.94
	2. Planned activities are monitored regularly.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	3.00
	3. The business activities are compiled as a report periodically.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]	2.75
B. Budget management	1. Budget is requested based on planning.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	3.25
	2. Execution of budget is periodically monitored.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	3.31

C. Staffing	1. The number of staff is adequate for assigned duties.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]	2.38
	2. Duties and responsibilities of each staff is clear.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]	2.67
D. Communication	1. Annual action plan is shared among members of the section/office.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	3.13
	2. There is regular occasions to share information among the members.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well,5. Can be a model for benchmarking]	3.13

(2) Individual Level

Items of assessment and the results are shown in Table 5.23. Core capacity is large concept and seems to be related to entire management. The selection of the assessment items, the Project mainly focuses the capacity which is expected to be developed through C/Ps' activities of the Project.
The targets of the assessment are as listed in Table 5.22.

(1) Awareness, leadership

Most staff marked higher than other items regardless of the position. More than 45 % of staff marks "4. Actively". Some younger staff feel difficulty to apply what they learn to their job because they seem not to have enough experience to link the theory to practices.

(2) Management

Obviously, staff in higher position marked higher except "2-3 reporting". On "2-3 reporting", few staff mark "4. I can do alone in sufficient quality". This result matches assessment result of the organization level on planning that "quality of the report is need to be improved".

(3) Problem solution

In present organization structure, the discretion is not well delegated to the worksite. Therefore, staff is not familiar to make plans by themselves. This type of capacity is limited to younger staff especially grasping and understand the problems (3-1, 3-2).

Table 5.22 Project members assessed

Project involvement	Name	Position	Section	Division
Finance	Myint Myint Than	Officer	Finance	Admin & Finance
	Khin Khin Htwe	AE	Finance	Admin & Finance
	Moe Moe Khine	AE	Finance	Admin & Finance
	Thin Thin Yi	Accountant 1	Finance	Admin & Finance
	Tin Tin Moe	Accountant 1	Finance	Admin & Finance
	San San Myint	Accountant 2	Finance	Admin & Finance
	May Thet Kyaw	Accountant 4	Finance	Admin & Finance
	Able Khin Myint	WA	Finance	Admin & Finance
	Ohnmar Soe	WA	Finance	Admin & Finance
	San Yu Maw	WA	Finance	Admin & Finance
	Hnin Mya Khine	WA	Finance	Admin & Finance
	Shwe Zin Aung	WA	Finance	Admin & Finance

HRD	Kyaw Kyaw Oo	AE	Other Lakes	Water Supply
	Aung Moe Kyaw	SAE	Office	Reservoir
	Su Nandar Linn	SAE	House Connection	Water Supply
	Mya Mya Aye	Supervisor	Admin	Admin & Finance
	Khin Zin Mar Myint	Programer	Admin	Admin & Finance
	Moh Moh San	WA	Computer	Reservoir
	May Htoo Aung	WA	Office	Reservoir
NRW	Zayar Tun	AE	Resorvoir	Resorvoir
	Tint Zaw	AE	Transmission Pipe 1	Water Supply
	Pyone Cho	AE	Transmission Pipe 2	Water Supply
	Aye Pyae Aung	SAE	Reservoir	Reservoir
	Aung Min Oo	SAE	Reservoir	Reservoir
	Ohnmar Myint	SAE	Reservoir	Reservoir
	Aung ko Ko Win	SAE	Transmission Pipe 1	Water Supply
	Kaung Khant	SAE	Transmission Pipe 1	Water Supply
	Than Winn	SAE	Transmission Pipe 1	Water Supply
	Tun Tun Hlaing	SAE	Transmission Pipe 1	Water Supply
	Myat Hsu Hlaing	SAE	Transmission Pipe 2	Water Supply
	San San Htwe	SAE	Transmission Pipe 2	Water Supply
	Aung Ko Ko Tin	SAE	Transmission Pipe 2	Water Supply
	Min Thant Zin	SAE	Transmission Pipe 2	Water Supply
	Myo Thant Tun	SAE	Transmission Pipe 2	Water Supply
	Than Oo	SAE	Transmission Pipe 2	Water Supply
	Aye Myat Thu	Flat	Reservoir	Reservoir
	Hein Htun	Flat	Reservoir	Reservoir
	Tin Tin Win	Flat	Reservoir	Reservoir
	Phyo Phyo khaing	WA	Transmission Pipe 2	Water Supply
Water Treatment	Zaw Oo	AE	WTP	Reservoir
	Nyi Nyi Aung	AE	WTP	Reservoir
	Thidar Su Su Khin	SAE	WTP	Reservoir
	May Thaw Tar Oo	Flat	WTP	Reservoir
Water Quality Monitoring	Ei Khaing Mon	AE	Water Quality & Monitoring	Supporting
	Nwe Nwe Zin	SAE	Water Quality & Monitoring	Supporting
	May Zin Oo	SAE	Water Quality & Monitoring	Supporting
	New New Sin	SAE	Water Quality & Monitoring	Supporting
	Thondor Myat	SAE	Water Quality & Monitoring	Supporting
	Aye Aye Thuzar	Flat	Water Quality & Monitoring	Supporting
	Hsu Myat Mon	Flat	Water Quality & Monitoring	Supporting
	May Zin Oo	WA	Water Quality & Monitoring	Supporting
	Myat Su Mon	WA	Water Quality & Monitoring	Supporting

Table 5.23 Results of Capacity Assessment of Core Capacity – Individual Level-

Category	Items	Criteria	Average	Officer (N=11)	SAE below (N=25)	WA-Flat (N=16)
1. Awareness, leadership	1. Applying what s/he learnt in actual job.	[1. Never, 2. Sometimes, 3. Mostly, 4. Actively]	3.4	3.6	3.4	3.1
	2. Sharing what s/he learnt with colleagues/staff.	[1. Never, 2. Sometimes, 3. Mostly, 4. Actively]	3.1	3.5	2.9	2.9
2. Management	1. Implementing assigned job with well-scheduling.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Can teach to others]	2.9	3.3	3.2	2.1
	2. Coordinating/contacting with related sections properly	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 6. Can teach to others]	2.8	3.0	3.2	1.9
	3. Making documents such as report properly.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 7. Can teach to others]	2.3	2.5	2.4	2.0
3. Problem solution	1. Grasping and analyzing actual situation properly.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 8. Can teach to others]	2.6	3.1	2.8	1.9
	2. Understanding problems/issues.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 9. Can teach to others]	2.5	2.9	2.6	1.9
	3. Making plans for solving the problems.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 10. Can teach to others]	2.2	2.5	2.2	1.9
	4. Having ability to get things done.	[1. Little, 2. A little, 3. Having, 4. Greatly, 5. Can be a model to other staff]	3.1	3.3	3.2	2.7
	5. Having willingness to solve existing problems.	[1. Little, 2. A little, 3. Having, 4. Greatly, 6. Can be a model to other staff]	2.8	3.0	2.9	2.6

5.3.2 Achievement State/Expected Outcomes in Capacity Development (Phase 1 & 2)

To achieve sustainable HRD to realize WSD mission, the achievement state and in coming five years' outcomes are suggested as follows.

Achievement state in longer view	Expected outcomes in 5 years
Staff is allocated based on plan a human resource development plan.	1.1. A HRD plan is set and its implementation is initiated.
The capacity of staff is developed sustainably.	2.1. Prioritized training programs are available according to level of staff 2.2. Training courses are conducted effectively. 2.3. OJT is conducted systematically. 2.4. Self-learning system is introduced.
The staff is motivated and performs with their best effort.	3.1. Incentive system is discussed. 3.2. Personnel evaluation system is introduced in WSD.
The organization functions efficiently.	4.1. Duties and responsibilities of each section are clear.

5.3.3 Training plan/Implementation plan

To achieve the expected outcomes mentioned above, the following activities are planned.

Expected outcomes in 5 years	Activities
1.1. A HRD plan is set and its implementation is initiated.	1. Set a HRD Plan. 2. Support to initiate the Plan.
2.1. Prioritized training programs are available according to level of staff 2.2. Training courses are conducted effectively. 2.3. OJT is conducted systematically. 2.4. Self-learning system is introduced.	1. Set up a training center. 2. Prepare training programs to satisfy training needs. 3. Conduct TOT for training skills. 4. Conduct prioritized training courses with PDCA cycle. 5. Set SOP for training management. 6. Enhance OJT activities. 7. Prepare information recourses for self-learning.
3.1. Incentive system is discussed. 3.2. Personnel evaluation system is introduced in WSD.	1. Discuss incentive system. 2. Discuss personnel evaluation system. 3. Introduce personnel evaluation system.
4.1. Duties and responsibilities of each section are clear.	1. Confirm current duties and responsibilities of all section. 2. Help each section to make job descriptions of each section. 3. Update the description as needed.

5.4 SUMMARY OF MAJOR ISSUES

Based on the results of the survey, it is found that WSD is in urgent needs for sustainable HRD. The main reasons as follows;

- Employment age as permanent staff around 30 years old.
- Many clerks of WSD are retiring in 10 years.
- It is difficult to recruit to recruit qualified staff since employment condition is not attractive.
- There is no institute such as university or research institute related to water supply in a country
- The water supply business scale is projected to expand rapidly.

In establishing the sustainable HRD system, WSD has major issues to be solved as follows.

Main problems	Related issues
WSD has not been responsible for HRD of its staff	- No full time staff for HRD - HRD is assumed as only training - No HRD policy/plan from long term view
Difficulties to promote HRD activities in each workplace.	- No clear responsibilities to bring up staff - Low awareness of mid-level managers for HRD - Much turnover of WA - Retirement of well experienced staff - The number of staff is not properly assigned. - Too busy - Less experience and knowledge on HRD
Staff capacity is not fully activated.	- No official system for personnel evaluation. - No official system for personnel evaluation. - No changes in job for long term due to no job transfer/rotation. - No incentives for self-learning. - No official support system for self-learning.
Training course are not well lined-up.	- Existing training courses do not satisfy all training needs. - No system to reflect training needs to training plan - Few system to improve quality of training course. - Not enough training facilities/equipment for training. - Only part-time trainer; difficulties in their availability
The organization does not function efficiently enough.	- The discretion is not well delegated. - Responsibilities of each section/leader is not clear. - Information-sharing does not work well.

5.5 PROGRESS OF THE PROJECT

5.5.1 Performance Indicators

Based on the results of objective analysis, performance indicators were selected to monitor the achievement of two main objectives corresponding to Objective Analysis; 1) to improve the capacity of current staff, and 2) to have enough qualified staff.
By examining the availability of data and measurability, the following PIs were selected.

Table 5.24 PIs for HRD

	PIs	Data in 2015	Formula
A. Volume of training			
1.	Rate of Trained staff in a year	5.73%	Rate of Trained staff of WSD in a year/all staff of WSD
2.	Rate of trained Technicians in a year	N/A	Rate of Trained Technicians of WSD in a year/all Technicians of WSD
3.	Average training days for each staff	1.47 day	Total training opportunities (=participants x training period)/Total staff
B. Quality of training			
4.	Number of Trainees per trainer	N/A	Average ratio of total No. of trainers/day/No. of trainees of each course
5.	Ratio of practice sessions	N/A	Average ratio of practice sessions/total sessions of each training course
C. Adequate number of staff			
6.	Total staffs number/1000 connections	7.64 persons	Total staffs number/1000 connections (unit person)

5.5.2 Interview to Analyze Current Situation

In October 2015, the HRD group conducted interview with key officers and staff of WSD in order to grasp actual situation of HRD, and ideas for new training courses. The interviewees are at listed in Table 5.25.

Table 5.25 Interviewees

	Division	Position	Interviewee
	Head of Department	Chief Engineer	Mr. Myint Oo
	Deputy Head of Department	Deputy Chief Engineer 2	Mr. Myo Thein
		Deputy Chief Engineer 3	Mr. Thein Min
	Water Supply Division	North District Officer (EE)	Mr. Nay Lin
		South District Officer (EE)	Mr. Thant Zin Oo
		Township Engineer (AE)	Ms. Cho Lae' Soe
		Township Engineer (AE)	Ms. Ni Mar Zin
		Head of Transmission pipe Section 1 (AE)	Mr. Tint Zaw
	Electrical & Mechanical Division	Head of Division (ACE)	Mr. Aung Khin Zaw
		Head of Electrical Section (EE)	Ms. Aye Pa Pa Nyo
	Reservoir Division	Head of Division (ACE)	Mr. Myint Sein
		Manager of NNP WTP	Mr. Zaw Oo
	Supporting Division	Head of Computer Section (EE)	Ms.Aye Aye Mar
	Administration & Finance Division	Head of Division (ACE)	Mr. Thet Lwin
		Head of Admin Section	Mr. Win Zau Oo
		Head of Income & Expenditure Section (Officer accountant)	Ms. Myint Myint Than
	Sanitation Division	Head of sanitation division (ACE)	Mr. Way Lwin
		Chief of WWTP (EE)	Ms. Khin Aye Myint

The results of this interview has been reflected to the Baseline Survey. For ideas for the new training courses which was risen during this interview, are combined with ideas of JICA experts of each field and summarized as in Table 5.26.

Table 5.26 Ideas of Training Course

No	Supposed training course	Target	Current problems to be solved by training	Examples of detail training subjects
1.	Service Pipe connection and meter installation.	Personal in charge Plumbers and T/S staff	The cause of leakage are mostly at the joint between distribution pipe and service pipe Meter installation is not regulated well. Some meters were installed improper direction. This is one reason of commercial loss	Basic knowledge for type of meter, pipe Procedures of pipe connecting, installation, Inspection Effect of water pollution and NRW.
2.	Repairing pipes leakage	Basic workers in T/S	Even after repair, many leakage happen soon Knowledge and skill are necessary	Pipe fitting Pipe Connection Pipe Laying
3.	Meter Reading	Meter Readers	Meter reader cannot answer the questions and complaints from customers properly Meter readers sometimes do not read meter properly	Outline of water supply System and NRW. Tariff calculation, Meter accuracy, How to treat customer complain
4.	Safety Measures	All workers, and supervisor working in site.	Most workers do not have any knowledge how their working site has risk. Working sites do not equip safety wear sufficiently. It causes sometimes serious accidents	Dangers in each working site, Importance of safety first to raise worker's awareness
5.	Computer skills	T/S officers Staffs and office workers, some clerks	Most paper works are done by manually. It's very inefficient. At the same time of installation of PCs at T/Ss offices, training is necessary	Basic Knowledge Database
6.	Pipe materials and pipe network design	Engineers in transmission Pipe, GIS, inspection, research section	Difficult to calculate the diameter of pipe to fit water demand. Not clear how to select pipe materials depending on the situations. Difficult to calculate how much water are wasted.	Basic knowledge of type pipes and accessories. How to calculate size of pipe diameter based on daily maximum production, Design and drawing. Knowledges of flow meter Operation and maintenance.
7.	Mechanical and Electrical knowledge	Pump operators in T/S	Pump operators of T/S (Tube wells & booster) cannot repair even minor cases.	Basic Electrical works Basic Mechanical works O&M of Pumps
8.	Water Treatment Process	Staffs and daily workers in WTP (operators)	Operators don't understand the whole process of water treatment plant as a system.	Chlorine dosing Rapid Stand Filter Back wash Sedimentation Water Quality
9.	Budget and expenditure finance project management	EE, AE, SAE	Not enough knowledge how to control the whole project including finance	Related to Project and financial management

No	Supposed training course	Target	Current problems to be solved by training	Examples of detail training subjects
10.	Training for group leaders	Group leaders	Necessary to understand the importance of the responsible duties in whole system of water supply management. Staff can be more improved and are intended to be more skillful about their works	Mission of WSD, Overview of water supply system, water supply management, Staff awareness and Office management
11.	Training for new staff	Newly employed staff	Little chance to understand mission of WSD and whole system of water supply, and management of the utilities.	Mission of WSD, Overview of water supply system, water supply management, customer service

CHAPTER 6 PUBLIC RELATIONS AND PUBLIC AWARENESS

6.1 BASELINE SURVEY

6.1.1 Present grievance system of WSD and YCDC

YCDC has several ways to receive the grievance / complaint from the citizens:

- Complaint section under Administration Department of YCDC
- One-stop service
- Individual call to the YCDC staff

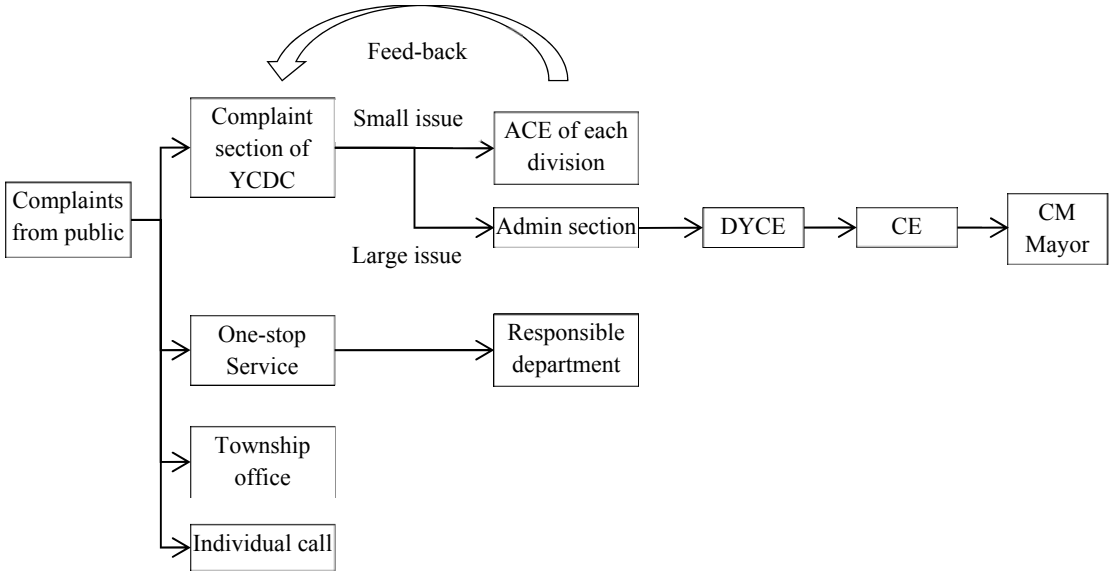


Figure 6.1 Grievance System of YCDC

(1) Complaint Section under Administration Department of YCDC

YCDC has the Complaint Section under Administration Department of YCDC. The Complaint Section handles every kind of grievance / complaint related to the services that YCDC provides to the public. The grievance / complaint reaches to this Section by telephone, letter, direct visit, Facebook and website. The grievance / complaint posted in the newspaper and magazine are also handled. Six staffs are working in the Section from Monday to Friday.

When the grievance is received, the information such as date, time, contents and personal information is recorded in the book. Then the grievance /complaint are transferred to the responsible departments to take necessary actions against the grievance/complaint. The responsible departments send the feed-back to the Section and such documents are filed in the Section. However, not all feed-back comes to the Section and the Section does not monitor the actions by the responsible departments.

(2) One-stop service

"One-stop service" is located in the corner of the contact that public visits. The staff of this service comes from various departments such as Admin Dept., WSD, Building and Land Administration, Road & Bridge and PCCB to solve the various grievance / complaint quickly. When they receive the grievance / complaint, those are recorded in the book and when they are solved immediately, the result is also recorded in the book. When the grievance cannot be solved, the document is sent to the responsible department. The grievance related to water and sanitation do not come to this service, as the most of the grievance are received at township office and WSD directly.

(3) Township office

The township office receives the grievance from the public. There is no specific section to receive the grievance, but receiving the grievance is one of the responsibilities of the township.

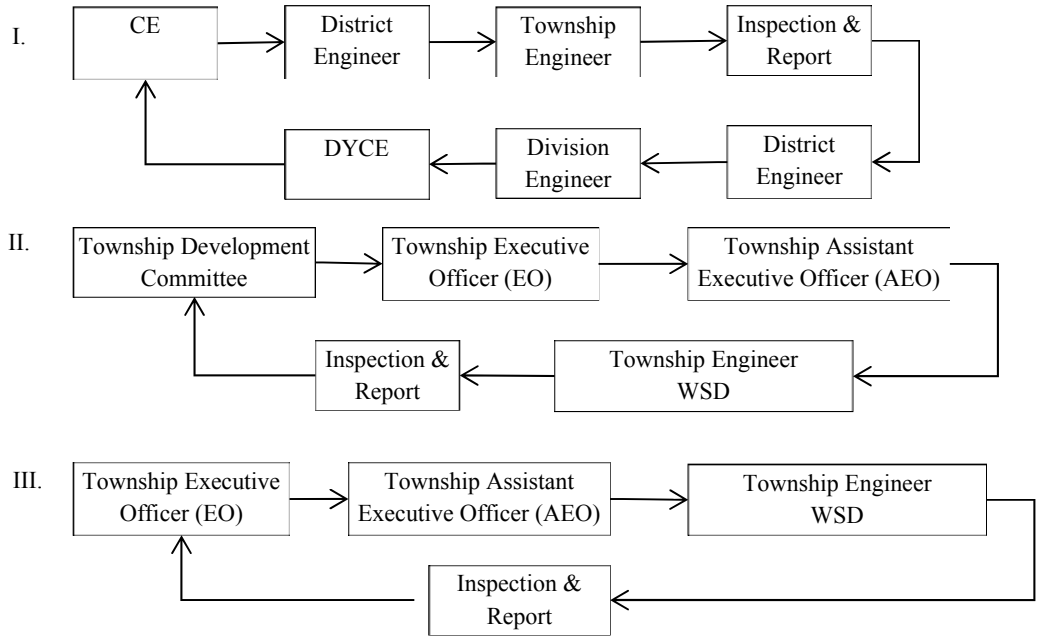


Figure 6.2 Grievance System in Township

The township office receives the grievance by phone, mail, through newspaper, journal and social media. The grievance that the township office received are about meter reading, water leakage, low pressure, water quality, water shortage, water tariff, construction and new connection application.

(4) Individual call

The engineers of WSD and officers in township office are sometimes received the grievance from the public by direct phone call. The actions or solutions for those grievance are not clear as there is no system to handle those grievance received by individual calls.

6.1.2 Present public relations and awareness activities

Public relations activities are implemented by Information Section and City FM under the Public and Relations & Information Department (PR&I). PR&I Department have four sections: City FM, E-government, Information and International Relations.

(1) Information Section

There is 14 staff working in Information Section. YCDC transmits the necessary information to the citizens through this Section. There are no direct activities with the citizens but when citizens visit the Section for inquiries, they respond to it.

1) City News (newspaper)

The City News is published from 1991, every day except Sunday and holidays. 5,000 copies are published and sold by 100 Kyats. The articles that the departments need to be published are provided by each department to this Section. The Section also collects news data and prepares the articles.

2) City Magazine
The City Magazine is also published monthly from 1991. 2,000 copies are published and sold by 2,500 Kyats. The main topics are related to entertainment.

(2) City FM
City FM is used to be operated by YCDC staff till January 2012, but now it is operated together with the private company. There is the program called "YCDC News". Within the YCDC News, information such as water disturbance, construction of water supply facilities and so son are notified to the public. The information that WSD needs to announce to the public are reported from DYCE of WSD by phone and the Section send the information to City FM by fax.

(3) WSD
WSD implements the public awareness activities occasionally in cooperation with PR&I Department. Those activities are implemented request basis.

6.2 SUMMARY OF MAJOR ISSUES

(1) Grievance System

The Complaint Section under Administration Department of YCDC is working properly. The received grievance is transferred to the responsible department from the Complaint Section and feedback is returned. The documents are kept in the files. Some feedback is not returned so that the notification to return the feedback shall be sent to the responsible department and it should be monitored by the Complaint Section.

The grievance is also received at the township office. However, there is no special telephone line for grievance nor fixed person / section to receive the grievance. For this reason, the grievance and actions are not properly recorded and managed. Same occurs with the individual call. Nobody grasps the number of grievance received related to water issues and actions including responded or ignored. This is a big problem for WSD that they do not know the users' real opinions and the users' feelings against the WSD could be worsen if the grievance is not treated properly. The grievance received within WSD and township office should be properly handled and recorded.

(2) PR Activities

The RP Activities are implemented by PR&I Department of YCDC through newspaper, magazines and radio. These activities are handled by several sections under the PR&I Department and work very well. However, there is no direct activity to the public. As WSD, some information can be provided through the activities by PR&I Department, however, more detail information and enhancement of awareness of users may be required.

All the C/P members think that PR activity is important for WSD and PR activity will improve the customer's attitude, such as payment, usage of water and leakage report. However, opinions about the responsible organization to implement the PR activity are different by C/P. Some of them consider that PR&I Department is appropriate, some consider that the officers of township is appropriate as they contact with the customers frequently, and some think about establishment of new section for PR. As the method to implement the PR activity, all chose the activity through media and direct communication (meeting with public). Based on those opinions, the future implementation of PR activities shall be discussed in the next step.

6.3 PROGRESS OF THE PROJECT

The present system of grievance redress and PR activities are identified. As next step, the discussion of improvement of grievance redress system within WSD and township shall be implemented and identify

how to improve the system.

As for PR and awareness activities, the opinions from some of C/P are obtained but this is not the representative opinions as WSD, so more research shall be required. Then, when activities that WSD would like to implement and which section is appropriate to implement will be clear, the strategy and plan for PR and awareness activities shall be prepared and implementation shall be started.

CHAPTER 7 NON-REVENUE WATER AND GIS

7.1 BASELINE SURVEY

7.1.1 Results of Township Survey

JICA experts and output (2) group surveyed and investigated 33 townships in Yangon region for Non-Revenue Water management. We knew that water resources: Phugyi, Gyobyu, Hlawga and Ngamoeyeik reservoirs for every township. YCDC owned tube-wells are reinforcing in some townships.

Water supply pressure is low especially in township that are far away from reservoirs. These townships are supported by tubewell. There may be disturbance of electricity shortage in water supply system.

We don't know actual water inflow rate because of lack of installation inlet and outlet flow meter in every township. Free of charges and unsystematic pipeline networks and illegal connections make high NRW rate. So we should install flow meters in every township to know water supplied amount exactly and to reduce NRW ratio. Free of charges (eg., monastery, pagoda and mosque etc) should collect reasonable price. Replacing old and unsystematic pipes (spaghetti) and replacing old and damage meters with new good quality meters should be done first.

1	8.9.2015	North Dagon, East Dagon, Dagon Seikkan, South Dagon	U Zaw Win Aung
2	9.9.2015	Thingangyun, South Okkala, North Okkala, Mingalardon	Daw Ohmma Myint Daw Aye Pyae Aung
3	10.9.2015	Hlaingthayar, Shwepyithar, Insein	Daw Tin Tin Win
4	11.9.2015	Hlaing, Kamaryut, Bahan, Yankin	Daw Aye Myat Thu
5	14.9.2015	Tarmwe, Mingalar Taung Nyunt, Pazundaung, Botahtaung	
6	15.9.2015	Mayangone	U Zayar Tun
7	16.9.2015	Tharkata, Dawbon, Dala	U Aung Min Oo U Ye Zayya
8	17.9.2015	Kyeemyindine, Sanchaung, Lanmadaw	U Hein Tun
9	18.9.2015	Pabedan, Latha	
10	21.9.2015	Ahlone, Dagon, Kyauktada, Seikkan	

Figure 7.1 Schedule of Township Survey

Photo 7.1 Township Survey(Interview)

Some of meter readers are lack of awareness (for example, not reading meter regularly and not replacing new meter if the meter is out of order, and mistake of meter installation). The bad water quality may cause meters damaged. Water treatment facility is insufficient in Yangon City Water Supply System.

Pipe leakage repair reports are incomplete in most of the townships. Pipe leakages are being repaired as soon as possible. There is no update pipeline network map and need up-to-date and systematic database in every township office and maintenance section of transmission main using computers. Now, weekly report for distribution pipe leakage repair from every township is only submitted to District office.

7.1.2 Current Conditions of NRW Management

Current NRW situation in every township can be known as mentioned above. There is no bulk flow meter in every township so that water inflow volume and NRW ratio cannot be known exactly. Replacing the old pipe lines, installation of new pipe line network, replacing and installing water meters are being done in some townships. Meters are being installed for flat rate (18% of total connections) to reduce NRW ratio.

Engineering Department (Water & Sanitation) opened training courses for NRW management and practice in pilot project of Mayangone and Yankin township. Now, NRW team is working together with

Mitsubishi Manila Water for NRW reduction pilot project in Insein and South Okkalapa. Our department arrange pilot project in Yankin township to reduce NRW ratio and to practice NRW counterparts. JICA experts and NRW counterparts surveyed No (13) ward to reduce NRW ratio.

First, we have checked to know the existing of street with old map in pilot project. And then we have collected meter data and recorded information for each customer's house. We have recorded customer's meter with photo. We will continue NRW functions gradually.

Photo 7.2 Water Meter (1)

Photo 7.3 Water Meter (2)

Photo 7.4 Water Meter (3)

Photo 7.5 Water Meter (4)

We have measured junction point of pipe and location of valves with GPS and import the data from GPS to GIS software. We have checked the 7 junctions point of pipe by digging and measured to know exactly length of roads.

7.1.3 Outlines of Donor of NRW Projects

In current situation, there is much non-revenue water in YCDC area. So, Internationals arrived to help in reducing NRW. YCDC is cooperating with these organizations to develop water distribution.

Table 7.1 List of Activities of Donors (1)

Item	Project for NRW Reduction in Mayangone T/S	FS on NRW Reduction by Denmark
Source of fund	MOFA of Japan, Grassroots grant aid	
Implementation body (Consultant etc.)	Japan Construction	DWS (Danish Water Service + My Associate)
Implementation period	Oct 2014 – Oct 2015	17.2.2013 (LOI)
Current status	Almost completed	20.2.2014 (F/S)
Target areas	A pilot area in Mayangone	Yankin (ward No 13,14,15,16)
Scale of pilot project (the number of households)	400 households	259 households

Table 7.2 List of Activities of Donors (2)

Item	FS on NRW Reduction by Manila Water	Rehabilitation Program of Yangon Water Supply System –Pilot Project
Source of fund		
Implementation body (Consultant etc.)	Mitsubishi –Manila Water	EGIS, France; MWI
Implementation period	1 year	9.5.2014 (Agreement)
Current status	Survey	6.5.2015 (Final Report)
Target areas	Pilot Area (To, JS)	Tarmwe, Thingangyun
Scale of pilot project (the number of households)	TO -372 /connection, JS - 311/321 connection	

7.2 RESULTS OF PCM WORKSHOP

7.2.1 Problem Analysis

If we don't have update detail map for pipeline network, we cannot know pipe age and difficult to find leakage point. Weakness of leakage detection technology, difficulties to find the location of invisible leakage, we can't detect leakage with device when pressure is low, it can cause physical loss. Weakness in technology of pipe installation and repairing can cause more leakage and physical loss. We don't have database for age of pipe and update detail map of pipeline network. We are difficult to know age of pipe. The other facts of causing physical loss are low water pressure.

There are various types of damage meter in townships. The causes of damage meters are necessity of knowledge how to use horizontal and vertical meter, the fact that customers don't obey YCDC rules for meters and low water quality.

In meter installation, some meters are at the back of the high-rise buildings, meter position is very high. So, meter readers in townships are facing the problem of difficulties of meter reading. Besides, there are not enough staff to read meter because water meter connection increase.

And also shortage of electricity can disturb water distribution management. YCDC staff need to collect water tariff regularly and check illegal connection. Therefore, we should do above mentioned facts to improve YCDC budget.

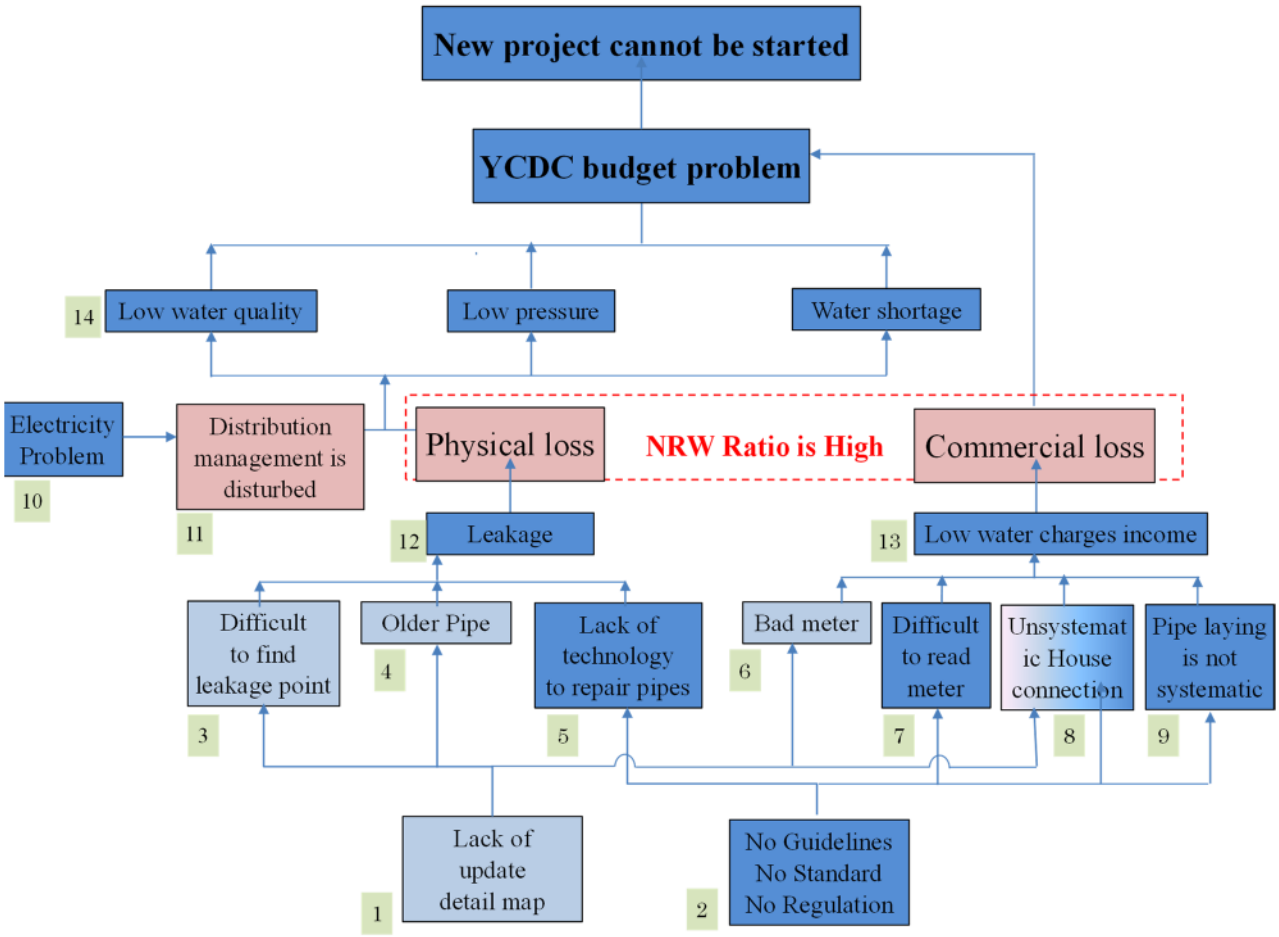


Figure 7.2 Result of Problem Analysis of NRW

7.2.2 Objective Analysis

We should make update detail map of pipe network and customer database with GIS to reduce rapidly NRW ratio. If the water pressure is good, we are easy to find leakage point. Every townships should be replaced the older pipe with new one. It can also be reduced leakage and our department can supply sufficient water to the customer houses. Above mentioned facts can reduce physical loss.

We can prepare guidelines, standards and regulations. We should have technology to repair pipes. All pipeline and household connection should be connected systematically to reduce leakage. Bad meters and damage meters should be replaced with good meters. So, meter readers can be read easily. All pipelines and household connections should be connected systematically and collect the bill month by month completely. It can reduce leakage. Thus, it will be high water tariff. Above mentioned facts can reduce commercial loss.

If we can reduce physical loss and commercial loss, it will be good water distribution with suitable pressure. Finally, we can supply sufficient water to the public. Therefore, YCDC budget can be increased and YCDC can start new project.

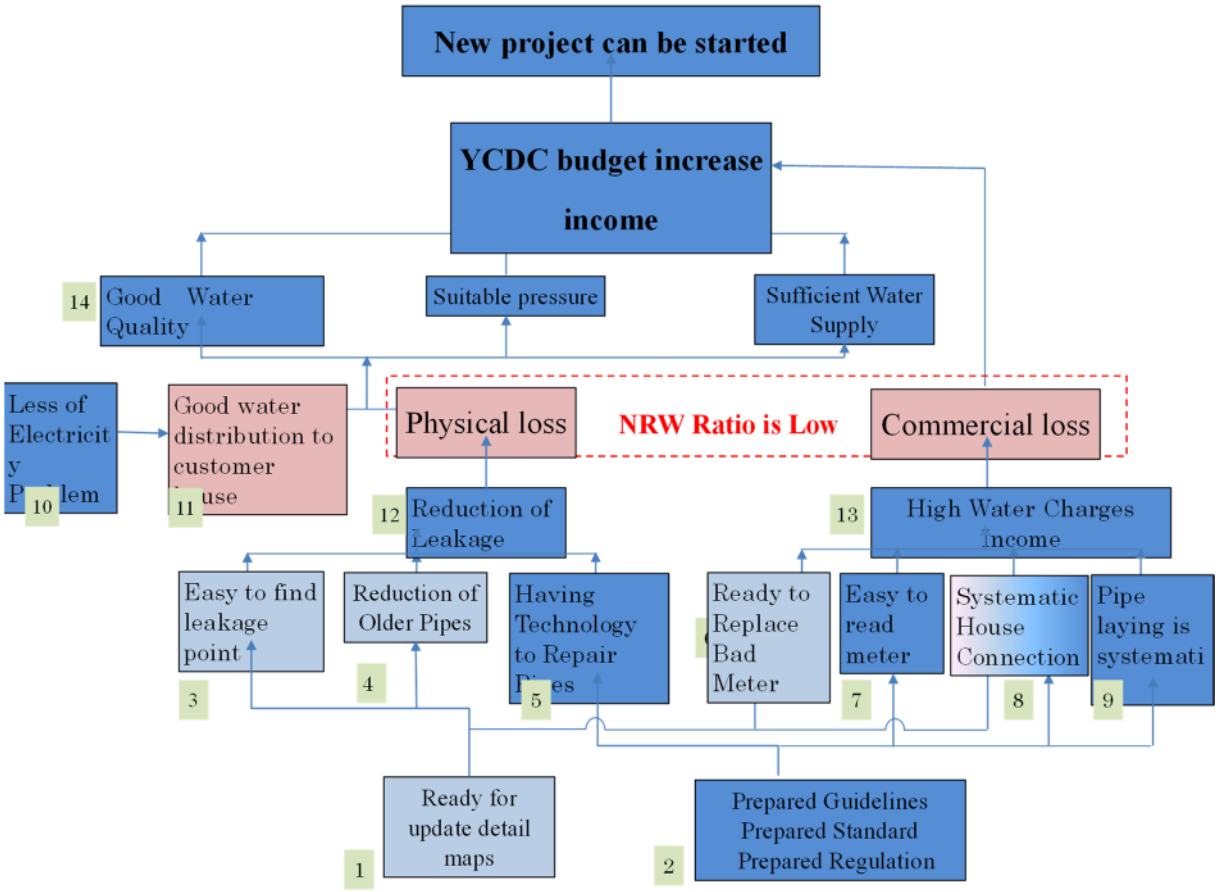


Figure 7.3 Result of Objective Analysis of NRW

7.3 CAPACITY ASSESSMENT (INDIVIDUAL AND ORGANIZATION)

7.3.1 Results of Assessment

1) Results of NRW Individual Technical Capacity Assessment
Individual technical capacity assessment of the person who will in charge of NRW management has been carried out by using the questions as shown Table 7.3.

Table 7.3 Questionnaire for NRW Individual Technical Capacity Assessment

2015/10/8

Capacity Assessment & P I

YCDC-Resoirvor Section Name : Age : Grade :

Knowledge Level (1) : You have "no" knowledge & experience.
Knowledge Level (2) : You have knowledge but "not" experience.
Knowledge Level (3) : You have both knowledge & experience. But not easy to implement (operation).
Knowledge Level (4) : You have lots of knowledge & experience to implement.
Knowledge Level (5) : Can teach to others.

C／P Assessment items	Knowledge Level					Remarks
	1	2	3	4	5	
Ⅰ Concept of Waterworks						
Definition of the word "waterworks"						
Difference between "raw water" and "treated water"						
Why is water pressure needed for water pipes ?						
Can you explain how to produce water pressure?						
How do you calculate the pipe diameter? (Explain the basis?)						
Mechanism of loosing water pressure (hydraulic gradient)						
Requirement for water pipes						
Ⅱ Countermeasures against NRW						
Can you explain what "NRW" is?						
Can you explain what "Effective water" is?						
Can you explain what "Ineffective water" is?						
Can you explain what "Metering inaccuracy" is?						
Can you explain what "Water distribution amount" is?						
Can you explain what "DMA" is?						
Knowledge of types of flowmeter						
Experience of water flow measurement						
Can you explain what "Minimum Night Flow" is?						
Mechanism of leak occurrence						
Knowledge for leak detection						
Experience of leak detection						
How to check water pipe degradation						
How to measure accurate water consumption						
Ⅲ Piping map creating & recording						
Experience of scale piping maps etc..						
Experience of making drawings with records of water serviced houses						
Experience of survey with completed water service pipe drawings						
Characteristics of multibranched piping						
Characteristics of network piping						

The result of the assessment made the following matters clear.

[Regarding to “I: Concept of waterworks”]
Present capacity of understanding and knowledge of waterworks is low. It is first step for every staff of YCDC to understand basis of waterworks, as example why water pressure is needed and what the mechanism of water pressure is. Moreover, pipeline design capacity is not adequate. It is difficult to calculate relevant pipe diameter and to choose material themselves at present stage.

[Regarding to “II: Countermeasures against NRW”]
Capacity regarding Countermeasures against NRW is not adequate. There is a few opportunity to learn countermeasures against NRW due to lack of section which deal with NRW. On-site training is needed to develop their capacity of NRW.

[Regarding to “III: Piping map creating and recording”]
Skill and experience are inadequate at the present stage. There is no scale map and piping map. C/Ps can gain skill and experience through NRW countermeasures activities in the pilot area.

2) Results of NRW Organization Technical Capacity Assessment
Organization technical capacity assessment of the person who will be in charge of NRW management has been carried out by using the questions as shown table 7.4. As the result, there are standards of design, estimate, material, and construction. However, technical level of YCDC staffs is not enough. Low capacity of design section and construction section shows lack of management of construction site.

Table 7.4 Questionnaire for NRW Organization Technical Capacity Assessment

Capacity Assessment of Organization

Pipe Section 1

Technical Capacity

Category	Items
Material Standards	☞ Material standards of newly pipe installation, repairing, etc.
	☞ Inspection of procured materials
Design Standards	☞ Design standards of newly pipe installation, repairing, etc.
Estimate Standards	☞ Estimate standards of newly pipe installation, repairing, etc.
Construction Standards	☞ Consruction standards of newly pipe installation, repairing, etc.
Inspection Standards	☞ Inspection standards for completion test of newly pipe installation, rehabilitation, etc.
Technical Training	☞ Training of distribution pipe design, estimation, etc.
	☞ Technical training of distribution pipeline construction.
	☞ Training of leak detection method, etc.
	☞ Training of measurement method of water leakage amount, etc.
Pipe Information Management	☞ Grasp precisely pipeline location, materials, laying date, etc.
	☞ Record and up-to-date pipeline information (location, etc.) as a pipeline map.
Equipments	☞ Equipments for pipe laying, repairing, etc.
Technical Level	☞ Technical level of staffs of each section.

3) Results of GIS Individual Technical Capacity Assessment

We assessed technical capacity of staffs in GIS section. Table 7.5 shows the technical categories and questions of capacity assessment for individual.

Table 7.5 Questionnaire for GIS Individual Technical Capacity Assessment

Categories		Items
A. Baseline knowledge and skills of GIS	Baseline knowledge	Can you describe the following items? A1. What is GIS(Geographic Information System)? A2. What are the advantages of using GIS? A3. What is attention of managing GIS in YCDC?
	Skill and experience	Do you have experience of the following items? A4. Browsing and searching data in GIS. A5. Making GIS maps. A6. Building GIS Database(DB) on pipe-network. A7. Building DB on facilities and housings. A8. Building DB on house connections and customer meters.
B. Utilization to design and management of pipe-network	Skill and experience	Do you have experience of the following items? B1. Building DB on pipe-network based on offset-survey* drawings. (*:result of field measurement) B2. Building DB on O&M of pipe-network. (ex. water pressure, leakage, history of repair work) B3. Customizing DB in itself. (ex. Addition or change of layers and attribute items) B4. Importing base maps* to GIS and building DB based on the maps. (*:road map, air photo and so on)
	Advanced utilization	Do you have experience of the following items? B5. Aggregate calculation utilizing GIS. (ex. calculating leakage totals by each area) B6. Analysis of result of aggregate calculation. (ex. leakage hazard prediction) B7. Hydraulic analysis* utilizing GIS DB. (ex. EPA-NET) B8. Design of pipe-line network based on hydraulic analysis. B9. Geographical analysis utilizing GIS DB. (ex. extraction of area lacking fire tape)
C. Utilization to customer management	Skill and experience	Do you have experience of the following items? C1. Connection between GIS DB and Customer DB. (ex. Importing information on defective meters, non-paying customers to GIS) C2. Building DB on route and area of meter reading.
	Advanced utilization	Do you have experience of the following items? C3. Aggregate calculation utilizing GIS. (ex. defective meter and customer claim by each area) C4. Geographical analysis utilizing GIS DB. (correlation between water pressure and tariff unpaid)
D. Utilization to asset management	Advanced utilization	Do you have experience of the following items? D1. Management of current assets utilizing GIS DB. D2. Future forecast of assets based on the above analyses D3. Making long- term construction / replacement plan based on future forecast of assets

Example answers)

A1: GIS is possible to view information of facilities and execute various analyses. It is an indispensable system for water supply operation.

A2: To utilize for daily field works, planning of field works and long-term planning of water supply.

A3: Up-to-dating and consolidating of database are important together.

The result of the assessment made the following matters clear.

[Regarding to "A. Baseline knowledge and skills of GIS"]
Base knowledge and skill are inadequacy at the present stage, but the staffs have good knowledge pertaining to advantages of using GIS. This result means expectation for effective utilization of GIS.

[Regarding to "B. Utilization to design and management of pipe-network"]
Skill and experience are inadequacy at the present stage, but some staffs have some experience through

other projects as such as “Rehabilitation Program of Yangon Water Supply System –Pilot Project by EGIS-France” and “activities with the adviser dispatched form Fukuoka City Waterworks Bureau”. GIS and hydraulic analysis are of recognized value in design and management of pipe-network.

[Regarding to “C. Utilization to customer management” and “D. Utilization to asset management”]
Skill and experience are inadequacy at the present stage, but the C/Ps can gain skill and experience through NRW countermeasures activities in the pilot area.

4) Results of GIS Section Technical Capacity Assessment
We assessed technical capacity of GIS section itself. Table 7.6 shows the technical categories and questions of capacity assessment.

As the result, the capacities were found to be inadequacy. Because the GIS section is not yet established officially and the operations are at the beginning of preparing for GIS.
We urgently need to establish GIS section officially and begin operations as soon as possible.

Table 7.6 Questionnaire for GIS Section Technical Capacity Assessment

Category		Items
A. Establishment of section and GIS database(DB)	Section	A1. GIS section has been established.
		A2. Duties regulations of GIS section has been formulated.
	GIS DB (basic level)	A3. Human resources and equipment have been arranged.
		A4. GIS DB(basic level*) has been built. (*ex. only location and shape of pipeline)
B. Standard utilization of GIS	Operating plan of GIS in YCDC	B1. Operating plan of GIS has been formulated in YCDC.
	Standard utilization	B2. GIS DB(standard level*) has been built. (*ex. including information of diameter,material, installation year)
		B3. YCDC's DB has been consolidated in GIS.
		B4. GIS DB is constantly updated.
		B5. GIS section provides some drawings to other departments for management of pipeline and facility.
C. Advanced utilization of GIS	Advanced utilization	C1. GIS DB(advanced level*) has been built. (*ex. including O&M data, such as open/close of valve, water pressure, flow rate, leakage detection, leakage repair work and so on)
		C2. Customer data of GIS have been constantly updated by connection to customer DB.
		C3. GIS has been utilized to improve service of water supply. (ex. operation of valves and booster pumps).
		C4. GIS has been utilized to reduce NRW (physical loss). (ex. prioritization of pipeline for leakage detection).
		C5. GIS has been utilized to reduce NRW (commercial loss). (ex. countermeasure against defective meter and illegal connection).
		C6. Hydraulic analysis has been utilized to design pipe-line network. (ex. decision of diameter)
		C7. Geographical analysis has been utilized to improve service of water supply. (ex. reduction of customer claim and lack of fire tape).
		C8. GIS has been utilized to make long- term construction replacement plan.

5) Results of NRW and GIS Individual/Organization Core Capacity Assessment
- Individual

To be prepared. And see Chapter 5.

- Organization

To be prepared. And see Chapter 5.

Table 7.7 Questionnaire for GIS Section Technical Capacity Assessment

Capacity Assessment of Individual 【Field; Non Revenue Water *Development* 】

【Resorvoir Section : Name , Age : Grade : 】

08 / DEC / 2015

Core Capacity		Assessment					
Category	Items	1	2	3	4	5	Remark (criteria)
E. Awareness, leadership	1. Applying what s/he learnt in actual job.						[1. Never, 2. Sometimes, 3. Mostly, 4. Actively]
	2. Sharing what s/he learnt with colleagues/staff.						[1. Never, 2. Sometimes, 3. Mostly, 4. Actively]
F. Management	1. Implementing assigned job with well-scheduling.						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Can teach to others]
	2. Coordinating/contacting with related sections properly						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 6. Can teach to others]
	3. Making documents such as report properly.						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 7. Can teach to others]
G. Problem solution	1. Grasping and analyzing actual situation properly.						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 8. Can teach to others]
	2. Understanding problems/issues.						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 9. Can teach to others]
	3. Making plans for solving the problems.						[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 10. Can teach to others]
	4. Having ability to get things done.						[1. Little, 2. A little, 3. Having, 4. Greatly, 5. Can be a model to other staff]
	5. Having willingness to solve existing problems.						[1. Little, 2. A little, 3. Having, 4. Greatly, 6. Can be a model to other staff]

7.3.2 Achievement State/ Expected Outcomes in Capacity Development (Phase 1 & 2)

(1) Phase1

- Individual capacity

Understanding of concept of waterworks will be developed to level 4, “Adequately Understand“. Through the OJT in the pilot area, the individual capacity will be developed to level 4, “Can do alone in sufficient quality“.

- Organization capacity

There is no section which deals with NRW. In phase 1, NRW Unit will be established, and as organization capacity will be developed to level 2, "existing but not working".

(3) Phase2

- Individual capacity

The training of YCDC worker will be held through the OJT sight.
Through this activity, the technical capacity of counterparts will be achieved to the level 5, “Can teach to others”.

- Organization capacity

The capacity of the organization will be achieved to the level 4, “Working well”, it means the NRW unit established in the phase 1 can be operated well.

7.3.3 Training Plan

1) Training Plan in the NRW field
Training plan for NRW management are set from the result of C/P present capacity. Four main fields should be trained, understanding of materials, design, inspection, technique for construction. Contents of planed training are shown as table 7.8.

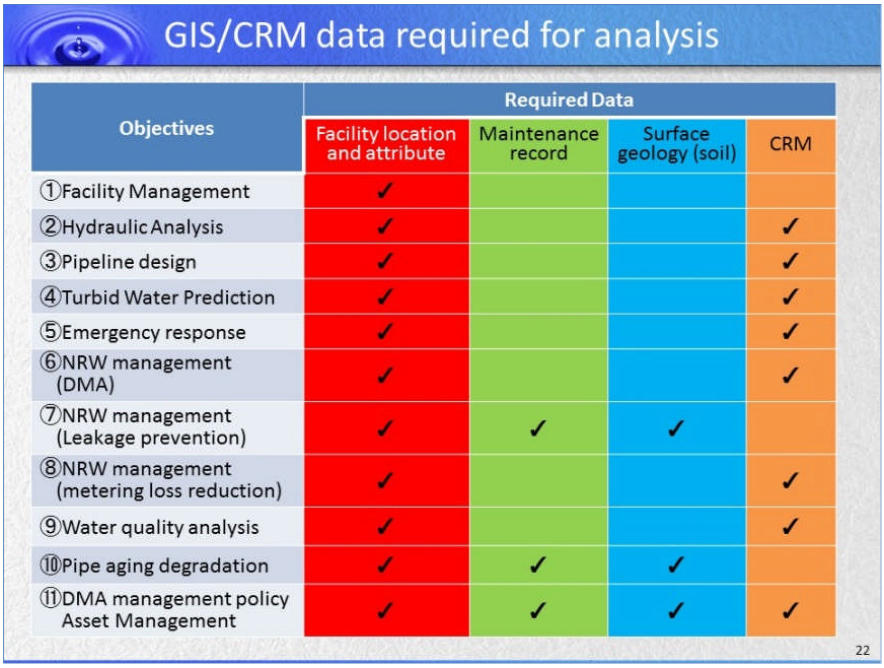
Table 7.8 Training Plan for NRW

Training Items	Training Contents	Counterpart				
		Pipe 1～4	G I S	Coordination	Inspection	Research
Ⅰ. Material	☞ Materials of house-connection ➪ Off-JT & Inspection 1. Transmission/Distribution(Pipe, Valve, Joint) 2. Service pipe (Pipe, Valve, Joint) 3. Water supply equipment	○	○	○	○	○
	☞ Regulation of materials of Distribution/Service pipe ➪ Off-JT 1. Transmission/Distribution(Pipe, Valve, Joint) 2. Service pipe (Pipe, Valve, Joint) 3. Water supply equipment	○	○	○	○	○
Ⅱ. Design	☞ How to decide diameter ➪ Off-JT 1. How to calculate Daily Maximum Consumption (Calculation of supply amount/ Concurre 2. Hydraulic gradient (Velocity/Flow amount) 3. Decide diameter	○	○	○	○	-
	☞ Piping ➪ Off-JT 1. How to decide pipe laying position. 2. How to decide valves position. Valve, Air Valve, Check Valve, flow regulating valve, etc. 3. Study joint at branch/pipe changing position. Fitting, Separation-Prevention, Constraint length, Bridge attaching, Inverted-Siphon 4. Distribution zone blocking/Building DMA 5. Installation of flow meter/pressure gauge	○	○	○	○	○
	☞ Design ➪ Off-JT 1. Making a Map(Scale map) which is base of Drawing/Completion Drawing Making Legends on the map ・Topographic Information : Road boundary, Area boundary, Drainage, Rail way, Creek, etc. ・Pipe Diameter : Classify by pattern of lines (New line or Existing line) ・Symbol of Valves : Valve, Air-Valve, Fire Hydrant, Pressure gauge, Flow meter, etc.	○	○	○	○	-
	☞ Making detail drawing ➪ Off-JT ※ Usful for forsight leak point, comfirmation of used materials, etc, for maintenance. 1. Arround Valves,Branch point, Bend point, connection with existing pipe, etc.	○	○	○	○	-
	☞ Making drawing/Completion drawing 1. Drawing based on on-site measurement It is possible to check the pipe length on the Drawing. 2. Drawing offset To record the distance from the point valves, branch, bend to the point which is settled permanently around the construction site.	○	○	○	○	-
Ⅲ. Inspection	☞ Inspection ➪ Off-JT ※ To inspect construction specification achievement and proper use of materials by completion drawing. 1. Inspection of materials Check by using list of used materials, Test report by manufacturer, construct specification etc. 2. Inspection of construction work Contents of completion drawing, Pictures of digging site, pressure test with witness Completion inspection with witness: Measuring pipeline length, checking location of valves/plugs, Matching to the completion drawing 3. Inspection of construction of service branch Check the state of service connection of existing supplied houses in construction site. 4. Check the state of water flow Check the state of water flow (Turbidity, Water Pressure)	○	○	○	○	○
Ⅳ. Construction Technique	☞ Connection/Plumbing technique every material ➪ Off-JT & OJT 1. Basic knowledge (Characteristics of pipe, etc.) DIP, PVC, HDPE, SGP, PP, etc. 2. Permutation connecting DIP, PVC, HDPE, SGP, PP, etc. 3. Partial rehabilitation for leakage repair(Existing pipe cutting + Repair connection) DIP, PVC, HDPE, SGP, PP, etc. 4. To understand every joint DIP, PVC, HDPE, SGP, PP, etc.	○	○	-	○	-
Ⅴ. Others	☞ Water Flow Measurement ➪ OJT&Off-JT 1. How to measure the flow by usingUltrasonic flow meter, electromagnetic flow meter, etc.	○	○	-	-	-
	☞ Check the state of inside of aged pipe. 1. Check the state of aged CIP by using in-pipe camera.	○	○	○	○	○

2) Training plan in the GIS field

The C/Ps and JICA experts have a discussion about concept of GIS in order to make the training plan. Eleven objectives listed in Figure 7.4 were matters to discuss. Appendix 1 shows full material for the

discussion.



Notice) CRM: Customer Relationship Management

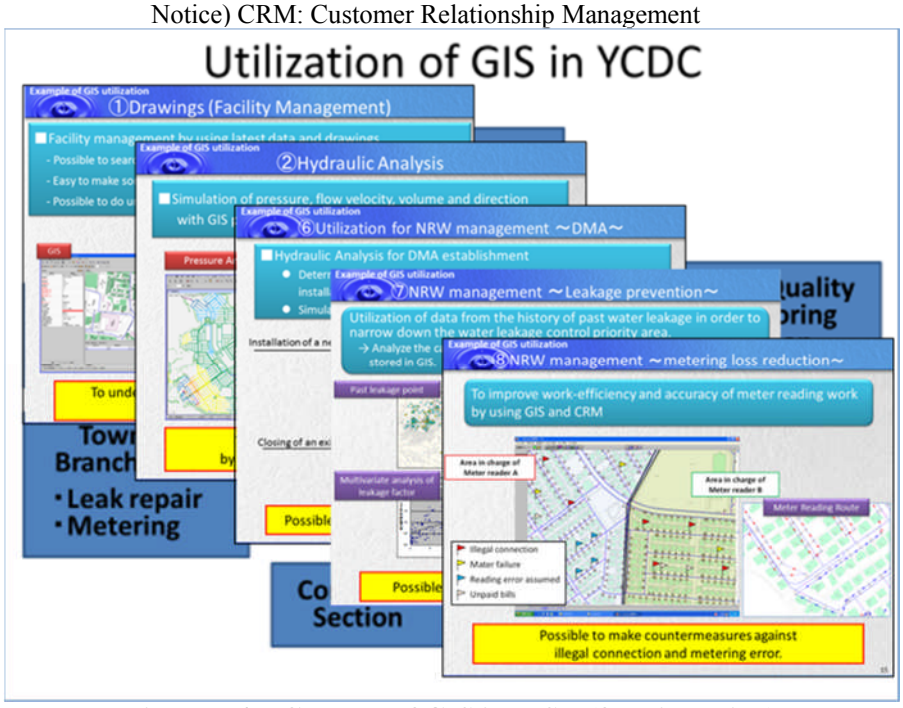


Figure 7.4　Concept of GIS in WSD (for discussion)

As the result of the discussion, the following objective laid down by the C/Ps and the JICA experts.
[①Facility Management and ②Hydraulic Analysis]
First, we achieve ① and ② for increase of dairy works efficiency and design of systematic pipe network in WSD.

[⑥⑦⑧ NRW management (for DMA, leakage prevention and metering loss reduction)]
At the same time, we achieve ⑥,⑦ and ⑧ for implementation of countermeasures against NRW in WSD.
[Other]

"④Turbid Water Prediction" and "⑨Water quality analysis" are needed in the future. But, at first phase of the Project (TA), we make water quality information only accessible on the GIS.

After the setting of target objectives, we made training plan for utilizing GIS. Table 7.9 shows the plan. The JICA GIS expert will implement the training plan in concurrence with the above NRW training.

Table 7.9 Training Plan in the GIS Field

Training Category	Training Contents	Software
I. Basic Operation of GIS	Management operation File, Display, Search, Customize of attribute color and legend, Print and so on Edit operation Draw(Node, Shape, Polygon), Edit(Division, Connection, Move, Delete), Input(Attributes), Handling image data and so on	Arc GIS
II. Advanced Operation of GIS for Facility Management	Customer data connect Customize attribute table, Connect to customer database, Display, Search and so on Import record of O&M Customize attribute table, Import record of O&M, Display, Search and so on Pipeline totals Various calculation(Attribute table calculation, Geographical calculation and so on)	Arc GIS
III. Hydraulic Analysis for design of pipeline network	The basis of Hydraulic Analysis Basic Principles, Static head and hydraulic grade line, Hazen-Williams formula and coefficients and Application to pipeline network Convert database Convert pipeline data from GIS to hydraulic analysis software Setup analysis conditions Hydraulic formula, Coefficients, Customer consumption, Uniform time coefficient, Reservoir water level, pump pressure, Valve status and other boundary conditions and so on Hydraulic analysis Various analysis-modes and simulations	Arc GIS & EPANET
IV. Analysis for countermeasures against NRW	Design DMA Various analysis-modes and simulations Make leakage hazard map Calculation of past leakages, Multivariate analysis of leakage factor, Prediction of leakage and Import of result of the prediction Reduce metering loss Import of record of metering, Connect to customer database, Attribute table calculation and Geographical calculation	Arc GIS & EPANET & MS-Excel

7.4 SUMMARY OF MAJOR ISSUES

The observation of NRW management team's survey is as follows:

- Aged pipe

- Bad meters
- Unsystematic House connections
- Insufficient Pressure
- Leakage
- Technical Support
- GIS

7.4.1 Aged Pipe

In every township of YCDC area, there are many aged pipes, unsystematic pipe laying and pipe fitting. They may cause pipe leakage, and so they should be replaced correctly with new ones.

7.4.2 Bad Meters

There have been found unqualified meters and wrong installation of meters in townships. Meter accuracy is also concerned with installation positions. When the connections are systematically reinstalled with new meters in Yangon City, our department can reduce the % of NRW. Flow meters can be installed in Yangon City. If so, we can know water supply amount from department and usage from customer exactly. If the flow meter units and the usage of customer meter units are different, we can know where NRW occur easily, and also we can detect immediately.

7.4.3 Unsystematic House Connections

Not only transmission pipes but also house connections should also be systematic to reduce leakage and NRW ratio. When new water connections can be supplied systematically in Yangon City, it will get more revenue for department.

7.4.4 Insufficient Pressure

Pressure is very low if the townships are far from pumping stations although water is pumped by booster pumps. So, it is difficult to find the location of leakage.

7.4.5 Leakage

Most of the townships don't have pressure gauge and leakage detector. Leakage may occur due to lack of knowledge and skills of pipe-connection of labors. Training of labors is needed to improve this situation.

7.4.6 Technical Support

When new water connections can supply in Yangon City, it will get more income for department. So, to do this systematically, we need technical support from international experts. Technology about pipe installation and usage of pipe materials has to be learned from JICA experts by working in pilot project.

7.4.7 Distribution / Charge Collection

From the township survey, there are problems as following:

(1) There are more than 46,000 long-term absences in Yangon city. Actual number of long-term absence is not grasped. House connections are remained in long-term absence. These may be hotbeds of illegal connections. WSD should create rules grasping customer's move.

(2) There are facilities which are free of charge. 19 townships cannot get actual consumption of these facilities due to some facilities have not a meter.

(3) Cannot grasp water supply amount by each township due to there is not flow meter.

(4) Newly house connections are installed in upstream of water supply area. However existing house

connections are decreasing downstream area due to low water pressure.

(5) Responsibility of service pipe repairing is different in each Township. According to YCDC's rule, the repair work must be implemented by licensed plumber. However, recently it becomes a mere shell or dead letter.

(6) There are no valves for distribution management.

Table 7.10 Current Situation of Water Supply Service (1)

Water Service Survey by Township in Yangon

10/OCT/2015

N : Nyaunghnapin
H : Hlawga
G : Gyoubyu
Y : Yegu Pumping Station
K : Kokkine
S : Shwedagon

※ Meter installation ratio = (Billing Nb. − Flat Rate Nb.) /(Service cons. −unbilled nb.)
Approximately 80% of unbilled number have been installed water meter

No	Town ship	Population	Household	Service Cons.	overed Are	Billed Cons.	Billing	Billing ratio	Flat	Consumption	Average Consumption (m³/M)		Water supply of Domestic(%)		Meter Installation	Un-Billed Cons.						Un-Billed Water Consumption	Pipe Repairing	Report		Repair	Pressure	Distribution System						Limited	Groundwater
		(persons)	A	B	[B/A]%	C	(Kyat)	[C/B]%	D	(m³)	All	Domestic	billing ratio	consumption ratio	Ratio	mple/Pago	Dep.	V I P	Tank	g-term abse	Total	(m³/M)	Num./ Yea	Yes	No	Worker	Mpa	N	H	G	Y	K	S	supply	ratio
1	Dagon North	203,883	42,658	12,353	29.0%	10,820	18,316,298	87.6%	0	190,890.0	17.6	16.1	87.5%	86.9%	100%	6	4	0	0	1523	1,533	1,676	300	○		2	0.030	○	-	-	-	-	-	24H	0%
2	Dagon East	165,518	33,943	4,198	12.4%	4,038	4,165,690	96.2%	0	42,412.0	10.5	18.4	96.2%	96.7%	100%	0	0	0	0	160	160		60				0.020	○	-	-	-	-	-	12H	33.7%
3	Dagon South	371,579	76,899	16,132	21.0%	6,303	6,524,814	39.1%	0	64,480.0	10.23	8.7	79.6%	81.0%	100%	5	21	0	0	9803	9,829		300		○	7	0.015	○	-	-	-	-	-	8~12H	32.6%
4	Thingangyun	209,301	43,549	16,051	36.9%	13,689	25,730,992	85.3%	0	256,383.0	18.7	18.1	76.0%	81.0%	100%	103	6	0	0	2253	2,362		2,500	○		7	0.015	○	-	-	-	-	-	24H	3.7%
5	Dawbon	74,994	14,405	2,935	20.4%	2,074	2,560,832	70.7%	102	23,438.0	11.9	9.7	69.0%	76.7%	95%	0	0	0	0	861	861		72		○	1	0.003	○	-	-	-	-	-	24H	%
6	Mingaladon	332,520	66,231	7,343	11.1%	6,963	51,902,514	94.8%	97	403,253.0	58.8	22.7	25.8%	35.9%	99%	46	0	0	0	334	380		120		○	2	0.120	○	○	○	-	-	-	24H	0%
7	Northokkalapa	332,869	64,876	36,542	56.3%	33,866	60,265,818	92.7%	5,084	518,519.0	18.0	15.0	62.4%	76.6%	85%	219	0	0	316	2141	2,676		300		○	3	0.210	○	-	○	-	-	-	24H	%
8	Southokkalapa	160,956	32,745	16,393	50.1%	13,477	24,974,060	82.2%	1,183	235,840.0	19.2	17.3	72.8%	82.2%	91%	100	16	0	159	2641	2,916		600	○		2	0.020	○	-	○	-	-	-	24H	18%
9	Tamwe	165,348	35,268	31,226	88.5%	27,770	73,590,192	88.9%	5,518	537,784.0	24.2	21.0	56.3%	81.9%	80%	108	1	0	0	3347	3,456		240	○		2	0.018	○	○	-	-	-	-	24H	0%
10	Mingala Taungnyunt	132,209	25,916	19,394	74.8%	16,439	63,258,754	84.8%	4250	424,317.0	34.8	25.3	39.3%	62.9%	74%	140	1	0	0	2814	2,955		240	○		3	0.018	○	○	-	-	-	○	24H	2%
11	Pazuntaung	48,245	10,195	9,472	92.9%	8,253	19,294,972	87.1%	3,137	123,395.0	24.1	16.9	38.2%	62.9%	62%	51	1	0	0	1167	1,219	1,296	24	○		1	0.012	○	○	-	-	-	-	24H	0%
12	Thakayta	220,447	45,394	7,665	16.9%	6,175	12,049,054	80.6%	1,670	98,980.0	22.0	17.5	51.8%	67.3%	73%	55	1	0	47	1387	1,490		60	○		1	0.021	○	○	-	-	-	-	24H	1%
13	Shwe pyi tha	343,270	73,900	1,361	1.8%	1,357	9,644,086	99.7%	0	88,051.0	64.9	24.2	20.0%	16.8%	100%	4	0	0	0	0	4		50	○		1	0.060	-	○	-	-	-	-	24H	0%
14	I nsein	305,670	61,692	10,911	17.7%	8,980	35,045,499	82.3%	40	329,430.0	36.8	34.1	62.7%	73.4%	100%	84	16	0	1	1830	1,931		240	○		1	0.030	-	○	-	-	-	-	24H	18.5%
15	Mayangone	198,038	38,737	10,107	26.1%	9,212	66,867,346	91.1%	577	408,270.0	47.3	32.9	35.2%	63.3%	94%	73	0	28	0	794	895		480	○		2	0.015	-	○	-	-	-	-	24H	%
16	Hline	160,018	32,751	7,735	23.6%	6,497	20,115,096	84.0%	1,051	190,576.0	35.0	24.6	55.5%	63.8%	84%	45	0	0	0	1238	1,283		120	○		2	0.013	-	○	-	-	-	-	24H	6.5%
17	Hlinethaya	686,827	148,695	2,642	1.8%	1,724	13,614,260	65.3%	0	117,406.0	68.1	27.6	19.0%	24.0%	100%	51	4	0	10	853	918		180	○		3	0.003	-	○	-	-	-	-	24H	
18	Botahtaung	40,849	8,352	8,237	98.6%	5,887	18,628,810	71.5%	2,164	109,882.0	29.5	17.4	26.5%	46.7%	63%	34	1	0	0	2315	2,350		36				0.013	-	○	-	-	-	-	24H	2.1%
19	Kamayut	84,368	16,262	2,940	18.1%	2,293	7,209,714	78.0%	1,538	41,116.0	54.5	28.1	15.4%	30.0%	33%	7	33	0	29	578	647		36		○	1	-	-	○	-	-	○	-	4H	%
20	Kyimyindine	111,566	23,041	1,630	7.1%	1,515	2,600,630	92.9%	743	12,178.0	15.8	14.1	34.7%	76.8%	51%	6	4	0	0	105	115	183	60	○		1	0.060	-	○	-	-	-	○	6H	%
21	Kyauktada	29,796	6,109	7,506	122.9%	6,738	18,181,564	89.8%	3,935	115,826.0	41.3	18.8	18.0%	29.9%	41%	33	0	0	0	717	750	760	24		○	1	0.009	-	○	-	-	-	○	24H	25.6%
22	Bahan	96,703	17,414	11,728	67.3%	9,635	51,598,558	82.2%	1,548	373,284.0	46.2	26.3	33.2%	50.0%	84%	361	28	33	3	1668	2,093		420	○		1	0.045	-	○	-	○	○	-	3~12H	0.03%
23	Yankin	70,992	14,617	10,503	71.9%	9,669	79,314,226	92.1%	3,304	352,013.0	55.3	30.5	18.7%	44.1%	66%	56	3	5	0	770	834	16,065	300	○		1	0.300	-	-	○	○	-	-	24H	%
24	Dagon	25,563	4,610	2,571	55.8%	1,927	11,886,638	75.0%	842	47,887.0	44.1	29.9	19.9%	47.3%	54%	34	3	0	0	538	575	6,798	24		○	1	-	-	-	○	-	-	○	24H	71.1%
25	Sangchaung	99,772	20,753	3,519	17.0%	2,887	6,802,000	82.0%	1,765	37,030.0	33.0	29.4	34.1%	61.1%	37%	48	0	0	20	406	474	4,501	145	○		2	0.007	-	-	-	-	○	-	2~7H	%
26	Ahlon	55,412	10,993	2,639	24.0%	2,300	6,107,376	87.2%	1,111	38,564.0	32.4	21.3	34.2%	58.4%	52%	7	0	0	0	332	339		24		○	1	0.010	-	-	-	-	○	-	8H	2%
27	Lanmadaw	47,123	8,639	7,137	82.6%	6,124	14,536,510	85.8%	2,979	74,777.0	23.8	17.2	28.6%	59.2%	49%	28	3	0	0	751	782	103	120	○		1	0.007	-	-	-	-	-	○	1H	3%
28	Latha	24,926	4,470	6,184	138.3%	4,983	11,006,416	80.6%	2,417	53,407.0	20.8	15.0	25.1%	54.4%	56%	23	5	0	0	1,541	1,569	144	30		○	1	0.003	-	-	-	-	-	○	24H	71.4%
29	Pabendan	33,264	6,564	8,001	121.9%	7,940	17,129,702	99.2%	3,735	88,401.0	21.0	18.2	26.7%	53.6%	60%	60	1	0	0	873	934	3,006	60		○	1	0.006	-	-	-	-	-	○	24H	57.5%
30	Dala	173,376	37,905	3,916	10.3%	3,709	5,239,236	94.7%	0	54,308.0	14.6	14.0	89.3%	88.5%	100%	24	1	0	25	157	207	1,271	360	○		1	0.015	-	-	-	-	-	-	6H	100%
31	Seikkan	2,815	412	0	0.0%	0	0	0.0%	0	0.0	0	0.0	0	0		0	0	0	0	0	0		0			0									%
32	Seikkyi / khana	33,978	7,727	0	0.0%	0	0	0.0%	0	0.0	0	0.0	0	0		0	0	0	0	0	0		0			0									0%
33	Dagon Seikkan	167,346	37,887	0	0.0%	0	0	0.0%	0	0.0	0	0.0	0	0		0	0	0	0	0	0		0												%
	計	5,209,541	1,073,609	288,971	26.9%	243,244	758,161,657	84.2%	48,790	5,452,097	28.0	19.9	42.9%	64.1%	80%	1,811	153	66	610	43,897	46,537	35,803	(Nb.) 7,525	18	(Nb.) 10	(persons) 53	(Mpa)								

Table 7.11 Current Situation of Water Supply Service (2)

Actual status of water supply by Township (Yangon)

No. 1

No	TOWN SHIP	Actual status of Water supply																										Long-term Absence
		House connection	Domestic			Commercial			Foreigner			Hotel			School, Hospital, Dep. Facilities			Dep. Commercial			Facilities of Military			FLAT LATE			T O T A L			
			Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number
1	Dagon N	**12,363**	10,402			412			0			1			8			0			0			0			10,820			1,523
			96.1%	167,282		3.8%	19,669			0		0.0%	3		0.0%	3,936			0			0			0			100.0%	190,890		
				87.6%	15,761,000		10.3%	2,204,790			0		0.0%	3,640		2.1%	346,868			0			0			0		100.0%	18,316,298	
					86.0%			12.0%						0.0%			1.9%												100.0%	
2	Dagon E	**4,198**	3,957			79			0			0			2			0			0			0			4,038			160
			98.0%	41,003		2.0%	1,347			0			0		0.0%	0			0			0			0			100.0%	42,412		
				96.8%	4,009,620		3.2%	156,070			0			0			0			0			0			0		100.0%	4,165,690	
					96.3%			3.7%							※included into Domestic														100.0%	
3	Dagon S	**16,132**	6,013			279			0			0			10			1			0			0			6,303			9,829
			95.4%	52,217		4.4%	9,884			0			0		0.2%	2,202		0.0%	127			0			0			100.0%	64,430		
				81.0%	5,196,428		15.3%	1,115,140			0			0			3.5%	199,176			0.2%	14,070			0			0		100.0%	6,524,814	
					79.6%			17.1%										3.1%				0.2%								100.0%	
4	Thingan	**16,051**	12,972			670			0			7			39			1			0			0			13,689			2,362
			94.8%	208,888		4.9%	43,227			0		0.1%	1,063		0.3%	3,153		0.0%	323			0			0			100.0%	256,383		
				81.9%	19,679,408		16.9%	4,821,960			0		0.4%	942,440			1.2%	281,364		0.0%	5,820			0			0		100.0%	25,730,992	
					76.5%			18.7%						3.7%				1.1%				0.0%								100.0%	
5	Dawbon	**2,935**	1,847			123			0			0			1			1			0			0			2,074			861
			89.1%	17,973		5.9%	4,696			0			0		0.0%	125		0.0%	644			0			4.9%			100.0%	23,438		
				76.7%	1,766,332		20.0%	528,860			0			0			0.5%	11,100			2.7%	70,940					183,600		100.0%	2,560,832	
					69.0%			20.7%										0.4%				2.8%								7.2%		100.0%	
6	Mingala	**7,343**	6,561			247			0			2			0			13			33			109			6,963			380
			94.2%	148,618		3.5%	30,054			0		0.0%	89			0		0.2%	33,033		0.5%	191,457		1.6%			100.0%	403,253		
				36.9%	13,734,488		7.5%	3,330,640			0		0.0%	80,320			0			8.2%	3,634,950		47.5%	16,851,516			14,270,600		100.0%	51,902,514	
					26.5%			6.4%						0.2%							7.0%			32.5%			27.5%			100.0%	
7	N okkal	**36,542**	26,440			2,235			0			8			92			2			0			5,084			33,860			2,676
			78.1%	397,701		6.6%	106,310			0		0.0%	312		0.3%	13,586		0.0%	607			0			15.0%			100.0%	518,519		
				76.7%	37,642,460		20.5%	11,917,620			0		0.1%	282,800			2.6%	1,204,768		0.1%	66,970			0			9,151,200		100.0%	60,265,818	
					62.5%			19.8%						0.5%				2.0%				0.1%								15.2%		100.0%	
8	S okkal	**16,393**	11,217			1,019			0			3			47			8			0			1,183			13,477			2,916
			83.2%	193,972		7.6%	35,781			0		0.0%	30		0.3%	3,886		0.1%	2,171			0			8.8%			100.0%	235,840		
				82.2%	18,191,192		15.2%	4,037,790			0		0.0%	29,400			1.6%	346,668		0.9%	239,610			0			2,129,400		100.0%	24,974,060	
					72.8%			16.2%						0.1%				1.4%				1.0%								8.5%		100.0%	
9	Tamwe	**31,226**	21,262			919			0			11			56			4			0			5,518			27,770			3,496
			76.6%	446,927		3.3%	48,777			0		0.0%	16,420		0.2%	25,400		0.0%	234			0			19.9%			100.0%	537,784		
				83.1%	41,455,784		9.1%	5,457,340			0		3.1%	14,460,600			4.7%	2,241,328		0.0%	28,340			0			9,946,800		100.0%	73,990,192	
					56.3%			7.4%						19.7%				3.0%				0.0%								13.5%		100.0%	
10	Ming Ta	**19,394**	10,953			1,126			3			14			81			2			5			4,253			16,439			2,955
			66.6%	274,301		6.8%	84,563		0.0%	706		0.1%	18,800		0.5%	45,088		0.0%	709		0.0%			25.9%			100.0%	424,317		
				64.7%	25,239,240		19.9%	9,424,440		0.2%	313,640		4.4%	16,558,000			10.6%	3,976,344		0.2%	88,090						7,659,000		100.0%	63,258,754	
					39.9%			14.9%			0.5%			26.2%			6.3%			0.1%	※Included into Dep.						12.1%			100.0%	
11	Pazunta	**9,472**	4,651			388			0			18			54			2			2			3,138			8,253			1,219
			56.4%	78,431		4.7%	27,459			0		0.2%	1,877		0.7%	15,536		0.0%	92		0.0%			38.0%			100.0%	123,395		
				63.6%	7,367,004		22.3%	3,059,320			0		1.5%	1,669,760			12.6%	1,372,768		0.1%	10,320						5,815,800		100.0%	19,294,972	
					38.2%			15.9%						8.7%				7.1%				0.1%								30.1%		100.0%	

※Military with no number of Amount/Bill wil be into Dep. Commercial

Table 7.12 Current Situation of Water Supply Service (3)

Actual status of water supply by Township (Yangon)

No. II

No	TOWNSHIP	Actual status of Water supply																										Long-term Absence
		House connection	Domestic			Commercial			Foreigner			Hotel			School, Hospital, Dep. Facilities			Dep. Commercial			Facilities of Military			FLAT LATE			T O T A L			
			Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number	Amount	Bill	Number
12	Thakayt	**7,665**	3,809			658			0			3			33			2			0			1,670			6,175			1,490
			61.7%	66,708		10.7%	23,653			0		0.0%	19		0.5%	8,364		0.0%	238			0		27.0%			100.0%	98,980		
				67.4%	6,251,212		23.9%	2,667,630			0		0.0%	19,720		8.5%	78,332		0.2%	26,160			0			3,006,000		100.0%	12,049,054	
					51.9%			22.1%						0.2%			0.7%			0.2%						24.9%			100.0%	
13	Shwepyi	**1,361**	866			480			0			0			10			0			0			1			1,357			4
			63.8%	20,918		35.4%	30,909			0			0		0.7%	36,224			0			0		0.1%	0		100.0%	88,051		
				23.8%	1,927,384		35.1%	3,447,990			0			0		41.1%	3,188,712			0			0			1,080,000		100.0%	9,644,086	
					20.0%			35.8%									33.1%								※Military×1		11.2%			100.0%	
14	Insein	**10,911**	7,378			1,507			2			12			33			6			2			40			8,980			1,931
			82.2%	249,123		16.8%	61,741		0.0%	345		0.1%	3,694		0.4%	13,491		0.1%	1,031		0.0%			0.4%			100.0%	329,430		
				75.6%	22,660,368		18.7%	6,942,160		0.1%	153,800		1.1%	3,262,720		4.1%	1,190,708		0.3%	114,010						721,733		100.0%	35,045,499	
					64.7%			19.8%			0.4%			9.3%			3.4%			0.3%	※Included into Dep.			※Military×2		2.1%			100.0%	
15	Mayang	**10,107**	7,899			627			27			25			33			8			6			587			9,212			895
			85.7%	259,790		6.8%	84,716		0.3%	3,706		0.3%	12,451		0.4%	36,224		0.1%	11,377		0.1%			6.4%			100.0%	408,270		
				63.6%	23,651,952		20.7%	9,381,420		0.9%	1,657,640		3.0%	10,981,600		8.9%	5,597,444		2.8%	1,252,270						14,345,029		100.0%	66,867,346	
					35.4%			14.0%			2.5%			16.4%			8.4%			1.9%	※Included into Dep.			※Military×9		21.5%			100.0%	
16	Hline	**7,735**	4,933			475			0			4			27			6			1			1,051			6,497			1,283
			75.9%	121,458		7.3%	33,372			0		0.1%	637		0.4%	2,214		0.1%	3,198		0.0%	29,700		16.2%			100.0%	190,576		
				63.7%	11,181,564		17.5%	3,718,410			0		0.3%	160,640		1.2%	2,810,632		1.7%	352,050		15.6%				1,891,800		100.0%	20,115,096	
					55.6%			18.5%						0.8%			14.0%			1.8%	※Included into Dep.(Bill)					9.4%			100.0%	
17	Hlinetha	**2,642**	1,023			681			0			11			9			0			0			0			1,724			918
			59.3%	28,284		39.5%	83,710			0		0.6%	1,339		0.5%	4,073			0			0					100.0%	117,406		
				24.1%	2,591,280		71.3%	9,474,136			0		1.1%	1,189,520		3.5%	359,324			0			0			0			13,614,260	
					19.0%			69.6%						8.7%			2.6%												100.0%	
18	Botahta	**8,237**	3,111			535			0			12			56			3			6			2,164			5,887			2,350
			52.8%	53,889		9.1%	28,253			0		0.2%	5,095		1.0%	22,203		0.1%	440					36.8%			100.0%	109,882		
				49.0%	5,053,360		25.7%	3,161,310			0		4.6%	4,495,600		20.2%	1,960,240		0.4%	48,700						3,909,600		100.0%	18,628,810	
					27.1%			17.0%						24.1%			10.5%			0.3%						21.0%			100.0%	
19	Kamayu	**2,940**	602			131			7			4			11			0			0			1,538			2,293			647
			26.3%	15,161		5.7%	23,875		0.3%	203		0.2%	178		0.5%	1,699			0			0		67.1%			100.0%	41,116		
				36.9%	1,394,392		58.1%	2,639,350		0.5%	96,320		0.4%	160,640		4.1%	150,612			0			0			2,768,400		100.0%	7,209,714	
					19.3%			36.6%			1.3%			2.2%			2.1%									38.4%			100.0%	
20	Kyimyin	**1,630**	687			62			0			1			22			0			0			743			1,515			115
			45.3%	9,707		4.1%	1,285			0		0.1%	100		1.5%	1,086			0			0		49.0%			100.0%	12,178		
				79.7%	922,912		10.6%	147,550			0		0.8%	89,000		8.9%	97,768			0			0			1,343,400		100.0%	2,600,630	
					35.5%			5.7%						3.4%			3.8%									51.7%			100.0%	
21	Kyaukta	**7,505**	2,073			646			0			18			63			3			0			3,935			6,738			750
			30.8%	34,890		9.6%	27,444			0		0.3%	42,184		0.9%	10,315		0.0%	993			0		58.4%			100.0%	115,826		
				30.1%	3,277,614		23.7%	3,083,400			0		36.4%	3,714,000		8.9%	914,020		0.9%	109,530			0			7,083,000		100.0%	18,181,564	
					18.0%			17.0%						20.4%			5.0%			0.6%						39.0%			100.0%	
22	Bahan	**11,728**	7,106			804			55			43			62			6			7			1,552			9,635			2,093
			73.8%	186,690		8.3%	144,382		0.6%	4,253		0.5%	12,666		0.6%	22,206		0.0%	3,073		0.1%			16.1%			100.0%	373,284		
				50.0%	17,140,024		38.7%	15,962,390		1.1%	1,927,200		3.4%	11,191,680		5.9%	1,961,028		0.8%	338,870						3,077,966		100.0%	51,598,558	
					33.2%			30.9%			3.7%			21.7%	※temple*&military*		3.8%			0.7%	※Included into Dep.			※mil×1,Dep×3		6.0%			100.0%	

※Military with no number of Amount/Bill will be

Table 7.13 Current Situation of Water Supply Service (4)

Actual status of water supply by Township (Yangon)

No. III

Actual status of Water supply

No	TOWNSHIP	House connection	Domestic Number	Domestic Amount	Domestic Bill	Commercial Number	Commercial Amount	Commercial Bill	Foreigner Number	Foreigner Amount	Foreigner Bill	Hotel Number	Hotel Amount	Hotel Bill	School, Hospital, Dep. Facilities Number	School, Hospital, Dep. Facilities Amount	School, Hospital, Dep. Facilities Bill	Dep. Commercial Number	Dep. Commercial Amount	Dep. Commercial Bill	Facilities of Military Number	Facilities of Military Amount	Facilities of Military Bill	FLAT LATE Number	FLAT LATE Amount	FLAT LATE Bill	TOTAL Number	TOTAL Amount	TOTAL Bill	Long-term Absence Number
23	Yankin	**10,503**	5,882			397			6			9			61			2			4			3,308			9,669			834
			60.8%	173,182		4.1%	29,836		0.1%	154		0.1%	51,326		0.6%	97,308		0.0%	117		0.0%			34.2%			100.0%	352,013		
				49.2%	15,828,188		8.5%	3,321,680		0.0%	73,760		14.6%	45,175,880		27.7%	8,577,524		0.0%	13,070					6,324,124		100.0%	79,314,236	
					20.0%			4.2%			0.1%			57.0%			10.8%			0.0%	※Included into Dep.					8.0%			100.0%	
24	Dagon	**2,571**	870			192			1			2			13			0			0			850			1,927			575
			45.1%	25,989		10.0%	13,051		0.1%	50		0.1%	4,992		0.6%	3,805			0			0		44.1%			100.0%	47,887		
				54.3%	2,373,988		27.3%	1,454,810		0.1%	23,000		10.4%	4,394,960		7.9%	336,040			0			0			3,303,840		100.0%	11,886,638	
					20.0%			12.2%			0.2%			37.0%			2.8%							※Military×8		27.8%			100.0%	
25	Sangch	**3,519**	862			245			0			1			14			0			0			1,765			2,887			474
			29.9%	25,373		8.5%	10,844			0		0.0%	130		0.5%	683			0			0		61.1%			100.0%	37,030		
				68.5%	2,318,996		29.3%	1,217,340			0		0.4%	11,560		1.8%	61,504			0			0			3,192,600		100.0%	6,802,000	
					34.1%			17.9%						0.2%			0.9%									46.9%			100.0%	
26	Ahlon	**2,639**	1,065			102			0			4			17			1			0			1,111			2,300			339
			46.3%	22,831		4.4%	13,687			0		0.2%	331		0.7%	1,308		0.0%	407			0		48.3%			100.0%	38,564		
				59.2%	2,115,652		35.5%	1,515,770			0		0.9%	295,280		3.4%	116,804		1.1%	44,870			0			2,019,000		100.0%	6,107,376	
					34.6%			24.8%						4.8%			1.9%			0.7%						33.1%			100.0%	
27	Lanma	**7,137**	2,573			525			0			20			27			0			0			2,979			6,124			782
			42.0%	44,366		8.6%	26,265			0		0.3%	2,087		0.4%	2,079			0			0		48.6%			100.0%	74,777		
				59.3%	4,161,468		35.1%	2,939,430			0		2.8%	1,856,560		2.8%	185,652			0			0			5,393,400		100.0%	14,536,510	
					28.6%			20.2%						12.8%			1.3%									37.1%			100.0%	
28	Latha	**6,184**	1,951			372			0			12			31			0			0			2,417			4,983			1,569
			39.2%	29,237		11.5%	21,514			0		0.2%	1,473		0.6%	1,179			0			0		48.5%			100.0%	53,407		
				54.7%	2,767,936		40.3%	2,423,700			0		2.8%	1,311,760		2.2%	106,820			0			0			4,396,200		100.0%	11,006,416	
					25.1%			22.0%						11.9%			1.0%									39.9%			100.0%	
29	pabend	**8,001**	2,700			1,454			0			18			33			3			0			3,735			7,940			934
			34.0%	49,222		18.3%	32,443			0		0.2%	1,583		0.4%	3,461		0.0%	1,688			0		47.0%			100.0%	88,401		
				55.7%	4,601,544		36.7%	3,714,310			0		1.8%	1,409,800		3.9%	307,868			1.9%	185,980		0			6,910,200		100.0%	17,129,702	
					26.9%			21.7%						8.2%			1.8%			1.1%						40.3%			100.0%	
30	Dala	**5,916**	3,525			148			0			0			38			15			0			0			3,709			207
			95.0%	49,242		4.0%	4,031			0		0			0.9%	990		0.0%	25			0					100.0%	54,308		
				90.7%	4,687,556		7.4%	458,210			0			0		1.8%	90,620			0.0%	2,850		0			0		100.0%	5,239,236	
			※temple×5		89.0%			8.7%									1.7%			0.1%									100.0%	
	Total	**288,971**	**176,197**			**17,738**			**101**			**262**			**976**			**71**			**66**			**48,833**			**243,244**			
			72.0%	**3,493,837**		7.3%	**1,106,760**		0.0%	**9,419**		0.1%	**178,885**		0.4%	**381,972**		0.0%	**60,367**		0.0%	**221,157**		20.1%			100.0%	**5,452,097**		
				64.1%	**324,950,346**		**20.3%**	**123,724,966**		0.2%	**4,246,360**		3.3%	**123,747,280**		**7.0%**	**38,072,036**		**1.1%**	**6,647,470**		**4.1%**	**16,851,616**			**119,922,683**		100.0%	**758,161,657**	
					42.9%			**16.3%**			0.6%			16.3%			**5.0%**			**0.9%**			**2.2%**			15.8%			100.0%	
	rm absence = 43,897 (15.2%)				**495,475,817**			**164,037,683**			**4,246,360**			**123,747,280**			**53,300,850**			**8,109,913**			**31,343,820**			**119,922,683**			**980,183,306**	

Repair 7,525 / 1year (= 3.0%)

9,097,939,884 Kyat/ 1year

11,762,199,672 Kyat/ 1year

	Domestic		Commercial		Foreigner		Hotel		School, Hospital, Dep. Facilities		Dep. Commercial		Facilities of Military		FLAT LATE		TOTAL AVELAGE	
	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat	㎥	Kyat
Average Amount / 1 House	**19.9**		**62.4**		**93.3**		**682.8**		**391.4**		**850.2**		**3350.9**		**0.0**		**28.0**	
Average Bill / 1 House		**1,855**		**6,975**		**42,033**		**472,318**		**39,008**		**93,626**		**255,326**		**2,456**		**3,117**

7.4.8 Geographic Information System (GIS)

We have serious problem with information accuracy of pipeline. It was immediately obvious when the C/Ps and the JICA experts conducted field survey in the pilot area. Auto CAD data in the Research and Drawings Section are low accuracy. It is caused by data update based on uncertain drawings. Figure 7.5 shows a sample of design drawing. AutoCAD data are updated based on the design drawing and not completion drawing. This is one of the causes of inaccuracy. The inaccuracy has large negative effect on all work in WSD. Therefore, for improvement of accuracy of pipeline information, we need to survey in township offices and the field including test digging.

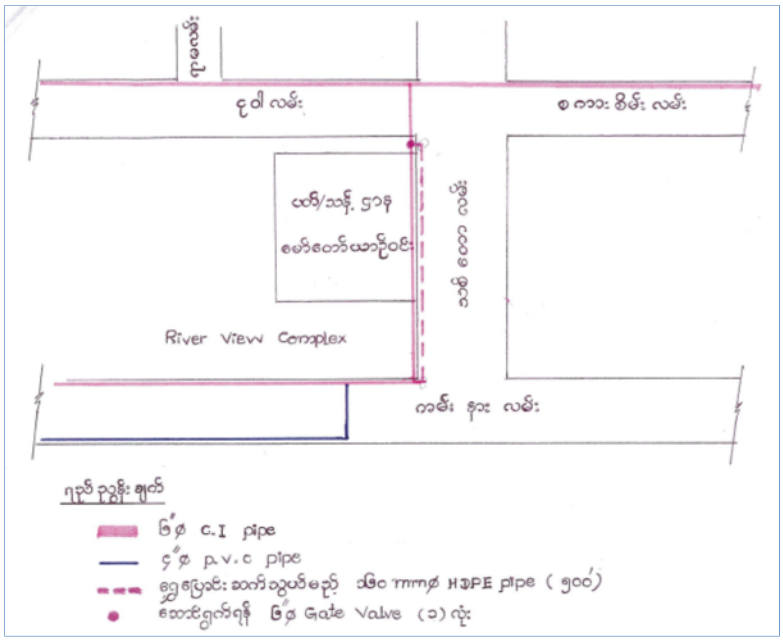


Figure 7.5 Design drawing (sample)

Today GIS staffs are preparing GIS database. Accuracy information of facilities is needed to utilize GIS for design of pipeline and NRW countermeasures.

7.4.9 The Groundwater Use

We surveyed current situation of the groundwater use in 33 townships. Table 7.14 shows the total result of groundwater use. Table 7.15 shows detail result of groundwater use. Amount of the groundwater use listed in Table 7.16 is calculated from well pump capacity and operating hour based on the township survey.

Table 7.14 Result of The Survey on The Groundwater use

Tube well (unit)	Operation Time (hours/day)	Pump Capacity (gallon/h)	Amount of the groundwater		Remark
			(gallon*/day)	(m3/month)	
280 unit (Diameter 2"～12")	1～12	600～10,000	6,788,750	925,850	The amount is possibly reduced by aging pumps and lack of the ground water.

*: 1 gallon = 4.546 liter

There are problems as following.

- The well pumps connect pipeline supplying treated water despite the inadequacy of water quality test for the groundwater. It is serious problem the aspect of public sanitation.
- Actual NRW ratio cannot be grasped due to complete lack of flow meter for tube well.
- Today the groundwater is drying up. WSD should switch water resource from the groundwater to the surface water as possible. Therefore, NRW control and distribution management are important.

Table 7.15 Result of The Survey on The Groundwater use

No.	Township Branch	Tube well (unit)						Operation Time (hours/day)							Pump Capacity (gallon/h)						Amount of the groundwater		Remark	Survey Date
		2"	4"	6"	8"	10"	12"	Average	2"	4"	6"	8"	10"	12"	2"	4"	6"	8"	10"	12"	(gallon*/day)	(m3/month)		
1	Mingaladon	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		9-Sep-2015
2	Shwepyithar	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		10-Sep-2015
3	Insein	0	4	2	7	0	1	9	-	-	-	-	-	-	-	1800	2,000	6,000	-	6,500	537,300	73,277	Be slashed by lack of the ground water.	10-Sep-2015
4	Mayangone	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		15-Sep-2015
5	North Okkalapa	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		9-Sep-2015
6	South Okkalapa	26						6	-	-	-	-	-	-	-	-	-	-	-	-	311,959	42,545	We inquired the total volume(m3/month). Be reduced by aging pumps.	9-Sep-2015
7	Yankin	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		11-Sep-2015
8	Bahan	0	0	2	0	0	0	-	-	-	3	-	-	-	-	-	-	-	-	-	792	108	We inquired the total volume(m3/month).	11-Sep-2015
9	Tamwe	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		14-Sep-2015
10	Mingalar Taungnyunt	0	0	1	1	0	0	-	-	-	10	10	-	-	-	-	2,200	3,000	-	-	52,000	7,092		14-Sep-2015
11	Thingangyun	0	0	28		0	0	-	-	-	6		-	-	-	-	500		-	-	84,000	11,456	Pump design capacity is 2000(gallon/h). But, It is slashed by aging pumps.	9-Sep-2015
12	Hlaing	0	0	0	3	0	0	-	-	-	-	6	-	-	-	-	-	6,000	-	-	108,000	14,729		11-Sep-2015
13	Kamayut	20						-	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a	All the tubewells are for donation.	11-Sep-2015
14	Sanchaung	0	2	0	17	2	0	6	-	-	-	-	-	-	-	3000	-	5,000	6,000	-	618,000	84,283		17-Sep-2015
15	Kyimyindaing	0	0	1	11	3	1	6	-	-	-	-	-	-	-	-	4,000	6,000	7,500	9,000	609,000	83,055	Be reduced by aging pumps.	17-Sep-2015
16	Ahlone	0	0	5	16	0	1	6	-	-	-	-	-	-	-	-	3,000	5,000	-	10,000	630,000	85,919		21-Sep-2015
17	Dagon	0	0	0	15	0	0	5	-	-	-	-	-	-	-	-	-	4,000	-	-	300,000	40,914		21-Sep-2015
18	Lanmadaw	0	0	3	18	1	0	6	-	-	-	-	-	-	-	-	4,000	6,000	8,000	-	768,000	104,740		17-Sep-2015
19	Latha	0	0	0	14	0	0	8	-	-	-	-	-	-	-	-	-	3,000	-	-	336,000	45,824		18-Sep-2015
20	Pabedan	0	0	0	14	0	0	8	-	-	-	-	-	-	-	-	-	4,000	-	-	448,000	61,098		18-Sep-2015
21	Seikkan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No house connection.	21-Sep-2015
22	Kyauktada	0	0	4	3	0	0	-	-	-	9	9	-	-	-	-	3,500	5,000	-	-	261,000	35,595		21-Sep-2015
23	Botataung	7	0	0	0	0	0	5	-	-	-	-	-	-	600	-	-	-	-	-	21,000	2,864		14-Sep-2015
24	Pazundaung	0	0	2	0	0	0	0.57	-	-	-	-	-	-	-	-	1,500	-	-	-	1,710	233	The pumps operate twice a week(2 H x 2).	14-Sep-2015
25	East Dagon		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	126,000	17,184	We inquired the total volume(gallon/h).	8-Sep-2015
26	North Dagon	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		8-Sep-2015
27	South Dagon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153,989	21,001	We inquired the total volume(m3/month).	8-Sep-2015
28	Dagon Seikkan	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		8-Sep-2015
29	Thaketa	0	0	6	18	1	0	-	-	-	12	12	12	-	-	-	3,000	3,000	4,000	-	912,000	124,379		16-Sep-2015
30	Dawbon	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0		16-Sep-2015
31	Hlaingtharya	10						-	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a	All the tubewells are for donation.	10-Sep-2015
32	Seikkyi Kanaungto	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Not YCDC Service	-
33	Dala	0	0	0	0	6	4	7.5	-	-	-	-	-	-	-	-	-	-	6,000	8,000	510,000	69,554	The pumps operate once two day(15 H).	6-Oct-2015
Total		280						-							-						6,788,750	925,850	The amount is possibly reduced by aging pumps and lack of the ground water.	-

*: 1 gallon = 4.546 liter

7.5 PROGRESS OF THE PROJECT

7.5.1 Establishment of NRW Management unit and GIS Section

Currently, GIS and NRW section have not been existed formally. Now, pilot project is being made in (13) ward, Yankin. This project is set as a sample, and NRW reduction will be continued, combining NRW and GIS for remaining areas of the Yangon city.

At present, GIS and NRW are working for the above process. Later exact section of GIS and NRW will be established to continue these projects.

[Regarding to establishment of NRW Unit]

The propose structure and duty of NRW Unit are shown in table below.

Table 7.16 Structure and Duties of NRW Unit (conception)

Section	Team	Duties
NRW Planning and Monitoring (3)		☞ Study and analysis of Revenue & Non-Revenue water rates • To study and analyze "Metered consumption", "Unmetered consumption", and "Ineffective water" etc. ☞ Planning of specific survey and study for NRW management ☞ Formulation of NRW management plan and monitoring the progress of plan • To formulate 5 year/10year NRW management plan and monitor the progress of plan, if required the plan should be revised.
Commercial loss management (4)		☞ Checking and study on the causes of inaccurate monthly meter reading data and guidance for collection • To check the accuracy of the data of meter reading of each Township with Township staff, and prescript and perform corrective actions. ☞ Study of water charge collection rate of each Township • To check the water charge collection rate and the reason of nonpayment through the monthly meter reading data. Study and give guidance on how to collect the water charge, etc. ☞ Analysis of water meter condition and reporting ☞ Quarterly Analysis of revenue water on the basis of monthly meter reading • To analyze Revenue & Non-Revenue water from the data of monthly meter reading and leakage volume, and report the outcome quarterly, and provide the results to NRW Planning and Monitoring Section.
Physical loss (Leakage) Management (16)	Water Flow Measurement (3)	☞ Water flow measurement of main distribution system • To measure water flow (by Ultrasonic flow meter) at fixed points periodically by main water distribution system in the city. • To analyze the water balance between the water supply and demand, and provide the information to "NRW Planning and Monitoring Section". ☞ Establishment of "Model district for water flow measurement" • To measure water flow and leakage and the change of water flow volume resulting from leakage repair etc. To collect and analyze the information above to estimate Non-Revenue water rate in other areas.
	Leakage Detection (8)	☞ Leakage patrol and detection • To formulate an annual leakage detection plan. • To detect leakage visually in the daytime and by using detector in the nighttime.
	Leakage Repairing (5)	☞ Instruction of leakage repair and inspection on site • To instruct township to repair the leakage detected, and inspect the repairing work according to guidelines prepared. ☞ Leakage repairing • To repair leakage as needed, and report the water leak volume to "NRW Planning and Monitoring Section". ☞ Provide materials and equipment for leakage repair • To keep the tools and equipment for leakage repair, and provide them as needed.

[Regarding to establishment of GIS section]

As previously described, GIS section should be established officially in order to implement countermeasures against NRW and make customer management more efficient. Table 7.17 shows the conception of duties of GIS Section. However, these are just final duties of GIS section in future. From conception to realization, we need to consider step-by-step how to achieve real improvement.

Table 7.17 Structure and Duties of GIS Section (conception)

Section / Team	Number of staffs	Duties
Section Manager	1 person /Post	☞ **Management of the GIS Section**
Pipe-line network Analysis Team	3 persons	☞ **Undertaking calculation works and analytical works utilizing GIS** - Consult with other sections, including NRW Control Unit, concerning methodology of calculation and analysis utilizing GIS. - Undertake calculation and analysis utilizing GIS at requests of other sections. (ex. prioritization of target pipelines for leakage detection work against NRW, analysis of correlation between water pressure and customer complain for customer satisfaction improvement, hydraulic analysis for design of pipeline network and so on.) ☞ All other atypical works in GIS Section
Database Management Team	12 persons	☞ **Revising GIS DB based on report from the Field Survey Team** ☞ **Updating GIS database(DB) based on report from other sections** (ex. Record of construction work by the PIPE Section and the Township offices, results of water pressure measurement and leakage detection by NRW Control Unit, record of customer's water consumption by the Computer Section and so on.) ☞ **Migrating data from AutoCAD, which the Drawings & Research Section holds, to GIS** ☞ **All works which the Drawings & Research Section performs today**
Field Survey Team	4 persons	☞ **Survey on WSD construction history for accuracy improvement of GIS** - Gather records of past construction works and replacement works of pipeline and meter at the PIPE Section and the Township offices. - Regarding unspecified facilities, supervise and witness field survey and test digging works onsite. - Make accurate drawings for revision of GIS DB. (Notice: The following 4 persons are assigned on the assumption that WSD outsources to the field survey and test digging work to private sector. If WSD directly conducts the works, this team requires more engineers and skillful workers.)
Total	**20 Persons**	

The location of pipe lines, valves, chambers, fire hydrants and pump house are collected by GPS and imported them into GIS software for 6 townships (downtown). The pipeline of the rest township have already been digitized in web GIS. The location of old pipelines and valves are surveyed and measured with GPS and import the data from GPS to GIS in pilot area No (13) ward in Yankin Township.

The data concerned with water distribution and water bill (demand and collect) are recorded by surveying in 33 townships. No (13) ward in Yankin Township was surveyed to collect customer data, meter operation, position and condition. The lengths of the roads were measured by three groups in that ward. Seven junctions of pipes were dug to know their actual location and depth. The measured pipelines, buildings and roads have already been drawn GIS software.

7.5.2 Progress of Pilot Project

The main purpose of making pilot project is to become YCDC staff as trainers in the future and to continue to reduce NRW ratio for the whole Yangon city.

The reason for choosing (13) ward Yankin as pilot area is that it has suitable pressure to test, high population density, many spaghetti pipes, many leakages, unsystematic pipes and house connections.
To do NRW reduction in pilot area, firstly we need to build District Meter Area (DMA) to assign the

specific water inlet point. And inlet valves and outlet valves are needed to install for easy maintenance. To construct DMA, we need the data such as population, households, house connections, elevation, base demand, road distance, pressure and velocity. We can calculate pipeline design using these data with EPANET software.

When the pipeline network design is finished, cost estimation for labors and required materials is calculated by referencing safety factors from JICA master plan and by quoting standard and guideline from YCDC.

JICA experts and NRW counterparts surveyed No (13) ward to reduce NRW ratio for pilot project. First, we have taken land parcels from Department of City Planning and Land Administration. And then our team have checked the existing streets with old map in pilot project and have measured the length and width of the street by three groups. We have recorded customer's meter with photo. And we drew detail street map and block map by collecting actual survey data.

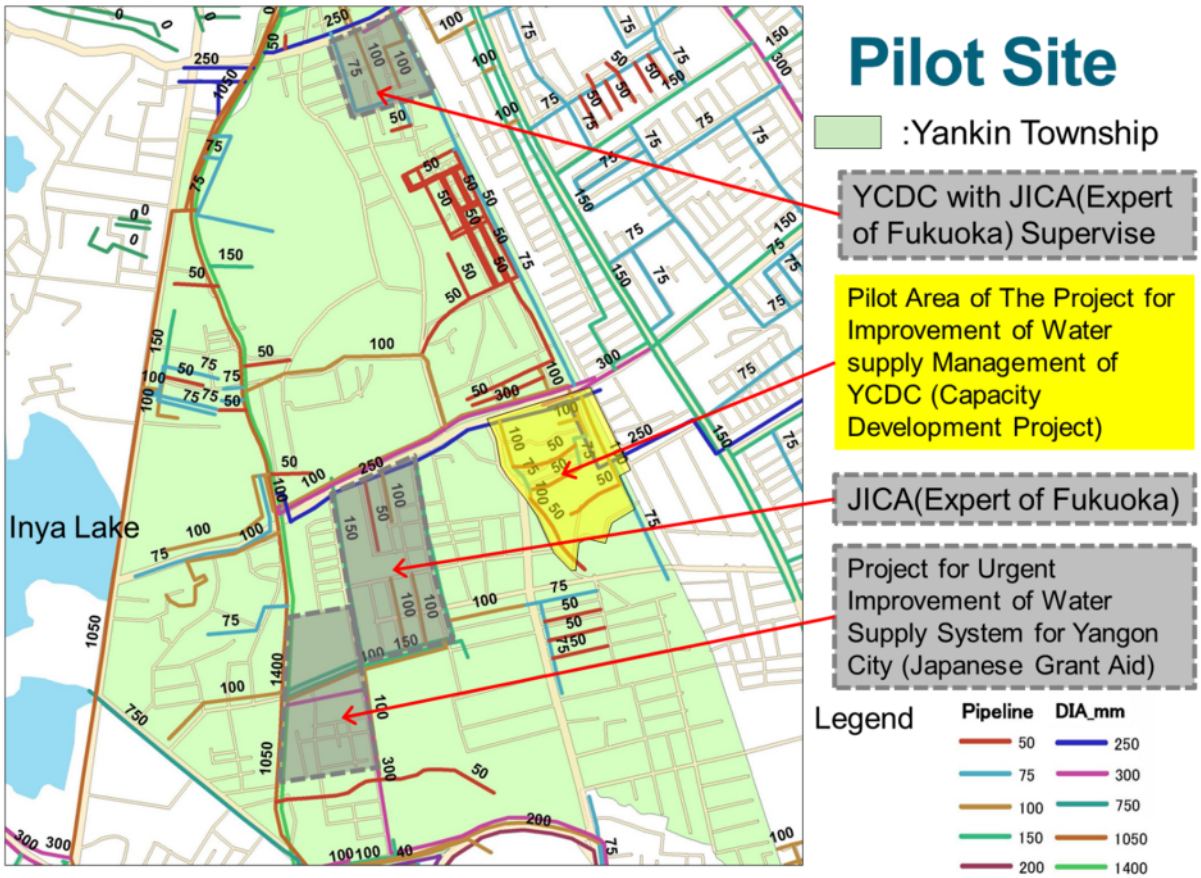


Figure 7.6 Pilot Site for NRW Management

Figure 7.7 Road Map (Pilot Area)

Figure 7.8 Land Parcels Map (Pilot Area)

Figure 7.9 House Map (Pilot Area)

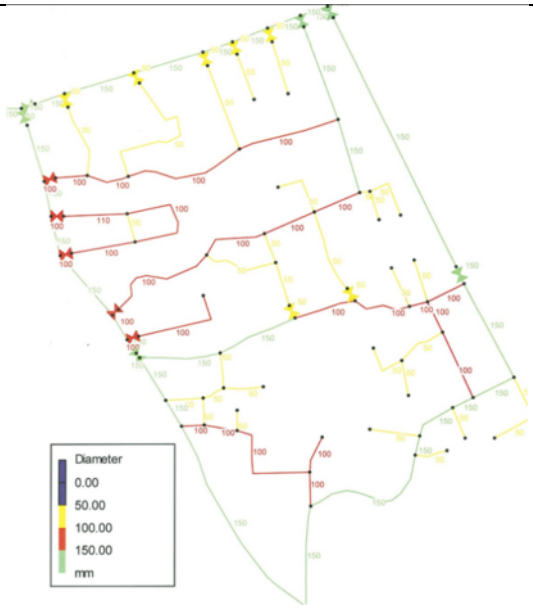


Figure 7.10 Pipeline Map (Conception)

Photo 7.6 Site Survey (Pilot Area)

7.5.3 Performance Indicators

There is no systematically collected data about distribution pipe network. The events in townships (e.g. new pipeline installation, meter replacing, pipe leakage repairing) need to inform to head office. So, performance indicators are needed to assign for monitoring the up-to-date pipeline network condition.

Table 7.18 Performance Indicators of NRW (1)

No	Name	Unit
1	Length of water distribution network (end of month)	km
2	Length of network disconnected (D>50mm)	km/year
3	Length of network added (D>50mm)	km/year
4	Length of old distribution network	km
5	Number of leaks repaired	Nos.
6	Number of leaks reported	Nos.
7	Duration of water supply	hours/day
8	Population served-water	'000 inhabitants
9	Total population in area of responsibility-water	'000 inhabitants
10	Number of water pipe breaks in the distribution network	Nos./year
11	Number of house meter	Nos.
12	Number of meter added	Nos./year
13	Number of replaced meter	Nos./year

Table 7.19 Performance Indicators of NRW (2)

No	Performance Indicators (PIs)	Unit
Ratio		
1	Water coverage	%
2	Water coverage - household connection	%
3	Old pipeline	%
4	Non Revenue (formerly Unaccounted For) Water	%
5	Non Revenue (formerly Unaccounted For) Water	m3/km/day
6	Non Revenue (formerly Unaccounted For) Water	m3/conn/day
7	Pipe breaks	breaks/km/yr
8	Metering level	%
9	Number. of repaired pipe breaks on network per km	Nos./km
10	Number of repaired pipe breaks on connection / 1000 con	Nos./1000con
11	% of number. of pipe breaks repaired to number of pipe breaks reported	%
12	Continuity of service	hours/day
13	Customers with discontinuous supply	%

7.5.4 Procurement of Equipment for NRW Management

The equipment for NRW management has been identified and a list was prepared. It will be added later.

CHAPTER 8 WATER QUALITY MONITORING

8.1 BASELINE SURVEY

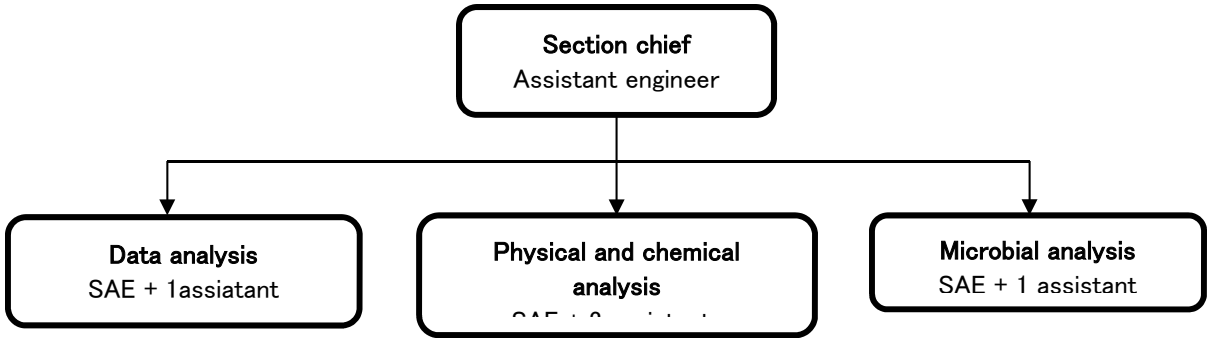
8.1.1 Existing condition of water quality laboratory

(1) Organization

Water quality monitoring laboratory which is under the Department of Water and Sanitation was established in 2014 July. It has totally 9 staffs for both water quality analyses. These staffs are not cover for onsite sampling. Water sampling is done by township engineers. Therefore, detail of sampling point and sampling method are not clear.

Because of the limitation of our manpower and capacity, our laboratory can't cover the whole water supply area in Yangon City. Currently, sampling water quality survey is done in the two townships (Kyauktada TS and Pabadan TS) near from our laboratory (as of December, 2015). However, we are trying to do our works to be the best.

The manpower of our water quality monitoring section is very limited. Total number of our section is 9. The organization chart of laboratory is as follow. Our laboratory has 3 sections, i.e. Data analysis (2 staffs), Physical and chemical analysis (4 staffs) and Microbial analysis (2 staffs).



Source: YCDC

Figure 8.1 Organization Chart of Laboratory

(2) Existing Equipment

At present, we can analyze 15 parameters; 13 parameters are physical chemical parameter and 2 parameters are microbial parameter. However, we have a plan to increase analysis parameter year by year.

For water quality analysis, we need lab equipment and reagents which are difficult to purchase in our local market. However, we are trying to search the local suppliers and order from foreign countries to solve that problem. List of analysis parameter and analysis equipment is shown below.

Table 8.1 Equipment List

No.	Equipment	Model	No of Equipment
1	pH meter	METTLER TOLEDO B349058773	1
2	Conductivity meter	METTLER TOLEDO B330607539	1
3	Chlorine meter	HACH Pocket Chlorometer	4
4	Turbidity meter	HANNA HI 93703	2
5	Spectrometer	HACH DR 6000	1
6	Autoclave	DAIHAN LAB TECH	1

No.	Equipment	Model	No of Equipment
		LAC5060S	
7	Incubator	POL-EKO LIB-060M	2
8	Incubator	DAIHAN LAB TECH LIB-060M	1
9	Fume food	ADVANCED LAB	1
10	Analytical balance	METTLER TOLEDO ME204 OHAUS-PA4102	2
11	Microscope	OPTIMA G302	1
12	Jar tester	VELP SCIENTIFICATION JLT6	1

Source: YCDC

Table 8.2 List of Analytical Parameter

Parameter	Unit	Standard value of Myanmar water quality standard
pH		6.5 – 8.5
Turbidity	NTU	<5
Electrical Conductivity	µS/cm	1500
Total Dissolved Solids	mg/l	1000
Salinity	ppt	0-0.5
Chloride	mg/l	<250
Calcium	mg/l	<250
Lead	mg/l	0.01
Magnesium	mg/l	<150
Manganese	mg/l	<0.5
Total Hardness	mg/l	<500
Iron	mg/l	0.3
Arsenic	mg/l	<0.001
Total Coliform	CFU	0 in 100
Fecal coliforms	CFU	0 in 100

Source: YCDC

Photo 8. 1 Laboratory (Dec. 2015)

(3) Problems in laboratory Measuring Works

Now we have few issues in water quality measuring. Some water quality parameters are measured with UV Spectrometer which needs reagents. However, we can't purchase these reagents easily in our local market.

Another problem is to enhance the capacity of our laboratory member. We are required to get the advanced laboratory equipment and technology. About advanced analytical technology, we also need to modify the existing SOPs to develop quality assurance and quality control of lab works.

8.1.2 Existing Monitoring Plan

(1) Sampling location

Water quality monitoring schedule of weekly, monthly and yearly are developed. In the weekly monitoring, Yegu pumping station (PS), Nyaunghnapin Water Treatment Plant (WTP) and Kokkowa River are monitored. In the monthly monitoring, Gyophyu, Hlawga, Phyugyi Reservoirs, Aungtagon and Barlar creek, Lagunpin creek and Thaephyu, Yangon-Pauk and Dagon (54&107) water station are monitored. In township (TS) monitoring, tubes well and tap water in 33 TSs are monitored. Sampling of each location of TS is done in every 4 months.

Table 8.3 Summary of Sampling Location

Monitoring frequency	Sampling location
Weekly	Yegu PS Nyaunghnapin WTP Kokkowa River (Water source)
Monthly	Nyaunghnapin WTP Gyophyu, Phugyi and Hlawga Reservoir Aungtagon and Barklar Creek (One of water source of Hlawga reservoir) Yangonpauk, Thaephyu and South Dagon (No.54 and No.107) Water station Lagunpin Creek (Water source)
3 times in a year	33 Townships (Sampling in each township is done in every 4 months)

Source: YCDC

(2) Monitoring Parameters

Monitoring parameter is shown below.

Table 8.4 Monitoring parameter

Monitoring frequency	Monitoring parameter
Weekly	pH, TDS, EC, Total hardness, Turbidity, Total alkalinity, Carbonate, Bicarbonate, Chloride, Salinity, Ca, Mg, Fe, Mn
Monthly	pH, TDS, EC, Total hardness, Turbidity, Total alkalinity, Carbonate, Bicarbonate, Chloride, Salinity, Ca, Mg, Fe, Mn
3 times in a year	Total coliform, Fecal coliform

Source: YCDC

(3) Sampling Schedule

Water samples from pumping station, tap water and WTP are measured in every week. Samples from reservoirs, water station and water source are measured once a moth.

Table 8.5 Weekly sampling schedule

No.	Location	Mon.	Tue.	Wed.	Thur.	Fri.
1	Nyaunghnapin WTP	√				
2	Yegu PS	√				
3	Kokkowa River	√				

Note

1. To make bacteria test on sample water, the sterilized bottle must be taken from the laboratory on Friday and can be tested in every Monday.
2. Do not fill the water to the full level of bottle and do not touch inside the bottle cover.
3. At fifth day, the result can be known on that day.
4. For testing of physical and chemical analysis, water must be filled fully to the 1 liter bottle for each water sample to be sure there has no void.
5. Carry the water sample bottle carefully, not to pose sunlight directly.
6. Send water sample to the laboratory in time about 9:30 AM.
7. Co-operate to accomplish analysis work during the day.
8. For ground water sample, note a type of well, name of pumping station and full address on the sample bottle.

Source: YCDC

Table 8.6 Monthly sampling schedule

No.	Location	Mon.	Tue.	Wed.	Thur.	Fri.
1	Nyaunghnapin WTP	√				
	Raw water					
	Phase-1					
	Phase-2		√			
2	Gyophyu, Phugyi, Hlawga Reservoir		√			
3	Aungdagon and Barlar Creek			√		
4	Yangonpauk Water station					√
5	Thaephyu Water station					√
6	South Dagon water station					
	(107) pumping station					
	(54) pumping station					√
7	Lagunpin Creek					

Note

1. To make bacteria test on sample water, the sterilized bottle must be taken from the laboratory on Friday and can be tested in every Monday.
   - Do not fill the water to the full level of bottle and do not touch inside the bottle cover.
   - At fifth day, the result can be known on that day.
2. For testing of physical and chemical analysis, water must be filled fully to the 1 liter bottle for each water sample to be sure there has no void.
3. Carry the water sample bottle carefully, not to pose sunlight directly.
4. Send water sample to the laboratory in time about 9:30 AM.
5. Co-operate to accomplish analysis work during the day.
6. For ground water sample, note a type of well, name of pumping station and full address on the sample bottle.

Source: YCDC

To analyze the water samples from tube wells or pump house in 33 townships, we made a schedule for three times per year. Schedules for water sampling are as shown below.

Table 8.7 Sampling schedule of TS

Table for Water Sampling Dates in 33 Townships

No	Number of Sample	Township	1.12.15	to	3.12.15	8.12.15	to	10.12.15	15.12.15	to	17.12.15	22.12.15	to	24.12.15	29.12.15	to	31.12.15	5.1.16	to	7.1.16	12.1.16	to	14.1.16	19.1.16	to	21.1.16	26.1.16	to	28.1.16	2.2.16	to	4.2.16	9.2.16	to	11.2.16	16.2.16	to	18.2.16	23.2.16	to	25.2.16	1.3.16	to	3.3.16	8.3.16	to	10.3.16
1	22	Lanmadaw																																												
	3	Mingalartaungnyunt																																												
	2	Tamwe																																												
2	15	Kyimyindine																																												
3	22	Sanchaung																																												
4	2	Puzundaung																																												
	6	Thirketa																																												
	5	Botahtaung																																												
	12	Kyauktada																																												
5	16	Latha																																												
6	16	Alon																																												
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13	10	Shwegyitar																																												
	15	Hlaingtaryar																																												
	1	Hlaingtaryar Industrial																																												
	1	Dagonayar Highay																																												
14	20	Thingangkun																																												
15	18	Innsein																																												
	2	Seikgyikhanaungtoe																																												
	297																																												

Source: YCDC

Note (Expert): Above mentioned sampling schedule is decided for tube well. YCDC uses tube well as auxiliary water source. However, database about detailed location and specification of each tube well are not developed.

(4) Problems of Periodical Monitoring

Because of the capacity of laboratory and human resources, we can't go on site for sampling and we can't set the sampling points on each township. Usually, townships engineers and staffs take water samples to our lab by schedule. Therefore, to obtain exact sampling data is difficult.

Other problem is the limitation of capacity of manpower. Because of this reason, it is difficult to cover the whole water service area in Yangon City. We also need to distribute systematically sampling procedure to all sampling staffs in our department.

8.1.3 Existing Operation Procedures

(1) Work schedule

Our water quality monitoring section collected all water sampling and tested data. If we found unusual results in monitoring data, we reported about this to our head of department and solve the problems as soon as possible. Every end of the months, we report about our monitoring results to our Head of Department and record it. Daily works schedule of laboratory is shown below.

Table 8.8 Weekly Work Schedule of Laboratory

Category	Mon.	Tue.	Wed.	Thur.	Fri.
Receive water sample	√	√	√	√	√
Physical and chemical analysis	√	√	√	√	√
Preparation of bacterial test		√			√
Measurement of bacterial test (Total coliform and Fecal coli)			√		
Data analysis					√
Cleaning & Maintenance of analysis equipment	√	√	√	√	√

Source: YCDC

(2) List of Existing SOPs and Schedule of SOPs development

List of SOPs is shown below. At present, 9 SOPs are prepared. These SOPs are developed by the aid of WHO. However, in this project, other necessary SOPs will develop within 2016.

Table 8.9 List of Existing SOPs

No.	Parameters
1	Water Sampling Procedure
2	Total Hardness
3	Calcium
4	Magnesium
5	Chloride
6	Carbonate
7	Bicarbonate
8	Total Alkalinity
9	Total coliform and Fecal coli

Source: YCDC

8.1.4 Review of Existing Water Quality

In Yangon, surface water has high turbidity and ground water have a problem of Fe and salinity. To check the quality of distributed water, we usually reference the Myanmar National Drinking Water Quality (MNDWQ) Standard and WHO drinking water quality guidelines (4th). Priority parameters of MNDWQ are shown below.

Table 8.10 Priority Parameter of MNDWQ

Priority parameters	Standard value
Total coliform	0CFU/100ml
Fecal coliform	0CFU/100ml
Taste	Acceptable
Odor	Acceptable
Color	15TCU
Turbidity	<5 NTU
Arsenic	0.001mg/l
Lead	0.01mg/l
Nitrate	50mg/l
Manganese	0.5mg/l
Chloride	250mg/l
Hardness	500mg/l as $CaCO_3$
Iron	0.3mg/l
pH	6.5 – 8.5
Sulphate	250mg/l
TDS	1,000mg/l

Source: YCDC

Turbidity in surface water is usually higher in rainy season than dry season. Most of the underground

water which is near the river bank has high contamination of EC and TDS. The existing water quality of treated water is required to satisfy MNDWQ, however, distributed water is contaminated because of the old aged and insufficient managed waterworks facilities.

(1) Characteristics of Water Quality in Each Sampling Location

In this section, water quality of WTP and Hlawga, Gyophyu and Phugyi reservoir are described. Hlawga, Gyophyu and Phugyi reservoir are used for water source of YCDC. Water from these reservoirs is transmitted and distributed without treatment. We monitor the water quality above mentioned waterworks facilities weekly and monthly.

1) Nyaunghnapin WTP

In Nyaunghnapin WTP, raw water and treated water were analyzed. Turbidity of raw water is usually higher in raining season than drying season. Maximum value was 79 NTU and minimum value was 5.2 NTU. Phase -1 Treated Water Turbidity is always higher than Phase-2. The maximum value of Phase-1 Turbidity is 10 NTU and minimum value is 0 NTU. Maximum and minimum Turbidity values of Phase -2 treatment plant are7.69NTU and 0 NTU. During the end of June, there was highest Turbidity value in WTP because of the heavily rainfall for this year.

pH of raw water is lower than the treated water; it is something errors affect by the quality of coagulant. But, after the end of June that raw pH value is higher than the treated water. This is because of the adding coagulant (Aluminum Chlorohydrate: ACH) in treated water. The maximum value of 7.81 and minimum value is 6.64.

In total alkalinity, due to the effect of coagulant raw water value must be lower than treated water. That total alkalinity is one of important indicator in water coagulation and flocculation process in water treatment system. In the dry period, the total alkalinity value is lower than wet season. According to the amount of total alkalinity value in raw water we can adjust the dosing amount of coagulant.

EC in treated water must be lower than the raw water. If treated water value is high, that the water is contaminated by other effects. We must be checked the operation system of WTP again.

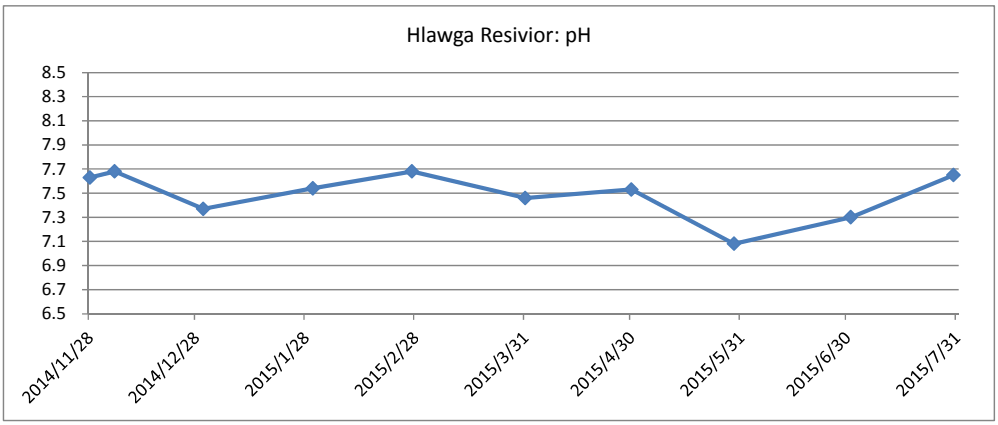
Fe content in water is change at end of June, during this month heavily rainwater fell and intermittent operation occurred. Because of this, we found unpleasant water quality from water treatment plant.

Other parameters such as Calcium, Magnesium, Chloride and Total hardness were normal value in water treatment plant.

> ***Note (Expert)***: Electrical data set of Nyaunghnapin WTP was not received (as of Dec.2015). Until now, their monitoring data are written on notebook. Currently, water quality database using EXCEL is developing.

2) Hlawga reservoir

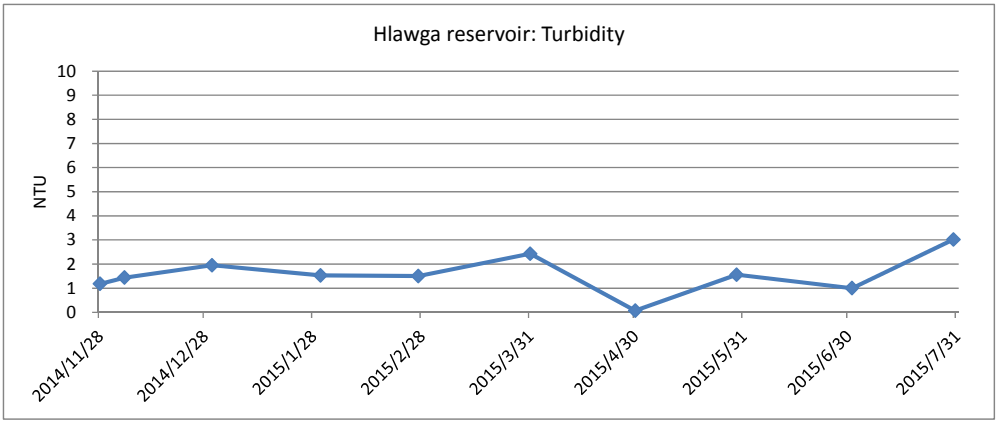
According to the test result from November 2014 to July 2015, pH of Hlawga reservoir was relatively stable. Maximum value was 7.68 and minimum value was 7.37.



Source: YCDC

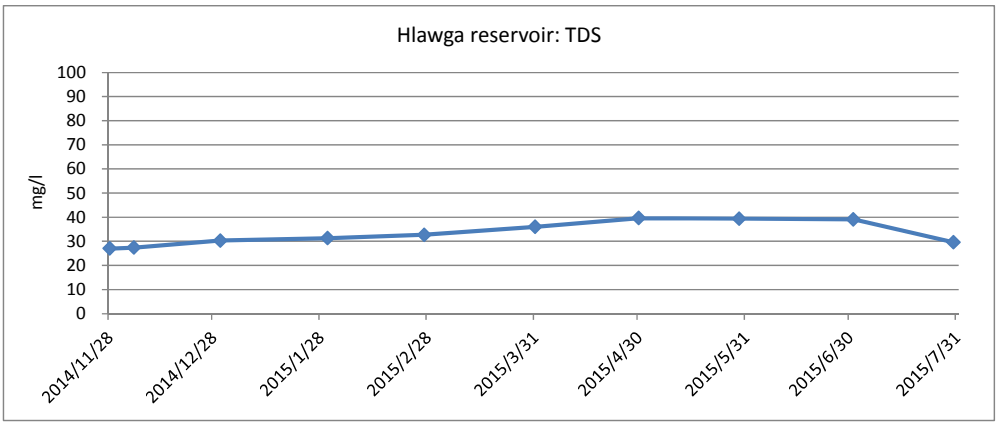
Figure 8.2 Hlawga reservoir: pH

Highest value of Turbidity was 3.02 NTU. Therefore, Turbidity satisfy MNDWQ (<5NTU). TDS is slightly difference between dry season and wet season. The highest value was found from April to July.



Source: YCDC

Figure 8.3 Hlawga reservoir: Turbidity

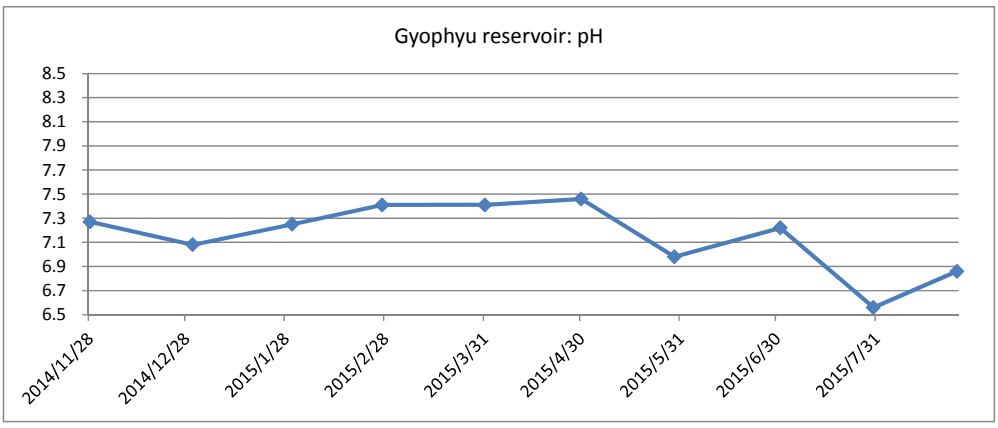


Source : YCDC

Figure 8.4 Hlawga reservoir : TDS

3) Gyophyu reservoir

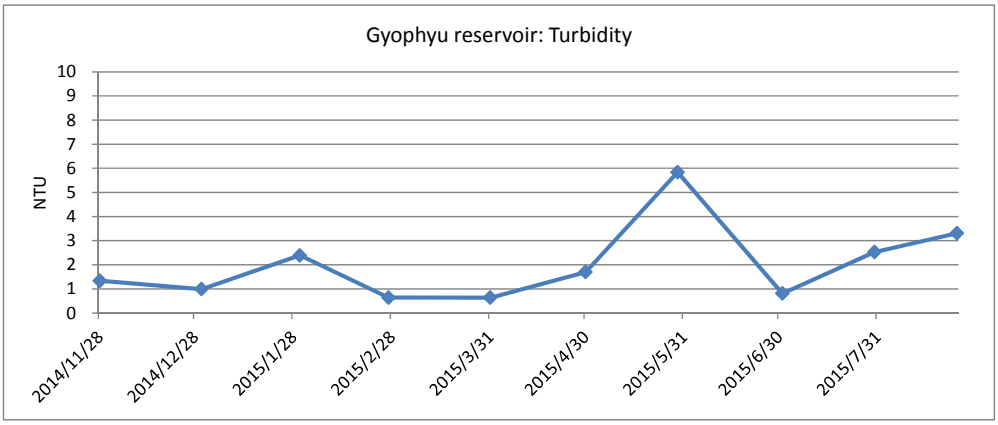
pH of Gyophyu storage reservoir was lower than Hlawga storage reservoir. Maximum value was 7.46 and minimum value was 6.56. In addition, increase of pH was observed in dry season.



Source : YCDC

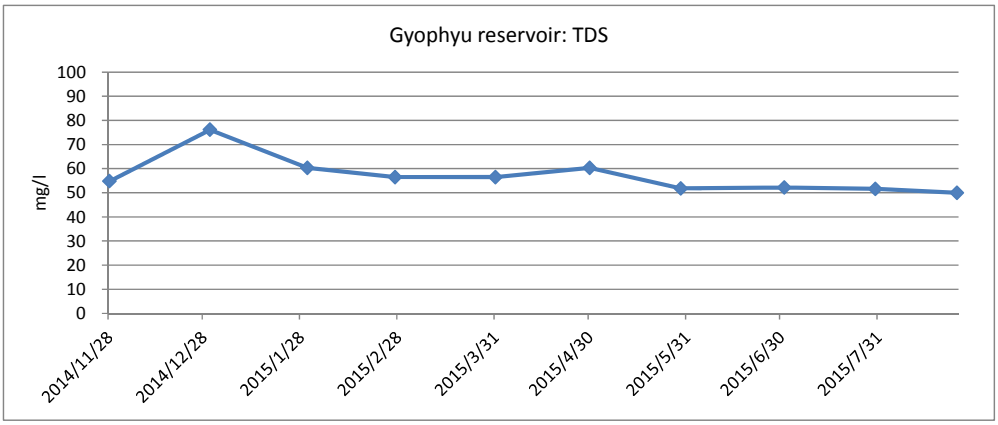
Figure 8.5 Gyophyu reservoir : pH

Turbidity was decreased in dry season. However, increase was observed in April, and moderate increase was observed in rainy season (June and July). TDS increased in November 2014. However, observed value was stable (50 – 60 mg/L).



Source: YCDC

Figure 8.6 Gyophyu reservoir: Turbidity



Source : YCDC

Figure 8.7 Gyophyu reservoir : TDS

4) Phugyi reservoir

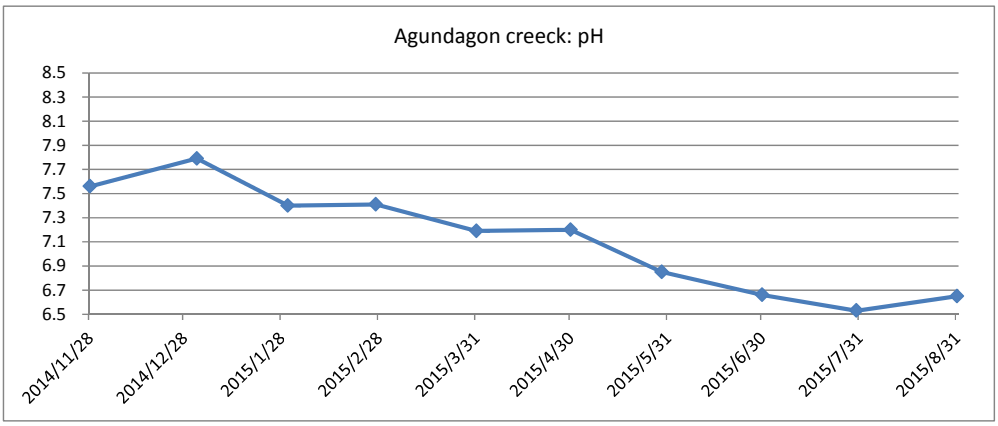
In Phugyi reservoir, pH is stable and it was around 7.5. TDS fluctuated, but their maximum value is less than the standard value of MNDWQ.

In the rainy season, test results of Fe, Mn, Total Hardness, Calcium and Magnesium were usually high. Turbidity and Alkalinity were higher in dry season than rainy season.

> ***Note (Expert)***: Electrical data set of Phugyi reservoir was not received (as of Dec.2015). Until now, their monitoring data are written on notebook. Currently, water quality database is developing.

5) Aungdagon creek

pH in Aungdagon creek decreased in rainy season. The highest pH was 7.79 and lowest was 6.53.

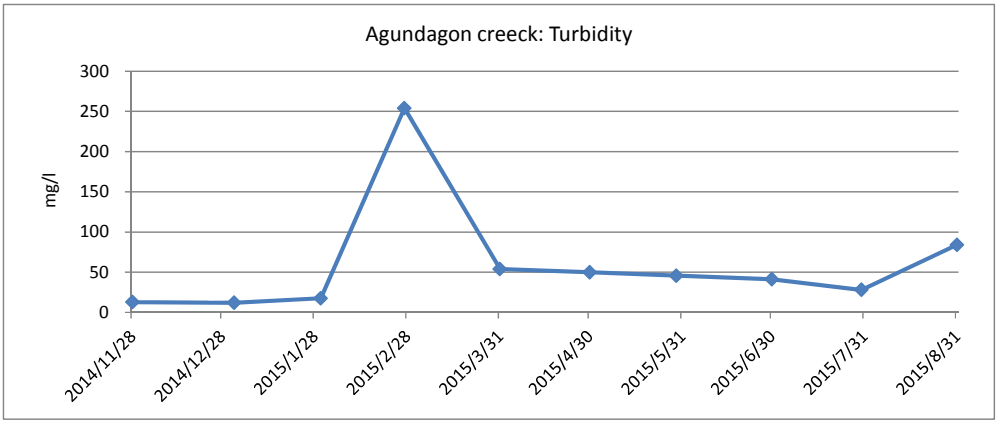


Source: YCDC

Figure 8.8 Aungdagon creek: pH

TDS decreased in rainy season; however, these results were acceptable. The Total Alkalinity value is slightly increased in rainy season. The maximum chloride was 69 mg/l in April and the minimum value was 13mg/l.

Turbidity of Aungdagon creek exceeds MNDWQ standard value (5.0 NTU). Lowest value was 12.0 NTU (January 1st). The maximum value was 254 NTU (January). The reason of this increase is supposed that the inflow of highly polluted wastewater.

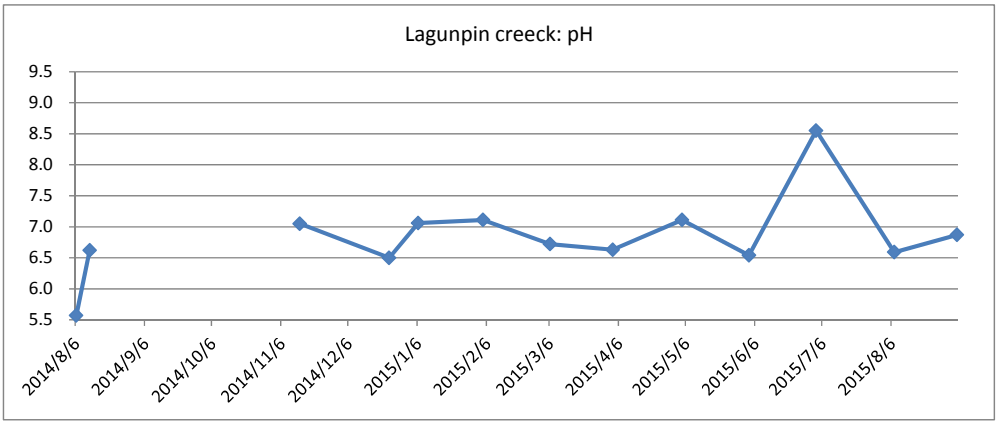


Source: YCDC

Figure 8.9 Aungdagon creek: Turbidity

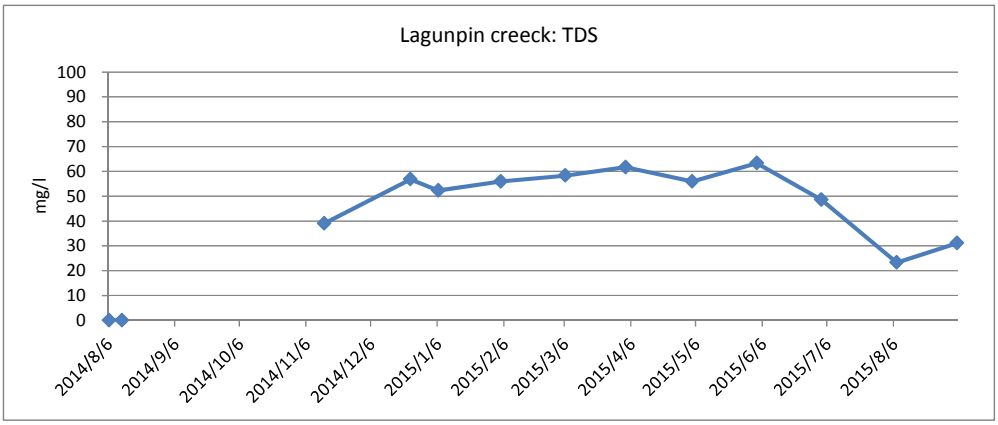
6) Lagunpyin creek

pH was acceptable level, however, low pH was observed in rainy season (August, 2014). TDS passed the standard value, however, increase of TDS in dry season was observed. Total Hardness, Calcium, Magnesium results are fluctuation. Fe value is strange, because in the surface water we can't normally find the iron content. High Turbidity value is observed in rainy season (August 2014: 84NTU and July 2015: 67NTU).



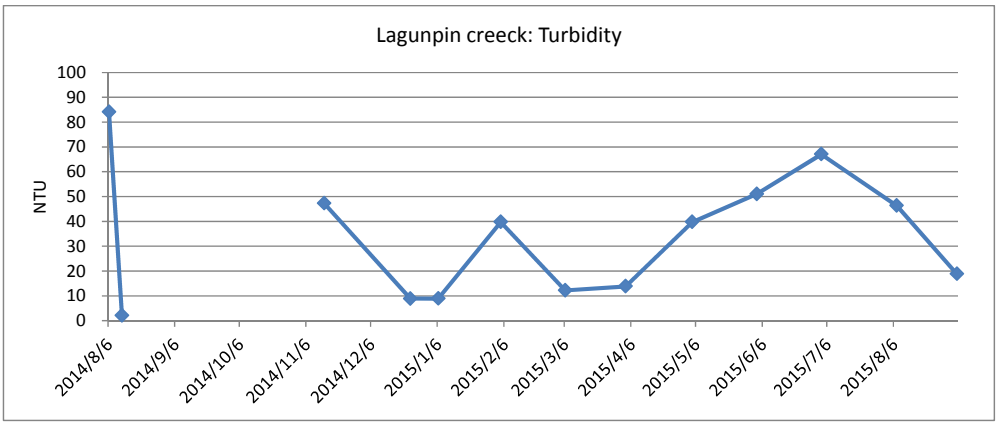
Source: YCDC

Figure 8.10 Lagunpin creek: Turbidity



Source: YCDC

Figure 8.11 Lagunpin creek: TDS

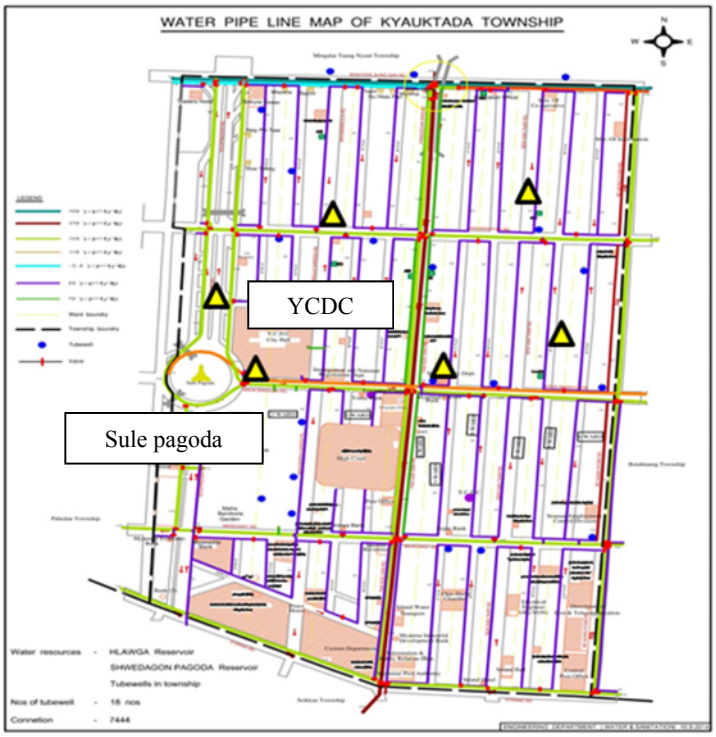


Source: YCDC

Figure 8.12 Lagunpin creek: Turbidity

7) Township

Periodical monitoring of tap water is done in Kyayktada TS and Pabedane TS. Sampling point is shown yellow triangle. Monitoring item parameter is Total coliform and Fecal coliform. Total coliform and Fecal coliform were detected in all samples of tap water.



Source: YCDC

Figure 8.13 Tap water sampling location: Kyayktada TS

Source: YCDC

Figure 8.14 Tap water sampling location: Pabedan TS

Note (Expert): Because of the limitation of manpower of laboratory, tap water monitoring is implemented in Kyayktada TS and Pabedane TS. Both TS locates near YCDC HQ (laboratory). In the weekly meeting in Dec.4, Mr Thein Min

(DYCE) asked Ms. Ei Khaing Mon to increase sampling point of tap water (He instructed to increase sampling point around 6). We will consider this instruction, and revise sampling plan of tap water.

(2) Problems of Water Quality in Yangon

According to the test results, our raw water quality is passed the relevant standard, however the distributed water quality have some Turbidity problem. In some places which use both underground water and surface water have high EC, TDS and Iron problems. To calibrate the tested results, we need to collect more accurate results. The facts of the lack of chlorine disinfection, most of the tap water are detected by bacteria.

8.1.5 Issue of Water Quality Monitoring

Our water quality monitoring section has many issues in both technical and administrative capacity.

For technical issue, our water quality monitoring laboratory can measure only 15 parameters and we have to increase the measuring parameters. Our laboratory needs to cover the priority water parameters of MNDWQ Standard. Moreover, we have to consider the industrial waste pollution in our water sources. Therefore, effective method of heavy metal analysis is necessary. For this purpose, advanced techniques and equipment are important for our laboratory.

On the other hand, the basic standard analytical methods are important for our laboratory because our staffs are insufficient in analytical experience. So that laboratory training is one of the important issues to our section.

Another issue is water sampling. This is important work for water quality monitoring section. Systematically sampling is required to implement water quality monitoring processes. Therefore, we started the development of SOPs with the help of expert. In addition, select the adequate sampling point is also important for a good water quality monitoring. We also need to select more sampling points to cover the whole water service area of YCDC.

The number of staffs of water quality monitoring section is serious issue. At present, we have only 9 staffs; therefore, we can’t cover the whole water supply system in Yangon. Therefore, we need more staffs.

We have to start water quality management. The performance indicator (PIs) for water quality management will be noticed to all township engineers. We wish they will cooperate with us, and to improve of water quality.

8.2 RESULTS OF PCM WORKSHOP

8.2.1 Problem Analysis

Result of problem analysis is shown below. From this diagram, water quality monitoring section now faces many problems. Major problem is a lack of analytical equipment which is necessary for heavy metal analysis. We need to get training for water quality analysis. Another problem is difficultly of purchasing of laboratory equipment in local market. Other issue is the establishment of SOPs for both sampling and water quality analysis.

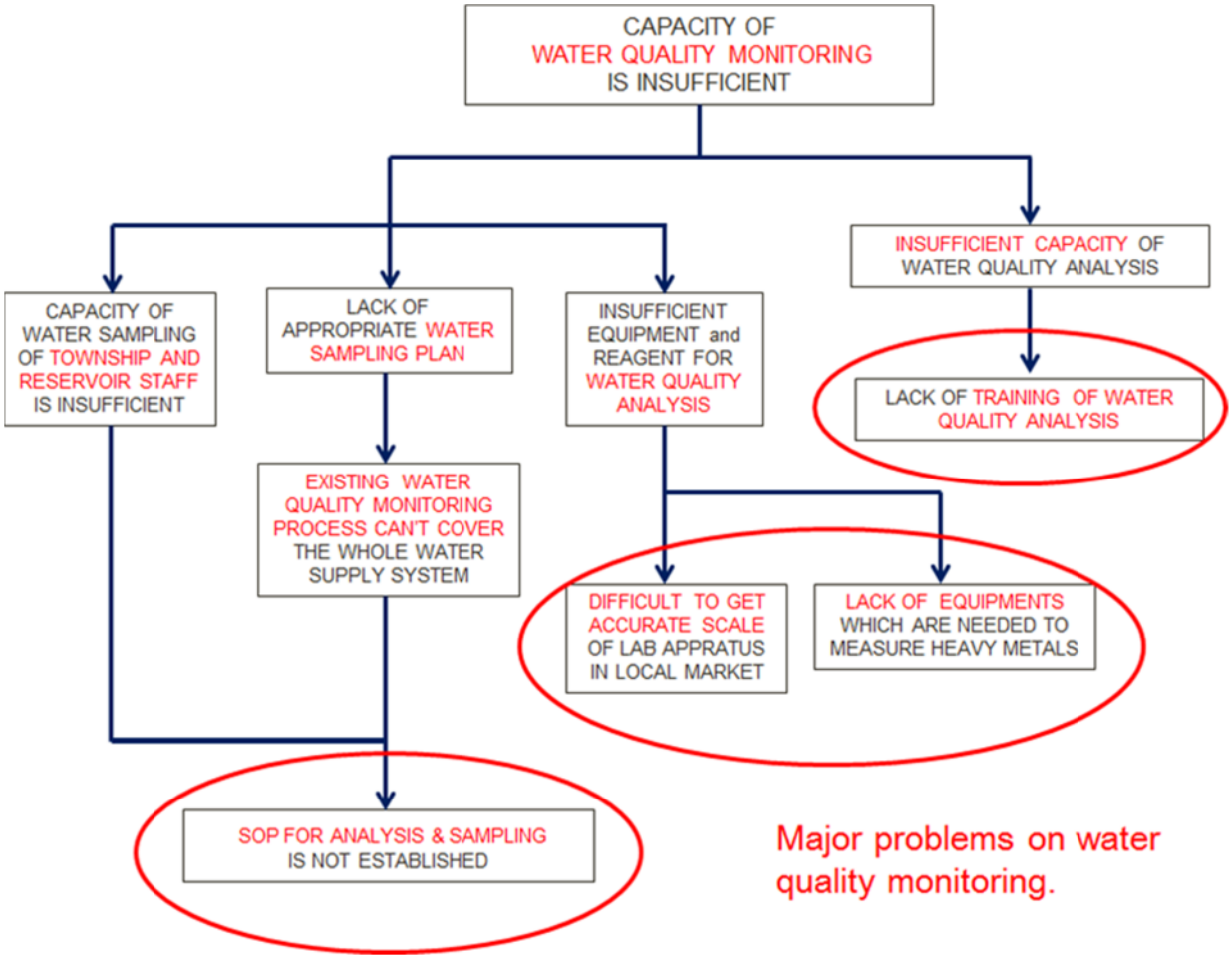


Figure 8.15 Diagram of Problem Analysis

8.2.2 Objective Analysis

To obtain a sufficient capacity of water quality monitoring, we have to enhance the capacity of water quality analysis and data analysis. Especially, we have to learn more knowledge about water quality data analysis. Therefore, training for water quality data analysis is necessary.

Moreover, we have to establish SOPs of sampling and analysis. These SOPs are necessary to implement an appropriate water quality monitoring to cover the whole water coverage area of YCDC.

Another necessary thing is advanced analytical equipment. If we have sufficient laboratory equipment and reagents, capacity of our laboratory work will improved. Then, we will become a good water quality monitoring laboratory to assure a safety and drinkable water distribution in Yangon.

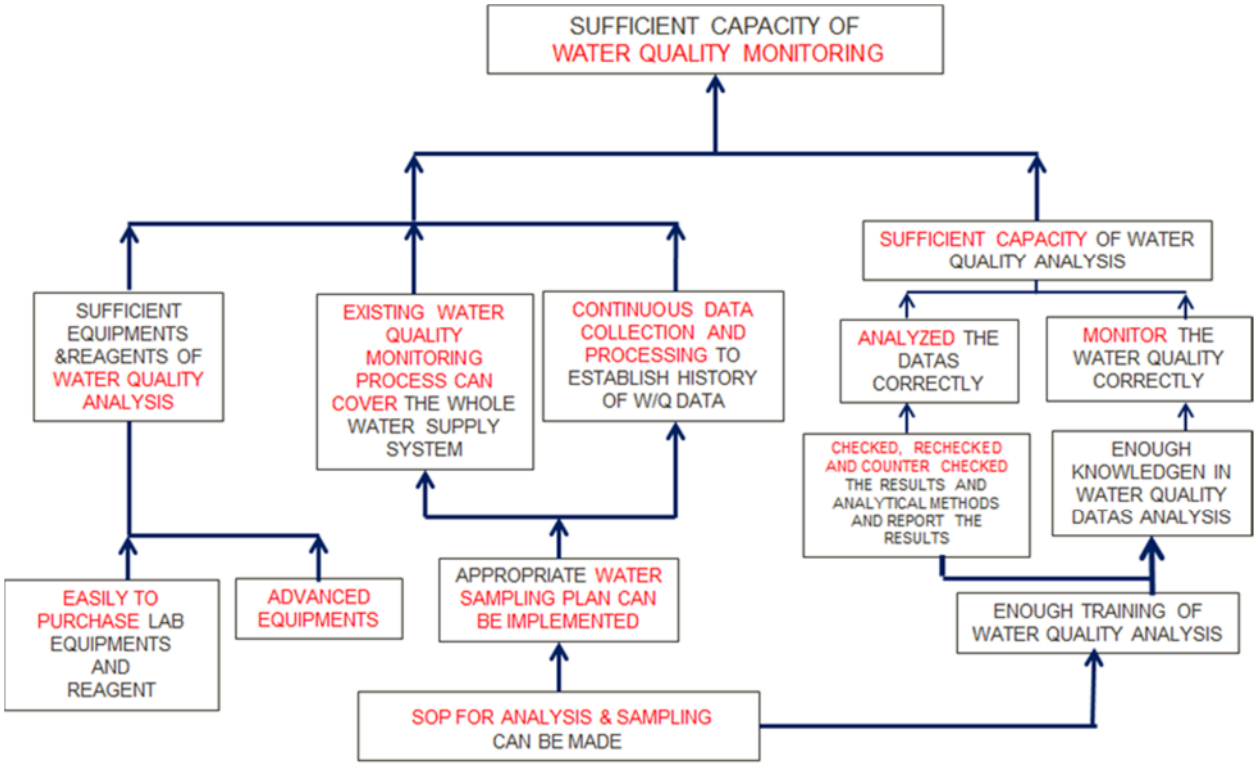


Figure 8.16 Diagram of Objective Analysis

8.3 CAPACITY ASSESSMENT

8.3.1 Result of Assessment

(1) Assessment Item

Technical capacity of Organization and Individual were assessed. Assessment items are shown below.

Table 8.11 Technical Assessment Item: Organization

Category	Item
Technical knowledge (Organization)	Planning of water quality monitoring (select sampling point, sampling frequency, monitoring item and analytical method).
	Knowledge of water treatment technology (water treatment technology in WTP, e.g. coagulation, sedimentation, sand filtration and chlorination).
	Opportunity to obtain the technical knowledge and analytical skill through training, etc.
Administrative rules and record keeping	Administrative rule of analytical equipment and reagents.
	Administrator of analytical equipment and reagent.
	Procedure of purchase of analytical equipment and reagent.
	Recordkeeping of purchase, repair, maintenance and disposal of analytical equipment.
	Recordkeeping of purchase, consumption and disposal of reagent.
SOP and manual	SOPs for water quality analysis
	Manual or SOP for accuracy management
	Procedure of development and revision of SOPs and manual.
	Procedure of accident response manual during sampling work and laboratory, e.g. emergency contact number list.
	Procedure of disposal of experimental waste
Operation	Number of analytical item which available in laboratory.
	Procedure of preparation of monitoring plan.

Category	Item
	Procedure of sample storage e.g. storage method (room temperature, refrigerator) and storage period
	Format of data sheet and procedure of store keeping of analytical data.

Table 8.12 Technical Assessment Item: Individual

Category	Item
Knowledge of water quality management	Capacity of water quality analysis (1) Appropriate use of analytical equipment (pH meter, EC meter, UV-vis spectrometer)
	(2) Appropriate use of grass ware for measurement (measuring flask, whole pipette, measuring cylinder)
	(3) Appropriate washing of analytical equipment and grass ware (select of appropriate washing agent and rinse)
	(4) Preparation of reagent (dilution of reagent)
	(5) Preparation of sample (clean up and dilution of sample)
	(6) Preparation of analytical curve
	(7) Statistic calculation for accuracy management, e.g. average, standard deviation, CV-value, correlation)
	(8) Aseptic manipulation for biological test
	Understanding of nature of sample, e.g. nitrogen compound in groundwater, EC or salinity in tidal river, fluctuation of turbidity in river water, etc.
	Analysis of water quality data, e.g. explain using appropriate table and graph, calculate significant correlation
	Understanding of SOPS and manuals
	Understanding of accuracy management
	Knowledge of water treatment process (water treatment technology in WTP, i.e. coagulation, sedimentation, sand filtration and chlorination, and change of water quality in water treatment process).
Capacity of planning	Capacity of planning of water quality analysis (1) Deeside appropriate sampling point considering the purpose of analysis
	(2) Select appropriate analysis item (Considering the characteristics of sample and purpose of analysis)
	(3) Making a work schedule considering work volume (number of sample, time required for sampling, time required for analysis work, number of staff, etc.)
	Knowledge of WSP（Water Safety Plan）
Problem-solving capacity	Capacity of problem -solving to improvement of water quality (improvement of treated water quality, prevent a pollution in water distribution system, etc.)
	Capacity of problem-solving in the situation of unusual water quality (water quality accident, high turbidity, etc.)

(2) Result of Assessment

In this survey, following information are obtained from questionnaire and interview.

Organization (Technical)

- Organization in laboratory is already decided (3 groups are organized).
- Administrator of analysis equipment and reagent is already decided.
- Activity of laboratory is managed by monthly and weekly sampling schedule. Result of water quality survey is reported to DYCE and CE, periodically.
- The contents of periodical report should be improved.
- Manpower is not enough.
- Analytical equipment is not enough.

- Purchase of analytical equipment and reagent in local market is very difficult.
- Administrative rule of analytical equipment and reagents is not documented.
- SOPs of analysis is not prepared (A few draft SOPs are developed).
- Procedure of sample storage is not decided.
- Procedure of experiment waste disposal is not decided.

Individual capacity (Technical)

- All of the members have certain degree of knowledge about water sampling. However, knowledge about water quality data analysis is insufficient.
- At present, YCDC doesn't have a training course about water quality monitoring. Therefore, they don't have an opportunity to learn.
- However, all staffs have high motivation to learn latest technology.

Recommendations

- The enhancement of capacity of chemical analysis and water quality monitoring is priority matter.
- The establishment of appropriate training course (training course of chemical analysis and water quality monitoring) is required to update and maintain the required capacity by themselves.
- Considering required task of laboratory, increase the number of staff is necessary.
- Considering a sustainable operation of laboratory, difficulty of procurement of analysis equipment and reagent will be serious issue. Further research of local market and/or neighbor countries is necessary.

8.3.2 Achievement state/ Expected outcomes in capacity development (Phase 1 &2)

Achievement state and expected outcomes in capacity development are shown below. Achievement state includes 3 items. That is: (1) Capacity of laboratory staffs is enhanced, (2) Improvement of analytical method and (3) Establish Water Quality Management Plan.

The priority is to enhance a capacity of laboratory staffs. For this purpose, OJT and seminar are proposed (Summary of training is described in next clause).

For analytical method, JICA expert proposes introduction of "Standard methods". At present, YCDC laboratory uses HACH test kit and simple test method. However, these test kit is difficult to keep an accuracy of data quality. In addition, it is desirable to learn commonly used chemical analysis technique to enhance a capacity of water quality analysis.

The final target of outcome is to establish Water Quality Management Plan. For this purpose, enhancement of basic capacity, that is, capacity of water quality monitoring, capacity of water quality data processing and capacity of water quality survey planning are important. The enhancement of these capacities is done in OJT and seminar.

Table 8.13 Achievement state/ Expected outcomes in capacity development

Achievement state in capacity development	Expected outcomes in Phase1 and 2
1. Capacity of laboratory staff is enhanced.	1.1. Training of laboratory staff is implemented. 1.2. Capacity of water quality analysis including chemical analysis, accuracy management and data processing is enhanced.
2. Improvement of analytical method	2.1. Introduction of Standard methods 2.2. Improvement of precision of analysis
3. Establish Water Quality Management Plan	3.1. Relationship with Water Treatment Section is established. 3.2. Rational water monitoring plan (rational sampling point, rational monitoring item and rational monitoring frequency) is established. 3.3. Periodical water quality monitoring is implemented 3.4. Issue of water quality in Yangon city become apparent. 3.5. Water Quality Management Plan is established by the collaboration with Water Treatment Section.

Source: JICA Expert

8.3.3 Training Plan

There is no training system for water quality analysis, at the present. It is necessary to enhance a capacity of water quality monitoring and a problem-solving ability about water quality issue. Think of Achievement state / Expected outcomes in capacity development (mentioned above), JICA expert team has proposed an integrated training which combines OJT in daily routine work and seminar.

Purpose of OJT is;

1. To enhance a capacity of water quality analysis technique.
2. To study improved water quality monitoring method.
3. To enhance a capacity of water quality data processing.
4. To enhance a capacity of planning of water quality survey.

On the other hand, seminar is implemented to complement OJT. The purpose of seminar is;

1. To study basic knowledge about water quality.
2. To study basic knowledge about water quality data processing method.

8.4 SUMMARY OF MAJOR ISSUES

Through this baseline survey, existing condition of laboratory is cleared. Major issues and action plans are shown below.
Among these issues, (i) Difficulty of procurement of analysis equipment and reagent and (ii) Lack of manpower will be serious problem in future.

Table 8.14 Major Issue and Action Plan

Major Issue	Proposed action Plan
Capacity issues	
Insufficient experience of chemical analysis	OJT and seminar
Insufficient experience of data analysis	OJT and seminar
Development SOPs	OJT Few draft SOPS are already prepared
Development of monitoring plan	OJT
Technical issues	
Analytical parameter is insufficient	At least, Priority parameters of MNDWQ should be measured. For this purpose, procreation of additional analytical equipment is planned.
Improvement of analysis method	Introduce "Standard methods" to improve simple test method.
Other issues	
Difficulty of procurement of analysis equipment and reagent	Require consideration
Lack of manpower	Require consideration

Source: JICA Expert

8.5 PROGRESS OF PROJECT

8.5.1 Procurement of equipment

Considering a comparison of Priority parameters in MNDWQ and current measurement item in laboratory, improvement of analytical method and necessity of additional measurement of reservoir water, procurement of additional equipment is proposed by expert.

Proposed additional analytical item is as follows;

- SS: Monitor of reservoir water (Gyobyu, Phugyi and Hlawga Reservoir)
- TDS: Improvement of analysis method (Simple test → Standard methods)
- Metal (Fe, Mn, Pb, As) : Improvement of analysis method (Simple test → Standard methods)
- Nitrate, Nitrite, Ammonia: Improvement of analysis method (Simple test → Standard methods)
- Color: Additional equipment is necessary
- Sulphate: Additional equipment is necessary

List of additional analytical equipment (Major equipment) is shown below;

Table 8.15 List of additional analytical equipment (Major equipment)

Item	Purpose and Analysis item	Nos.
Turbidity meter	Turbidity (Laboratory use)	1
Color meter	Color	1
Muffle furnace	TDS	1
Grass desiccator	TDS, SS	1
Water bath	TDS	1
Aspirator	SS	1
Vacuum bell	SS	2
Filter funnel	SS	3
UV-vis spectro meter	Metal, NO_3	1

8.5.2 Performance indicators

7 PIs are decided to assess a performance of laboratory. No.1 to 3 shows progress of water quality

monitoring in each month, and No.4 to 7 shows progress of improvement of water quality improvement.

Progress of planned water quality monitoring of waterworks facility is almost implemented in Oct. 2015 and Nov.2015. Sampling record of tube well and tap water is not separated (as of Dec.2015). Therefore, PI No.2 andNo.3 dhows total number of Tap water and Tube well monitoring. Progress of Tap water and Tube well monitoring is lower than Waterworks facility monitoring. Major reason of this delay is a lack of manpower (both sampling staff and laboratory staff).

PI No.4 (Turbidity) is 69% (Oct.2015) and 83% (Nov. 2015). This result shows many of sampled water satisfy MNDWQ (Turbidity). However, this result should be considered as a reference; because sampling area of Tap water is very limited at present.

PI No.5 and No.6 are 0%. This result means all sampled water polluted by Total coliforms and Fecal coliform. This is due to the lack of disinfection system (Chlorination) in water distribution system.

Table 8.16 List of proposed PI

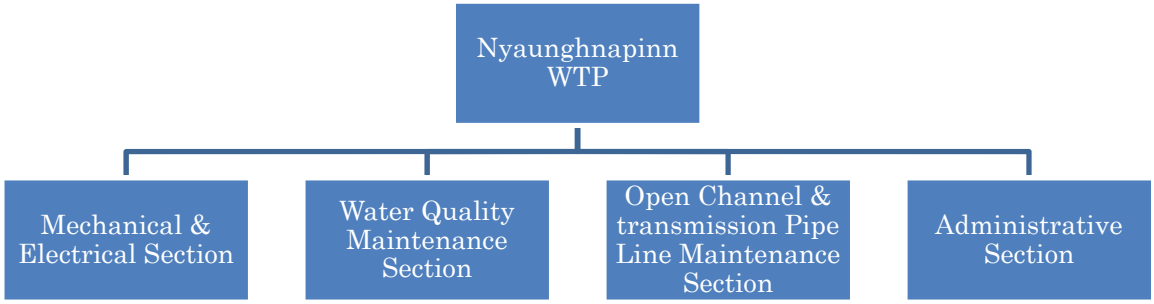
No.	Indicator	Definition	Unit	Oct. 2015	Nov. 2015
Category: Progress of planned water quality monitoring					
1	Achievement ratio of monthly water sampling (1) Waterworks facility	Executed number of sampling of waterworks facility (monthly) / Monthly planned number of sampling of waterworks facility x 100(%)	%	89	100
2	Achievement ratio of monthly water sampling (2) Tap water in TS	Executed number of sampling of tap water of TS / Monthly planned number of sampling of tap water in TS x 100(%)	%	39 Total of Tap and Tube well	8 Total of Tap and Tube well
3	Achievement ratio of monthly water sampling (3) Tube well	Executed number of sampling of tap water of TS / Monthly planned number of sampling of tap water of TS x 100(%)	%		
Category: Progress of water quality improvement					
4	Achievement ratio of water quality standard (1)Turbidity	Monthly number of turbidity test which satisfy Myanmar water quality standard / Monthly number of turbidity test x 100(%)	%	69	83
5	Achievement ratio of water quality standard (2) Fecal-coli	Monthly number of E-coli test with negative result (Not detected) / Monthly number of E-coli test x 100(%)	%	0	0
6	Achievement ratio of water quality standard (3) Total coliform	Monthly number of total coliform test with negative result (Not detected) / Monthly number of total coliform test x 100(%)	%	0	0
7	***After chlorination is started** Achievement ratio of water quality standard (4) Residual chlorine	Monthly number of total coliform test with positive result (Detected) / Monthly number of residual chlorine test x 100(%)	%	--	--

CHAPTER 9 Water Quality Treatment

9.1 BASELINE SURVEY

9.1.1 Existing organization structure of water treatment plants

Existing organization structure of Nyaunghnapin WTP is shown in Fig.9.1. There are 4 sections in the WTP. Total number of the staff is 112, including only 2 Assistant Engineers (AE) and 4 Sub Assistant Engineers (SAE). It is considered that number of sub-manager class is short compared to the number of all staff in the WTP.



Source: YCDC

Figure 9.1 Organization Structure of Nyaunghnapin Water Treatment Plant

9.1.2 Existing operation procedures

List of existing Standards Operation Procedure (SOP) at Dec. 2015, is shown in Table 9.1. There is only one SOP in Nyaunghnapinn WTP. (See. Appendix 9.1)

Table 9.1 List of Existing Standards Operation Procedures

No.	Title	Date
1	Measurement of Turbidity and Color	N/A

Source: YCDC

SOP is understood to be very helpful for the quality and normal operation and maintenance of WTP. We will develop the SOPs written in the below table as early as possible. On the other hand, it is essential for developing SOPs after establishing proper operation procedures and maintenance procedures. SOPs which are necessary to operate and maintained the WTP are shown in Table 9.2. The target date of SOPs development is also described in the Table 9.2.

Table 9.2 List of Necessary Standards Operation Procedures

No.	Title	Target Date
	Operation	
1	Raw water pump	Within 1 years
2	Chemical dosing	Within 1 years
3	Flocculation basin	Within 1 years
4	Sedimentation basin	Within 1 years
5	Rapid sand filter	Within 1 years
6	Distribution pump	Within 1 years
	Maintenance	
7	Pumps	Within 2 years
8	Valves	Within 2 years
9	Supply of chemicals	Within 2 years
10	Rapid sand filter	Within 2 years

No.	Title	Target Date
11	Electric equipment	Within 2 years
	Monitoring	
12	pH	Within 6 months
13	Electric Conductivity	Within 6 months
14	Total Dissolved Solid	Within 6 months

Source: JICA expert

9.1.3 Existing water quality in WTP

(1) Monitoring item and sampling point

Water quality monitoring of Nyaunghnapin WTP has been begun from middle part of August 2015. At first, two water quality parameters have monitored, because we don't have much experiences of the water quality monitoring. After learning the technic of the monitoring methods from the laboratory of WSD of YCDC, we have started the other four parameters of measurement from the first part of September 2015.

We have tried to measure the water quality at the beginning of 2015, but we couldn't continue the measurement. There was no English written instruction; therefore, we didn't know how to use the water quality meter corrector.

The present water quality monitoring plan, such as parameters, sampling point and so on, are shown in the below.

1) Measurement methods and monitoring instruments

No.	Monitoring Item	Monitoring Instruments
1	Turbidity and Color	Kyoritsu Chemical-Check Lab., Corp., Model WA-PT-4DG
2	pH	Mettler Toledo AG., "FEP 20"
3	EC	Mettler Toledo AG., "FEP 30"
4	TDS	Mettler Toledo AG., "FEP 30"

Note (Expert): Turbidity and color meter (item No.1) is produced in Japan. The unit of turbidity of Japan and Myanmar is different because of the difference of measuring method. Generally, measurement result of Japanese turbidity (degree) is confirmed to show lower value compared to the Myanmar turbidity (NTU). For instance, 5 NTU is the standard value in the Myanmar National Drinking Water Quality (MNDWQ) Standards and it is known that the value is equal to 2.5 to 3.5 degree of the Japanese standards.

2) Monitoring Parameters

Turbidity, Color, pH, Electric conductivity, Total dissolved solid, Salinity

3) Sampling Points

3 points in WTP treatment process: raw water, after sedimentation basin (Phase 1, Phase 2) and clear water tank (Phase 1, Phase 2)

4) Frequency

Every day including Saturday and Sunday

5) Sampling time in a day

Ten to Eleven AM of every day

(2) Result of water quality analysis in WTP

1) Seasonal change of raw water quality

Raw water quality of Nyaunghnapin WTP is shown in Table 9.3. The table shows average, minimum

and maximum turbidity of each month. Average turbidity of during four and half months is 6 degree to 11 degree. Maximum turbidities are 26.0, 11.0, 12.0 and 13.0 on Sep., Oct., Nov. and Dec., respectively. The turbidity of raw water in these has not been so high. It is assumed that these are the dry season in Myanmar and the rainfall in these months is not large, therefore, the raw water turbidity is law. It is well known that the turbidity in the rainy season become much higher than the dry season, from all staff's experiences.

Table 9.3 Monthly Raw Water Turbidity of Nyaunghnapin Phase 1 (Sep. to Dec., 2015)

Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	15.22	9.47	6.21	8.06
Min. (degree)	10.0	3.0	1.2	3.0
Max. (degree)	20.0	26.0	11.0	12.0

Source: YCDC

Table9.4 shows the color of raw water in Nyaunghnapin WTP. The maximum color of the raw water is 30 degree to 65 degree. The average of them is around 20 degree, so it can be understood that the color in raw water is stable at rather high value.

Table 9.4 Monthly Raw Water Color of Nyaunghnapin Phase 1 (Sep. to Dec., 2015)

Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	20.56	21.00	21.94	23.95
Min. (degree)	5.0	12.0	9.5	7.0
Max. (degree)	35.0	65.0	45.0	30.0

Source: YCDC

2) Change of water quality in water treatment process

Nyaunghnapin WTP has water treatment processes of coagulation-flocculation- sedimentation and rapid dual media filtration. Treatment results of turbidity and color in each month are shown in the Figure 9.2 and Figure 9.3, respectively. Turbidity and color have reduced by the treatments but it seems that efficiency of each treatment hasn't always been enough. The figures show that the both treatment efficiency has often become very low.

3) Clear water quality and frequency of standards value violation

Turbidity and color of clear water are shown in the Table9.5 to Table9.8. Tables also show the frequency of standards value violation.

Table 9.5 Monthly Clear Water Turbidity of Nyaunghnapin Phase 1 and Frequency of Standards Value Violation (Sep. to Dec., 2015)

Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	3.37	1.66	1.90	2.13
Max. (degree)	7.0	4.5	8.0	4.0
No. of "more than 5 degree" samples.	3	0	1	0

Source: YCDC

Table 9.6 Monthly Clear Water Color of Nyaunghnapin Phase 1 and Frequency of Standards Value Violation (Sep. to Dec., 2015)

Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	11.20	8.09	9.00	6.55
Max. (degree)	21.0	19.5	20.5	16.0
No. of "more than 15 degree" samples.	5	1	2	1

Source: YCDC

Table 9.7 Monthly Clear Water Turbidity of Nyaunghnapin Phase 2 and Frequency of Standards Value Violation (Sep. to Dec., 2015)

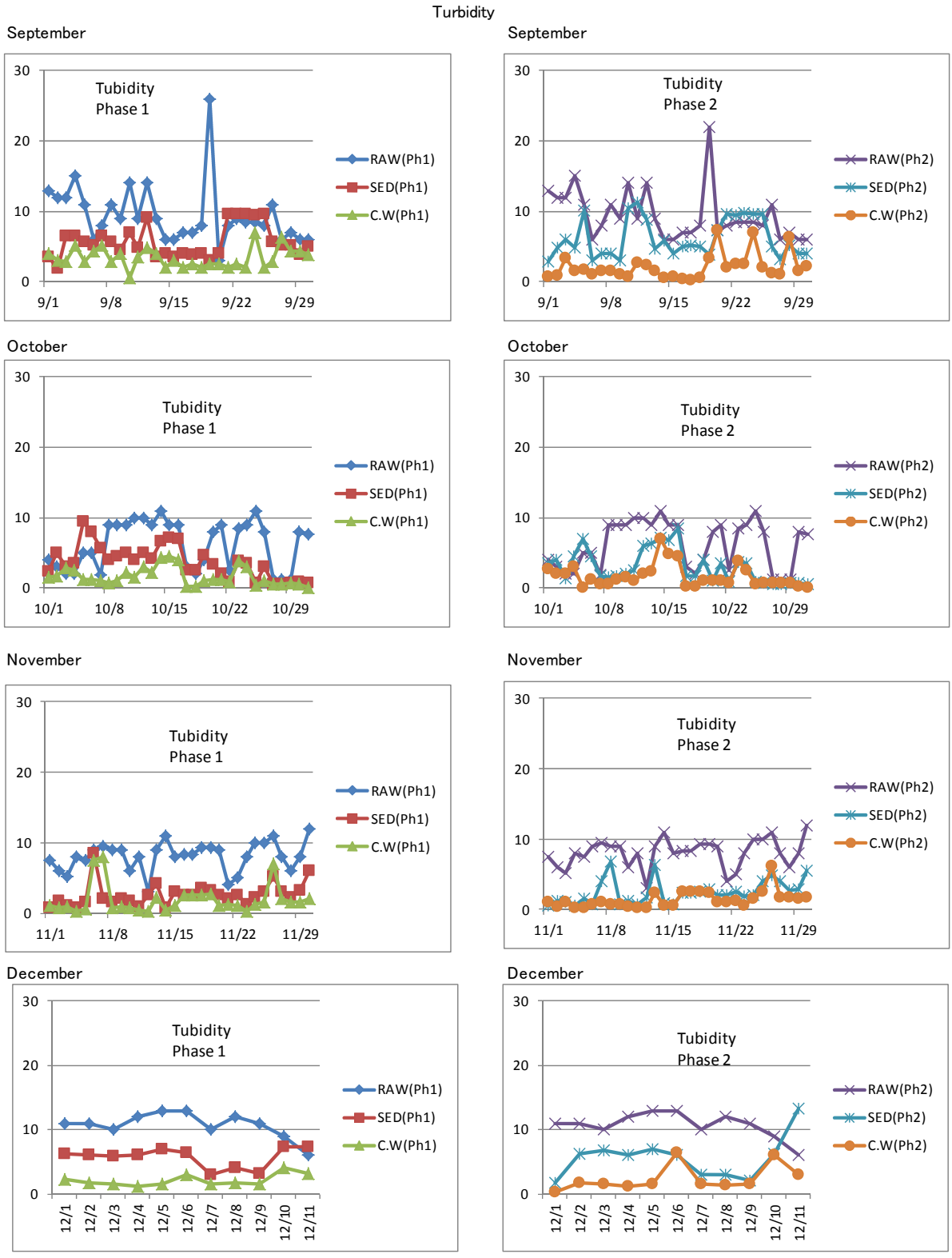
Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	2.11	1.67	1.39	2.37
Max. (degree)	7.3	7.0	6.2	6.5
No. of "more than 5 degree" samples.	3	0	1	1

Source: YCDC

Table 9.8 Monthly Clear Water Color of Nyaunghnapin Phase 2 and Frequency of Standards Value Violation (Sep. to Dec., 2015)

Items	Sep.	Oct.	Nov.	Dec.(1st to11th)
Ave. (degree)	7.08	8.39	7.97	5.91
Max. (degree)	20.0	20.5	19.5	14.0
No. of "more than 15 degree" samples.	2	3	2	0

Source: YCDC



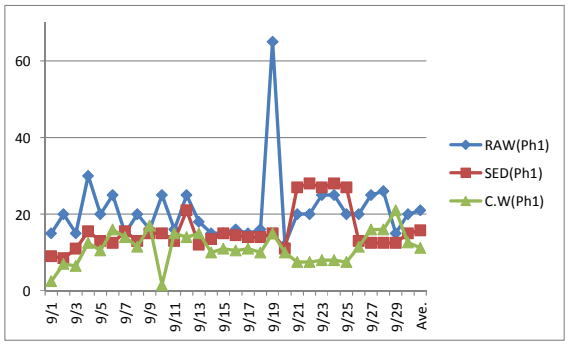
*Unit of all vertical axes are degree.

Source: YCDC

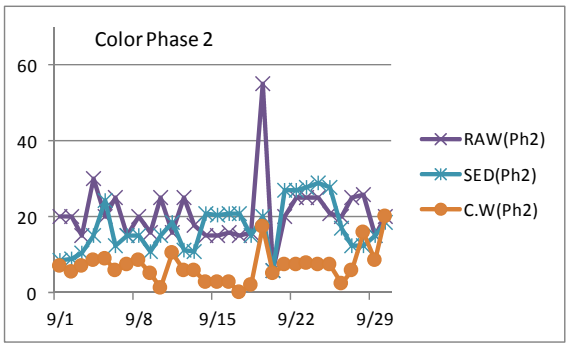
Figure 9.2 Change of Turbidity in Water Treatment Process of Nyaunghnapin Phase 1, 2 (Sep. to Dec 2015)

Color

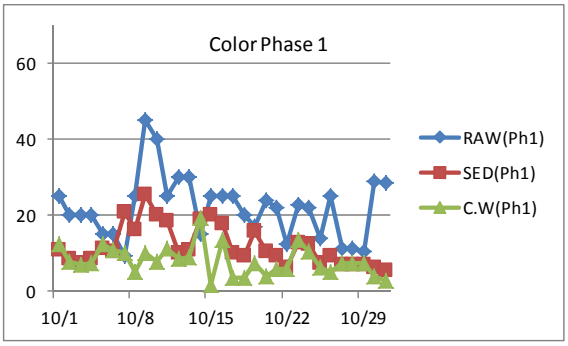
September



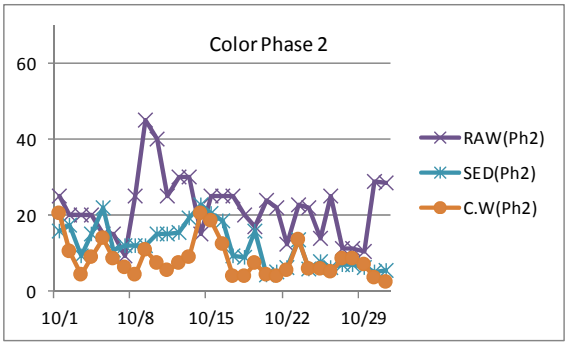
September



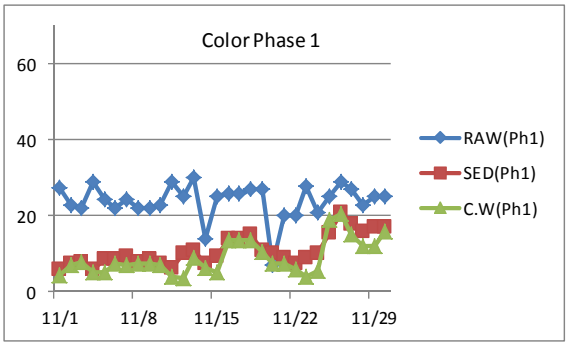
October



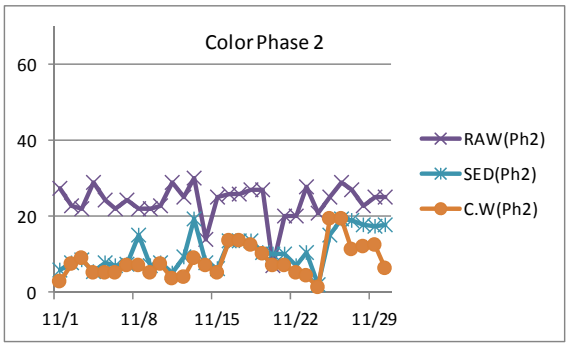
October



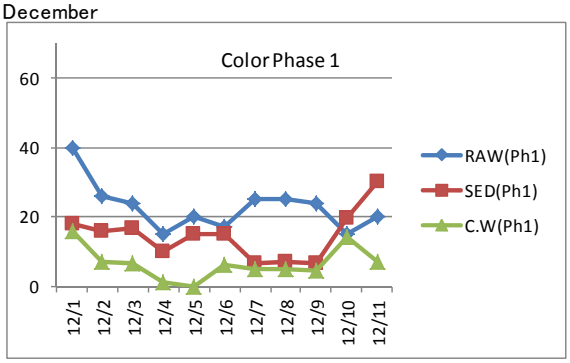
November



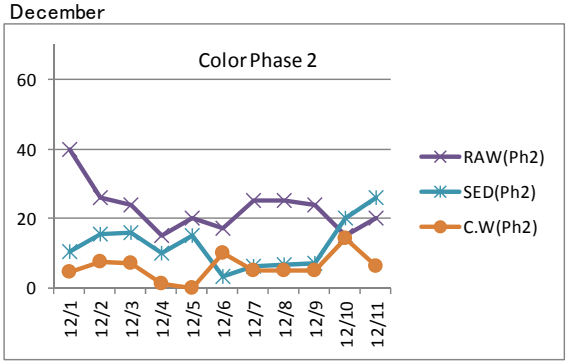
November



December



December



*Unit of all vertical axes are degree.

Source: YCDC

Figure 9.3 Change of Color in Water Treatment Process of Nyaunghnapin Phase 1, 2 (Sep. to Dec 2015)

Samples which exceeded turbidity standards value are 5 at Phase 1 and Phase 2 both, during September to December. Samples which exceeded color standards value are 9 at Phase 1, 7 at Phase 2, during September to December. These results show that Nyaunghnapin clear water have often violated the Myanmar Drinking Water Standards. The reason of the standards value violation is not a single one. There might be some causes and they might be occurred one another or sometimes occurred at the same time.

9.1.4 Issues of water quality treatment

There is no water flow meter in the WTP except phase 1 and phase 2 pumping stations. Raw water lifting pump is assumed that one pump have lifted 15 MGD each, so 3 pumps operation have lifted maximum capacity of 45 MGD. Both backwash and surface water wash lines of rapid dual media filter don't have any water flow meter. Backwash rate and surface wash rate have been controlled by manually. WTP labors control the wash rates by watching a wash water level and when the level exceeds a top of trough, they decrease the wash rates and increase it when the level below the top of trough. Coagulant dose lines have floating meters and can be monitored at each site. Amount of coagulant dose don't monitored regularly, or don't used for dosage control.

There is no water quality monitoring meter except phase 2 pumping station, however the meter haven't been used at present.

There is no systematic training system in the WTP alone. All staff and workers have been trained by their senior staff by orally at sites, so called On-the-Job Training.

9.2 RESULTS OF PCM WORKSHOP

9.2.1 Problem analysis

To supply safe and clean water for city dwellers is one of our missions and we have studied the method to improve our Nyaunghnapin WTP. Our study result which indicates problems of the WTP is shown in the below.

- To check water quality every day.
- To check chemical dosing.
- To repair high water jump flocculator to sedimentation basin.
- To store ACH (Aluminum Hydro Chloride) in a place where there is no direct sun light.
- To establish the method to remove sludge from a bottom of sedimentation basin.
- To establish the method for filter backwash.
- To perform the filter back wash systematically.
- To check size and specification of anthracite, filter sand and gravel.
- To install flow meters at raw water outlet and backwash pipe.
- Require a roof for the phase 1 clear water tank.
- To clean clear water tank frequently.

9.2.2 Objective analysis

The plan to solve the problem is shown in below.

- To check water quality every day.
  We need to build mini laboratory in the WTP. It also needs analysis instruments, water quality testing plan, technology for water quality monitoring. In the future plan, it is necessary to dose chlorine. (The placement of the mini laboratory has been finished and we have checked water quality every day.)

- To check chemical dosing.
  To get the exact chemical dosing rate, installation of flow meter at water tower outlet and ACH

pump outlet.

- To repair high water jump flocculator to sedimentation basin.
  The repair of flocculator is necessary. For the repair, we need flocculator design parameter.

- To store ACH (Aluminum Hydro Chloride) in a place where there is no direct sun light.
  We need to construct roof or cover of ACH. (This is under the construction now.)

- To establish the method to remove sludge from a bottom of sedimentation basin.
  For the establishment of the method, we need sedimentation design basin design and sludge removal design parameter.

- To establish the method for filter backwash.
- To perform the filter back wash systematically.
- To check size and specification of anthracite, filter sand and gravel.
  We need to develop ability for testing the filter media. We need the thieving test equipment so that we will be able to check the size of anthracite and filter sand. We will also be able to improve the backwash system.

- To install flow meters at raw water outlet and backwash pipe.
  We need to install flow meters in the treatment process.

- Require a roof for the phase 1 clear water tank.
- The construction of the roof has finished until now.

- To clean clear water tank frequently.

9.3 CAPACITY ASSESSMENT (INDIVIDUAL AND ORGANIZATION)

9.3.1 Results of assessment

(1) Assessment item
Technical capacity of Organization and Individual were assessed. Assessment items are shown below.

Table 9.9 Technical Assessment Item: Organization

Category		Item
Organization and staffing	Organization and staffing	Organization of management section of WTP (number of staff, chain of order, duty and power).
		Organization of maintenance and repair section of WTP (number of staff, chain of order, duty and power).
		Specialized section for operation and maintenance of electrical equipment.
		Specialized section for operation and maintenance of mechanical equipment.
		Rule of staff recruitment of WTP.
Information management	Document control and data management	Document control and data management system in WTP is established.
	Drawing of facility and equipment	Preparation and store keeping of design drawing and layout drawing of facilities and equipment.
		Preparation and store keeping of tabulated list of specification of facilities and equipment.

Category		Item
	Technical information	Technical information management (obtain, arrangement and storekeeping of technical information) of mechanical and electrical service
		Technical information management (obtain, arrangement and storekeeping of technical information) of water treatment and water quality management (e.g. water treatment technology, water quality equipment, etc.)
Management of O&M	Management system of O&M work	Annual plan of O&M (e.g. chemical procurement, water quality monitoring, periodical inspection, etc.)
		Management system of O&M works (Store keeping of O&M record, confirmation of planned O&M activity, establishment of O&M plan, etc.)
		Organization plan and manual of repair
	Rules of O&M work	Internal rule (rule of YCDC) of O&M.
		Rules of procurement and purchase of spare parts, chemical, etc.
	O&M record	Preparation of O&M report
		Development and recordkeeping of O&M report
		Preparation of repair report
		Development and recordkeeping of repair report
	Ledger of facility and equipment	Registration of facility and equipment.
		Track record of facility and equipment from installation.
	Outsourcing	Outsourcing of O&M work (what kind of outsourcing work)
		Rules of outsourcing of O&M work.
O&M manual and SOPs	O&M manual and SOPs	O&M manual and SOPs of facility and equipment. (1) Raw water pump
		(2) Coagulation tank
		(3) Coagulant injection facility and coagulant injector
		(4) Sedimentation tank
		(5) Sand filtration tank and backwashing facility
		(6) Chemical storage facility
		Procedure of making, review and storekeeping of operation manual and SOPs
		Procedure of preparation and storekeeping of operating record.
Budget and procurement	Responsible person	Responsible person of budget (cost estimation) for O&M
	Procurement and purchase	Internal rule for procurement and purchasing spare parts, chemicals, etc.
		Understanding of domestic and overseas supply situation of equipment, spare parts, chemicals, etc.
Technical capacity	Technical capacity (Organization)	Operator's understanding of water treatment technology for WTP operation (e.g. coagulation-sedimentation, sand filtration, chlorination)
		Opportunity to receive training about water treatment technology (in house training of YCDC).
		Opportunity to obtain the latest water treatment technology (receives training, attend seminar, etc.).
		Contents of instruction to site operator (intelligibility of operator, specific suggestion is necessary or not)
		Understanding of concept of preventive maintenance.

Category		Item
	Understanding of ability of WTP (Organization)	Capacity operating ratio of WTP (actual water production / designed water production)
		Understanding of WTP's ability of water treatment (degree of turbidity reduction, etc.).
		Understanding of trend of raw water quality.
		Understanding of planned value ant trend of treated water quality.
Operation of WTP	Operation of WTP	Priority level of facility and equipment (Facility and equipment which should be kept the function to maintain the function of WTP)
		Operating plan including quantity of water intake, production volume, water transmission volume (daily, hourly),etc.
		Recorded operation parameter (daily, weekly and monthly). e.g. water production, number of operating sedimentation pond, number of operating filtration pond, etc.
		Preparation and store keeping of operation record
		Preparation and reporting (to YCDC HQ) of periodical operation report.
		Periodical inspection plan of WTP
		Item of periodical inspection
		Record and store keeping of periodical inspection report.
		Contingency plan including electric outage, malfunction of equipment, anomaly of water treatment, etc.
	Chemical injection (coagulant, chlorine and pH adjuster)	Control of chemical injection
		Determination of chemical injection volume
		Monitoring of injection ratio
		Installation of backup equipment
		Establishment of operation manual of chemical injection
	Supply of chemicals (coagulant, chlorine and pH adjuster)	Purchase schedule of water purification chemicals.
		Problems about acquisition of water purification chemical (date required, buying procedure, etc.)
		Reserved amount of water purification chemicals.
		Storage condition of each water purification chemicals (temperature control, ventilation, with or without of shading device)
		Quality control system of storage water purification chemicals
	Control and monitoring of chemical injection	System of injection control and monitoring of each water purification chemicals.
		Record of chemical injection control (kind of chemical, injection rate (ppm), injection period)
		Usage of chemical injection record.
	Flow rate and water level monitoring	Location of flowmeter
		Control method of treated water volume
		Location of water-level gage
	Coagulation tank and sedimentation tank	Operation control of flush mixing (adjust flow rate, adjust G value, etc.)
		Operating condition of flush mixing facility (flow rate, G value)

Category		Item
		Operation control of slow mixing (adjust flow rate, adjust G value, etc.)
		Operating condition of slow mixing facility (flow rate, G value)
		Condition of flocculation (size, sedimentation property)
		Frequency of sludge withdraw of sedimentation tank
		Turbidity after sedimentation process (Target value: 5NTU)
	Filtration tank	Operating control of filtration tank (adjust flow rate, etc.,)
		Operating condition of filtration tank (flow rate, filter run time, maintenance schedule)
		Operating control of back washing (adjust backwashing rate, backwashing period, etc.)
		Condition of backwashing (procedure of backwashing, backwashing rate, condition of start and stop of backwashing)
		Periodical inspection of backwashing rate and condition of filtration media.
		Periodical supply (refill) of filtration media
		Making and storekeeping of operation record of filtration tank.
	Clear water tank	Periodical cleaning of clear water tank
	Water transmission pump	Operating plan of water transmission pump
		Making and storekeeping of operation record.
		Usage of operation record of water transmission pump
	Water quality monitoring	Location and of water quality monitoring in water purification process
		Water quality monitoring item
		Making and store keeping of water quality monitoring data.
		Usage of water quality data
Stock of spare parts and repairing material	Stock of spare parts and repairing material	Stock of spare parts and repairing material

Table 9.10 Technical Assessment Item: Organization

Category	Item	Category
Administrative capacity	Knowledge about rule and manual	Understanding of internal rule (rule of YCDC) of O&M.
		Understanding of contents of O&M manual of each facility and equipment in WTP.
		Understanding of appropriate procedure of repair of facilities and equipment in WTP
		Understanding of contingency plan of WTP.
	Document control	Prepare documents of O&M report and repair report, etc. properly.
		Understanding of document control system in WTP.
	Knowledge of water treatment technology.	Opportunity to receive a training course of water treatment technology.
		Understanding of water treatment technology (1) Coagulation - sedimentation process
		(2) Sand filtration process

Category	Item	Category
		(3) Chlorination process
		Understanding of operation manual.
	Procurement and purchase	Understanding of procurement and purchase procedure (specific procedure in YCDC)
Operation of WTP	Knowledge about ability of WTP	Understanding of function of each facility and equipment. (1)Water intake facility
		(2)Receiving tank
		(3) Coagulation tank
		(4) Sand filtration tank
		(5) Clear water tank
		(6) Service reservoir
		Understanding of the ability of WTP (Ability of Nyaunghnapin WTP: water production, acceptable water quality).
		Understanding of fluctuation of raw water quality e.g. difference of water quality in rainy season and dry season, seasonal change or water quality accident.
		Understanding of proper WTP operation for the change of raw water quality
	Handling of water purification chemical	Understanding of operation manual of water purification chemical handling facility (chemical storage facility and chemical injection facility)
		Understanding procedure of quality management of stock water purification chemical.
	Coagulation process	Implement jar test properly, and decide coagulant injection ratio.
		Understanding of appropriate control technique to produce adequate (thick and large) flock.
	Sand filtration	Understanding of appropriate operation procedure of sand filtration pond (control of appropriate flow, etc.)
		Understanding of appropriate O&M procedure of sand filtration pond.
		Understanding of appropriate backwash operation, e.g. timing of start / stop backwash, adequate control of back wash flow.
		Understanding of appropriate particle size distribution of sand filter
	Water quality monitoring	Understanding of the necessity of water quality monitoring.
		Understanding of water quality analysis item and sampling point in WTP.
		Procedure of feedback of analyzed water quality data to WTP operation.
	Chlorination	Understanding of appropriate operation of chlorine injector (decide appropriate chlorine injection ratio) base on water quality data, e.g. raw water quality, residual chlorine concentration.
	Unusual situation (accident, etc.)	Understanding of appropriate WTP operation and water quality monitoring in the case of unusual water quality, e.g. water quality accident, high turbidity, etc.

(2) Result of assessment

In this survey, following information was obtained from questionnaire and interview.

<u>Organization</u>

- Number of well-educated staff is not enough.

- Because of the location of WTP (very far from central Yangon, and lack of transportation facility), staff recruitment is very difficult.
- Specification (design document) of WTP is not kept in WTP. Therefore, no one understands the specification of WTP.
- Operation manual and SOPs are not prepared. Therefore, O&M of facility and equipment are inadequate and insufficient.
- Operating record and repair record is not kept. Therefore, history of equipment is not clear.
- Opportunity to obtain water treatment technology is severely-limited.
- Technical training of worker (site operator) is important.

Individual
- Technical knowledge is insufficient. YCDC don't have a training course of water treatment.
- However, all engineers in WTP have a willingness to learn technology.

Recommendations
- The priority issue is an enhancement of technical capacity of WTP staffs on water treatment technology. Implementation of technical seminar and OJT are proposed.
- Operation manuals and SOPs are not prepared. Operation procedure is transferred by orally. To maintain an adequate technical skill and appropriate operation procedure, establishment of SOPs and manual is necessary.

9.3.2 Achievement state/ Expected outcomes in capacity development (Phase 1 & 2)

Achievement state and expected outcomes in capacity development are shown below. Achievement state includes 6 items. That is: (1) Problems of WTP are identified and most of them are improved by WTP staff, (2) Maintenance plan of WTP is established and maintenance activity is practiced, (3) WTP is operated by appropriate SOPs, (4) Capacity of WTP staffs are enhanced, (5) Water quality of distributed water from reservoir is improved and (6) Capacity of chlorination is enhanced.

The priority item is "(1) Problems of WTP are identified and most of them are improved by WTP staff" by the enhancement of technical capacity. Prerequisite for this fruit, "(2) Maintenance plan of WTP is established and maintenance activity is practiced" and "" (3) WTP is operated by appropriate SOPs" are necessary.

In addition, monitoring and improvement of water quality of Hlawga, Phugyi and Gyobyu reservoir are proposed. Water of these reservoirs are transmitted and distributed in Yangon City without treatment. Therefore, improvement of water quality of these reservoirs is important to improve water quality of distributed water in Yangon City.

At present, chlorination is not implemented in Yangon City waterworks. However, installation of new chlorination facility in Yegu PS is planned. In this project, capacity development of chlorination is planned by the OJT in Yegu chlorination facility.

Table 9.11 Achievement state / Expected outcomes in capacity development

Achievement state in capacity development	Expected outcomes in Phase 1 and 2 n this project
1. Problems of WTP are identified and most of them are improved by WTP staff.	1.1. Additional measurement and test equipment, e.g. flow meter, sieve test equipment, water quality test equipment are established. 1.2. Improvement of O&M of sand filtration facility and back washing by the installation of model sand filter approach. 1.3. Most problems on WTP operation e.g. flow control and coagulant injection, etc. are cleared.
2. Maintenance plan of WTP is established and maintenance activity is practiced.	2.1. Facilities and equipment are well maintained according to the annual maintenance plan.

Achievement state in capacity development	Expected outcomes in Phase 1 and 2 n this project
3. WTP is operated by appropriate SOPs	3.1. SOPs of WTP O&M in each operation process and equipment, i.e. coagulant injection, sedimentation, sand filtration, pump, etc. are established. 3.2. Treatment process water quality is monitored regularly based on SOPs.
4. Capacity of WTP staffs are enhanced	4.1. Management capacity and technical capacity is enhanced by adequate staffing and training. 4.2. Leadership capacity of YCDC HQ is enhanced by the installation of Water Treatment Section. 4.3. Enhancement of WTP worker by OJT.
5. Water quality of distributed water from reservoir is improved.	5.1. Water quality monitoring of Hlawga, Phugy and Gyobyu reservoir is implemented (SS monitoring is added). 5.2. Simple water treatment of reservoir water (e.g. micro strainer filtration) is implemented.
6. Capacity of chlorination is enhanced	6.1. SOP of Yegu chlorination facility is established. 6.2. OJT is implemented in Yegu chlorination facility. 6.3. Based on this capacity training, chlorination facility is operated safely (after 2019).

9.3.3 Training Plan

There is no systematic “Off-the-Job Training” system for water treatment or water engineering, at the present. As one of the training plan, JICA expert team has proposed having the “Seminar on Water Treatment Technic”. Purpose of the seminar is

1. To study about basic standards of WTP design, operation and maintenance.
2. To find the basic design parameters of Nyaunghnapin WTP
3. To establish more appropriate methods and procedures for the operation and maintenance of Nyaunghnapin WTP.

And the target treatments process in the seminar is

1. Chemical (Coagulant) dose procedure.
2. Flocculation process.
3. Rapid dual media filter.
4. Specification of the filter media.

9.4 SUMMARY OF MAJOR ISSUES

Clear water of Nyaunghnapin WTP sometimes violated the standards values, as mentioned in the section 9.1.3. It is assumed that the reasons of the violation include below technical issues.

- Control system of coagulant dosage should be established.
- Condition of the flocculation basin is not adequate.
- Structure of the last part of the flocculation basin needs to improve.
- Sludge on the bottom of sedimentation basin needs to remove periodically.
- The efficiency of coagulation-sedimentation treatment has been sometime low.
- There is less depth of the filter media compared to the plan.
- Filter wash system is improper.
- Operation and management issues are also very concerned on the WTP performance which sometime shows a violation of standard values.
- Standard operation procedures are not established.
- Preventive maintenance system is not improper.
- Recording of monitoring and maintenance and their storage needs to improve.

- Proper technical training system is necessary.

9.5 PROGRESS OF THE PROJECT

9.5.1 Problems in water treatment

- Technical issues.
  - ✓ Control system of coagulant dosage should be established.
  - ✓ Condition of the flocculation basin is not adequate.
  - ✓ Structure of the last part of the flocculation basin needs to improve.
  - ✓ Sludge on the bottom of sedimentation basin needs to remove periodically.
  - ✓ The efficiency of coagulation-sedimentation treatment has been sometime low.
  - ✓ There is less depth of the filter media compared to the plan.
  - ✓ Filter wash system is improper.

- Operation and management issues.
  - ✓ Standard operation procedures are not established.
  - ✓ Preventive maintenance system is not improper.
  - ✓ Recording of monitoring and maintenance and their storage needs to improve.
  - ✓ Proper technical training system is necessary.

The following observations are carried out by JICA Expert.
Appendix 9.2 Observation of the filter washing procedure in NaughnapineWTP
Appendix 9.3 Observation of anthracite used for dual media filter of Nyaunghnapin WTP

9.5.2 Preliminary water quality improvement plan

At present, almost all major basic design parameters haven't been available because those haven't been kept in the WTP nor the YCDC Headquarter. Those parameters are essential not only for setting the WTP operational conditions, such as filtration rate and so on, but also maintenance plan. We will set to get the basic design parameters as the first action in an action plan. Specially, the coagulation-sedimentation treatment and filtration treatment are the two main treatments in the WTP, so the both treatment will be set as main research field at the begging. On the same time, we have continued the water quality monitoring in the treatment process. We also establish the record keeping and storing system in the early period.

"Seminar on Water Treatment Technic" is going to be held with JICA expert team. The seminar is intended to study about basic standards of WTP design, operation and maintenance, to find the basic design parameters of Nyaunghnapin WTP and to establish more appropriate methods and procedures for the operation and maintenance of Nyaunghnapin WTP. The target treatments process in the seminar is chemical (Coagulant) dose procedure, flocculation process, rapid dual media filter and specification of the filter media.

9.5.3 Performance indicators

Performance Indicators of WTP have been set for showing the improvement progress of WTP performance. Table 9.12 shows 3 categories, which are "Water Production", "Maintenance" and "Water Quality" and 9 PIs. At present, figures of 2 indicators out of 9 are available and both are quality indicators.

Table 9.12 Monthly Clear Water Color of Nyaunghnapin Phase 2 and Frequency of Standards Value Violation (Sep. to Dec 2015)

Indicator	Unit	Definition
Water Production		
Operation ratio of WTP water production	%	Daily average water production in a month per daily water production capacity of WTP
Achievement ratio of water production	%	Planned water production in a month per water production of WTP in a month
Maintenance		
Recovery ratio of key equipment and facility from major malfunction within relevant registered time	%	No. of recovered major equipment and facility within the registered time per No. of malfunctioned major equipment and facility in a year
Achievement ratio of routine (daily, weekly, ,monthly) check	%	No.of executed routine check per planed No. of routine check
Water Quality		
Achievement ratio of water quality standard in Nyaunghnapin WTP (1) Turbidity	%	Monthly number of clear water turbidity test which satisfy Myanmar water quality standard / Monthly number of turbidity test x 100(%)
Achievement ratio of water quality standard in Nyaunghnapin WTP (2) color, pH, TDS	%	Monthly number of clear water color, pH, TDS test which satisfy Myanmar water quality standard / Monthly number of turbidity test x 100(%)
Achievement ratio of WTP target value in Nyaunghnapin WTP (3) Turbidity	%	Monthly number of sediment water turbidity test which satisfy WTP target value / Monthly number of turbidity test x 100(%)

The figures of 2 water quality indicators are shown below. As mentioned in clause 9.1.3, turbidity and color of clear water have sometime exceeded the standards value. Their PIs are 83 % to 100 % and we believe that we will be able to increase the PIs and will achieve 100 % near future.

Table 9.13 PIs of turbidity in Nyaunghnapin Phase 1 (Sep. to Dec 2015)

Items	Sep.	Oct.	Nov.	Dec (1st to11th)
. No. of sampling	30	31	31	11
No. of "more than 5 degree" samples	3	0	2	0
PI (%)	90	100	94	100

Table 9.14 PIs of color, pH, TDS in Nyaunghnapin Phase 1 (Sep. to Dec 2015)

Items	Sep.	Oct.	Nov.	Dec (1st to11th)
. No. of sampling	30	31	31	11
No. of "more than 5 degree" samples	5	1	2	1
PI (%)	83	97	94	91

Table 9.15 PIs of turbidity in Nyaunghnapin Phase 2 (Sep. to Dec 2015)

Items	Sep.	Oct.	Nov.	Dec (1st to11th)
. No. of sampling	30	31	31	11
No. of "more than 5 degree" samples	3	0	1	1
PI (%)	90	100	97	91

Table 9.16 PIs of color, pH, TDS in Nyaunghnapin Phase 2 (Sep. to Dec 2015)

Items	Sep.	Oct.	Nov.	Dec (1st to11th)
. No. of sampling	30	31	31	11
No. of "more than 5 degree" samples	2	3	2	0
PI (%)	93	90	94	100

Appendix 9.1 SOP of Measurement of Turbidity and Color

SOP
Measurement of Turbidity and Color

Title: Sampling & measurement record	Revision No:
Date of Revision	Page 1 of

Measurement of Turbidity and Color

Author Title:Flat Name:May Thaw Tar Oo
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Distribution

In Charge of Water Quality Monitoring
Water Quality Laboratory, Nyaungnhapin WTP

Revision Record

Revision	Date	Responsible Person	Description of Change

Contents

1.Purpose

- To measure the water quality everyday
- To check Turbidity & Color

2.Summary of method

Firstly, make calibration method. And then fill sample water to the indication line. Close the lid of the cell and depress start button. Measured value is shown on display part.

Function	Explanation of function
Automatic power off	Power is automatically turned off 10 minutes after last key operation
Measurement	Button pressing gives you the result of both turbidity & color at the same time
Date in memory	Result is automatically kept in memory. Last data is kept in memory even after power off.
Battery power display	According to the residual power of battery, it shows 4stages of display.
Mode change	By pressing mode button, turbidity & color changes.
Calibration	Zero and span calibration

3.Sampling and Measurement procedure of Turbidity and Color

Basic measuring operation is described here.

1.Depress ON/OFF button for power supply.
2.Rinse the cell with zero water or pure water several times, then fill zero water or pure water to the indication line.
3.Close the lid of the cell, depress calibration button for 2seconds and change it to calibration mode.
4.For zero calibration, during calibration, ZERO mark blinks and END is indicated after calibration.
5.Rinse the cell several times with sample water without removing the cell, then fill sample water to the indication line.
6.Close the lid of the cell and depress start button, measured value is shown.
7.Every time you depress mode button, turbidity and color changes.

4.Check list of measurement instrument

1.Device (with 1 cell)
2.Spare cell (2 pcs)

3.Cleaning wiper (1 sheep)
4.Case
5.Zero water (1 bottle)
6.Alkaline battery type AAA for function check
7.Cell cleaning liquid (1 bottle)
8.Instruction Manual (1 set)

Title: Sampling & measurement record	Revision No.
Date of Revision	Page

Record sheet of sampling & measurement

Place
Date

Sampling

Sample No.	1	2	3
Sampling point	Raw	Sedimentation	Clear water
Sampling Time	10:00	10:00	10:00
Sampling person			

Measurement

Turbidity

Sample No.			
Reading of the meter (Degrees)			
Ratio of dilution			
Result (Degrees)			

Color

Sample No.			
Reading of the meter (Degrees)			
Ratio of dilution			
Result (Degrees)			

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE REPUBLIC OF THE UNION OF MYANMAR
YANGON CITY DEVELOPMENT COMMITTEE (YCDC)

REPORT ON CAPACITY ASSESSMENT
- ANNEX -

April 2016

PROJECT FOR IMPROVEMENT OF WATER SUPPLY MANAGEMENT OF YCDC

YCDC TECHNICAL COOPERATION COUNTERPARTS TEAM
AND
JICA EXPERT TEAM

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ABBREVIATION

ACE	Assistant Chief Engineer
AE	Assistant Engineer
CE	Chief Engineer = Head of Department
DYCE	Deputy Chief Engineer
EE	Executive Engineer
HRD	Human Resource Development
MGD	Million Gallons per Day
M&E	Mechanical & Electrical
OJT	On-the-Job training
NRW	Non Revenue Water
O&M	Operation & Maintenance
PCM	Project Cycle Management
PDM	Project Design Matrix
P/S, PS	Pumping Station
SAE	Sub-Assistant Engineer
SOP	Standard Operation Procedures
UCSB	Union of Civil Service Board
T/S, TS	Township
WA	Work Authority (temporary staff of YCDC)
WSD	Water and Sanitation Department
WTP	Water Treatment Plant

Abbreviation for the Relevant Studies

The Preparatory Study for Urban Development Programme in the Greater Yangon (JICA), 2012	JICA Urban Plan Study, 2012
Household Interview Survey (JICA), 2012	2012 JICA-HIS
The Study on Improvement of Water Supply System in Yangon City, 2002	2002 JICA-M/P
Preparatory Survey Report on the Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City in the Republic Of The Union Of Myanmar, March 2014	JICA M/P

UNIT

1 Gallon (British Gallon) = 4.546 liter
1 Acre = 4,047 m^2

CHAPTER 1. Procedures of Capacity Assessment

1.1 What is capacity assessment?

Definitions of concept related to capacity assessment are as follows.

- **"Capacity"** is defined as "the ability of developing countries to set and achieve targets and the ability to discover and resolve the issues of one's own country (development issues); in other words, it refers to capabilities for handling issues**"**
- **"Capacity Development"** is thought of as the process whereby the capabilities for handling issues of developing countries are developed at individual, organizational, and societal levels holistically.
- **"Capacity Assessment"** is "the process of broadly assessing both the current state of the developing countries' capacity at multiple levels and the extent to which development process has brought about positive changes (CD), and then sharing the results from this with concerned parties in order to formulate CD strategies."
- "Multiple levels" of capacity includes the individual, organizational, and societal level.

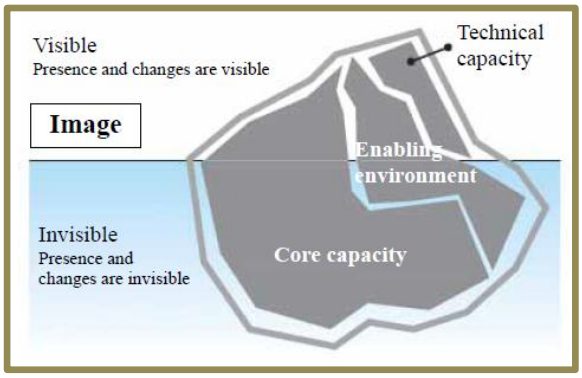
JICA (2008) Capacity Assessment Handbook – Project Management for Realizing Capacity Development –.

Aspect of capacity is defined as the follows.

Aspect of capacity; Capacity is broadly divided into two categories. These are **technical capacity** in the form of techniques and particular knowledge, and **core capacity** which utilizes technical capacity to independently resolve issues. Moreover, there is a need for a wider perspective of looking at the **enabling environment** in which efforts of C/P organizations lead to positive outcomes and solutions of problems.

1) **Technical capacity:** Techniques, particular knowledge, and tacit knowledge accumulated by the organization, etc.
2) **Core capacity:** The management capabilities, will and attitude, leadership, etc; to resolve issues by using technical capacity
3) **Enabling Environment:** The systems, societies, and so on which underpin such capacities.

JICA (2008)



Source; JICA (2008)

Figure 1.1 Image of Characteristics of Capacity

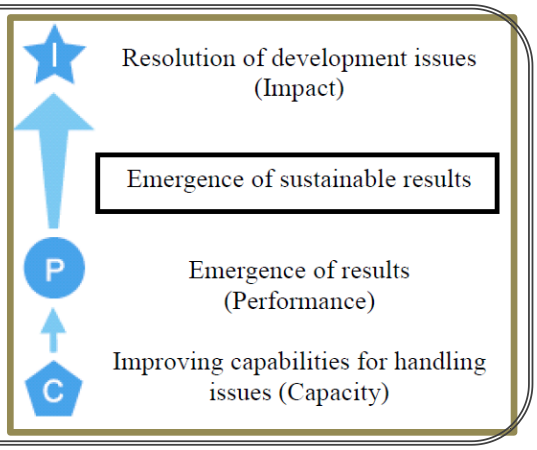
Table 1.1 Characteristics of Capacity

	Technical Capacity	Core Capacity
Characteristics	Specific capabilities required within specific fields	Driving force for producing results. Capabilities for sharing across all technical fields
Visibility	**visible**	**invisible**
Difficulty for improvements	Relatively **easy** Can be changed in **short-term**	Relatively **difficult** Taking **longer time** to be improved

Relation of capacity, performance and impact is explained as shown below.

- **Impact** --- Problem solution which is gradually realized through the accumulation of results (= Performance)
- **Performance** --- Daily results generated by the entity of Capacity Development
- **Capacity** --- Capabilities for handling issues.

JICA (2008)



1.2 Outlines of Assessment Conducted

In this section, purpose and procedures of capacity assessment conducted through the Project for Improvement of Water Supply Management of YCDC (the Project) are described.

(1) What for?

Purpose of the capacity assessment is as follows.

- To **understand the baseline** and **changing process** of capacities of WSD/YCDC
- To **create strategies** for capacity development and **determine the target** to be achieved
- To be used as **a dialogue tool**

(2) What?

Responding to its purpose mentioned above, the assessment focuses on two levels of capacity; 1) individual level and 2) organization level, and two aspects of capacity; a) technical capacity and b) core capacity, because these capacity mainly matches scope of the Project and is expected to be improved through the Project.

(3) How?

Capacity can be assessed through interview, questionnaire, examination, confirming related documents, etc. In this capacity assessment, mainly interview, group discussion and questionnaire were used as follows.

Table 1.2 Method of Assessment of Each Capacity

	Technical Capacity	Core Capacity
Organization Level	Assessment was made through discussions among C/P members and experts according to assessment items prepared by each output team.	Assessment was made according to the unified assessment items. At most targeted sections, section heads made discussion with experts to make assessment.
Individual Level	Assessment was made through individual interview or filling questionnaire by each C/P according to assessment items prepared by each output team.	Assessment was made according to the unified assessment items by self-assessment. All counterparts were requested to assess their own capacity according to the questionnaire, and describe their "advantages" and "points to be improved" on each item. After self-assessment, his/her supervisor confirmed to settle the results.

Mostly, assessment was made in 5-scale. The highest score "Level 5" is considered to be a "model" referred by other utilities or staff.

Table 1.3 Assessment Indicator and Degree of Achievement

	Level 1	Level 2	Level 3	Level 4	Level 5
Degree of achievement	0 ~29%	30~59%	60~89%	90~100%	+α

(4) When and Who?

The assessment was conducted from August till December 2015 as one of baseline survey of the Project. The results of assessment were compiled as "Report on Baseline Survey & Capacity Assessment" in December 2015 and this ANNEX report.

The target of the assessment is as listed in each section, mainly sections and individuals of counterparts of the Project. JICA experts joined the assessment are as listed below.

Table 1.4 List of JICA Experts Joined the Assessment

Name	Fields in charge
Mr. Sato Hirotaka	Chief Advisor / Water Supply Operation
Ms. Yariuchi Mina	Institutional Capacity Development/ Human Resource Management
Mr. Ono Atsuo	Waterworks Planning/ Monitoring
Mr. Matsui Yoji	Financial / Business Management
Mr. Takayama Takao	Assistant for Financial /Business Management
Mr. Akanuma Tadashi	Non-Revenue Water Management (Commercial Loss)
Mr. Kishida Shinsuke	GIS
Mr. Okada Akihiro	Non-Revenue Water Management (Physical Loss)
Mr. Kodear Eizo	Assistant for Non-Revenue Water Management
Mr. Tashiro Masaru	Assistant for Non-Revenue Water Management
Mr. Terashima Katsuhiko	O&M of Water Supply Facilities
Mr. Morita Yasuhiko	Water Quality Management
Ms. Yamada Shoko	Assistant to Water Operation

1.3 Structure of the Report

For assessment results are described from Chapter 2 till 5 as shown in Figure 1.2. The technical capacity was assessed according to technical fields; 1) Planning and Monitoring, 2) Regulations, Standards, Guidelines and Manuals of WSD, 3) Financial Conditions and Utility Management, 4) Human Resources Management, 5) Non-Revenue Water and GIS, 6) Water Quality Monitoring, and 7) Water Treatment.

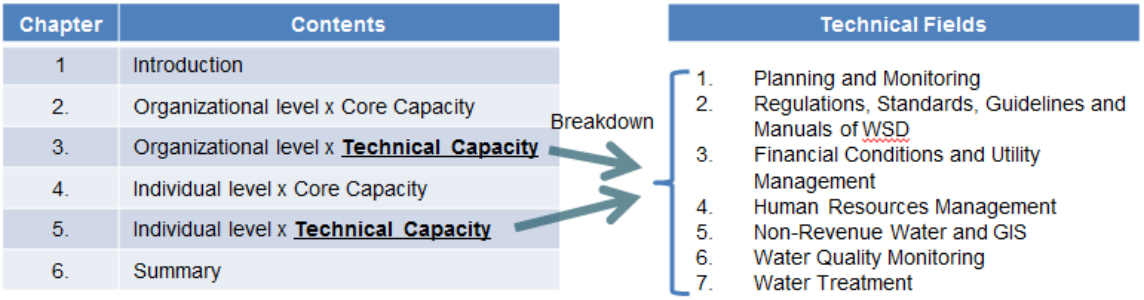


Figure 1.2 Structure of the report

Objective of this Annex report

This report is ANNEX of "Report on Baseline Survey & Capacity Assessment", intended to be distributed only to top management of YCDC and JICA.
In order to monitor progress of capacity development closely, it is important to record actual situation in detail as baseline of the Project including some sensitive information to be open to all project related persons such as assessment results of individual C/P, or assessment results by JICA experts which differs from ones of C/Ps.
Therefore, the Project separates this information from the Main Report and compiles as the ANNEX report.

CHAPTER 2. Organizational Core Capacity

2.1 Target of Assessment

Target of the assessment is existing 17 sections of WSD, which are closely related to the project activities as listed in Table 2.1. In addition to these sections, three DYCEs appraised core capacity of whole WSD respectively.

Table 2.1 Sections Related to the Project

	Division	Section	Main Duties
1.	Reservoir	Yegu P/S	Operation and maintenance of Yegu P/S
2.		Hlawga Reservoir	Operation and maintenance of Hlawga P/S
3.		Ngamoeyeik WTP	Operation and maintenance of Nyaunghnapin WTP
4.	Supporting	Research Section.	Check cost estimation for construction, rehabilitation.
5.		Computer Section.	Input and print water bills
6.		Water Quality & Monitoring Section	Check water quality of water from WTP till tap
7.	Electrical & Mechanical	Electrical section	Maintenance of booster pumps and pumps in tube wells.
8.		Mechanical Section	
9.		Tube well section	
10.	Water Supply	Transmission Pipe 1	Maintenance of transmission pipe from reservoirs till Yegu PS
11.		GIS Section	Manage GIS data
12.		North District	Supervise branch offices including T/S offices
13.		East District	
14.		South District	
15.		West District	
16.	Admin & Finance	Admin Section	Manage administrative issues including personnel management
17.		Finance Section	Manage financial issues including budgeting, settlement, and managing revenue.

2.2 Items of Assessment

Core capacity is wide concept and may include wide management related issues regardless of the duties of section, thus, all targeted sections are assessed with the unified criteria as shown in Table 2.2.

Table 2.2 Items of Assessment of Organizational Core Capacity

Category	Items	Criteria
A. Planning, Monitoring	1. There is annual action plan of section	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	2. Planned activities are monitored regularly.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	3. The business activities are compiled as a report periodically.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
B. Budget management	1. Budget is requested based on planning.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	2. Execution of budget is periodically monitored.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]

Category	Items	Criteria
C. Staffing	1. The number of staff is adequate for assigned duties.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	2. Duties and responsibilities of each staff is clear.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
D. Communication	1. Annual action plan is shared among members of the section/office.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	2. There is regular occasion to share information among the members.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]

2.3 Results of Assessment

The results of the assessment are shown in Table 2.3 and Table 2.4. As the assessment was made in five scales, the highest score is "5". In principle, the assessment of each section was conducted jointly by YCDC counterparts of the above-listed-section and JICA Experts in charge. However, there are some cases that both parties put different score, especially of "A. Planning and Monitoring". This happens mostly because YCDC counterparts satisfy with provided situation, and do not agree with lower mark which requires improvement. In this report, scores put by JICA Experts are adopted.

Table 2.3 Results of Capacity Assessment of Organizational Core Capacity

Category	Items	Average (5-scale)
A. Planning, Monitoring	1. There is annual action plan of section	2.86
	2. Planned activities are monitored regularly.	2.73
	3. The business activities are compiled as a report periodically.	2.55
B. Budget management	1. Budget is requested based on planning.	3.14
	2. Execution of budget is periodically monitored.	3.30
C. Staffing	1. The number of staff is adequate for assigned duties.	2.36
	2. Duties and responsibilities of each staff is clear.	2.71
D. Communication	1. Annual action plan is shared among members of the section/office.	2.82
	2. There is regular occasion to share information among the members.	2.91

Table 2.4 Results of Capacity Assessment of Organizational Core Capacity (detail)

Core Capacity		Reservoir Div.				Supporting Div.		Electrical & Mechanical Div.				Water Supply Div.						Admin & Finance Div.					
Category	**Items**	Yegu P/S	Hlawga Reservoir	Ngamoeyeik WTP	Research Section.	Computer Section.	Water Quality & Monitoring Section	El & Mech Div.	Electrical section	Mechanical Section	Tube well section	Transmission Pipe 1	GIS Section	North District	East District	South District	West District	Admin Section	Finance Section	PR	DYCE	DYCE	DYCE	**Average**
A. Planning, Monitoring	1. There is annual action plan of section	3	3	1	1	3	1	4	3	3	3	4	4	4	4	3	4	3	4	1	3	2	2	**2.86**
	2. Planned activities are monitored regularly.	3	3	1	3	3	3	3	1	1	1	4	4	3	4	3	4	3	3	1	4	3	2	**2.73**
	3. The business activities are compiled as a report periodically.	2	1	2	3	2	3	4	3	3	3	2	3	3	1	3	3	4	3	1	3	2	2	**2.55**
B. Budget management	1. Budget is requested based on planning.	3	3	1	1	4	3	4	3	3	3	4	4	4	4	3	3	4	4	1	4	4	2	**3.14**
	2. Execution of budget is periodically monitored.	4		3	1		4	4	4	4	4	3	4	3	3	3	3	4	4	1	4	4	2	**3.30**
C. Staffing	1. The number of staff is adequate for assigned duties.	3	4	2	3	4	1	3	1	1	2	2	2	3	2	3	3	1	3	1	3	3	2	**2.36**
	2. Duties and responsibilities of each staff is clear.	4	4	2	3	4	4	4	2	2	3	3	2	2	3	3	3	1	2	1	3	3	2	**2.73**
D. Communication	1. Annual action plan is shared among members of the section/office.	3	1	3	1	3	4	3	1	3	4	3	3	3	3	3	4	3	3	1	4	4	2	**2.82**
	2. There is regular occasions to share information among the members.	3	1	3	4	3	4	4	3	3	4	1	3	3	1	3	4	3	3	1	4	4	2	**2.91**

2.4 Overall Assessment and Approaches for Improvement

In addition to the scores shown above, comments and opinions for each items are collected. The following assessment is made based on the scores and the comments collected.

2.4.1 Planning, Monitoring

In WSD, annual implementation plan and budget plan is set annually, but these are not well shared with each section, branch after its approval. Annual plan is prepared mainly at division level, and is committed little by section level. Each section is not involved in making annual plan because of lack of capacity.

For monitoring the progress of the plan, monthly and biweekly meeting is held with attendance of section head and upper level personnel of WSD. However, section level does not know how the report and progress is reflected to the plan. Although the progress of the activities is regularly compiled, quality of the report is needed to be improved in the manner to show and analyze the data.

[Approaches to improve]

- ✓ Plans of each division should be committed by each section.
- ✓ Annual plan should be shared in writing with each section.
- ✓ Activities and achievement should be compiled with not only data but analysis in order to utilize the report for decision making.

2.4.2 Budget management

Budgeting and monitoring of its execution is done regularly, and procedures are set firmly. Scores on this category marks the higher than other categories. Although procedures of budget execution are clear, the authority is concentrated to the higher position; few activities can be managed by section level. Decision making may take longer time, and it makes difficult to reflect real situation into the consideration. In Addition, budget execution is monitored but requires so complicated documents that staff should consume too much time for documentation.

[Approaches to improve]

- ✓ Authority (discretion and budget execution) should be clearly defined, and delegated to as low position as possible to enable prompt action.

2.4.3 Staffing

Most sections have problems to secure qualified staff; the number of staff is insufficient to implement the assigned duties, staff has not enough knowledge related to the duties, skilled labor is retiring or WA and Flat turnover easily. Moreover, most sections do not have clear job descriptions of the both of section level and staff level.

[Approaches to improve]

- ✓ The number of staff should be reviewed and adjusted periodically by comparison with assigned duties.
- ✓ Working way should be improved in terms of efficiency including introduction of computerization.
- ✓ The long-term HRD plan should be set for developing capacity of staff sustainably and effectively.

2.4.4 Communication

Hierarchal communication: Regular meeting is held biweekly to monitor activities of each section with attendance of section heads and upper level. Important information is shared in the meeting but the annual plan is not distributed in writing but reported orally to each section.
Communication within section: While small sections tend to have close communications among section members, In larger sections, information cannot be conveyed properly to lower staff than SAE level.

Communication with related sections: information is shared only in the regular meeting. Without it, information sharing is not officially established. In particular, branch officies, located not in head office, has difficulties to communicate with other sections.

[Approaches to improve]

- ✓ Mid-manager should understand the importance to share information with their subordinate.
- ✓ For promote communication among related sections, the work procedures should be set such as SOP and manuals. Also regular meeting should be scheduled in annual activities plan as needed.

CHAPTER 3. Organizational Technical Capacity

3.1 Planning and Monitoring

3.1.1 Target of Assessment

The assessment of planning and monitoring capacity at organizational level targets the top management members of Water and Sanitation Department (WSD) of YCDC. The top management members include Chief Engineer and Deputy Chief Engineers. However, the assessment was carried out for three DYCEs except for CE in December 2016, because CE were absent during the assessment periods.

3.1.2 Items of Assessment

The assessment categories and items are shown as **Table 2.1**. The assessment categories for planning and monitoring capacity are consisted of the following three areas: (A). mid- and long- terms plan, (B). Short- term plan, (C). Benchmarking and Performance Indicators (PIs).

Table 3.1 Items for Assessment of Organizational Technical Capacity (Planning and Monitoring)

Category		Items
A. Mid-and Long-term Plan	A-1	Vision and the mission of WSD is set up
	A-2	The outline of mission and vision are understood by the WSD's staffs in what extent
	A-3	A planning section to formulate mind- and ling-term plan for WSD is established
	A-4	WSD has a mid- and long-term development plan except for JICA Master Plan
	A-5	A mid- and long-term development plan is documented/or compiled in the report
	A-6	Concrete target indicators are set up in the mid- and ling-term development plan.
	A-7	Water demand projection is included in the mid- and long-term development plan. Also the plan is based on the projection.
	A-8	The outline of a mid- and long-term development plan is understood by the WSD's staffs in what extent
	A-9	The implementation progress of a mid- and long-term development plan is monitored and evaluated
	A-10	A mid- and long-term development plan is revised and updated based on the results of monitoring and evaluation
	A-11	A process (institutional system) for revision and updating of a mid- and long-term development plan is clearly established
	A-12	A process for development of a mid- and long-term development plan is clearly established
	A-13	A process for approval of a mid- and long-term development plan is clearly defined
B. Short-term Plan	B-1	WSD has a short-term plan for budgeting, and rehabilitation and updating of facilities
	B-2	A short-term plan is documented/or compiled in the report
	B-3	A short-term plan is understood by the WSD's staffs in what extent
	B-4	Institutional capability for developing an effective short-term plan is secured
	B-5	The implementation progress of a short-term plan is monitored and evaluated
	B-6	A short-term plan is revised and updated based on the results of monitoring and evaluation
	B-7	A process (institutional system) for revision and updating of a short-term plan is clearly established
	B-8	A process for development of a short-term development plan is clearly established
	B-9	A process for approval of a short-term plan is clearly defined
C. Benchmarking	C-1	Project monitoring by using PIs is regularly carried out.
	C-2	Monitoring system for projects by using PIs is established

Category		Items
and PIs	C-3	An importance of project monitoring by using PIs is understood by the WSD's staffs
	C-4	Data of PIs is regularly collected without any delay
	C-5	A collection process of data for PIs is clearly established
	C-6	PIs and data are analyzed
	C-7	PIs are utilized for developing a future improvement plan of waterworks

3.1.3 Results of Assessment

The results of the assessment are shown in **Table 3.2**.

The assessment sheets were given to the respondents by JICA Expert and asked them to fill up with the sheets. In the most case, the Expert had another opportunity of interviewing with them after filling up with the sheets and confirmed the remarks, since we considered the situation that the most of top management were so busy for daily works.

The assessment sheet asked respondents to rate their assessment on planning and monitoring capacity of WSD. The rating was given along a scale ranging from, for instance, "Can be a model for benchmarking" with the highest "5" to "Not exist"/ "Not utilized"/ "Not understood" with the lowest "1".

In some items, the cognitive discrepancy can be seen between respondents' scores and Expert's scores. For instance, there was a tendency that the respondents put relatively higher scores rather than the observation results of the Expert. In that case, the Expert carefully adopted the score and summarized this report.

Table 3.2 Assessment Results of Organizational Technical Capacity (Planning and Monitoring)

Category	Items	Answer 1	Answer 2	Answer 3	Average score	Remarks
A. Mid-and Long-term Plan	A-1	4.0	4.0	3.0	4.0	There is vision and mission of WSD, which was developed by the JICA Preparatory Study for Master Plan.
	A-2	3.0	3.0	3.0	3.0	It would be said that vision and mission is not sufficiently understood by the all staff memebers. The further dissemination to the staff members is needed.
	A-3	1.0	1.0	1.0	1.0	The specialized section for planning is not existed and not institutinalized in WSD.
	A-4	2.0	2.0	2.0	2.0	WSD prepares 5 year actvity plan, which contains a brief explanation of the activity and the budget estimation, and submits to the regional government. It is not sufficiently developed based on the precise information of activity and budget, so that the accuracy is needed to be improved. Also, the institutional aspects including staffing and HRD needs to be considered to secure the comprehensiveness. The plan seems to be limited to an activity plan, but not a development plan.
	A-5	3.0	3.0	3.0	3.0	5 year activity plan is documented, however it seems not to be sufficiently formulated as a form of report or compiled.
	A-6	2.0	2.0	2.0	2.0	The targets of the individual activities might be basically indicated, however the comprehensive targets are not fully considered. Also the number of targets are limited to cover the overall management of waterworks.
	A-7	2.0	2.0	2.0	2.0	In general, water demand projection is comprehensively not considered. The some activities might consider the projection, however water demand projection as a whole is not enough.

	A-8	2.0	2.0	2.0	2.0	5 years activity plan is developed by only the relevant members in general, so that the relevant staffs/or the higher officials knows the responsible parts of the plan. The plan is not adequately shared by the WSD's staff.
	A-9	2.0	2.0	1.0	2.0	Monitoring and evaluation is not mostly done in the case of 5 years plan, however it would be fair to say that the monitoring and evaluation are partially carried out on an ad hoc basis in general.
	A-10	2.0	2.0	1.0	2.0	Monitoring and evaluation is limited, so that the revision and the updating are also limited to the partial implementation.
	A-11	2.0	1.0	1.0	1.3	The process for revision and updating is not institutionally established with clear indication.
	A-12	2.0	1.0	1.0	1.3	The process for development of a mid- and long-term development plan is not clearly prescribed institutionally.
	A-13	2.0	1.0	1.0	1.3	The process for approval of a mid- and long-term development plan is not clearly established.
	Sub-average				**2.00**	
B. Short-term Plan	B-1	3.0	3.0	3.0	3.0	An annual activity plan including the budgetary estimation are prepared by the relevant divisions. The contents and the accuracy of budgetary estimation is needed to be improved partially.
	B-2	3.0	3.0	3.0	3.0	A short-term plan is documented, however it seems not to be sufficiently formulated as a form of report or compiled.
	B-3	2.0	2.0	2.0	2.0	An annual activity plan is developed by only the relevant members in general, so that the relevant staffs knows the responsible parts of the plan. The plan is not adequately shared by the WSD's staff.
	B-4	3.0	3.0	3.0	3.0	WSD has made an annual activity plan. They are capable to prepare a short-term plan even if the partial improvement is necessary.
	B-5	2.0	2.0	2.0	2.0	Monitoring and evaluation is done in some cases on an ad hoc basis in general, and modofication is made. However it would be fair to say that the monitoring and evaluation are partially carried out.
	B-6	2.0	2.0	2.0	2.0	Monitoring and evaluation is limited, so that the revision and the updating are also limited to the partial implementation.
	B-7	2.0	1.0	2.0	1.7	The process for revision and updating is established in some extent, however the partial improvement is necessary
	B-8	2.0	1.0	2.0	1.7	The process for development of a short-term development plan is somehow guided by the top management. However it needs to be institutionally more clear.
	B-9	3.0	3.0	3.0	3.0	The approval for development of a short-term activity plan is somehow approved by the top management. However it needs to be institutionally more clear.
	Sub-average				**2.37**	

C. Benchmarking and PIs	C-1	2.0	3.0	2.0	2.3	Some Performance Indicators has been reported to the top management daily, weekly and monthly, however the number of PIs and the reporting system should be more timely and accurately.
	C-2	2.0	3.0	3.0	2.7	Some project activities are monitored by some collected PIs by the top management.
	C-3	2.0	2.0	2.0	2.0	The importance of PIs for project monitoring is not sufficiently understood by the WSD's staffs. The meaning of data and the importance should be more recognized by the staffs.
	C-4	2.0	2.0	2.0	2.0	The existing data of PIs is generally colected regularly. However some of weekly and monthly data is delaied sometimes.
	C-5	2.0	2.0	2.0	2.0	The existing data is relatively collected through a routine process in some extent. The collection process should be clearly defined.
	C-6	2.0	2.0	2.0	2.0	It seems that the exising data is not fully analyzed and is just collected and accumulated. The analysis practice should be enhanced for understanding the meaning of PIs.
	C-7	2.0	2.0	1.0	1.7	As the result of the above, the feedback of the analysis results of PIs is weak and the usage of PIs is very limited.
	Sub-average				**2.10**	
Total average					**2.14**	

3.1.4 Overall Assessment and Approaches for Improvement

1) Planning

An annual activity plan and a budgetary plan are prepared by each responsible section. Also 5 year plan including the activity and the budget is prepared by WSD. It is evaluated that WSD prepare these activity plans including budget allocation. The improvement can be necessary for the precise monitoring and evaluation of these plans in the view point of efficient PDCA cycle and clear institutional process for revision and modification, and the approval procedure, especially in case of the mid-and long-term plans. The bottleneck of planning and monitoring works is non-existence of the section specialized in planning and monitoring the overall waterworks in WSD.

[Approaches to improve]

- ✓ Planning Section needs to be established.
- ✓ Plan and condition of waterworks should be sufficiently shared among the staff members.
- ✓ Waterworks activities should be evaluated and revised periodically according to a PDCA (Plan-Do-Check-Action) cycle.

2) Benchmarking

Some Performance Indicators has been reported to the top management daily, weekly and monthly, however the information is limited to understand the present situation of comprehensive waterworks timely. The existing information of PIs is not adequately analyzed and not reflected on the planning. For more systematic planning, monitoring and analysis of waterworks, the information of PIs should be more enriched quantitatively and accurately.

[Approaches to improve]

- ✓ PIs and the monitoring system should be enriched and strengthened.
- ✓ Information based upon PIs needs to be sufficiently utilized for the future improvement planning of waterworks and the target setting.

3.2 Regulations, Standards, Guidelines and Manuals of WSD

3.2.1 Target of Assessment

The assessment of planning and monitoring capacity at organizational level targets the top management members of Water and Sanitation Department (WSD) of YCDC. The top management members include Chief Engineer and Deputy Chief Engineers. However, the assessment was carried out for two DYCEs in December 2016, because CE were absent during the assessment periods and one DYCE described that he was not in the position to assess the field of Regulations, Standards, Guidelines and Manuals.

3.2.2 Items of Assessment

The assessment categories and items are shown as **Table 3.3**. The assessment categories for planning and monitoring capacity are consisted of the following are: (A). Regulations, Standards, Guidelines and Manuals.

Table 3.3 Items for Assessment of Organizational Technical Capacity (Regulations, Standards, Guidelines and Manuals)

Category		Items
A. Regulations, Standards, Guidelines and Manuals	A-1	Regulation/Standard/Guideline/Manual related to the activities of WSD/relevant sec. are comprehensively managed by a list
	A-2	Regulation/Standard/Guideline/Manual related to the activities of WSD/the relevant sec are sufficiently developed
	A-3	Existing Regulation/Standard/Guideline/Manual related to the activities of WSD/relevant sec. are sufficiently understood by the staffs
	A-4	Existing Regulation/Standard/Guideline/Manual related to the activities of WSD/relevant sec. are sufficiently utilized by the staffs
	A-5	A process for development of Regulation/Standard/Guideline/Manual by WSD is clearly defined
	A-6	A process for approval of Regulation/Standard/Guideline/Manual by WSD is clearly defined
	A-7	Regulation/Standard/Guideline/Manual by WSD is revised and updated as necessary

3.2.3 Results of Assessment

The results of the assessment are shown in **Table 3.4**.

The assessment sheets were given to the respondents by JICA Expert and asked them to fill up with the sheets. In the most case, the Expert had another opportunity of interviewing with them after filling up with the sheets and confirmed the remarks, since we considered the situation that the most of top management were so busy for daily works.

The assessment sheet asked respondents to rate their assessment on planning and monitoring capacity of WSD. The rating was given along a scale ranging from, for instance, “Can be a model for benchmarking” with the highest “5” to “Not exist”/ “Not utilized”/ “Not understood” with the lowest “1”.

In some items, the cognitive discrepancy can be seen between respondents’ scores and Expert’s scores. For instance, there was a tendency that the respondents put relatively higher scores rather than the observation results of the Expert. In that case, the Expert carefully adopted the score and summarized this report.

Table 3.4 Assessment Results of Organizational Technical Capacity (Regulations, Standards, Guidelines and Manuals)

Category	Items	Answer 1	Answer 2	Average score	Remarks

Category	Items	Answer 1	Answer 2	Average score	Remarks
A. Regulations, Standards, Guidelines and Manuals	A-1	2.0	2.0	2.0	The existing Regulation/Standard/Guideline/Manual are not compiled in a comprehensive manner. The information is not sufficiently arranged with a list. The relevant information was dispatched and not organized.
	A-2	2.0	2.0	2.0	YCDC have YCDC law updated in 2014 and YCDC Regulation related to water and sanitation in 1999 which is currently under revision. In overall, the number of existing regulations, standards, guidelines and manuals on waterworks are limited at the organizational level. For instance, guidelines for design of water facilities, materials and equipment, NRW reduction, water tariff setting etc. are not prepared and utilized by WSD.
	A-3	2.0	2.0	2.0	Except for the YCDC law, the existing standards, regulations, guidelines and manuals are not well-known by the WSD staffs. Even the YCDC law, the contents is adequately understand by the staff members. Only relevant persons are familiar with the specified ones in general, therefore it is fair to say that the information is not sufficiently managed and shared among the WSD staffs.
	A-4	3.0	3.0	3.0	The existing Regulation/Standard/Guideline/Manual are partially utilized as necessary. The rate of roads and buildings which was prepared by Ministry of Construction is utilized for the cost estimation of construction works. It was told that guideline on water supply and sanitation 1996 is utilized for calculation of materials and labor works.
	A-5	2.0	2.0	2.0	There is no prescribed process for preparation of the development of Regulation/Standard/Guideline/Manual responsible for YCDC. This process had better to be clearly indicated for future development of the relevant documents.
	A-6	2.0	2.0	2.0	There is no prescribed process for approval of Regulation/Standard/Guideline/Manual responsible for YCDC. This process for approval had better to be clearly determined.
	A-7	3.0	3.0	3.0	The existing YCDC law is updated in 2014 and Regulation related to water and sanitation in 1999 is currently under preparation. Therefore it can be said that some of the existing law and regulation is revised even if the number of Regulation/Standard/Guideline/Manual is limited.
Total average				**2.29**	

3.2.4 Overall Assessment and Approaches for Improvement

YCDC have YCDC law updated in 2014 and YCDC Regulation related to water and sanitation in 1999 which is currently under revision. However, in overall, the number of existing regulations, standards, guidelines and manuals on waterworks are limited at the organizational level. For instance, guidelines for design of water facilities, materials and equipment, NRW reduction, water tariff setting etc. are not prepared and utilized by WSD. This may be attributed to the weak institutional arrangement of water sector at national level. Except for the YCDC law, the existing standards, regulations, guidelines and manuals are not well-known and shared by the WSD staffs. Only relevant persons are familiar with the specified ones in general, therefore it is fair to say that the information is not sufficiently managed and shared among the WSD staffs. Also, the process for preparation and approval need to be clearly indicated.

[Approaches to improve]
- ✓ Development of standards, guidelines and manuals at organizational level need to be enhanced
- ✓ A clear process of their preparation and enforcement is defined
- ✓ The information of existing standards, regulations and manuals related to waterworks should be managed and shared with the staff members more widely

3.3 Financial Conditions and Utility Management

3.3.1 Target of Assessment

At the Financial Section of WSD, staff members are in charge of expenditure and income of WSD, and management of budget. WSD's budget/account are included in the YCDC general budget/account and WSD manages its water supply as a "public works". WSD is one unit of the YCDC's general account. Then it is not easy to recognize financial condition of water supply precisely because they do not have independent account, or do not have P/L or B/S financial statement of water supply.

Usually a water supply entity is managed as a "water utility" which has an independent account and has corporate account or quasi-corporate account, such as P/L and B/S financial statements, and it runs its financial management as a self-sufficient manner.

Accordingly, staff members of WSD are familiar with governmental accounting, however, they are not familiar with corporate account which water utility introduced. In the future, WSD has intention to introduce self-sufficient account for water supply.

Then, the main purpose of the assessment here is to identify how much the Financial Section of WSD has interests in self-sufficient management of water supply and knowledge of water utility's P/L, B/S, principle of water tariff setting and so on.

3.3.2 Items of Assessment and Results of Assessment

Table 3.5 Items and Results of Assessment

Category	Items	Mark	Remark (criteria)
A. Budget Management **- Is the existing budget system (process) suitable for enhancing water supply situation in Yangon city?**	A1:Does WSD/YCDC have manuals and/or SOPs and they work (function) well at the workplace? (in Budget system)	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	A2:To what degree WSD/YCDC is interested in independent management (separate from general budget of YCDC), and has already implemented some measures towards such directions? (in Budget system)	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	A3:To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions?	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	A4:To what degree WSD/YCDC is interested in overall financial	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3.

Category	Items	Mark	Remark (criteria)
	balance which includes capital costs like depreciation (or repayment of loans/bonds) and interest, and has already implemented some measures towards such directions?		We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	A5:Does WSD/YCDC have a good budget control system to be an efficient and effective water supply utility?	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	A6:Does WSD/YCDC have any improvement program for budget management system and does it functions (works) efficiently?	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	A7:To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?	4	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
B. Accounting system **- Is the existing accounting system suitable for enhancing water supply situation in Yangon city?**	B1:Does WSD/YCDC have manuals and/or SOPs and they work (function) well at the workplace? (in Accounting system)	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	B2:To what degree WSD/YCDC is interested in independent accounting system of water supply, and has already implemented some measures towards such directions? (in Accounting system)	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	B3:To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions? (in Accounting system)	2	
	B4:Now WSD/YCDC implement government style accounting (single-entry bookkeeping), and to what degree WSD/YCDC is interested in double-entry bookkeeping system, and has already implemented some measures towards such directions? (in Bookkeeping system)	2	
	B5:To what degree WSD/YCDC is interested in introduction of depreciation and fixed asset accounting, and has already implemented some measures	2	

Category	Items	Mark	Remark (criteria)
	towards such directions?		
	B6:To what degree WSD/YCDC is interested in overall financial balance (including interest and repayment of loan/bond), and has already implemented some measures towards such directions?	2	
	B7:To what degree WSD/YCDC is interested in overall cash management, and has already implemented some measures towards such directions?	2	
	B8:To what degree WSD/YCDC gets information about revenues relating water services? (water tariff, connection fee, …..?)	4	
	B9:To what degree WSD/YCDC gets information about expenses relating water services? (salary, electricity fee, chemicals, stationery, pipes, valves, meters, …..?)	4	
	B10:To what degree WSD/YCDC is interested in independent annual financial report of water supply, and implements some measures towards such directions? (in Annual report)	2	
	B11:Does WSD/YCD have any improvement program for accounting system already and does it functions (works) efficiently?	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	B12:To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement improvement program?	4	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
C.Management of Capital Finance- Is the existing capital finance system suitable for enhancing water supply situation in Yangon city?	C1:Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Management of Capital Finance)	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	C2:To what degree WSD/YCDC is interested in independent capital investment budget of water supply (which includes both capital investment and its financial resources), and has implemented some measures already towards such directions? (in Budget system)	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	C3:To what degree WSD/YCDC	2	

Category	Items	Mark	Remark (criteria)
	is interested in independent capital investment account of water supply (which includes both capital investment and its financial resources), and has implemented already some measures towards such directions? (in accounting system)		
	C4:To what degree WSD/YCDC gets information about capital investment expenses relating water services? (construction costs for replacement/rehabilitation, expanding, upgrading facilities, salary, electricity fee, stationery, pipes, valves, meters …..?)	3	
	C5:Does WSD/YCDC gets all information regarding self savings, Government's subsidy, Loan from domestic bank, foreign/international grant aid, foreign/international loan, PFI	3	
	C6:Does WSD/YCDC gets all information regarding debt services (repayment and interest for loan and/or bond) and including it on the capital finance management	3	
	C7:Does WSD/YCDC have a capital improvement program which includes capital investment and their financial resources, and forecast of middle-term and long term balance of expense and income. The program shall include not only new construction for expanding area but also include construction of replacement, rehabilitation, and upgrading existing facilities.	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	C8:Does WSD/YCDC have any improvement program for management of capital finance system already and does it functions (works) efficiently?	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	C9:To what degree the management cycle (Plan -Do-Check-Act) has been introduced already to implement improvement program?	4	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
D. Financial Plan	D1:Does WSD/YCDC have manuals and/or SOPs and they	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but

Category	Items	Mark	Remark (criteria)
- Is the existing financial planning system suitable for enhancing water supply situation in Yangon city?	works (functions) well at the workplace? (in Financial Plan)		it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	D2:To what degree WSD/YCDC is interested in independent and self-sufficient in finance, or WSD has implemented already some measures towards such directions? (in financial plan)	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	D3:Does WSD/YCDC have annual, mid-term plan and long-term financial plan already and they works (functions) well at the workplace?	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	D4:Does WSD/YCDC's financial plan includes various plans (Construction plan, Replacement plan, O&M plan, Personnel plan (staff position plan), Cost efficiency plan (costs-cut, save energy, etc.)) which concerns expenditures and incomes, Those plan forecast of middle-term and long term balance of expense and income.	3	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	D5:Does WSD/YCDC have monitoring system for assessing the result of financial plan using Performance indicators.	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	D6:Does WSD/YCDC have public and customer communication tools and implement such activities?	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	D7:To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement financial plan?	3	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
E. Tariff Setting **- Is the existing tariff setting system suitable for enhancing water supply situation in Yangon city?**	E1:Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Tariff setting)	3	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	E2:To what degree WSD/YCDC is interested in beneficiary pay principle or WSD has implemented already some measures towards such directions?	2	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	E3:To what degree WSD/YCDC know that each customer pay all	4	

Category	Items	Mark	Remark (criteria)
	costs which used to supply water (provide service) to the customer (individual cost of service principle) or to each customer pay more/less costs which used to supply water (provide service) to the customer (cross-subsidies)		
	E4:To what degree WSD/YCDC recover full costs; recover depreciation expenditure, recover interests?	2	
	E5:To what degree WSD/YCDC is interested in customers' affordability to water tariff, or WSD/YCDC has implemented already some measures towards such directions?	3	
	E6:To what degree the management cycle (Plan -Do-Check-Act) has been introduced to implement in tariff setting?	3	
F.Institutional (Organization, Governance) Arrangement- Is the existing institutional (organizational, governance) system of YCDC suitable for enhancing water supply services in Yangon city?	F1:To what degree WSD/YCDC has been interested in independent and/or self-sufficient utility, or WSD/YCDC has implemented already some measures towards such directions?	2	
	F2:To what degree WSD/YCDC is interested in the management style such as government style, corporation style etc, or WSD/YCDC has already implemented some discussion/survey about management style?	2	
	F3:To what degree WSD/YCDC is interested in private sector involvement, or WSD has implemented already some measures towards such directions?	2	
	F4:To what degree WSD/YCDC is interested in organization structure such as centralized or de-centralized, or WSD/YCDC has already implemented some discussion/survey about this topic?	2	
	F5:To what degree WSD/YCDC is interested in separation of policy and operation in water supply organization, or WSD/YCDC has already implemented some discussion/survey about this topic?	2	

Category	Items	Mark	Remark (criteria)
	F6:To what degree WSD/YCDC is interested in vertical separation (separate distribution from production and make an independent department) and/or horizontal integration (merge outside YCDC area) of water utility, or WSD/YCDC has already implemented some discussion/survey about this topic	2	
G. Office Managementin Finance section and relating section **- Is the existing office management is suitable for enhancing efficiency of office**	G1:Does WSD/YCDC have the clear job description of individual members in Financial Division/Section and does it functions (works) efficiently?	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]
	G2:Does WSD/YCDC have reference documents (Law, Regulation, By-law Guideline, Standards) and all staff members can easily find around their desks, and efficiently functions (works)?	3	
	G3:Does WSD/YCDC have manuals and/or SOPs and staff members can find them easily around their desks, and efficiently function (work)?	3	
	G4:Does WSD/YCDC have the-state-of-the-art IT equipment and does it functions (works) efficiently?	3	
	G5:Does WSD/YCDC have any improvement program for office management for Financial Division/section and does it functions (works) efficiently?	3	
	G6:To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?	4	[1. We are not interested in that. , 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]
	G7:Does WSD/YCDC have the improvement plan of office management in accordance with WSD office moving to the new building in 2016	4	[1. No, we do not have. , 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]

3.3.3 Overall Assessment and Approaches for Improvement

(1) Overall Assessment

The result of technical assessment on organizational level revealed that Financial Section of WSD has rather weak point on management of "water utility" such as water tariff setting, corporate accounting system and corporate budget management as anticipated before. Regarding governmental account and

other items such as using manuals, conducting management cycle, making financial plan and capital finance and office management, the results look average or above level.

(2) Approaches for improvement
As the result of assessment is almost the same as anticipated, capacity development of following items are required in order that water supply of YCDC is getting to be managed as a self-sufficient manner and sustainable management. They shall be focused on the "water utilities" management because water supply in Yangon city is managed as "a public works". It shall be independent from general account of municipal government and financially self-sufficient, which is principle style for water supply entity of big cities like Yangon.

Accordingly, following training program shall be implemented in 5 year-term. The training shall be implemented by the Experts or C/Ps who are trained to be trainers. Also the training abroad will be very useful in these topics and such opportunities shall be prepared.

- Basics of Water Utilities Management
- Water Utility Financial Accounting
- Water Utility Tariff Rate Making
- Asset Management and Asset Accounting in Water Utility
- Private Sector Involvement in Water Utility
- OJT on development of Asset Registration

The last item is vital for a utility management because utility has a lot of facilities and to maintain them in a good condition is the main works of utility. YCDC should start asset account by establishing asset register system.

3.4 Human Resources Management

3.4.1 Target of Assessment

Before the Project starts, no section in WSD had been assigned as responsible sections for human resource management (HRM). Most practices related to personnel management are regulated by Administration Department of YCDC, and with which Administration Section of WSD works for personnel management affair with close relation. Since the assessment covers broad fields of HRM, target of the assessment came to be both Admin Department and Admin Section.

3.4.2 Items of Assessment

The assessment covers wide fields of HRM related to human resource development (HRD) as shown in Table 3.6.

Table 3.6 Items of Assessment of Organizational Technical Capacity -HRD-

Category	Items	Assessment criteria
A. Recruitment, transfer, retirement	A1: Does WSD/YCDC have any **plan or regulation to control the number of staff** recruited or assigned in each office?	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	A2: Does WSD/YCDC have clear regulation on procedures of staff recruitment? (Is transparency secured?)	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	A3: Does the **frequency and fields** of staff transfers in WDS/YCDC linked with developing staff capabilities?	
	A4. Is there any measure to retain staff of WDC/YCDC?	
B.	B1: Are **responsibilities and duties**	[1. Necessary for fundamental improvement,

Category	Items	Assessment criteria
Duties and responsibilities, evaluation, incentives	**divided** clearly defined for each office?	2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B2: Are **job description**s clearly defined for each staff position? (including managers, engineers, technicians, unskilled workers, administration staff of different kinds, etc.)?	
	B3: Does WSD/YCDC have a fair **evaluation system** for section/team performance?	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	B4: Does WSD/YCDC have an **annual appraisal and target setting** system for staff/managers?	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B5: Are **individual performance based incentives** working in WDS/YCDC (e.g. pay rises, promotions and bonuses based on individual performance)?	
	B6: Is there any linkage between **capacity development of individual staff and improvement of his/her salary** or benefits?	
	B7: Does WSD/YCDC have a **reward and recognition program** for all staff?	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	B8: Are there **any active criteria for promotion** to a management position? (such as promotion tests, professional qualification requirements, achievement of target performance level, etc.)	
C. General HRD	C1: Does WSD/YCDC have any **HRD strategy / plan** for staff?	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	C2: Does your **human resources development plan meet the current needs** of the utility?	
	C3: Are the **duties and responsibilities related to HRD of each office** clearly defined and regulated?	
	C4: Is **the supervisor responsible** for bringing up and training of the subordinates?	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	C5: Is there any occasion for each staff to think of their **career path** in YCDC?	
	C6: Does the utility have **any Incentives** for lecturers, participants in training courses?	
D. Training Management	D1: Does WSD/YCDC provide any training courses?	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D2: Are training activities (planning, implementation, evaluation, making report) managed properly?	
	D3: Is the procedures for implementing trainings defined?	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	D4: Are the procedures appropriate to select proper participants of training responding to the contents of the training.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D5: Are the procedures appropriate to	

Category	Items	Assessment criteria
	ensure the **programs and materials meet the training needs** (technical fields, administration and management fields)	
	D6: Are the results of the exam which is taken by the trainee after training course referred and utilized?	
E. OJT & self-learning	E1: Is **OJT** (on-the-job training) carried out effectively, in terms of the number of experienced staff who can provide OJT, recognition of the importance of OJT, an organized approach for OJT, etc.?	[1. OJT is not carried out, 2. Some OJT is carried out, but in an unorganized way, 3. Some OJT is carried out in a organized way, 4. OJT is a significant part of the organizational culture and it is carried out systematically]
	E2: Does WSD/YCDC have a **culture of knowledge-sharing** (senior or experienced staff teach junior or new staff and share experience and information?)	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	E3: Does WSD/YCDC provide a supportive environment for the staff to undertake **self-learning** (eg access to learning materials, equipment, information, communication with other utilities, financial support, etc.)?	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
F. Resource	F1: Does WSD/YCDC have a **training center** for staff?	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	F2: Is WSD/YCDC's **budget** for human resource development adequate?	[1. No specified budget, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F3: Does WSD/YCDC incorporate with **external training** (including those provided by private companies, development partners, and other authorities)?	[1. No information, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F4: Are there enough number of staff with teaching experiences in YCDC?	[1. No information, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F5: Are internal trainers capable enough of technical and/or communications skills.	

3.4.3 Results of Assessment

The results of assessment and current situation on each item are as shown in Table 3.7 and Figure 3.1

Table 3.7 Results of Assessment of Organizational Technical Capacity -HRD-

Category	Items	Mark	Results
A. Recruitment, transfer, retirement	A1: Does WSD/YCDC have any **plan or regulation to control the number of staff** recruited or assigned in each office?	2	There is only one regulation on official number of permanent staff in each level (from CE to labor) defined annually by UCSB (Union Civil Service Board). On the other hand, since labor cost of YCDC is regulated as within 30 % of total revenue of YCDC, the number of permanent staff is limited only to about half of the allocated number. The remaining workforce is supplemented by temporary staff such as Flat, WA, and Daily Wages.
	A2: Does WSD/YCDC have clear regulation on	2	Procedures are set as regulation but not transparent enough. For only AE level, the recruiting announcement is in public

Category	Items	Mark	Results
	procedures of staff recruitment? (Is transparency secured?)		through newspaper. For ordinary staff is recruited as WA level. There is no recruiting announcement in public for ordinary staff. WSD receives applications from students graduated anytime, and selects from them when needed. There are many cases that staff or ex-staff introduces their relatives.
	A3: Does the **frequency and fields** of staff transfers in WDS/YCDC linked with developing staff capabilities?	2	In principle, staff continue working in WSD without transferring beyond department boundary. Within WSD, staff is sometimes transferred mainly when the vacancies occurs due to retirement or promotion. There is no regular staff rotation aiming at HRD. The selection of staff to be transferred is based on his/her experience.
	A4. Is there any measure to retain staff of WDC/YCDC?	2	Not in particular. Salary is correlated only to position not to working period of each staff.
B. Duties and responsibilities, evaluation, incentives	B1: Are **responsibilities and duties divided** clearly defined for each office?	2	There is clear definition of duties and responsibilities of WSD and 7 divisions consisting of WSD, prescribed in YCDC Law (amended in 2014). However, duties of each section under division level is not defined clearly and often have minor changes of organization such as newly establishment of GIS section under Supporting Division due to technology advance.
	B2: Are **job description**s clearly defined for each staff position? (including managers, engineers, technicians, unskilled workers, administration staff of different kinds, etc.)?	2	Budget execution authority is clearly defined to CE, T/S Officer. Responsibilities of each level within department are set by CE, but not in writing. Some staff has clear individual job description such as meter reader, operator in WTP and P/S.
	B3: Does WSD/YCDC have a fair **evaluation system** for section/team performance?	2	There is not official evaluation system of performance of each division/section. Head of division, and head of section have responsibilities for the progress of the annual plan, and have to report the progress at regular meeting held every two weeks. At the end of the financial year, the achievement is evaluated to correspond to the annual plan.
	B4: Does WSD/YCDC have an **annual appraisal and target setting** system for staff/managers?	1	No regular evaluation system. For promotion, the supervisor is requested to make comment on the person's performance.
	B5: Are **individual performance based incentives** working in WDS/YCDC (e.g. pay rises, promotions and bonuses based on individual performance)?	2	There is few incentive system such as welfare (staff accommodation, commuter bus), chance for joining training abroad. For financial incentives, there is no additional allowance, overtime, bonus nor reword. The salary is unified among all civil servants regulated by UCSB.
	B6: Is there any linkage between **capacity development of individual staff and improvement of his/her salary** or benefits?	1	No. Salary is fixed based on job level.
	B7: Does WSD/YCDC have	3	Annually Admin Dep organizes staff rewarding. About 20

Category	Items	Mark	Results
	a **reward and recognition program** for all staff?		staff of WSD is selected based on their performance and recommended by CE and rewarded by the Minister annually.
	B8: Are there **any active criteria for promotion** to a management position? (such as promotion tests, professional qualification requirements, achievement of target performance level, etc.)	2	The Council has authority for the promotion of all YCDC staff. 1) For promoting to AE (officer level), there is unified examination of YCDC, 2) Lower level than AE (ordinary staff level), CE's recommendation for promotion on performance evaluation is taken consideration, 3) from temporary staff (Flat) to permanent staff, performance (evaluated by head of division) and academic qualification is evaluated. Although there is not clear and objective criteria for promotion, working performance (recommendation of head of department), academic qualification, training record, job attendance are evaluated.
C. Frame of HRD	C1: Does WSD/YCDC have any **HRD strategy / plan** for staff?	1	There is no policy/strategy or plan for HRD. Since duties and responsibilities of WSD do not include HRD so far, WSD never has such plan. For training organized by Admin Dep., EC meeting (attended by committee members and heads of department) approves the annual training plan prepared by Admin Dep.
	C2: Does your **human resources development plan meet the current needs** of the utility?	1	No system because HRD is not clearly assigned to any section in WSD.
	C3: Are the **duties and responsibilities related to HRD of each office** clearly defined and regulated?	2	Mainly Admin dep. For training courses in WSD, CE/DYCE rise idea for training course and make decision to implement. Admin Section is a focal section to contact related section to select/send trainees to each training course. These procedures are fixed, but not in writing. No section is assigned to examine HRD based on plan of WSD.
	C4: Is **the supervisor responsible** for bringing up and training of the subordinates?	3	Management staff has understood the importance of OJT but not actively promote OJT in the workplace.
	C5: Is there any occasion for each staff to think of their **career path** in YCDC?	2	For job vacancy, there are some cases that staff raises their will to move there. For most cases, job transfer is occurred only when promotion or substitute of retired person.
	C6: Does the utility have **any Incentives** for lecturers, participants in training courses?	2	There is no additional allowance for internal trainers and trainees. But most trainees are gladly join training courses because training records can be advantage for promotion.
D. Training Management	D1: Does WSD/YCDC provide any training courses?	3	Yes. Until 2014, WSD organized 2 training courses; 1) plumbing, 2) welding targeting not only staff of WSD, but staff from other department of YCDC, private companies. Some training courses such as GIS drawing, speaking English are also under implementation based on request by each division.
	D2: Are training activities (planning, implementation, evaluation, making report) managed properly?	2	Top management of WSD makes decisions to implement training courses ad-hoc base. There is no annual plan. For training course organized by Admin dep., there is no system to make request for training subject, nor feedback of the

Category	Items	Mark	Results
			results of conducted training.
	D3: Is the procedures for implementing trainings defined?	1	No. The procedures are fixed but not in writing.
	D4: Are the procedures appropriate to select proper participants of training responding to the contents of the training.	2	Mostly trainees are initially appointed in each work place responding to training invitation prepared by Admin Section. For training course organized Amin Dep., Admin Section keeps long list for the target trainees so as to send all entitled staff to the training.
	D5: Are the procedures appropriate to ensure the **programs and materials meet the training needs** (technical fields, administration and management fields)	2	Not in system. For individual training courses, lecturer has all responsibilities to prepare training materials. No stage to hear trainees' request or concerns before and after the training course. In the all training courses, trainees give suggestions for improvement in questionnaire, but the results are not conveyed to each trainers.
	D6: Are the results of the exam which is taken by the trainee after training course referred and utilized?	3	Participation of training is recorded in Admin Section in Staff Personal Record. Trainees who perform well in training evaluation will have advantage for promotion.
E. OJT & self-learning	E1: Is **OJT** (on-the-job training) carried out effectively, in terms of the number of experienced staff who can provide OJT, recognition of the importance of OJT, an organized approach for OJT, etc.?	2	Though many managers understand importance of OJT, OJT in workplace is not promoted actively enough. OJT is not conducted systematically.
	E2: Does WSD/YCDC have a **culture of knowledge-sharing** (senior or experienced staff teach junior or new staff and share experience and information?)	2	There is no culture to hinder knowledge sharing. But information and experience is not well conveyed among staff.
	E3: Does WSD/YCDC provide a supportive environment for the staff to undertake **self-learning** (eg access to learning materials, equipment, information, communication with other utilities, financial support, etc.)?	1	No. YCDC has library but the documents are not updated and few documents related to water supply.
F. Resource	F1: Does WSD/YCDC have a **training center** for staff?	3	Yegu pumping station and Hlawga pumping station has been utilized for training courses. They equip necessary equipment for training on welding or pipe connection. Training materials (textbooks) are not enough.
	F2: Is WSD/YCDC's **budget** for human resource	2	No fixed budget. Since HRD activities are not planned in annual schedule, there is not specified budget is secured.

Category	Items	Mark	Results
	development adequate?		
	F3: Does WSD/YCDC incorporate with **external training** (including those provided by private companies, development partners, and other authorities)?	2	During training courses for Engineer organized by Admin Dep., there are some site visit to private factories. Some sessions are taught by the outside lecturers such as HRD, computer.
	F4: Are there enough number of staff with teaching experiences in YCDC?	3	Enough trainers for technical courses; 16 trainers for plumbing, 10 for electrical course, 10 for welding, 10 for connecting.
	F5: Are internal trainers capable enough of technical and/or communications skills.	2	Necessary to improve especially presentation skills. In present, one way lecture dominates a training course; no discussion session.

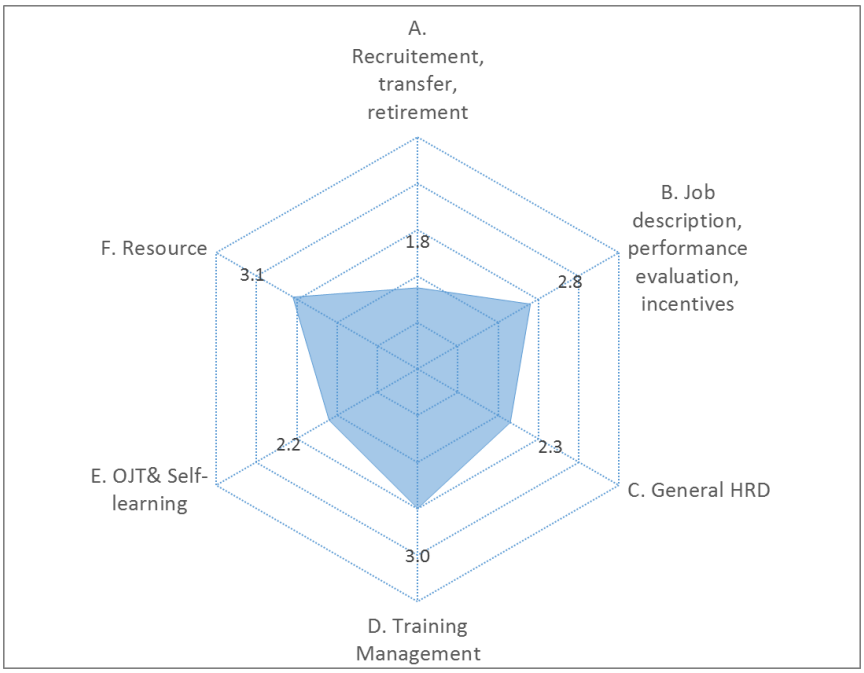


Figure 3.1 Results of Assessment of Organizational Technical Capacity -HRD-

3.4.4 Overall Assessment and Approaches for Improvement

The detail results of assessment are as shown in Table 3.7. Based on the results of the baseline survey and the collected information related to the questionnaire of CA, the main point of the assessment on each field can be summarized as listed below.

After the Project began, the Admin Section of WSD was assigned as the responsible sections on HRD responding to the suggestions of the Project. For improvement, Admin Section should be empowered on HRD, including allocation of full time staff for HRD.

1) Personnel management related to HRD

As shown in Figure 3.1, capacity on this category (category A) is low. Many personnel systems can be assessed as quite rigid and uniform, because which are regulated as unified as national civil servant,

which cannot be adjusted by WSD. In particular, there are no encouragement system to improve performance such as performance related salary system or incentives; hence it is difficult for staff to be motivated to improve their workings and efficiency.

[Approaches to improve]
- ✓ Work closely with Admin Department to improve practices related to personnel management.
- ✓ Start discussing applicable incentive and motivation systems and way to introduce.

2) Organization, duties and responsibilities

Since the discretion is centralized and not well delegated to lower level, decision-making takes longer time, and it is difficult to take account actual situation into making decision. While duties and responsibilities of division level are clearly defined, ones of section level (subordinate level of division) are not in writing. Job seems to be assigned not to the position/section, but to the individual personnel.

[Approaches to improve]
- ✓ Organization chart of WSD and duties and responsibilities should be clear and kept updated.
- ✓ Authorities should be delegated gradually to make action effectively and efficiency.

3) Frame of HRD

The responsible section for HRD in WSD had not been defined before project starts. Thus, WSD has neither strategy nor plan of HRD from longer term of view. Recruitment, staff transfer and training are not planned but on an ad hoc bases.

[Approaches to improve]
- ✓ The scale of WSD is large enough to have own HRD system to achieve organizational goal.
- ✓ Set policy and plan on HRD aligned with corporate plan.
- ✓ Assign specific section and allocate full-time staff of WSD to be responsible for HRD.

4) Training

WSD has sent its staff to the training courses organized by other departments and foreign donors responding to their invitation. On the other hand, there is no system to collect training needs in WSD for reflecting to training plan and few training courses specified to water supply. To utilize the training results, there are few supports or monitoring systems to encourage training participants to apply in their working place.

[Approaches to improve]
- ✓ Prepare training programs and training plans to satisfy training needs.
- ✓ Strengthen training management capacity for efficient and effective training
- ✓ Maximize application of training outcomes to workplace after training.

5) OJT & Self-learning

Although many managers agree with the importance of OJT, OJT is not work well in many workplaces mainly because there is no system to support OJT. Senior staff does not recognize their important role as instructor of OJT. Some offices face difficulties to promote OJT such as too busy daily work, or jobs working individually like meter reader, younger staff turnover easily. For self-learning, there is no official support system, and little incentives for staff to learn now. It seems to be little practices of self-learning of staff.

[Approaches to improve]
- ✓ Empower senior staff/managers to promote OJT activities
- ✓ Enhance OJT activities in each workplace.
- ✓ Improve self-learning environment to encourage staff to learn

6) Resources for HRD

Outside training centers are available for other department training courses. On the other hand, WSD does not have any specific training center or venue now. Some staff of WSD has experiences of trainers; however, it seems to have some rooms to improve teaching skills more. There are no budget and full time staff for HRD of WSD.

[Approaches to improve]
- ✓ Improve trainers' skills for effective training
- ✓ Improve training circumstances for sustainable training implementation including securing regular training venues as training center.
- ✓ Secure training budget regularly based on annual training plan.

3.5 Non-Revenue Water and GIS

3.5.1 Target of Assessment

(NRW)

There is no target due to NRW section has not been established. Currently "Pipe Section 1, 2, 4" are in charge of pipe installation and repairing. These three section are selected for target first organization capacity assessment.

(GIS)

The target of organization is GIS team which has been established already unofficially.

3.5.2 Items of Assessment

(NRW)

Table 3.8 Items of Assessment of Technical capacity (NRW)

Category	Items	Remark (criteria)
A. Material Standard	A1. Material standard for newly pipe laying and repairing is established.	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
	A2. Inspection of procured materials.	[1. Unnecessary, 2. Never implemented, 3.Conducting when it is needed, 4. Inspect all the procured materials, 5. Inspect & record all the procured materials]
B. Design Standard	B1. Design standard for newly pipe laying and repairing is established.	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
C. Estimation Standard	C1. Estimation standard for newly pipe laying and repairing is established.	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
D. Construction Standard	D1. Construction standard for newly pipe laying and repairing is established.	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
E. Inspection Standard	E1. Completion inspection standard for newly pipe laying and repairing is established.	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
F. Technical Training	F1. Training for design, estimation, etc. are implemented. F2. Technical training for construction are implemented.	[1. Not existing, 2. Training for new employees, 3. Occasionally, 4. Implement if it necessary 5. Implement according to training plan.]

Category	Items	Remark (criteria)
	F3. Training for leak detecting are implemented.	
	F4. Training for measuring leakage volume are implemented.	
G. Information Management	G1. Grasp the information (pipe position, material, laying date, etc.) of the area in charge.	[1. No record, 2.No record (but necessary), 3. Grasp information of the area in charge, 4. Record on piping map, 5.Making a ledger and record on it]
	G2. Pipe information is recorded accurately	[1. No record, 2.Recorded (entrusted by the person in charge), 3. Record with memory 4. Recording regularly, 5.Recording regularly with construction record]
H. Equipment	H1. Equipment for pipe laying and repairing is prepared.	[1. Nothing, 2. Using old equipment, 3. Procure when it necessary, 4. Essential equipment is prepared 5. Up-to-date equipment]
I. Technical Level	I1.. Technical level of workers	[1. Only Field survey 2. Basic planning & design 3. Detail design & estimation 4. Define a diameter with hydraulic analysis, 5. Making DMA & Distribution Network]

(GIS)

Table 3.9 Items of Assessment of Technical Capacity (GIS)

Category		Items	Remark (criteria)
A. Establishment of section and GIS database(DB)	Section	A1. GIS section has been established.	1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (human resources and equipment are adequate), 5. Good as a model of benchmarking.
		A2. Duties regulations of GIS section has been formulated.	1. Not formulating 2. In the planning phase for formulation, 3. Formulating (but necessary for revision), 4. Formulating (revised duties regulations), 5. Good as a model of benchmarking.
	GIS DB (basic level)	A3. Human resources and equipment have been arranged.	1. Not existing, 2. In preparation, 3. Existing (but inadequate), 4. Existing (human resources and equipment are adequate), 5. Good as a model of benchmarking.
		A4. GIS DB(basic level*) has been built. (*ex. only location and shape of pipeline)	1. Not existing, 2. In the planning phase for building of DB, 3. Completed (partial area), 4. Completed (whole Yangon), 5. Good as a model of benchmarking.
B. Standard utilization of GIS	Operating plan of GIS in YCDC	B1. Operating plan of GIS has been formulated in YCDC.	1. Not formulating 2. In the planning phase for formulation, 3. Formulating (but necessary for revision), 4. Operating (revised duties regulations), 5. Good as a model of benchmarking.

Category		Items	Remark (criteria)
	Standard utilization	B2. GIS DB (standard level*) has been built. (*Ex. including information of diameter, material, installation year)	1. Not existing, 2. In the planning phase for building of DB, 3. Completed (partial area), 4. Completed (whole Yangon), 5. Good as a model of benchmarking.
		B3. YCDC's DB has been consolidated in GIS.	1. Not consolidating, 2. In the planning phase for consolidating of DBs, 3. Connection among DBs, 4. Consolidated, 5. Good as a model of benchmarking.
		B4. GIS DB is constantly updated.	1. Not updating, 2. In the planning phase for updating of GIS, 3. Annual update, 4. up-to-the-minute (monthly) update, 5. Good as a model of benchmarking.
		B5. GIS section provides some drawings to other departments for management of pipeline and facility.	1. Not operating 2. Only plan, 3. Only provision of GIS drawings, 4. Operating (revised regulations), 5. Good as a model of benchmarking.
C. Advanced utilization of GIS	Advanced utilization	C1. GIS DB (advanced level*) has been built. (*ex. including O&M data, such as open/close of valve, water pressure, flow rate, leakage detection, leakage repair work and so on)	1. Not existing, 2. In the planning phase for building of DB, 3. Completed (partial area), 4. Completed (whole Yangon), 5. Good as a model of benchmarking.
		C2. Customer data of GIS have been constantly updated by connection to customer DB.	1. Not utilizing, 2. In the planning phase for utilizing, 3. Utilized (partial area), 4. Utilized (whole Yangon), 5. Good as a model of benchmarking.
		C3. GIS has been utilized to improve service of water supply. (Ex. operation of valves and booster pumps).	
		C4. GIS has been utilized to reduce NRW (physical loss). (Ex. prioritization of pipeline for leakage detection).	
		C5. GIS has been utilized to reduce NRW (commercial loss). (Ex. countermeasure against defective meter and illegal connection).	
		C6. Hydraulic analysis has been utilized to design pipe-line network. (Ex.. decision of diameter)	
		C7. Geographical analysis has been utilized to improve service of water supply. (Ex.. reduction of customer claim and lack of fire tape).	
		C8. GIS has been utilized to make long- term construction replacement plan.	1. Not utilizing, 2. In the planning phase for utilizing, 3. Management of current assets, 4. Making long-term plan, 5. Good as a model of benchmarking.

3.5.3 Results of Assessment

(NRW)

Table 3.10 Results of Capacity Assessment of Technical Capacity (NRW)

Category	Items	Mark
A. Material Standard	A1. Material standard for newly pipe laying and repairing is established.	4
	A2. Inspection of procured materials.	4
B. Design Standard	B1. Design standard for newly pipe laying and repairing is established.	4
C. Estimation Standard	C1. Estimation standard for newly pipe laying and repairing is established.	4
D. Construction Standard	D1. Construction standard for newly pipe laying and repairing is established.	4
E. Inspection Standard	E1. Completion inspection standard for newly pipe laying and repairing is established.	3
F. Technical Training	F1. Training for design, estimation, etc. are implemented.	3
	F2. Technical training for construction are implemented.	3
	F3. Training for leak detecting are implemented.	3
	F4. Training for measuring leakage volume are implemented.	1
G. Information Management	G1. Grasp the information (pipe position, material, laying date, etc.) of the area in charge.	3
	G2. Pipe information is recorded accurately	2
H. Equipment	H1. Equipment for pipe laying and repairing is prepared.	4
I. Technical Level	I1. Technical level of workers	1

(GIS)

Table 3.11 Results of Capacity Assessment of Technical Capacity (GIS)

Category		Items	Mark
A. Establishment of section and GIS database(DB)	Section	A1. GIS section has been established.	2
		A2. Duties regulations of GIS section has been formulated.	2
	GIS DB (basic level)	A3. Human resources and equipment have been arranged.	3
		A4. GIS DB (basic level*) has been built. (*Ex.. only location and shape of pipeline)	3
B. Standard utilization of GIS	Operating plan of GIS in YCDC	B1. Operating plan of GIS has been formulated in YCDC.	1
	Standard utilization	B2. GIS DB (standard level*) has been built. (*Ex.. including information of diameter, material, installation year)	2
		B3. YCDC's DB has been consolidated in GIS.	3
		B4. GIS DB is constantly updated.	1
		B5. GIS section provides some drawings to other departments for management of pipeline and facility.	1
C. Advanced utilization of GIS	Advanced utilization	C1. GIS DB (advanced level*) has been built. (*Ex.. including O&M data, such as open/close of valve, water pressure, flow rate, leakage detection, leakage repair work and so on)	1
		C2. Customer data of GIS have been constantly updated by connection to customer DB.	1
		C3. GIS has been utilized to improve service of water supply. (Ex. operation of valves and booster pumps).	1
		C4. GIS has been utilized to reduce NRW (physical loss). (Ex. prioritization of pipeline for leakage detection).	1

Category		Items	Mark
		C5. GIS has been utilized to reduce NRW (commercial loss). (Ex. countermeasure against defective meter and illegal connection).	3
		C6. Hydraulic analysis has been utilized to design pipe-line network. (Ex. decision of diameter)	1
		C7. Geographical analysis has been utilized to improve service of water supply. (Ex. reduction of customer claim and lack of fire tape).	1
		C8. GIS has been utilized to make long- term construction replacement plan.	1

3.5.4 Overall Assessment and Approaches for Improvement

(NRW)

Standard

Standards of material, design, estimation, construction, and inspection have been established already. It is difficult to apply inspection standard for YCDC engineers according to the result of this questionnaire. Many pipe laying constructions have been done with unsuitable materials and design due to limited budget. Standards refer to pipe laying will be the cause of NRW directly. Every YCDC staff must understand and apply these standards and manuals. Before establishing standard for NRW, for the first step, these standard should be revised refer to the case study of developed countries.

Technical Training

Technical trainings for pipe design, construction, and leak detecting are held occasionally for YCDC staff. Periodically technical training are needed to keep and develop technical capacity. These training plans will be established by our project (mainly by HRD team). Candidate for trainer will be chosen from the counterparts of output2.

Information Management

Only a few information of past construction (pipe position, material, date, etc.) is one of the most serious problem for maintenance. According to the result of this questionnaire, currently WSD does not enough to grasp the information of existing pipe. To improve information management, design and completion drawing are needed as a primary work.

Technical Level

Currently, YCDC staffs who are in charge of pipe repairing, design and construction are conducting only a field survey. Pipeline design with suitable diameter and material will be required for NRW management. In advance, DMA design also will be required. Training of design, diameter calculation, leakage management, etc. will be held as NRW pilot project to develop technical capacity. Moreover, training plan will be set to keep and develop technical capacity.

(GIS)

Establishment of section and GIS database

GIS section has not been established officially yet. GIS database of pipeline, only shape and location, has been built in partial area. Conducting to build GIS database, but human resource and equipment are not enough.

The GIS section will be established with re-organization of WSD. Human resource (Capacity) will be developed through the training of this pilot project.

Standard utilization of GIS

Although GIS section is conducting to build GIS database, GIS operating plan is not established in YCDC. (Planning phase for formulation)

Advanced utilization of GIS

Advanced utilization of GIS is not existing due to GIS section is now in a starting phase.

To improve standard and advanced utilization of GIS, suggestion of duties of GIS section has been submitted by GIS expert. It include GIS Analysis Team and Database Management Team which will conduct following works:

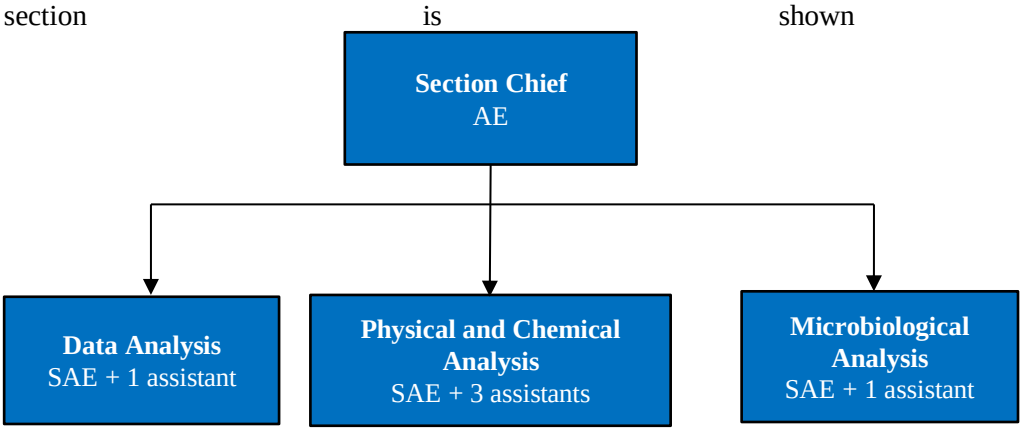
Table 3.12 Duties of GIS Section

GIS Analysis Team	Undertaking calculation works and analytical works utilizing GIS
	- Consult with other sections, including NRW Control Unit, concerning methodology of calculation and analysis utilizing GIS.
	- Undertake calculation and analysis utilizing GIS at requests of other sections. (Ex. prioritization of target pipelines for leakage detection work against NRW, analysis of correlation between water pressure and customer complain for customer satisfaction improvement, hydraulic analysis for design of pipeline network and so on.)
	All other atypical works in GIS Section
Database Management Team	Migrating data to GIS from AutoCAD and other concerned drawings
	Updating GIS database(DB) based on report from other sections (ex. Record of construction work by the PIPE Section and the Township offices, results of water pressure measurement and leakage detection by NRW Control Unit, record of customer's water consumption by the Computer Section and so on.)
	Checking the location of facilities required little or no field work

3.6 Water Quality Monitoring

3.6.1 Target of Assessment

Water quality monitoring section was established in July, 2014 under the Department of Water and Sanitation of YCDC. Purpose of this section is to monitor water quality in waterworks facility (Reservoir, WTP, and PS) and tap water, and to confirm a safety of water quality in water distribution system of YCDC. This section has 9 staffs. Staffs are allocated 3 sub-groups. Organization of this section is shown in Figure 3.2.



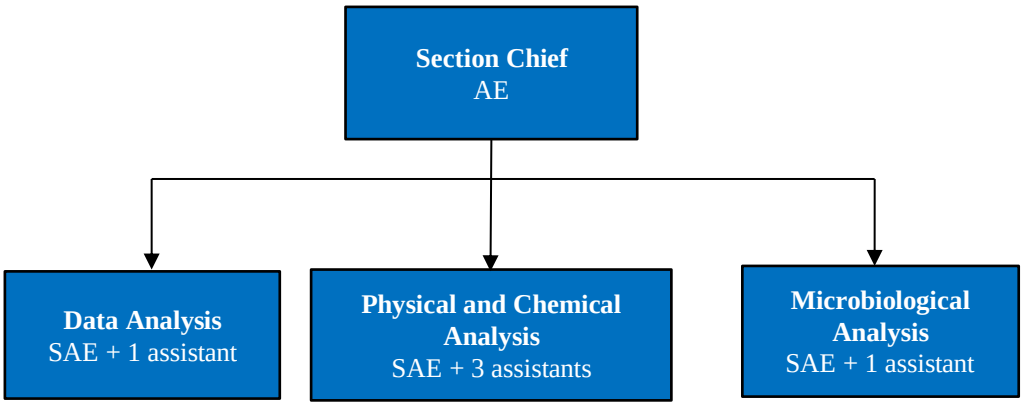


Figure 3.2 Organization of Water quality monitoring section

3.6.2 Items of Assessment

Item of assessment items is shown Table 3.13. Assessment items consist of 4 categories.

Table 3.13 List of assessment items

Category	Items	Criteria
A. Technical knowledge	A1. Planning of water quality monitoring (select sampling point, sampling frequency, monitoring item and analytical method).	[1. No knowledge, Cannot understand at all, 2. Understanding a little, Can understand when was explained, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others.]
	A2. Knowledge of water treatment technology (water treatment technology in WTP, e.g. coagulation, sedimentation, sand filtration and chlorination).	[1. No knowledge, Cannot understand at all, 2. Understanding a little, Can understand when was explained, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others.]
	A3. Opportunity to obtain the technical knowledge and analytical skill through training, etc.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking.]
B. Administrative rules and record keeping	B.1 Administrative rule of analytical equipment and reagents.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking.]
	B2. Administrator of analytical equipment and reagent.	
	B3. Procedure of purchase of analytical equipment and reagent.	
	B4. Recordkeeping of purchase, repair, maintenance and disposal of analytical equipment.	
	B5. Recordkeeping of purchase, consumption and disposal of reagent.	
C. SOPs and manual	C1. SOPs for water quality analysis	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking.]
	C2. Manual or SOP for accuracy management	
	C3. Procedure of development and revision of SOPs and manual.	
	C4. Procedure of accident response	

Category	Items	Criteria
	manual during sampling work and laboratory, e.g. emergency contact number list.	
	C5. Procedure of disposal of experimental waste	
D. Operation	D1. Number of analytical item which available in laboratory.	[1. Necessary for fundamental improvement, strengthening, 2. Necessary for major improvement, strengthening, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking.]
	D2. Procedure of development of monitoring plan.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking.]
	D3. Procedure of sample storage e.g. storage method (room temperature, refrigerator) and storage period	
	D4. Format of data sheet and procedure of store keeping of analytical data.	

3.6.3 Results of Assessment

Summary of assessment result is shown in Table 3.14, and radar chart is shown Figure 3.3.
Through this assessment, at first, development of SOPs and manuals is urgent need (Ref. C2 – C5). At present, development of SOPs of water quality monitoring is in progress. After that, SOPs and manuals of administration of water quality monitoring equipment, reagent, waste disposal and emergency response are developed.

Water quality monitoring plan is already exist. However, the capacity of improvement or revision of monitoring plan is not enough (Ref. A1and D2). For this capacity development, improvement of water quality monitoring plan is in progress. Based on this experience, procedure of revision of water quality monitoring plan is developed.

At present, sample storage procedure is not developed (Ref. D3). For this issue, not only a development of SOPs or manual, but also preparation of enough capacity sample storage equipment (storage space and refrigerator) is necessary.
Water quality monitoring section had started them activity since 2014. Therefore, the already have water quality data of over 1 years. In the early stage, these monitoring data are written on notebook. However, to utilize these data, it is necessary to establish an electrical data base system.
Water quality monitoring section already started an establishment of electrical data base system. After this, an establishment of management rule of data base is necessary.

Table 3.14 Result of assessment (Summary)

Category	Items	Mark
A. Technical knowledge	A1. Planning of water quality monitoring (select sampling point, sampling frequency, monitoring item and analytical method).	2
	A2. Knowledge of water treatment technology (water treatment technology in WTP, e.g. coagulation, sedimentation, sand filtration and chlorination).	2
	A3. Opportunity to obtain the technical knowledge and analytical skill through training, etc.	1
B. Administrative rules and record keeping	B.1 Administrative rule of analytical equipment and reagents.	1
	B2. Administrator of analytical equipment and reagent.	3
	B3. Procedure of purchase of analytical equipment and reagent.	4

	B4. Recordkeeping of purchase, repair, maintenance and disposal of analytical equipment.	4
	B5. Recordkeeping of purchase, consumption and disposal of reagent.	4
C. SOP and manual	C1. SOPs for water quality analysis	3
	C2. Manual or SOP for accuracy management	1
	C3. Procedure of development and revision of SOPs and manual.	1
	C4. Procedure of accident response manual during sampling worl and laboratory, e.g. emergency contact number list.	1
	C5. Procedure of disposal of experimental waste	1
D. Operation	D1. Number of analytical item which available in laboratory.	3
	D2. Procedure of development of monitoring plan.	3
	D3. Procedure of sample storage e.g. storage method (room temperature, refrigerator) and storage period	1
	D4. Format of data sheet and procedure of store keeping of analytical data.	1

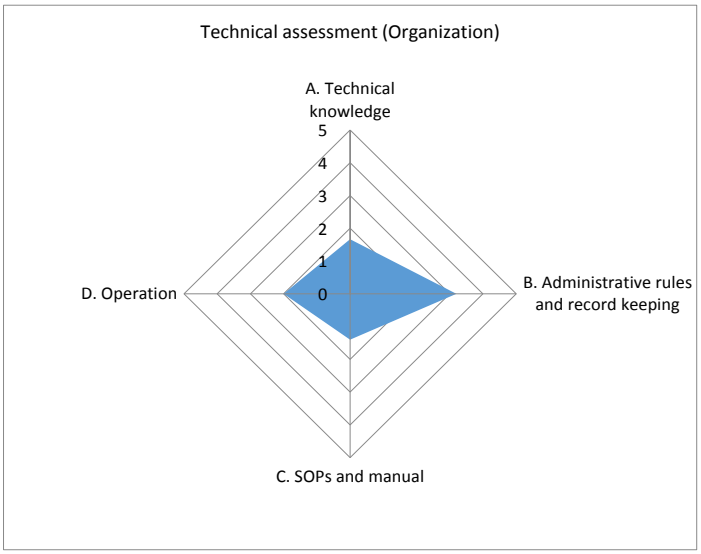


Figure 3.3 Rader chart of technical assessment (Organization)

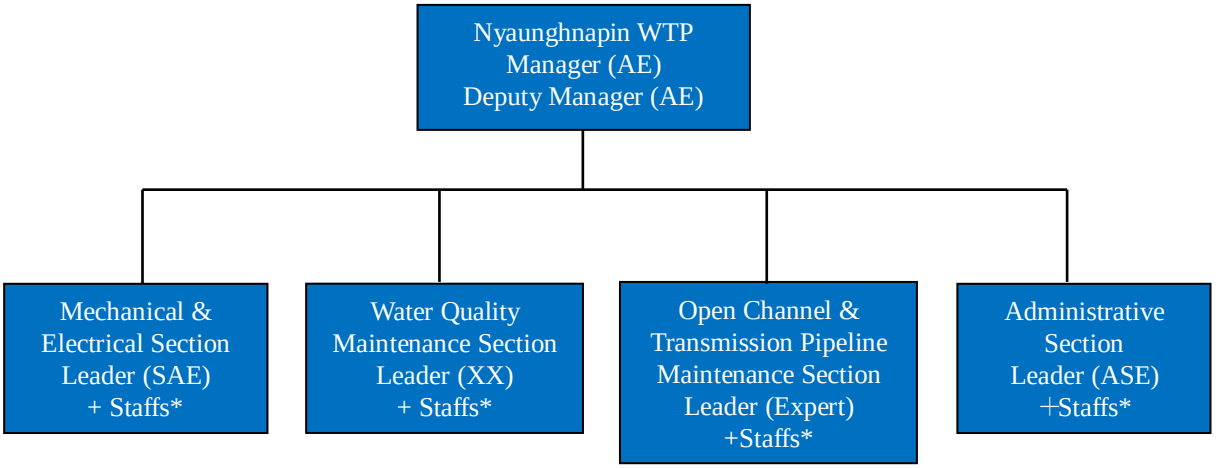
3.6.4 Overall Assessment and Approaches for Improvement

There is room for improvement about A. Technical knowledge, C.SOPs and manual and D. Operation.
For the capacity of technical knowledge, enhancement is done by the individual capacity development including OJT and seminar. However, enhancement of the opportunity of technical training (Ref. A3) is necessary to cooperate with Output 1.
For the capacity of SOPs and manual, development of SOPs is already started. SOPs of water quality monitoring are completed in Phase 1. In parallel of this SOPs development, procedure of sample storage and data management (Ref. D3 and D4) is improved.
However, procedure of experimental waste disposal (Ref. C5) is pressing issue. For this issue, cooperation with waste management section of YCDC is necessary.
Considering these issues, proposed contents of training plan is described in Section 5.6.

3.7 Water Treatment

3.7.1 Target of Assessment

Existing organization structure of Nyaunghnapin WTP is shown in Figure 3.4. There are 4 sections in the WTP. Total number of the staff is 112, including 2 Assistant Engineers (AE) and 4 Sub Assistant Engineers (SAE). It is considered that number of sub-manager class is short compared to the number of all staff in the WTP.



*Exact number of staffs of each section is not clear.
Source: YCDC

Figure 3.4 Organization Structure of Nyaunghnapin Water Treatment Plant

3.7.2 Items of Assessment

List of assessment items is shown Table 3.15. Assessment items consist of 8 categories.

Table 3.15 List of assessment items

Category	Items	Criteria
A. Organization and staffing	A1. Organization of management section of WTP (number of staff, chain of order, duty and power).	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	A2. Organization of maintenance and repair section of WTP (number of staff, chain of order, duty and power).	
	A3. Specialized section for operation and maintenance of electrical equipment.	
	A4. Specialized section for operation and maintenance of mechanical equipment.	
	A5. Rule of staff recruitment of WTP.	
B. Information management	B1. Document control and data management system in WTP is established.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	B2. Preparation and store keeping of design drawing and layout drawing of facilities and equipment.	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	B3. Preparation and store keeping of tabulated list of specification of facilities and equipment.	
	B4. Technical information management (obtain, arrangement and storekeeping of technical information) of mechanical and electrical service	
	B5. Technical information management (obtain, arrangement and storekeeping of technical information) of water treatment and water quality management (e.g. water	

Category	Items	Criteria
	treatment technology, water quality equipment, etc.)	
C. Management of O&M work	C1. Annual plan of O&M (e.g. chemical procurement, water quality monitoring, periodical inspection, etc.)	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C2. Management system of O&M work (Store keeping of O&M record, confirmation of planned O&M activity, establishment of O&M plan, etc.)	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	C3. Organization plan and manual of repair	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C4. Internal rule (rule of YCDC) of O&M.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C5. Rules of procurement and purchase of spare parts, chemical, etc.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C6. Preparation of O&M report	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C7. Development and recordkeeping of O&M report	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	C8. Preparation of repaur report	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C9. Development and recordkeeping of repair report	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	C10. Registration of facility and equipment.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C11.Track record of facility and equipment from installation.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C12. Outsourcing of O&M work (what kind of outsourcing work)	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	C13. Rules of outsourcing of O&M work.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
D. O&M manual and SOPs	D1. O&M manual and SOPs of facility and equipment. (1) Raw water pump	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	D2. O&M manual and SOPs of facility and equipment. (2) Coagulation tank	
	D3. O&M manual and SOPs of facility and equipment. (3) Coagulant injection facility and	

Category	Items	Criteria
	coagulant injector	
	D4. O&M manual and SOPs of facility and equipment. (4) Sedimentation tank	
	D5. O&M manual and SOPs of facility and equipment. (5) Sand filtration tank and backwashing facility	
	D6. O&M manual and SOPs of facility and equipment. (6) Chemical storage facility	
	D7. Procedure of making, review and storekeeping of operation manual and SOPs	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	D8. Procedure of preparation and storekeeping of operating record.	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
E. Budget and procurement	E1. Responsible person of budget (cost estimation) for O&M	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	E2. Internal rurle for procurement and purchasing spareparts, chemicals, etc.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	E3. Understanding of domestic and overseas supply situation of equipment, spareparts, chemicals, etc.	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
F. Technical Capacity	F1. Operator's understanding of water treatment technology for WTP operation (e.g. coagulation-sedimentation, sand filtration, chlorination)	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	F2. Opportunity to receive training about water treatment technology (in house training of YCDC).	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	F3. Opportunity to obtain the latest water treatment technology (receive training, attend seminar, etc.).	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	F4. Contents of instruction to site operator (intelligibility of operator, specific suggestion is necessary or not)	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	F5. Understanding of concept of preventive maintenance.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	F6. Capacity operating ratio of WTP	[1.Necessary for fundamental improvement,

Category	Items	Criteria
	(actual water production / designed water production)	strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	F7. Understanding of WTP's ability of water treatment (degree of turbidity reduction, etc.).	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	F8. Understanding of trend of raw water quality.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	F9. Understanding of planned value ant trend of treated water quality.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
G. Operation of WTP	G1. Priority level of facility and equipment (Facility and equioment which should be kept the function to maintain the function of WTP)	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	G2. Operating plan including quantity of water intake, production volume, water transmission volume (daily, hourly),etc.	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	G3. Recorded operation parameter (daily, weekly, monthly). e.g. water production, number of operating sedimentation pond, number of operating filtration pond, etc.	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for benchmarking.]
	G4. Preparation and store keeping of operation record	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	G5. Preparation and reporting (to YCDC HQ) of periodical operation report.	
	G6. Periodical inspection plan of WTP	
	G7. Item of periodical inspection	
	G8. Record and store keeping of periodical inspection report.	
	G9. Contingency plan including electric outage, malfunction of equipment, anomaly of water treatment, etc.	
	G10. Control of chemical injection	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	G11. Determination of chemical injection volume	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	G12. Monitoring of injection ratio	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4.

Category	Items	Criteria
		Not necessary for modification., 5.Can be a model for bench making.]
	G13. Installation of backup equipment	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	G14. Establishment of operation manual of chemical injection	[1.Not existing., 2.Existing but not working., 3. Working to some extent., 4.Working well., 5.Can be a model for benchmarking.]
	G15. Purchase schedule of water purification chemicals.	
	G16. Problems about acquisition of water purification chemical (date required, buying procedure, etc.)	
	G17. Reserved amount of water purification chemicals .	
	G18. Storage condition of each water purification chemicals (temperature control, ventilation, with or without of shading device)	
	G19. Quality control system of stoaged water purification chemicals	
	G20. System of injection control and monitoring of each water purification chemicals.	
	G21. Record of chemical injection control (kind of chemical, injection rate (ppm), injection period)	
	G22. Usage of chemical injection record.	
	G23. Location of flowmeter	[1.Necessary for fundamental improvement, strengthening., 2.Necessary for major improvement, strengthening., 3.Necessary for partial improvement., 4. Not necessary for modification., 5.Can be a model for bench making.]
	G24. Control method of treated water volume	
	G25. Location of water-level gage	
	G26. Operation control of flush mixing (adjust flow rate, adjust G value, etc.)	
	G27. Operating condition of flush mixing facility (flow rate, G value)	
	G28. Operation control of slow mixing (adjust flow rate, adjust G value, etc.)	
	G29. Operating condition of slow mixing facility (flow rate, G value)	
	G30. Condition of flocculation (size, sedimentation property)	
	G31. Frequency of sludge withdraw of sedimentation tank	
	G32. Turbidity after sedimentation process (Target value: 5NTU)	
	G33. Operating control of filtration tank (adjust flow rate, etc,)	
	G34. Operating condition of filtration tank (flow rate, filter run time, maintenance schedule)	
	G35. Operating control of back	

Category	Items	Criteria
	washing (adjust backwashing rate, backwashing period, etc.)	
	G36. Condition of backwashing (procedure of backwashing, backwashing rate, condition of start and stop of backwashing)	
	G37. Periodical inspection of backwashing rate and condition of filtration media.	
	G38. Periodical supply (refill) of filtration media	
	G39. Making and storekeeping of operation record of filtration tank.	
	G40. Periodical cleaning of clear water tank	
	G41. Operating plan of water transmission pump	
	G42. Making and storekeeping of operation record.	
	G43. Usage of operation record of water transmission pump	
	G44. Location and of water quality monitoring in water purification process	
	G45. Water quality monitoring item	
	G46. Making and store keeping of water quality monitoring data.	
	G47. Usage of water quality data	
H. Stock of spare parts and repairing material	H1. Stock of spare parts and repairing material	

3.7.3 Results of Assessment

Summary of assessment result is shown in Table 3.16, and radar chart is shown Figure 3.5.
At first, capacity of F: Technical capacity and G: Operation of WTP is low. There are few reasons of this result. One reason is a number of well-educated staff or SAE level engineer is not enough. However, because of the location of WTP (very far from central Yangon, and lack of transportation facility), staff recruitment is very difficult. Considering the establishment of new WTP in Lagunpin, issue of staff recruiting is a pressing issue for YCDC.

The other reason is an insufficient technical training of worker. Operation manual and SOPs are not prepared. Therefore, an appropriate technical knowledge is not shared among WTP staffs.
In addition, specification document of WTP (e.g. drawing, list of equipment, tracking record, etc.) are not managed in WTP. Therefore, technical understanding of WTP is not accelerated among WTP staffs.

Table 3.16 Result of assessment (Summary)

Category	Items	Mark
A. Organization and staffing	A1. Organization of management section of WTP (number of staff, chain of order, duty and power).	3
	A2. Organization of maintenance and repair section of WTP (number of staff, chain of order, duty and power).	3
	A3. Specialized section for operation and maintenance of electrical equipment.	3
	A4. Specialized section for operation and maintenance of mechanical equipment.	3

Category	Items	Mark
	A5. Rule of staff recruitment of WTP.	3
B. Information management	B1. Document control and data management system in WTP is established.	3
	B2. Preparation and store keeping of design drawing and layout drawing of facilities and equipment.	3
	B3. Preparation and store keeping of tabulated list of specification of facilities and equipment.	3
	B4. Technical information management (obtain, arrangement and storekeeping of technical information) of mechanical and electrical service	2
	B5. Technical information management (obtain, arrangement and storekeeping of technical information) of water treatment and water quality management (e.g. water treatment technology, water quality equipment, etc.)	2
C. Management of O&M work	C1. Annual plan of O&M (e.g. chemical procurement, water quality monitoring, periodical inspection, etc.)	3
	C2. Management system of O&M works (Store keeping of O&M record, confirmation of planned O&M activity, establishment of O&M plan, etc.)	3
	C3. Organization plan and manual of repair	2
	C4. Internal rule (rule of YCDC) of O&M.	1
	C5. Rules of procurement and purchase of spare parts, chemical, etc.	3
	C6. Preparation of O&M report	3
	C7. Development and recordkeeping of O&M report	3
	C8. Preparation of repair report	3
	C9. Development and recordkeeping of repair report	3
	C10. Registration of facility and equipment.	1
	C11.Track record of facility and equipment from installation.	1
	C12. Outsourcing of O&M work (what kind of outsourcing work)	1
	C13. Rules of outsourcing of O&M work.	1
D. O&M manual and SOPs	D1. O&M manual and SOPs of facility and equipment. (1) Raw water pump	1
	D2. O&M manual and SOPs of facility and equipment. (2) Coagulation tank	1
	D3. O&M manual and SOPs of facility and equipment. (3) Coagulant injection facility and coagulant injector	1
	D4. O&M manual and SOPs of facility and equipment. (4) Sedimentation tank	1
	D5. O&M manual and SOPs of facility and equipment. (5) Sand filtration tank and backwashing facility	1
	D6. O&M manual and SOPs of facility and equipment. (6) Chemical storage facility	3
	D7. Procedure of making, review and storekeeping of operation manual and SOPs	2
	D8. Procedure of preparation and storekeeping of operating record.	2
E. Budget and procurement	E1. Responsible person of budget (cost estimation) for O&M	3
	E2. Internal rule for procurement and purchasing spare parts, chemicals, etc.	3
	E3. Understanding of domestic and overseas supply situation of equipment, spare parts, chemicals, etc.	2
F. Technical Capacity	F1. Operator's understanding of water treatment technology for WTP operation (e.g. coagulation-sedimentation, sand filtration, chlorination)	2
	F2. Opportunity to receive training about water treatment technology (in house training of YCDC).	1
	F3. Opportunity to obtain the latest water treatment technology (receives training, attend seminar, etc.).	1
	F4. Contents of instruction to site operator (intelligibility of operator, specific suggestion is necessary or not)	3
	F5. Understanding of concept of preventive maintenance.	1
	F6. Capacity operating ratio of WTP (actual water production / designed water production)	3
	F7. Understanding of WTP's ability of water treatment (degree of turbidity reduction,	1

Category	Items	Mark
	etc.).	
	F8. Understanding of trend of raw water quality.	1
	F9. Understanding of planned value ant trend of treated water quality.	1
G. Operation of WTP	G1. Priority level of facility and equipment (Facility and equipment which should be kept the function to maintain the function of WTP)	1
	G2. Operating plan including quantity of water intake, production volume, water transmission volume (daily, hourly),etc.	1
	G3. Recorded operation parameter (daily, weekly, and monthly). e.g. water production, number of operating sedimentation pond, number of operating filtration pond, etc.	1
	G4. Preparation and store keeping of operation record	1
	G5. Preparation and reporting (to YCDC HQ) of periodical operation report.	1
	G6. Periodical inspection plan of WTP	1
	G7. Item of periodical inspection	1
	G8. Record and store keeping of periodical inspection report.	1
	G9. Contingency plan including electric outage, malfunction of equipment, anomaly of water treatment, etc.	1
	G10. Control of chemical injection	1
	G11. Determination of chemical injection volume	1
	G12. Monitoring of injection ratio	1
	G13. Installation of backup equipment	1
	G14. Establishment of operation manual of chemical injection	1
	G15. Purchase schedule of water purification chemicals.	1
	G16. Problems about acquisition of water purification chemical (date required, buying procedure, etc.)	1
	G17. Reserved amount of water purification chemicals.	1
	G18. Storage condition of each water purification chemicals (temperature control, ventilation, with or without of shading device)	1
	G19. Quality control system of stored water purification chemicals	1
	G20. System of injection control and monitoring of water purification chemicals.	1
	G21. Record of chemical injection control (kind of chemical, injection rate (ppm), injection period)	1
	G22. Usage of chemical injection record.	1
	G23. Location of flowmeter	1
	G24. Control method of treated water volume	1
	G25. Location of water-level gage	1
	G26. Operation control of flush mixing (adjust flow rate, adjust G value, etc.)	1
	G27. Operating condition of flush mixing facility (flow rate, G value)	1
	G28. Operation control of slow mixing (adjust flow rate, adjust G value, etc.)	1
	G29. Operating condition of slow mixing facility (flow rate, G value)	1
	G30. Condition of flocculation (size, sedimentation property)	1
	G31. Frequency of sludge withdraw of sedimentation tank	1
	G32. Turbidity after sedimentation process (Target value: 5NTU)	1
	G33. Operating control of filtration tank (adjust flow rate, etc.,)	1
	G34. Operating condition of filtration tank (flow rate, filter run time, maintenance schedule)	1
	G35. Operating control of back washing (adjust backwashing rate, backwashing period, etc.)	1
	G36. Condition of backwashing (procedure of backwashing, backwashing rate, condition of start and stop of backwashing)	1
	G37. Periodical inspection of backwashing rate and condition of filtration media.	1
	G38. Periodical supply (refill) of filtration media	1
	G39. Making and storekeeping of operation record of filtration tank.	1
	G40. Periodical cleaning of clear water tank	1
	G41. Operating plan of water transmission pump	1
	G42. Making and storekeeping of operation record.	1

Category	Items	Mark
	G43. Usage of operation record of water transmission pump	1
	G44. Location and of water quality monitoring in water purification process	1
	G45. Water quality monitoring item	1
	G46. Making and store keeping of water quality monitoring data.	1
	G47. Usage of water quality data	1
H. Stock of spare parts and repairing material	H1. Stock of spare parts and repairing material	3

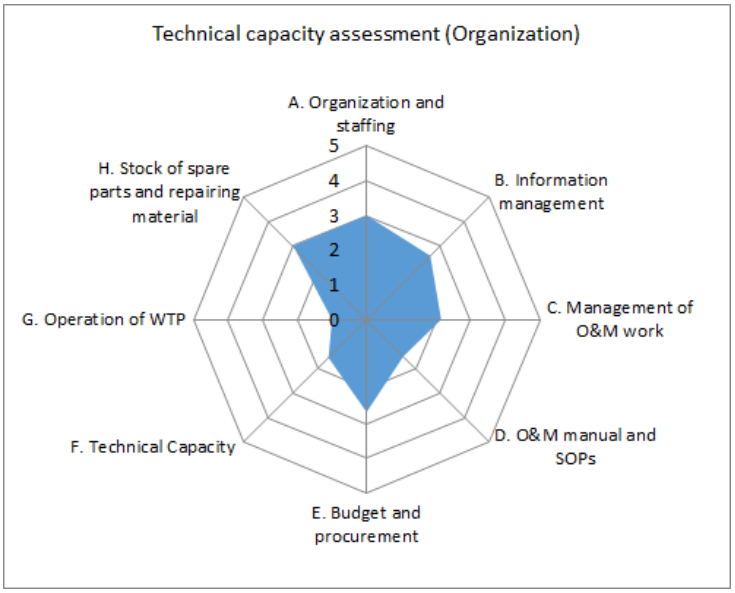


Figure 3.5 Rader chart of technical assessment (Organization)

3.7.4 Overall Assessment and Approaches for Improvement

Contents of training plan are described in Section 5.7. At present, revision of water treatment process and periodical water quality monitoring are started in Nyaungnapin WTP.

However, the priority issue is an enhancement of technical capacity of WTP staffs on water treatment technology. Considering the result of capacity assessment, technical capacity of staffs and workers are not trained systematically. Therefore, JICA expert team has proposed systematic training of water treatment technology including seminar and OJT.

In addition, operation manuals and SOPs are not prepared until now. Operation manual and SOPs are important items to maintain stable operation of WTP. In addition, operation manuals and SOPs are effective textbook to train staffs and workers. For this reason, operation manual and SOPs are developed early.

However, many of WTP staffs don't have enough knowledge of the specification of WTP and appropriate operation procedure of equipment. Therefore, review of existing O&M procedure (including orally trained procedure) and confirmation of specification of existing equipment and facility should be done.

CHAPTER 4. Individual Core Capacity

4.1 Target of Assessment

The targets of the assessment are mainly counterpart members of the Project in total 52 people as listed in Table 4.1.

Table 4.1 Project members assessed

Project involvement	Name	Position	Section	Division
Finance	Myint Myint Than	Officer	Finance	Admin & Finance
	Khin Khin Htwe	AE	Finance	Admin & Finance
	Moe Moe Khine	AE	Finance	Admin & Finance
	Thin Thin Yi	Accountant 1	Finance	Admin & Finance
	Tin Tin Moe	Accountant 1	Finance	Admin & Finance
	San San Myint	Accountant 2	Finance	Admin & Finance
	May Thet Kyaw	Accountant 4	Finance	Admin & Finance
	Able Khin Myint	WA	Finance	Admin & Finance
	Ohnmar Soe	WA	Finance	Admin & Finance
	San Yu Maw	WA	Finance	Admin & Finance
	Hnin Mya Khine	WA	Finance	Admin & Finance
	Shwe Zin Aung	WA	Finance	Admin & Finance
HRD	Kyaw Kyaw Oo	AE	Other Lakes	Water Supply
	Aung Moe Kyaw	SAE	Office	Reservoir
	Su Nandar Linn	SAE	House Connection	Water Supply
	Mya Mya Aye	Supervisor	Admin	Admin & Finance
	Khin Zin Mar Myint	Programmer	Admin	Admin & Finance
	Moh Moh San	WA	Computer	Reservoir
	May Htoo Aung	WA	Office	Reservoir
NRW	Zayar Tun	AE	Reservoir	Reservoir
	Tint Zaw	AE	Transmission Pipe 1	Water Supply
	Pyone Cho	AE	Transmission Pipe 2	Water Supply
	Aye Pyae Aung	SAE	Reservoir	Reservoir
	Aung Min Oo	SAE	Reservoir	Reservoir
	Ohnmar Myint	SAE	Reservoir	Reservoir
	Aung ko Ko Win	SAE	Transmission Pipe 1	Water Supply
	Kaung Khant	SAE	Transmission Pipe 1	Water Supply
	Than Winn	SAE	Transmission Pipe 1	Water Supply
	Tun Tun Hlaing	SAE	Transmission Pipe 1	Water Supply
	Myat Hsu Hlaing	SAE	Transmission Pipe 2	Water Supply
	San San Htwe	SAE	Transmission Pipe 2	Water Supply
	Aung Ko Ko Tin	SAE	Transmission Pipe 2	Water Supply
	Min Thant Zin	SAE	Transmission Pipe 2	Water Supply
	Myo Thant Tun	SAE	Transmission Pipe 2	Water Supply
	Than Oo	SAE	Transmission Pipe 2	Water Supply
	Aye Myat Thu	Flat	Reservoir	Reservoir
	Hein Htun	Flat	Reservoir	Reservoir
	Tin Tin Win	Flat	Reservoir	Reservoir
	Phyo Phyo khaing	WA	Transmission Pipe 2	Water Supply
Water Treatment	Zaw Oo	AE	WTP	Reservoir
	Nyi Nyi Aung	AE	WTP	Reservoir
	Thidar Su Su Khin	SAE	WTP	Reservoir

Project involvement	Name	Position	Section	Division
	May Thaw Tar Oo	Flat	WTP	Reservoir
Water Quality Monitoring	Ei Khaing Mon	AE	Water Quality & Monitoring	Supporting
	Nwe Nwe Zin	SAE	Water Quality & Monitoring	Supporting
	May Zin Oo	SAE	Water Quality & Monitoring	Supporting
	New New Sin	SAE	Water Quality & Monitoring	Supporting
	Thondor Myat	SAE	Water Quality & Monitoring	Supporting
	Aye Aye Thuzar	Flat	Water Quality & Monitoring	Supporting
	Hsu Myat Mon	Flat	Water Quality & Monitoring	Supporting
	May Zin Oo	WA	Water Quality & Monitoring	Supporting
	Myat Su Mon	WA	Water Quality & Monitoring	Supporting

4.2 Items of Assessment

Core capacity is large concept and seems to be related to entire management. Therefore, the assessment items are as unified to all counterparts as organizational core capacity. For selection of assessment items, the capacity which is expected to be developed through C/Ps' activities of the Project is prioritized. Target items of assessment are shown in Table 4.2.

Core capacity tends to be difficult to be seen and measured objectively. Therefore, assessment of individual core capacity is conducted by self-assessment of counterpart and confirmed by their supervisors respectively. The counterparts are asked to assess own capacity in 5 scales and also describe their advantage and points need to be improved concerning each area. As the characteristics of the assessment procedures, the results are not easily compared across counterparts, but are expected to be utilized for monitoring development of capacity of each counterpart through time.

Table 4.2 Items of Assessment of Individual Core Capacity

Category	Items	Criteria
1. Awareness, leadership	1. Applying what s/he learnt in actual job.	[1. Never, 2. Sometimes, 3. Mostly, 4. Actively]
	2. Sharing what s/he learnt with colleagues/staff.	
2. Management	1. Implementing assigned job with well-scheduling.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Can teach to others]
	2. Coordinating/contacting with related sections properly	
	3. Making documents such as report properly.	
3. Problem solution	1. Grasping and analyzing actual situation properly.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 8. Can teach to others]
	2. Understanding problems/issues.	
	3. Making plans for solving the problems.	
	4. Having ability to get things done.	[1. Little, 2. A little, 3. Having, 4. Greatly, 5. Can be a model to other staff]
	5. Having willingness to solve existing problems.	

4.3 Results of Assessment

Results of the individual assessment are compiled in APPENDIX. Table 4.3 and Figure 4.1 show the summarized results. To grasp status of core capacity, the assessed counterparts are grouped into 3 categories according to their position; A. officer level including job level of Assistant Engineer, Accountant 1, B. ordinal permanent staff including Sub Assistant Engineer, Supervisor, Accountant 2, Accountant 4, and Programmer, and C. non-permanent staff level including Flat and WA.

Table 4.3 Results of Assessment of Individual Core Capacity

Category	Items	Average	A. Officer (N=11)	B. SAE below (N=25)	C. WA-Flat (N=16)
A. Awareness, leadership	1. Applying what you learnt in actual job.	3.4	3.6	3.4	3.1
	2. Sharing what you learnt with colleagues/staff.	3.1	3.5	2.9	2.9
B. Management	1. Implementing assigned job with well-scheduling.	2.9	3.3	3.2	2.1
	2. Coordinating/contacting with related sections properly	2.8	3.0	3.2	1.9
	3. Making documents such as report properly.	2.3	2.5	2.4	2.0
C. Problem solution	1. Grasping and analyzing actual situation properly.	2.6	3.1	2.8	1.9
	2. Understanding problems/issues.	2.5	2.9	2.6	1.9
	3. Making plans for solving the problems.	2.2	2.5	2.2	1.9
	4. Having ability to get things done.	3.1	3.3	3.2	2.7
	5. Having willingness to solve existing problems.	2.8	3.0	2.9	2.6

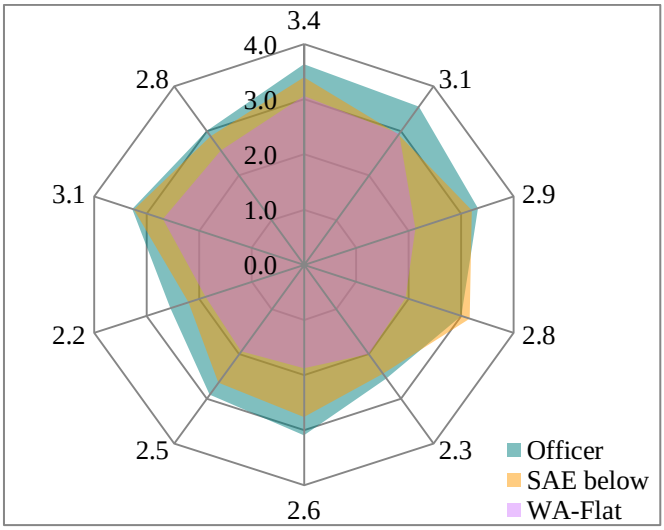


Figure 4.1 Graph of Result of Individual Core Capacity

4.4 Overall Assessment and Approaches for Improvement

4.4.1 Awareness, leadership

Most staff marked higher than other items regardless of the position. More than 45 % of staff marks "4. Actively". Some younger staff feels difficulty to apply what they learn to their job because they seem not to have enough experience to be able to link the theory learnt to practices.

[Approaches to improve]

- ✓ Encourage C/P members to apply what they experienced through project activities.
- ✓ Increase occasions for sharing C/Ps' ideas and experiences through regular meetings and workshops of the Project activities.

4.4.2 Management

Obviously, staff in higher position marked higher except "2-3 reporting". Management capacity seems to be developed through their daily work. Younger staffs seem to be unfamiliar not only to make and

work along work plan, but work closely with other sections. On "2-3 reporting", there are few staffs marking "4. I can do alone in sufficient quality". The result matches assessment result of the organization level on planning that "quality of the report is needed to be improved". As considering this is self-assessment, the quality of report is needed to be improved at personal level and organizational level.

[Approaches to improve]
- ✓ Make work plan and schedule for each activity before implementing.
- ✓ Encourage lower level staff to work closely with related sections through project activities.
- ✓ Empower counterparts to make report orally and in writing at every occasion.
- ✓ Improve quality of report to be able to be referred for decision making.

4.4.3 Problem solution

In present organization structure, the discretion is not well delegated to the worksite. Therefore, staff is not familiar to make plans by themselves. This type of capacity is limited to younger staff especially grasping and understand the problems (Item 3-1, 3-2, 3-3 of in Table 4.3). In general, ordinary staff does not have little opportunities to consider approaches for problem-solving. Once the direction to solve the issues is shown as work plan or order of a supervisor, most staff has self-confidence to do as shown in the results of 3-4 and 3-5 in Table 4.3.

[Approaches to improve]
- ✓ Provide lower staff more opportunities to think of background of problems.
- ✓ Provide counterparts more chances to discuss among counterparts for looking for better solutions through project activities.

CHAPTER 5. Individual Technical Capacity

5.1 Financial Conditions and Utility Management

5.1.1 Target of Assessment

Staff members of Financial Section are in charge of expenditure/income and management of budget of WSD which are a part of the YCDC's general account. Members have not experience of management of independent account, or P/L or B/S that is necessary to get a self-sufficient and sustainable management of water supply.

In daily work, members of EE and AE class are responsible for all works of Financial Section and looks very busy with coordination among CE, executive members of other divisions. Members of Accountant class are responsible for their own jobs and look not so pressing on their daily jobs. Members of WA class are assisting EE's job and look only following directions of their superiors'.

The table below shows the target of assessment which includes three C/Ps and 9 other members of Financial Section.

Table 5.1 Target of Assessment

Name	Section	Class
Ms. Myint Myint Than	Finance & Accounting	EE
Ms. Khin Khin Htwe	Finance & Accounting	AE
Ms. Moe Moe Khaing	Finance & Accounting	AE
Ms. Tin Tin Moe	Finance & Accounting	Accountant-1
Ms. Thin Thin Yi	Finance & Accounting	Accountant-1
Ms. San San Myint	Finance & Accounting	Accountant-2
Ms. May Thet Kyaw	Finance & Accounting	Accountant-4
Ms. Shwe Zin Aung	Finance & Accounting	WA
Ms. Hnin Mya Khaing	Finance & Accounting	WA
Ms. Ohn Mar Soe	Finance & Accounting	WA
Ms. Abal Khin Myint	Finance & Accounting	WA
Ms. San Yu Maw	Finance & Accounting	WA

In order to get self-sufficient and sustainable management, staff members of Financial Section of WSD shall have intention and knowledge to improve the present account system and financial system. Accordingly purpose of assessment here is how much they are interested in corporate accounting and management of "water utility" that common in usual water utility applied and how much they have knowledge about this matter.

5.1.2 Items of Assessment

Table 5.2 Items of Assessment

Category	Items	Remark (criteria)
A. Describe the present procedure of budget set-up and budget control in WSD/YCDC	A1:Can you describe the procedure of annual budget set up and budget control on expenditure in WSD/YCDC? It may include all sections of WSD and Budget Department of YCDC, the Regional Government and the Central Government.	[1: I can not describe it. I do not have knowledge regarding this matter. I have no experience regarding this matter., 2: I can describe rough sketch of it. I have some knowledge, and I can do this kind of job
	A2:Can you describe the legal and regulatory background of budget set up and budget control in WSD/YCDC and do you know the decision makers about budget at each step clearly?	
	A3:Can you describe how and why the system of budget has been changed for these 10, 20 or 30 years?	
	A4:Can you describe some characteristics about budget system in YCDC comparing other governmental budget system or private	

Category	Items	Remark (criteria)
	organization's budget system?	if I have manuals or getting some instructions., 3: I can describe almost all of it. I have experience doing this kind of job and I can do this kind of job by myself with a little challenge., 4. I can describe all of it. I have enough knowledge and I can do this kind of job by myself well enough., 5. I have a experience of making lectures about this kind of topics. I can make instructions regarding this kind of job]
	A5:Can you describe on-going renovation/reform plan/scheme(s) of budget system in YCDC, and/or do you have any idea to improve budget system in WSD/YCDC in the future?	
B. Describe the present procedure of accounting system and making financial statement in WSD/YCDC	B1:Can you describe the procedure of accounting and making financial statements at the end of fiscal year in WSD/YCDC? It may include all sections of WSD and other Department of YCDC, the Regional Government and the Central Government.	
	B2:Can you describe about legal and regulatory background of accounting and making financial statements of WSD/YCDC and do you know the decision makers about accounting and making financial statements?	
	B3:Can you describe how and why the system of accounting and making financial statements has been changed for these 10, 20 or 30 years?	
	B4:Can you describe some characteristics about accounting and making financial statements system in YCDC comparing other governmental system or private organization's system?	
	B5:Can you describe on-going renovation/reform plan/scheme of accounting system and making financial statements in YCDC, and/or do you have any idea to improve them in WSD/YCDC in the future?	
C. Describe the present procedure of water tariff setting in YCDC	C1:Can you describe the procedure of tariff setting (both metered rate and flat rate) in YCDC? It may include all sections of WSD and other Department of YCDC, the Regional Government and the Central Government.	
	C2:Can you describe the difference between metered rate customers and flat rate customers regarding customer services provided by YCDC.	
	C3:Can you describe the difference between customers who get the 24/7 water supply and customers who get the intermittent water supply in the aspect of water tariff?	
	C4:Can you describe the legal and regulatory background of tariff setting, and do you know the decision makers about tariff setting clearly?	
	C5:Can you describe how and why the system of tariff setting has been changed for these 10, 20 or 30 years?	
	C6:Can you describe some characteristics about tariff (price) setting system in YCDC comparing other governmental system or private organization's system?	
	C7:Can you describe on-going renovation/reform plan/scheme of tariff setting system in YCDC, and/or do you have any idea to improve it in YCDC in the future?	
D. Describe the present fees that WSD/YCDC levy/collect	D1:Can you describe fees that WSD/YCDC levy/collect from customers/ plumbing companies/ owners of land or building/ citizens regarding water supply services?	
	D2:Can you describe the legal and regulatory background of such fees, and do you know the decision makers about fees setting clearly?	
	D3:Can you describe how and why the system of such fees have been changed for these 10, 20 or 30 years?	
	D4:Can you describe some characteristics about fees in WSD/YCDC comparing other governmental system or private organization's system?	
	D5:Can you describe on-going renovation/reform plan/scheme of fee system in YCDC, and/or do you have any idea to improve it in YCDC in the future?	

Category	Items	Remark (criteria)
E. Describe the present fees that WSD/YCDC levy/collect	E1:Can you describe the meaning of the following figure/illustration which appears in the web-site of YCDC (English version) as "Facts about YCDC"?	
	E2:Can you describe how YCDC can move to "Desirable Circle"? Have you ever think about it?	
F. Describe the difference of government account and corporation account	F1:Can you describe the difference of government account and corporation account especially on Double-Entry bookkeeping and Single-Entry bookkeeping?	
	F2:Can you describe the difference of government account and corporation account especially on concept of depreciation of fixed (capital) assets?	
	F3:Can you describe the difference of government account and corporation account especially on the separation of expenditures for fixed assets (capital) account and expenditures for P/L account?	
	F4:Can you describe the difference of government account and corporation account especially on the accrual versus cash account? (When expenditures and revenues are recorded? Cash move or contracts are signed?)	
	F5:Can you describe the difference of government account and corporation account especially on the separation of expenditures for fixed assets (capital) account and expenditures for P/L account?	
	F6:Can you describe the difference of government account and corporation account especially about the cash flow account? Can you describe why cash flow account is required in corporation account and can describe what is it?	
	F7:Can you describe the main purpose of government account and that of corporation account? Can you describe the difference of purpose and the reason?	
G. Describe P/L account	G1:Can you describe what abbreviation of P/L stands for and describe some items P/L account includes?	
	G2:Can you describe how to put P/L account items in order to calculate profit?	
	G3:Can you describe what kind of information we get from P/L account statement?	
	G4:Can you describe some differences between governmental enterprise's P/L account and private corporation's?	
	G5:Can you describe some methods of depreciation that are used in P/L account?	
H. Describe B/S account	H1:Can you describe what abbreviation of B/S stands for and describe some items B/S account includes?	
	H2:Can you describe how to put B/S account items in order to make B/S account statement?	
	H3:Can you describe what kind of information we get from B/S account statement?	
	H4:Can you describe how to write down on the B/S account when you construct a purification plant?	
	H5:Can you describe if a government institution like YCDC introduce B/S account what kind of difficulties they encounter?	
I. Describe some Characteristics of public water supply in the market economy	I1:Can you describe how price of bottled water is fixed in the competitive market economy?	
	I2:Can you describe how efficient allocation of goods and services is achieved in market economy? Have you ever learned the meaning of marginal cost?	
	I3:Can you describe how price of goods or services in monopolistic industries like public water supply services should	

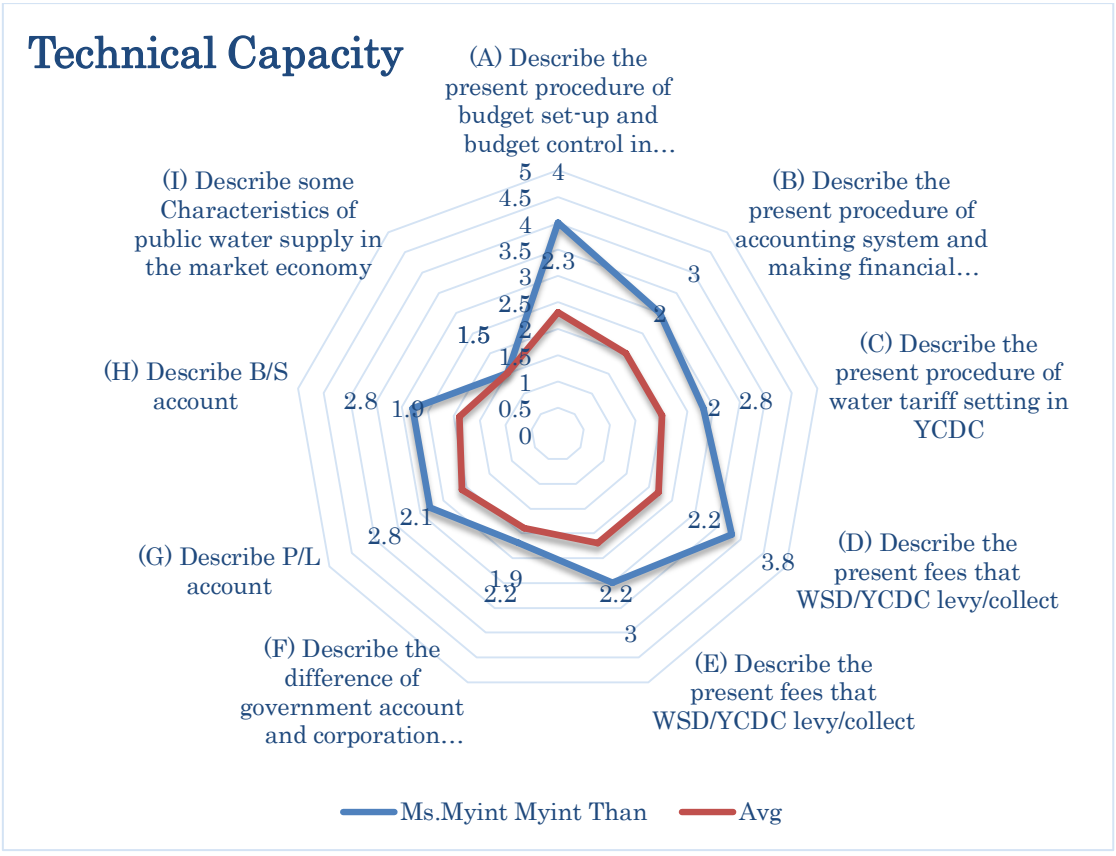
Category	Items	Remark (criteria)
	be fixed or decided?	
	I4:Can you describe the meaning and concept of "cost of service" which is introduced in monopolistic industry like public water supply services?	
	I5:Can you describe the meaning and concept of "self supporting system (self sufficient system)" which is introduced in the governmental enterprise such as governmental water supply enterprise, governmental electricity supply, governmental transportation system, governmental city gas supply, so on.	
	I6:Can you describe the meaning and concept of "beneficiary pay principle (polluter pay principle)" which is introduced in the governmental services such as	

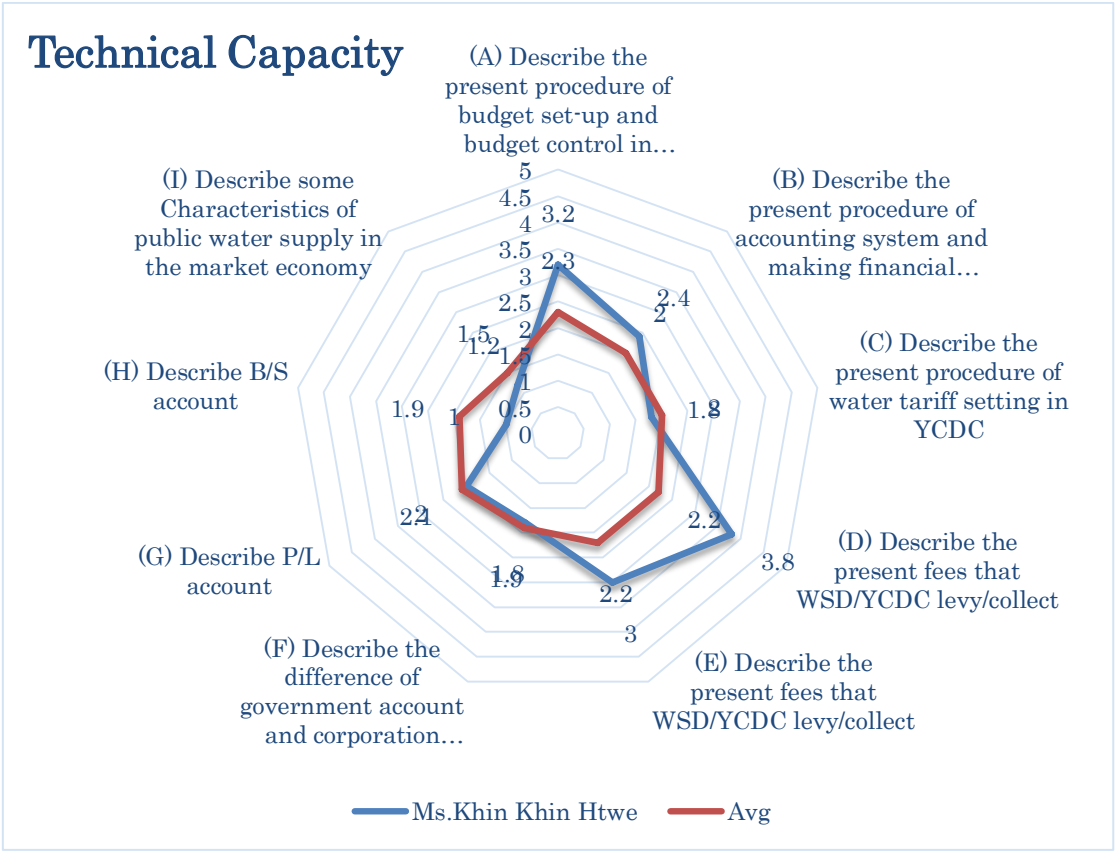
5.1.3 Results of Assessment

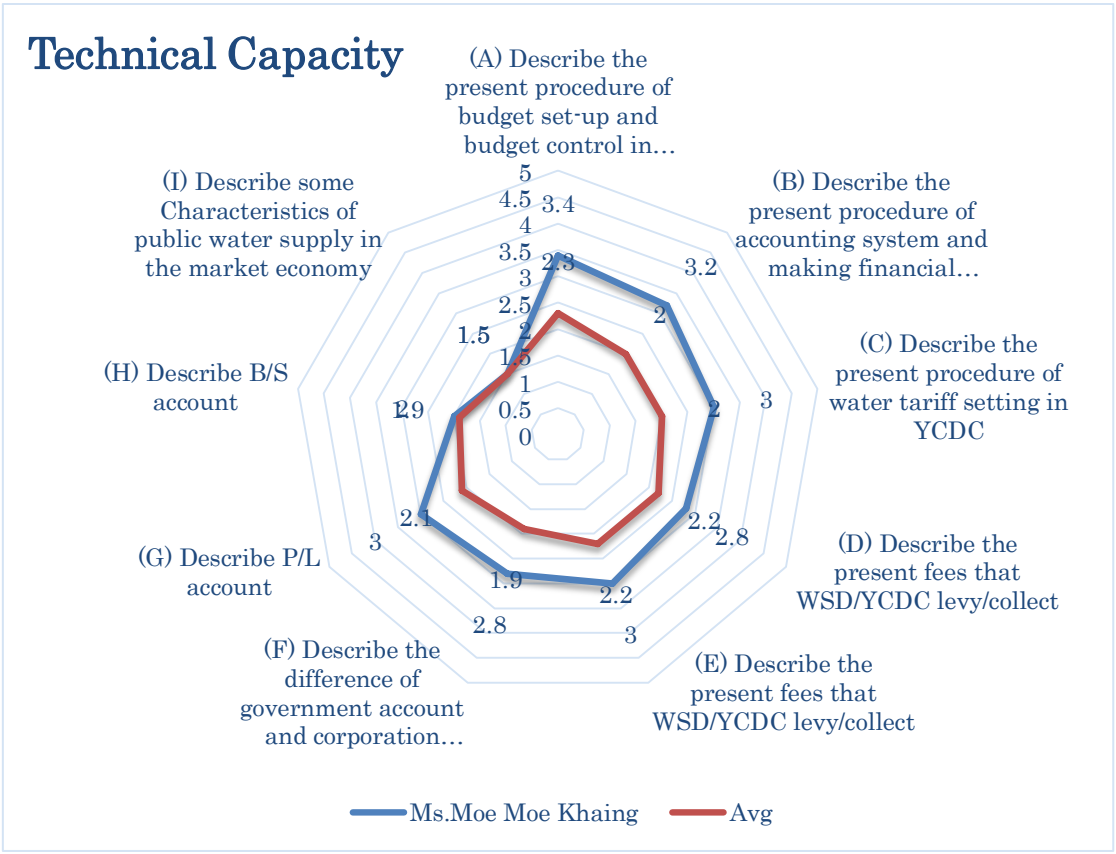
Table 5.3 Results of Assessment

Category	Items	Ms.Myint Myint Than	Ms.Khin Khin Htwe	Ms.Moe Moe Khaing	Ms.Tin Tin Moe	Ms.Thin Thin Yi	Ms.San San Myint	Ms.May Thet Kyaw	Ms.Shwe Zin Aung	Ms.Hnin Mya Khaing	Ms.Ohn Mar Soe	Ms.Abal Khin Myint	Ms.San Yu Maw	Average
A. Describe the present procedure of budget set-up and budget control in WSD/YCDC	A1	4	4	4	2	2	2	1	1	2	2	2	1	2.25
	A2	4	4	4	2	2	2	2	2	2	2	2	2	2.5
	A3	4	4	3	2	1		1	2	2	1	2	2	2.19
	A4	4	2	3	2	2	2	1	1	2	1	2	1	1.92
	A5	4	2	3	2	2	2	1	2	2	1	2	2	2.09
B. Describe the present procedure of accounting system and making financial statement in WSD/YCDC	B1	3	2	4	2	2	1	2	2	2	1	2	2	2.09
	B2	4	4	3	2	2	2	2	2	2	1	2	2	2.34
	B3	3	2	3	2	2	1	1	2	1	1	1	2	1.75
	B4	3	2	3	2	2	2	1	1	1	1	1	1	1.67
	B5	2	2	3	2	2	2	2	2	2	1	2	2	2
C. Describe the present procedure of water tariff setting in YCDC	C1	4	2	3	2	2	2	2	2	2	2	2	2	2.25
	C2	4	2	3	2	1	2	2	2	2	2	2	2	2.17
	C3	2	2	3	2	2	2	2	2	2	2	2	2	2.09
	C4	2	2	3	2	2	1	2	1	1	1	1	1	1.59
	C5	3	1	3	2	2	2	1	1	1	1	2	1	1.67
	C6	2	1	3	2	1	2	1	2	2	1	2	2	1.75
	C7	2	2	3	2	2	2	1	2	2	1	2	2	1.92
D. Describe the present fees that WSD/YCDC levy/collect	D1	5	5	3	2	2	2		1	2		2	1	2.5
	D2	4	4	3	2	2	2	2	1	2	2	2	1	2.25
	D3	4	4	3	2	2	2	1	2	1	1	1	2	2.09
	D4	2	2	3	2	2	2	1	1	2	1	2	1	1.75
	D5	4	4	2	2		2	2	2	2	1	2	2	2.28
E. Describe the present fees that WSD/YCDC levy/collect	E1	3	3	3	2		2	2	2	2	1	2	2	2.19
	E2	3	3	3	2		2	2	2	2	1	2	2	2.19
F. Describe the difference of government account and corporation account	F1	3	2	3	2	2	2	2	2	2	1	2	2	2.09
	F2	2	2	3	2	2	1	2	2	2	1	2	2	1.92
	F3	2	2	3	2	2	2	2	2	2	1	2	2	2
	F4	2	2	2	2	2	1	1	1	1	1	1	1	1.42
	F5	2	2	3	2	2	2	2	2	2	1	2	2	2
	F6	2	1	2	2	2	2	2	2	2	1	2	2	1.84
	F7	2	1	3	2	2	2	1	2	1	1	1	2	1.67
G.	G1	3	2	3	2	2	1	2	2	2	1	2	2	2

Category	Items	Ms.Myint Myint Than	Ms.Khin Khin Htwe	Ms.Moe Moe Khaing	Ms.Moe Moe	Ms.Tin Tin Thin Yi	Ms.Thin Myint Myint	Ms.San San Thet Kyaw	Ms.May Zin Aung	Ms.Shwe Mya Khaing	Ms.Hnin Soe	Ms.Ohn Mar Khin Myint	Ms.Abal Maw	Ms.San Yu	Average
Describe P/L account	G2	3	2	3	2	2	2	2	2	2	1	2	2		2.09
	G3	3	2	3	2	2	2	2	2	2	1	2	2		2.09
	G4	2	2	3	2	2	2	2	2	2	1	2	2		2
	G5	3	2	3	2	2	2	2	2	2	1	2	2		2.09
H. Describe B/S account	H1	3	1	2	2	2	2	2	2	2	2	2	2		2
	H2	3	1	2	2	2	2	2	2	2	1	2	2		1.92
	H3	3	1	2	2	2	1	2	2	2	1	2	2		1.84
	H4	3	1	2	2	2	2	1	1	1	1	1	1		1.5
	H5	2	1	2	2	2	2	2	1	2	1	2	1		1.67
I. Describe some Characteristics of public water supply in the market economy	I1	2	1	2	2	2	2	2	1	2	1	2	1		1.67
	I2	2	1	2	2	2	2	1	2	1	1	2	2		1.67
	I3	2	2	2	2	2	2	1	1	1	1	1	1		1.5
	I4	1	1	1	2	2	1	1	1	1	1	1	1		1.17
	I5	1	1	1	2	2	2	1	1	1	1	2	1		1.34
	I6	1	1	1	2		2	2	1	2	1		1		1.4




Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
Ms.Khin Khin Htwe
Avg


Technical Capacity
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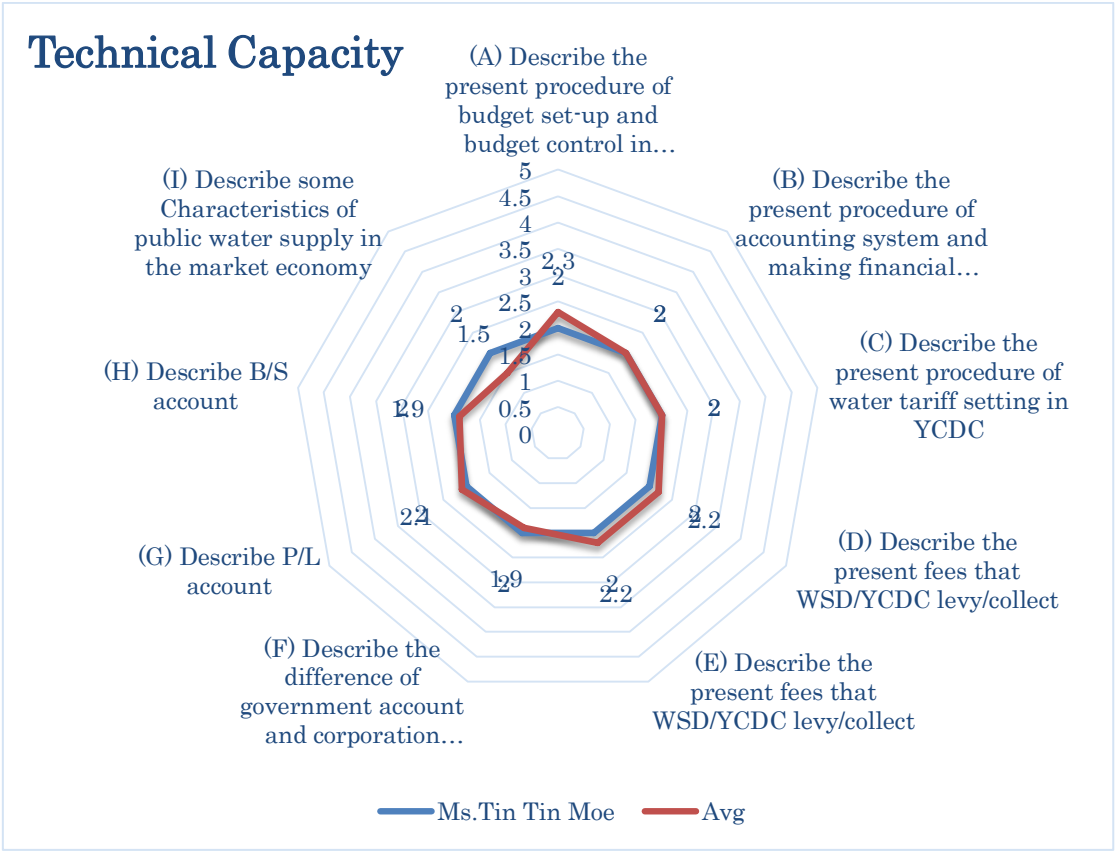
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
Ms.Moe Moe Khaing
Avg


Technical Capacity
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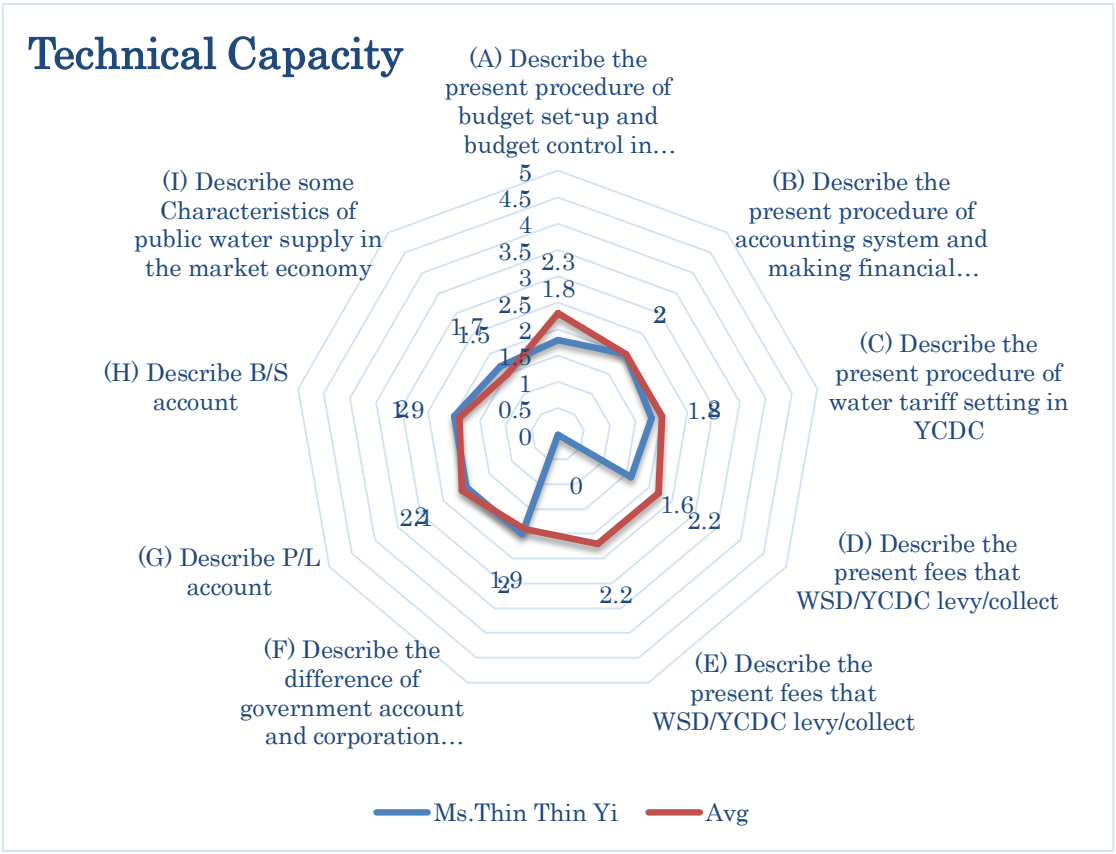
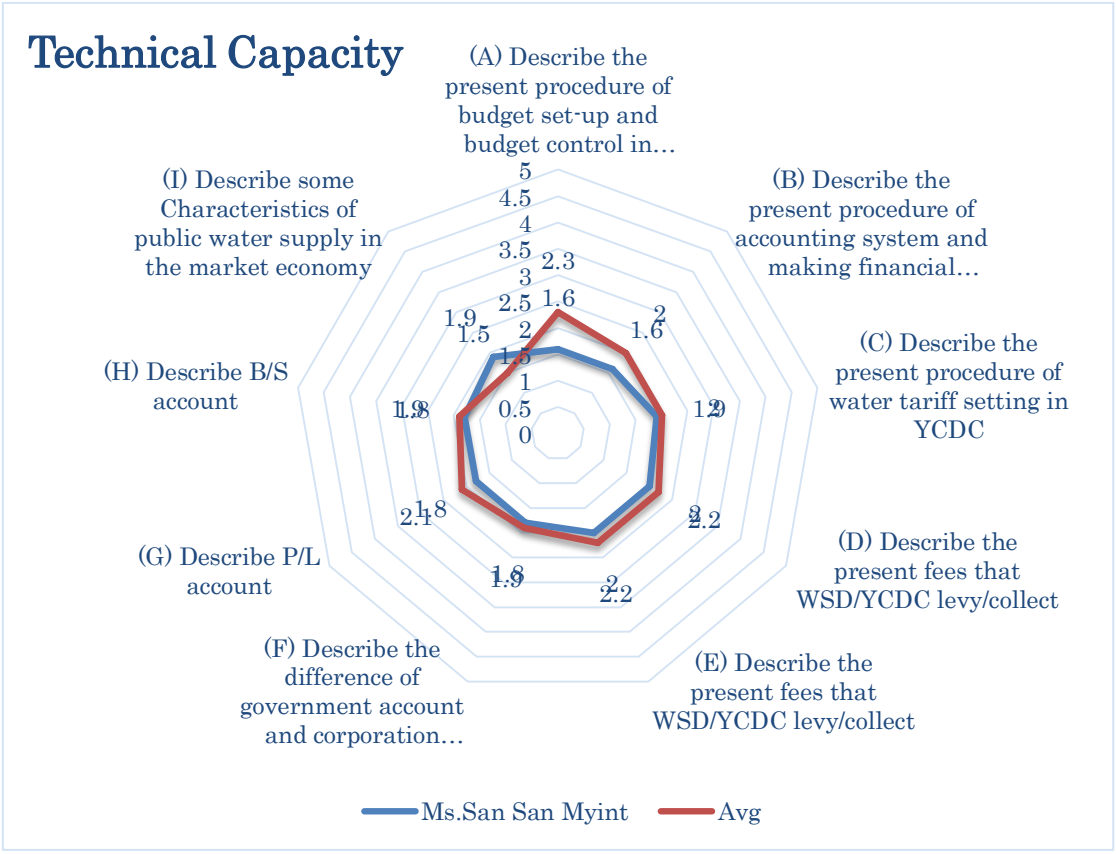
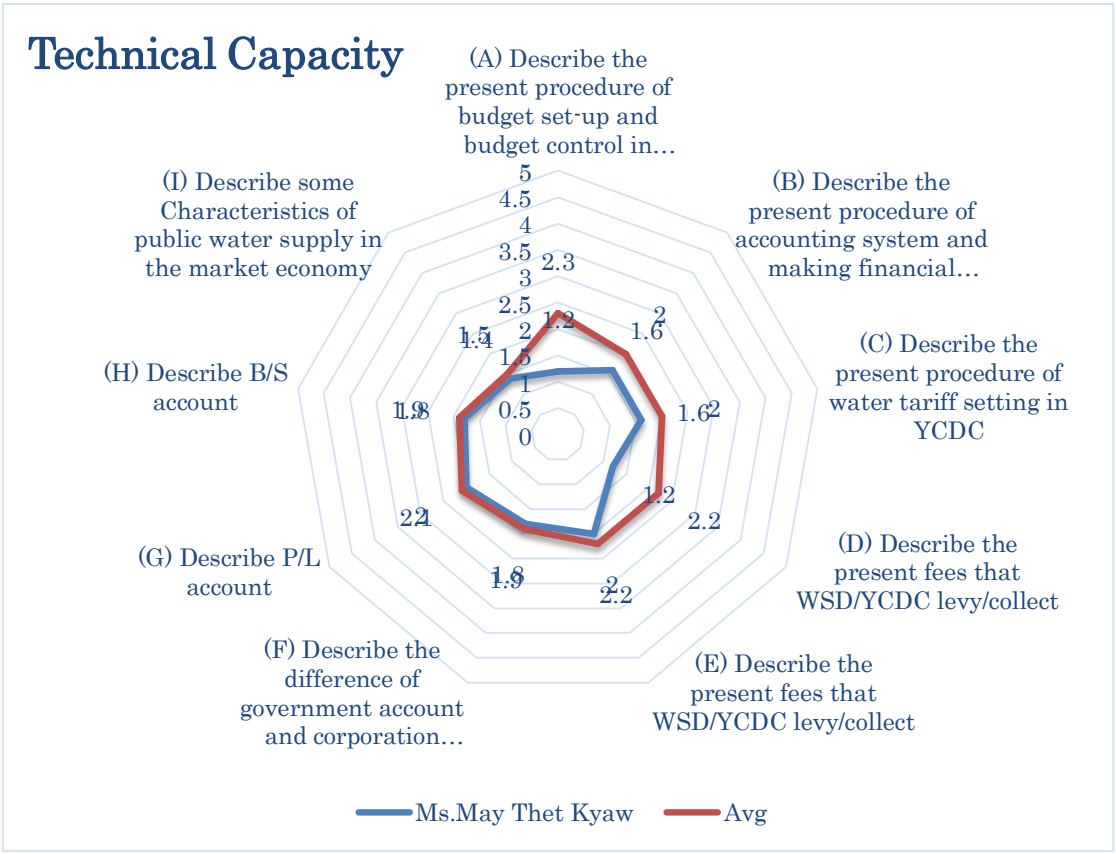
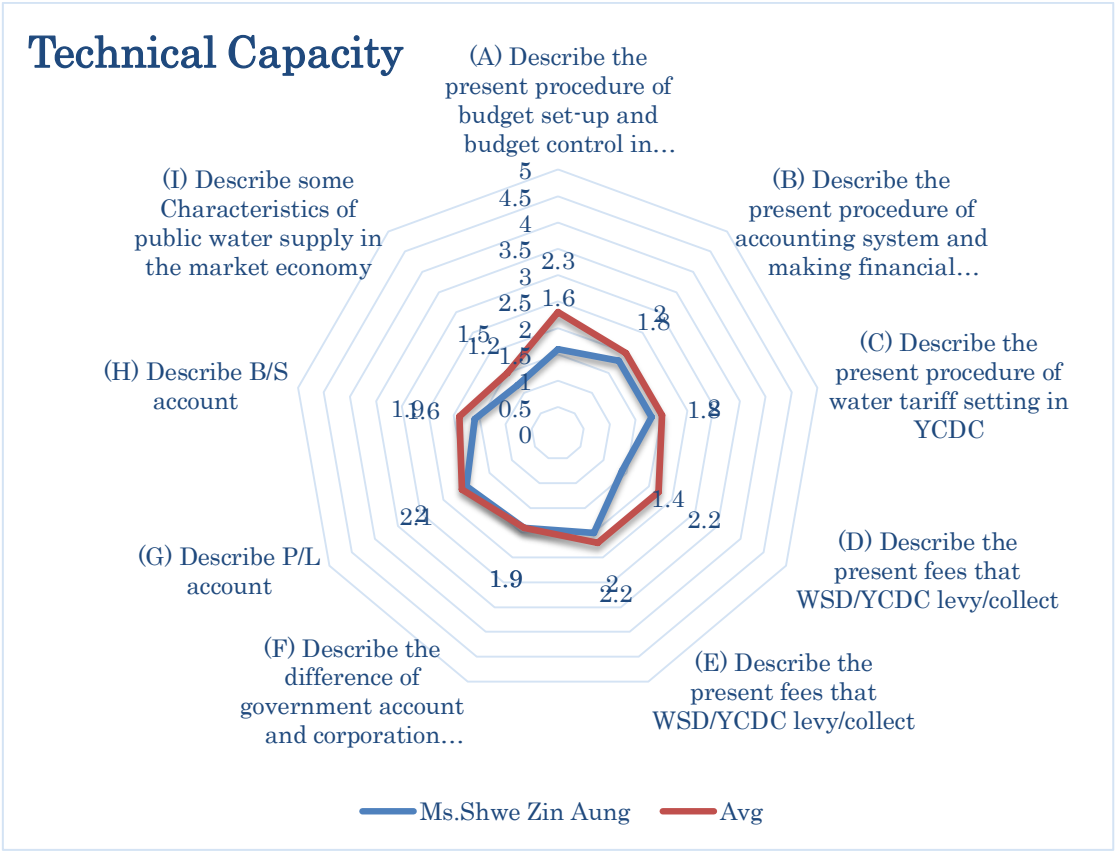
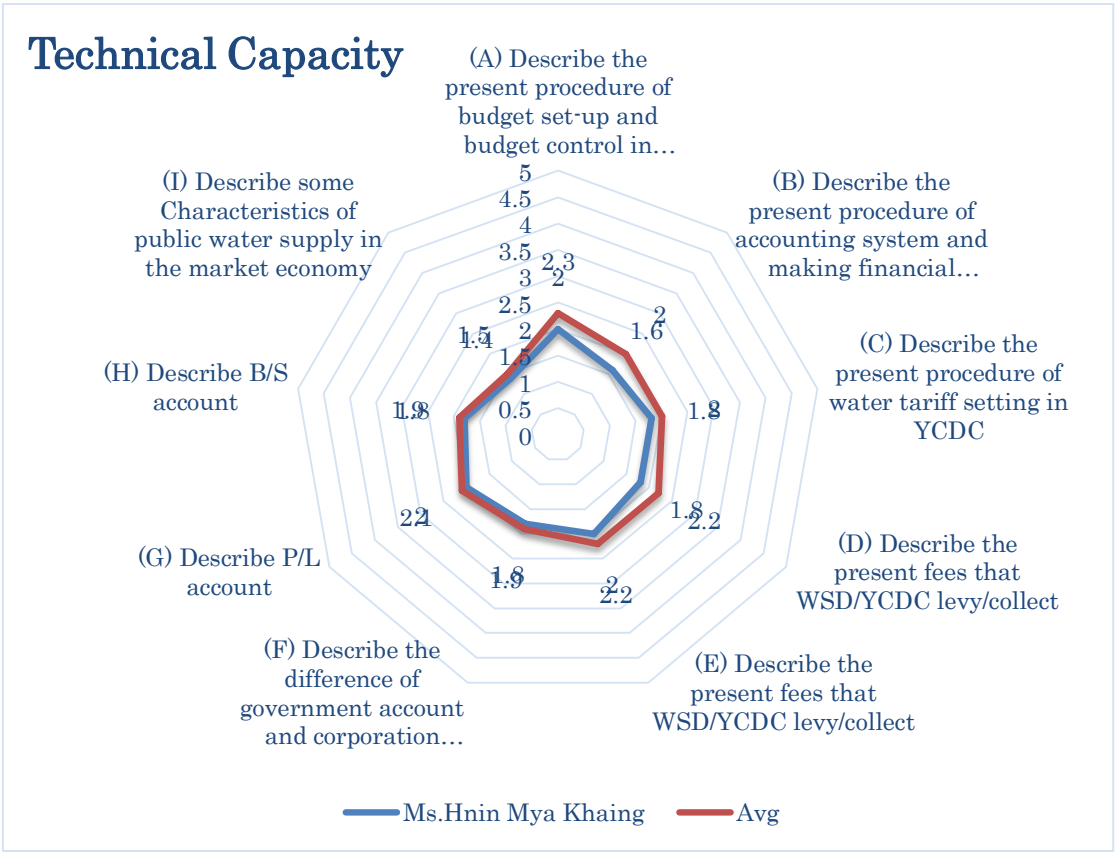
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.Tin Tin Moe
Avg

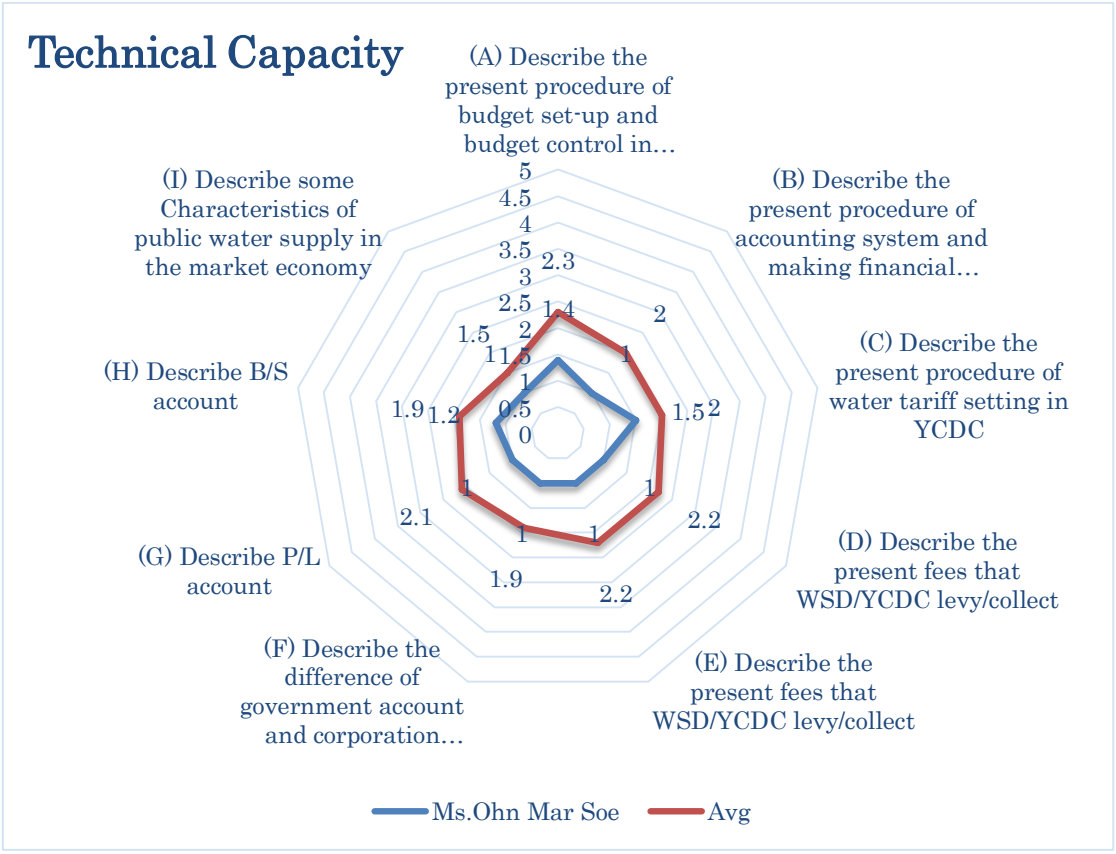

Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.Thin Thin Yi
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.San San Myint
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.May Thet Kyaw
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.Shwe Zin Aung
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Ms.Hnin Mya Khaing
Avg


Technical Capacity
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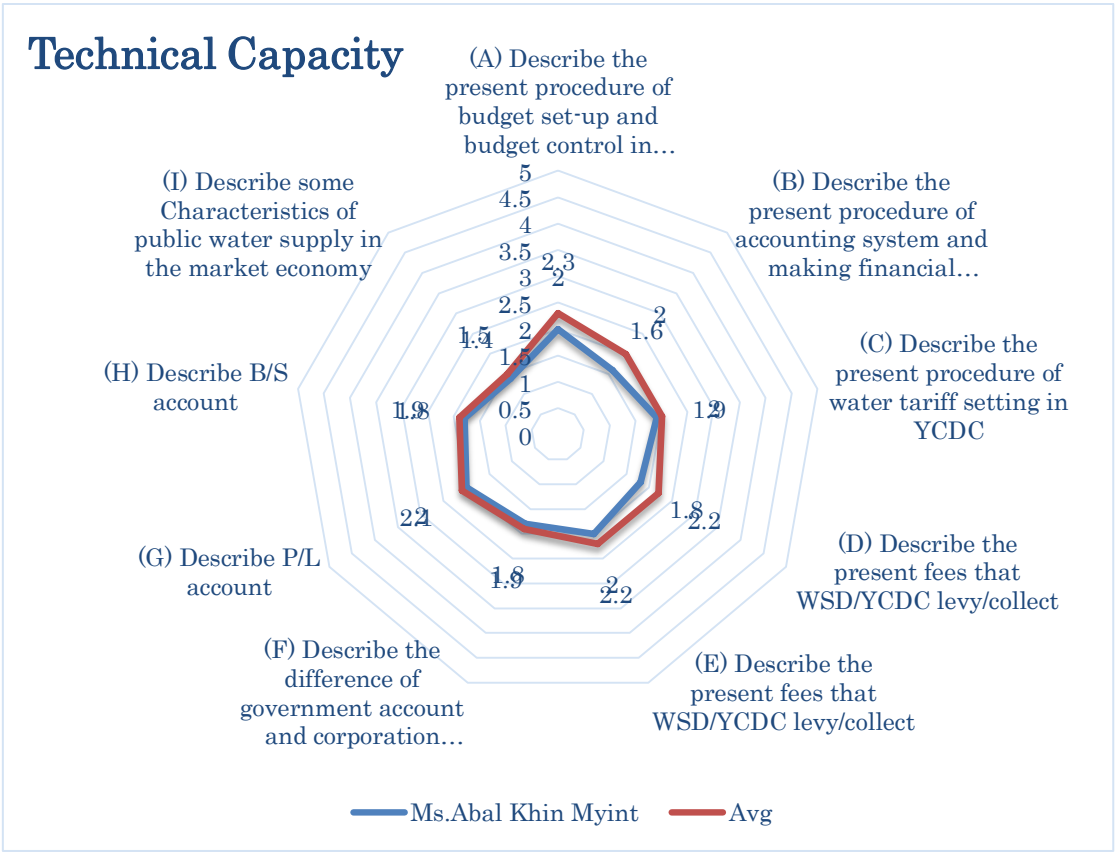
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2.3
1.4
2
1
1.5
2
1
2.2
1
2.2
1.9
1
2.1
1.9
1.2
Ms.Ohn Mar Soe
Avg


Technical Capacity
(A) Describe the present procedure of budget set-up and budget control in…
(B) Describe the present procedure of accounting system and making financial…
(C) Describe the present procedure of water tariff setting in YCDC
(D) Describe the present fees that WSD/YCDC levy/collect
(E) Describe the present fees that WSD/YCDC levy/collect
(F) Describe the difference of government account and corporation…
(G) Describe P/L account
(H) Describe B/S account
(I) Describe some Characteristics of public water supply in the market economy
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2.3
2
2
1.6
2
2.2
1.8
2.2
2
1.9
2.1
1.8
1.4
Ms.Abal Khin Myint
Avg

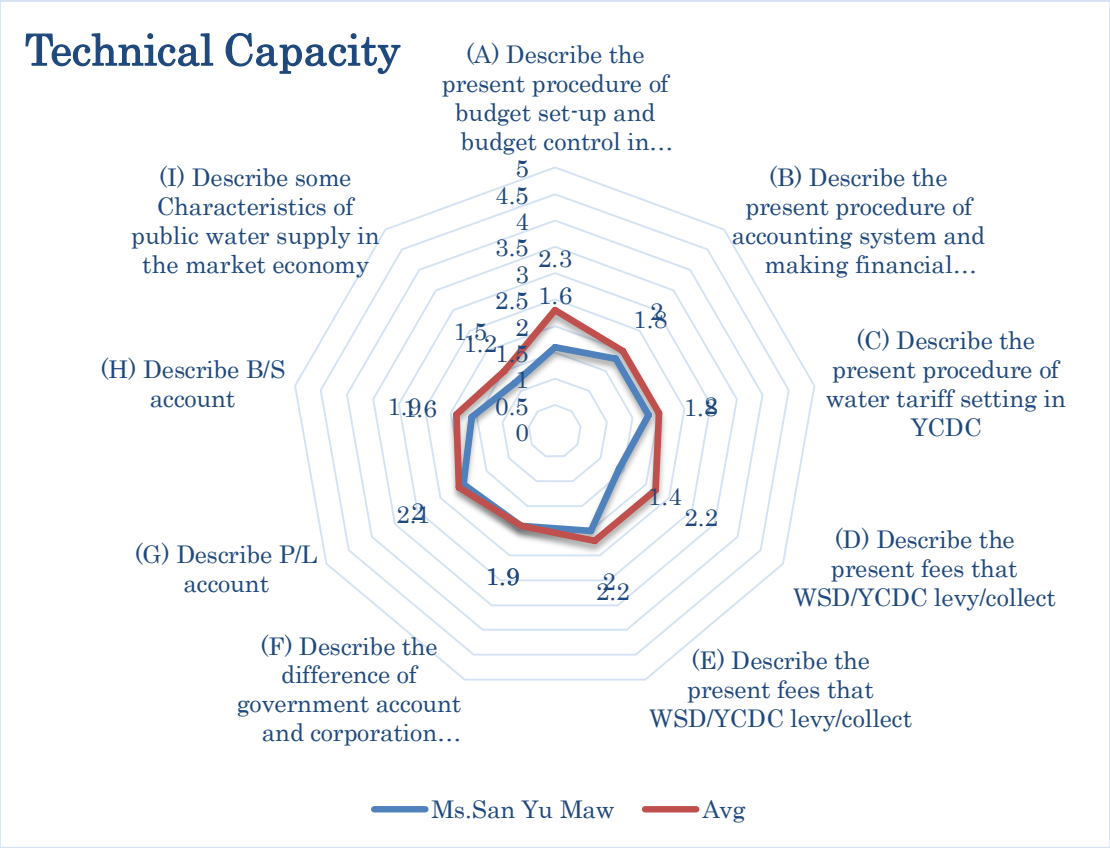


Figure 5.1 Graph of Results of Individual Technical Capacity

5.1.4 Overall Assessment and Approaches for Improvement

(1) Overall Assessment

The result of individual staff of Financial Section assessment revealed the same tendency of the result of organization level. That is, rather weak point on management of "water utility" such as water tariff setting, corporate accounting system and corporate budget management. Regarding governmental account and other items such as using manuals, conducting management cycle, making financial plan and capital finance and office management, the results look average or above level. The reason shall be the same as mentioned in the chapter of 3.4.3.

To look into the variance of each staff member, members of WA marked lower results than average. That means they have less experience generally. Although EE or AE have enough experience, their scores are not reach middle. Some have longer experience and marks rather higher scores but some weak points are revealed same as organization's tendency.

The assessment is implemented by self- judge style. Interview to targeted members was implemented by the Expert, however, the purpose of interview was to get how they could explain their present work because the Expert had rather strong impression that targeted members have no experience and few knowledge of water utility management. The Expert thinks the result of assessment expresses precisely the present capacity of members.

(2) Approaches for Improvement

Accordingly, following training program which are described in the chapter 3.4.3 shall be useful for capacity development of individual members of Financial Section, too. The training shall be implemented by the Experts. ToT for some subjects is effective to develop C/Ps' capacity. Also the training abroad will be very useful in these topics and such opportunities shall be prepared.

- Basics of Water Utilities Management
- Water Utility Financial Accounting
- Water Utility Tariff Rate Making
- Asset Management and Asset Accounting in Water Utility
- Private Sector Involvement in Water Utility
- OJT on development of Asset Registration

5.2 Human Resources Management

5.2.1 Target of Assessment

For HRD fields, the following members were assessed as counterparts of the Project.

Table 5.4 Project Members of HRD Group

	Name	Position	Section/Division	Working yeas in WSD*
1.	Mr. Kyaw Kyaw Oo	Assistant Engineer	Leader of Other Lakes Section, Water Supply Division	28
2.	Mr. Aung Moe Kyaw	Sub Assistant Engineer	Office Section, Reservoir Division	13
3.	Ms. Su Nandar Linn	Assistant Engineer	House Connection Section, Water Supply Division	15
4.	Ms. Mya Mya Aye	Supervisor,	Admin Section, Admin & Finance Division	31
5.	Ms. Khin Zin Mar Myint	Programmer	Admin Section, Admin & Finance Division	19
6.	Ms. Moh Moh San	W.A	Office Section, Reservoir Division	3 months
7.	Ms. May Htoo Aung	W.A	Major Maintenance Section (El), Reservoir Division	1 month

* Working years of in WSD is as of August 2015

5.2.2 Items of Assessment

Responding to the organizational capacity, individual capacity is assessed on the following items.

Table 5.5 Items of Assessment of Individual Technical Capacity -HRD-

Category	Items	Remark (criteria)
A. Personnel management measures concerning HRD	1. Able to examine **the number of staff allocation** in each office by recruitment and arrangement.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching to others]
	2. Understanding necessity to consider **personnel transfer** from the view of HRD.	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	3. Understanding necessity of **Duties and Responsibilities descriptions** of each office (What is Duties and Responsibilities description?)	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	4. Able to **make Duties and Responsibilities Descriptions** of each office (or able to support each division to make the description)	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching to others]
	5. Understanding **necessity of job description** (What is job	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5.

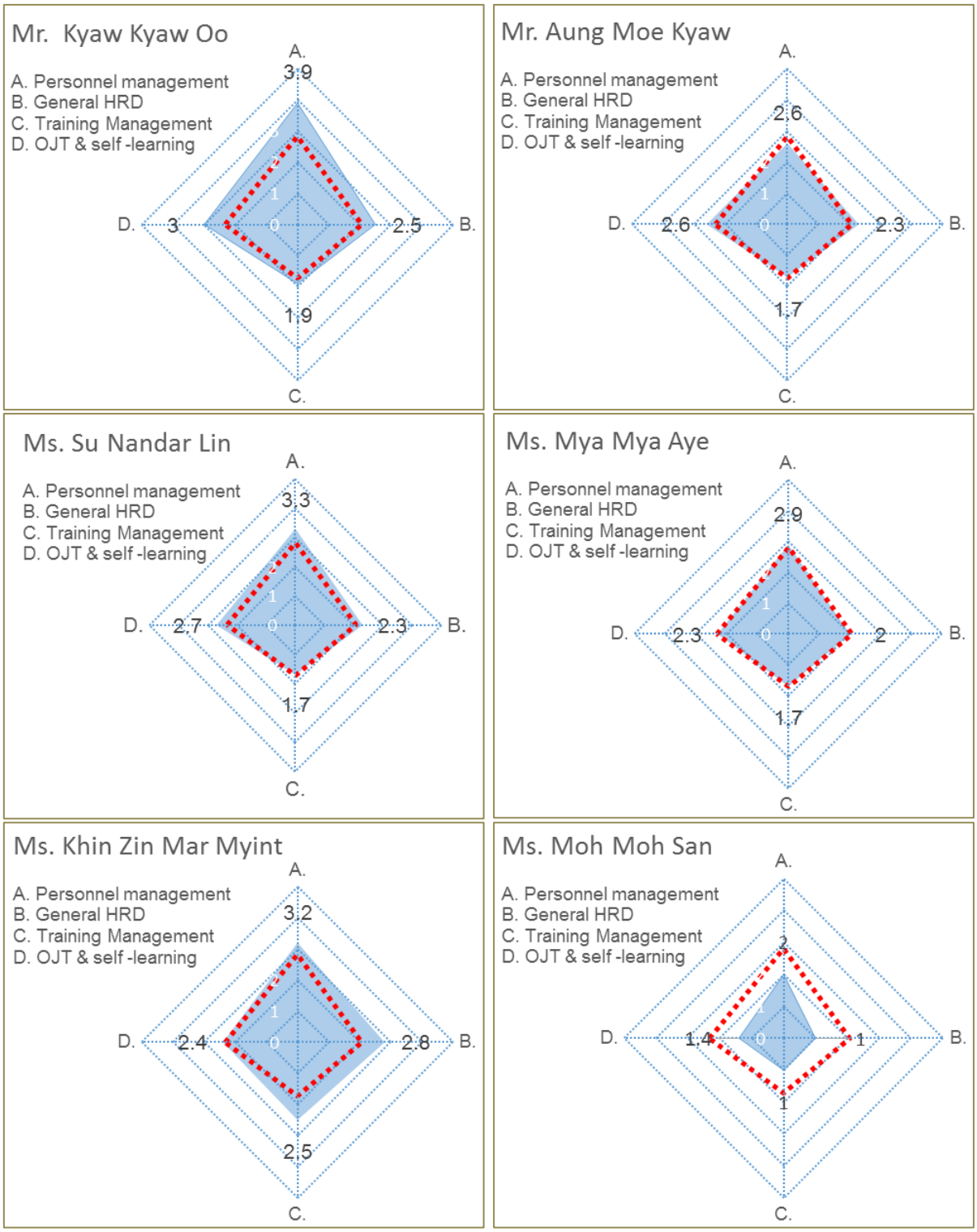
Category	Items	Remark (criteria)
	description?)	Having experience teaching to others]
	6. Able to **make job description** (or support each division to make job description)	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching to others]
	7. Understanding necessity of **performance evaluation system** (annual evaluation, target setting) of each division and staff.	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	8. Understanding necessity of **incentive mechanism** based on the performance.	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	9. Understanding various **kinds of incentives** (financial/ non-financial including career path)	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
B. Frame of HRD	1. Understanding necessity of **HRD strategy and plan**	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	2. Understanding **needs of HRD** of WSD/YCDC	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	3. Having experiences to conduct **needs survey** of HRD	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching to others]
	4. Grasping **responsibilities** of each divisions inside and outside of WS Dep, YCDC related to HRD	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
C. Training Management	1. Grasping **responsibilities** of each divisions inside and outside of WS Dep, YCDC related to training	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	2. Understanding the **PDCA cycle of training**	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	3. Able to **manage training program** such as planning training, supervising the implementation, evaluating, making reports.	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching to others]
D. OJT & self -learning	1. Understanding **necessity of OJT**	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	2. Grasping **how OJT is** conducted.	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]
	3. Understanding the necessity of **self-learning**	[1. Cannot understand at all, 2. Understanding a little, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others]

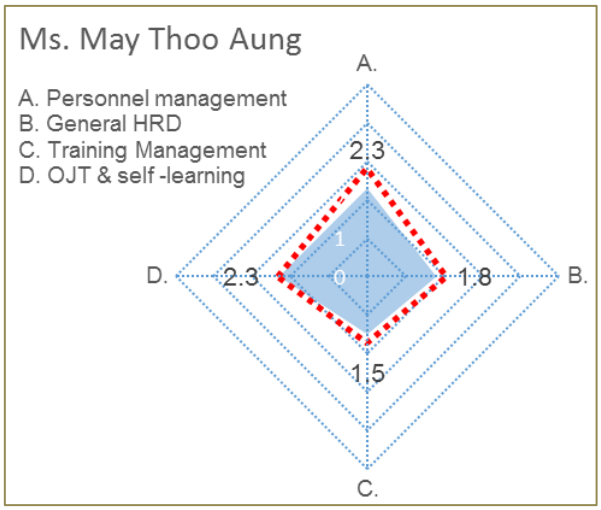
5.2.3 Results of Assessment

By the beginning of the Project, WSD had not assigned any section to be responsible for HRD. Therefore C/Ps have little experience and knowledge on HRD. Some C/Ps who are in a managing position have some experience to manage their staff and made efforts to improve staff capacity. The detail results are shown in the table below and * Note: Dotted red line shows average points of all counterparts. Figure 5.2

Table 5.6 Detail results of Assessment of Individual Technical Capacity -HRD-

Category	Items	Mr. Kyaw Kyaw Oo	Mr. Aung Moe Kyaw	Ms. Su Nandar Lin	Ms. Mya Mya Aye	Ms. Khin Zin Mar Myint	Ms. Moh Moh San	Ms. May Htoo Aung	Average
A. Personnel management measures concerning HRD	1. Able to examine **the number of staff allocation** in each office by recruitment and arrangement.	3	1	2	2	2	1	1	1.71
	2. Understanding necessity to consider **personnel transfer** from the view of HRD.	3	3	3	3	3	1	2	2.57
	3. Understanding necessity of **Duties and Responsibilities descriptions** of each office (What is Duties and Responsibilities description?)	3	2	2	2	2	2	2	2.14
	4. Able to **make Duties and Responsibilities Descriptions** of each office (or able to support each division to make the description)	3	1	1	1	2	1	1	1.43
	5. Understanding **necessity of job description** (What is job description?)	3	2	2	2	2	2	2	2.14
	6. Able to **make job description** (or support each division to make job description)	1	1	4	1	3	1	1	1.71
	7. Understanding necessity of **performance evaluation system** (annual evaluation, target setting) of each division and staff.	4	2	3	3	2	2	2	2.57
	8. Understanding necessity of **incentive mechanism** based on the performance.	3	3	3	3	4	1	2	2.71
	9. Understanding various **kinds of incentives** (financial/ non-financial including career path)	3	2	3	2	2	2	2	2.29
B. Frame of HRD	1. Understanding necessity of **HRD strategy and plan**	3	2	3	2	3	1	2	2.29
	2. Understanding **needs of HRD** of WSD/YCDC	2	3	2	2	3	1	2	2.14
	3. Having experiences to conduct **needs survey** of HRD	1	1	1	1	1	1	1	1.00
	4. Grasping **responsibilities** of each divisions inside and outside of WS Dep, YCDC related to HRD	4	3	3	3	4	1	2	2.86
C. Training Management	1. Grasping **responsibilities** of each divisions inside and outside of WS Dep, YCDC related to training	4	3	3	3	4	1	2	2.86
	2. Understanding the **PDCA cycle of training**	2	2	2	2	4	1	2	2.14
	3. Able to **manage training program** such as planning training, supervising the implementation, evaluating, making reports.	1	1	1	1	1	1	1	1.00
D. OJT & self -learning	1. Understanding **necessity of OJT**	3	2	3	2	3	2	2	2.43
	2. Grasping **how OJT is** conducted.	3	3	3	2	2	1	2	2.29
	3. Understanding the necessity of **self-learning**	3	3	2	3	2	1	3	2.43


Mr. Kyaw Kyaw Oo
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
3.9
B.
2.5
C.
1.9
D.
3
Mr. Aung Moe Kyaw
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
2.6
B.
2.3
C.
1.7
D.
2.6
Ms. Su Nandar Lin
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
3.3
B.
2.3
C.
1.7
D.
2.7
Ms. Mya Mya Aye
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
2.9
B.
2
C.
1.7
D.
2.3
Ms. Khin Zin Mar Myint
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
3.2
B.
2.8
C.
2.5
D.
2.4
Ms. Moh Moh San
A. Personnel management
B. General HRD
C. Training Management
D. OJT & self -learning
A.
2
B.
1
C.
1
D.
1.4



* Note: Dotted red line shows average points of all counterparts.

Figure 5.2 Chart of Detail Results of Individual Technical Capacity -HRD-

5.2.4 Overall Assessment and Approaches for Improvement

Presently, WSD has not assigned any section to be responsible for HRD. Therefore C/Ps have little experience and knowledge on HRD. Some C/Ps who are in a managing position have some experience to manage their staff and made efforts to improve staff capacity.

[Approaches for improvement]

- ✓ Full-time staff for HRD is necessary.
- ✓ Understand outline of HRD through the Project activities.
- ✓ Understand necessary HRD measures with long-term view through the activities, especially setting HRD Plan.
- ✓ Work with Admin Department closely to work for improvement personnel management system.
- ✓ Compile knowledge and experiences to be acquired through the Project Activities and utilize them in training session on HRD.

5.3 Non-Revenue Water and GIS

5.3.1 Target of Assessment

(NRW)

Table 5.7 Assessed Member (NRW)

Name	Section	Class	Remarks
Mr. Aung Min Oo	Pipe Section	SAE	Sub-Leader, Joined EGIS Project
Mr. Aye Pyae Aung	GIS	FLAT	Joined Mr. Matsuoka training.
Mr. Aye Myat Thu	GIS	FLAT	Joined EGIS Project
Ms. Ohnmar Myint	East District	SAE	
Ms. Tin Tin Win	GIS	FLAT	
Mr. Hein Htun	GIS	WA	
Mr. Zayar Tun	Major Maintenance	AE	

(GIS)

Table 5.8 Assessed Member (GIS)

Name	Section	Class	Remarks

Name	Section	Class	Remarks
Mr. Zaw Win Aung	GIS	SAE	Sub-Leader, Joined EGIS Project
Mr. Ye Zay Yar	GIS	FLAT	Joined Mr. Matsuoka training.
Ms. Tin Tin Win	GIS	FLAT	Joined EGIS Project
Ms. Thiri Win	GIS	FLAT	
Ms. Aye Myat Thu	GIS	FLAT	
Mr. Hlaing Win Ko	GIS	WA	
Mr. Nyein Chan Aung	GIS	FLAT	
Mr. Hein Htun	GIS	WA	Counterpart of Mayangone Project.
Mr. Aung Min Oo	Pipe Section	SAE	Counterpart of Mayangone Project.
Mr. Aung Kyaw Linn	GIS	FLAT	
Ms. Ohnmar Myint	East District	SAE	

5.3.2 Items of Assessment

(NRW)

Table 5.9 Items of Assessment of Individual Technical Capacity (NRW)

Category	Items	Remark (criteria)
A. Concept of Waterworks	A1. Definition of the word "waterworks"	1. No knowledge 2. A little knowledge 3. Enough knowledge 4. Much knowledge 5. With experience as an instructor
	A2. Difference between "raw water" and "treated water"	
	A3. Why is water pressure needed for water pipes?	
	A4. Can you explain how to produce water pressure?	
	A5. How do you calculate the pipe diameter? (Explain the basis)	
	A6. Mechanism of losing water pressure (hydraulic gradient)	
	A7. Requirement for water pipes	
B. Countermeasures against NRW	B1. Can you explain what "NRW" is?	1. No knowledge 2. A little knowledge 3. Enough knowledge 4. Much knowledge 5. With experience as an instructor
	B2. Can you explain what "Effective water" is?	
	B3. Can you explain what "Ineffective water" is?	
	B4. Can you explain what "Metering inaccuracy" is?	
	B5. Can you explain what "Water distribution amount" is?	
	B6. Can you explain what "DMA" is?	
	B7. Knowledge of types of flowmeter	
	B8. Experience of water flow measurement	
	B9. Can you explain what "Minimum Night Flow" is?	
	B10. Mechanism of leak occurrence	
	B11. Knowledge for leak detection	
	B12. Experience of leak detection	
	B13. How to check water pipe degradation	
	B14. How to measure accurate water consumption	
C. Piping map creating & recording	C1. Experience of scale piping maps etc.	1. Neither knowledge nor experience, 2. A little knowledge 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor
	C2. Experience of making drawings with records of water serviced houses	
	C3. Experience of survey with completed water service pipe drawings	
	C4. Characteristics of multibranched piping	1. No knowledge, 2. A little knowledge, 3. Enough

Category	Items	Remark (criteria)
	C5. Characteristics of network piping	knowledge, 4. Much knowledge 5. With experience as an instructor

(GIS)

Table 5.10 Items of Assessment of Individual Technical Capacity (GIS)

Category		Items	Remark	
A. Baseline knowledge and skills of GIS	Baseline knowledge	Can you describe the following items?	Criteria	Example answer
		A1. What is GIS (Geographic Information System)?	1. No knowledge, 2. A little knowledge, 3. Enough knowledge, 4. Much knowledge, 5. With experience as an instructor	1. Unknowing 2. Possible to view information of facilities 3. Also, possible to execute various analyses 4. Indispensable system for water supply operation
		A2. What are the advantages of using GIS?		1. Unknowing, 2. To utilize for field works 3. Also, to utilize for planning of field works 4. Also, to utilize long-term planning
		A3. What is attention of managing GIS in YCDC?		1. Unknowing, 2. Database is up-to-date 3. Database is consolidated 4. Important to be both up-to-date and consolidated
	Skill and experience	Do you have experience of the following items?	Criteria	
		A4. Browsing and searching data in GIS.	1. Neither knowledge nor experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor	
		A5. Making GIS maps.		
		A6. Building GIS Database (DB) on pipe-network.		
		A7. Building DB on facilities and housings.		
		A8. Building DB on house connections and customer meters.		
B. Utilization to design and management of pipe-network	Skill and experience	Do you have experience of the following items?	Criteria	
		B1. Building DB on pipe-network based on offset-survey* drawings. (*:result of field measurement)	1. Neither knowledge nor experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor	
		B2. Building DB on O&M of pipe-network. (ex. water pressure, leakage, history		

Category		Items	Remark
		of repair work)	
		B3. Customizing DB in itself. (ex. Addition or change of layers and attribute items)	
		B4. Importing base maps* to GIS and building DB based on the maps. (*:road map, air photo and so on)	
	Advanced utilization	Do you have experience of the following items?	Criteria
		B5. Aggregate calculation utilizing GIS. (ex. calculating leakage totals by each area)	1. No experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor
		B6. Analysis of result of aggregate calculation. (ex. leakage hazard prediction)	
		B7. Hydraulic analysis* utilizing GIS DB. (ex. EPA-NET)	
		B8. Design of pipe-line network based on hydraulic analysis.	
		B9. Geographical analysis utilizing GIS DB. (ex. extraction of area lacking fire tape)	
C. Utilization to customer management	Skill and experience	Do you have experience of the following items?	Criteria
		C1. Connection between GIS DB and Customer DB. (ex. Importing information on defective meters, non-paying customers to GIS)	1. Neither knowledge nor experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor
		C2. Building DB on route and area of meter reading.	
	Advanced utilization	Do you have experience of the following items?	Criteria
		C3. Aggregate calculation utilizing GIS. (ex. defective meter and customer claim by each area)	1. No experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor
		C4. Geographical analysis utilizing GIS DB. (correlation between water pressure and tariff unpaid)	
D. Utilization to asset management	Advanced utilization	Do you have experience of the following items?	Criteria
		D1. Management of current assets utilizing GIS DB.	1. No experience, 2. Only training, 3. Some skill and experience, 4. Enough skill and experience, 5. With experience as an instructor
		D2. Future forecast of assets based on the above analyses	
		D3. Making long- term construction / replacement plan based on future forecast of assets	

5.3.3 Results of Assessment

(NRW)

Table 5.11 Results of Assessment of Individual Technical Capacity (NRW)

Category	Items	Mr.Aung Myint Oo	Ms.Aye Pyae Aung	Ms.Aye Myat Thu	Ms.Ohunmar Myint	Ms.Tin Tin Win	Mr.Hein Htun	Mr.Zayar Tun	Average
A. Concept of Waterworks	A1. Definition of the word "waterworks"	3	2	2	2	2	2	2	2.1
	A2. Difference between "raw water" and "treated water"	2	2	2	2	2	2	2	2
	A3. Why is water pressure needed for water pipes?	3	2	2	2	2	2	2	2.1
	A4. Can you explain how to produce water pressure?	3	2	2	2	2	2	2	2.1
	A5. How do you calculate the pipe diameter? (Explain the basis)	2	2	3	2	2	2	2	2.1
	A6. Mechanism of losing water pressure (hydraulic gradient)	2	2	2	2	2	2	2	2
	A7. Requirement for water pipes	3	2	2	3	2	2	2	2.3
B. Countermeasures against NRW	B1. Can you explain what "NRW" is?	3	3	3	3	2	3	3	2.9
	B2. Can you explain what "Effective water" is?	2	2	2	2	2	2	2	2
	B3. Can you explain what "Ineffective water" is?	2	2	2	2	2	2	2	2
	B4. Can you explain what "Metering inaccuracy" is?	2	2	2	2	2	2	2	2
	B5. Can you explain what "Water distribution amount" is?	2	2	2	2	2	2	2	2
	B6. Can you explain what "DMA" is?	3	2	2	2	2	2	2	2.1
	B7. Knowledge of types of flowmeter	3	2	2	2	2	2	2	2.1
	B8. Experience of water flow measurement	3	2	2	2	2	2	2	2.1
	B9. Can you explain what "Minimum Night Flow" is?	1	1	1	1	2	1	1	1.1
	B10. Mechanism of leak occurrence	3	2	2	2	2	3	3	2.4
	B11. Knowledge for leak detection	3	3	2	2	2	3	3	2.6
	B12. Experience of leak detection	3	2	2	2	2	3	3	2.4
	B13. How to check water pipe degradation	2	2	2	2	2	2	2	2
	B14. How to measure accurate water consumption	2	2	2	2	2	2	2	2
C. Piping map creating & recording	C1. Experience of scale piping maps etc.	1	1	2	1	2	1	1	1.3
	C2. Experience of making drawings with records of water serviced houses	1	1	3	1	3	1	1	1.6
	C3. Experience of survey with completed water service pipe drawings	1	1	2	1	2	3	1	1.6
	C4. Characteristics of multi-branched piping	1	1	1	1	2	1	1	1.1
	C5. Characteristics of network piping	1	1	1	1	2	1	1	1.1

(GIS)

Table 5.12 Results of Assessment of Individual Technical Capacity (GIS)

Category	Items		Mr. Zaw Win Aung	Mr. Ye Zay Ya	Ms.Tin Tin Win	Ms. Aye Myat Thu	Ms. Thin Win	Mr. Hlaing Win Ko	Mr. Nyein Chan Aung	Mr. Hein Htun	Mr. Aung Min Oo	Mr. Aung Kyaw Linn	Ms. Ohnmar Myint	Average
A. Baseline knowledge and skills of GIS	Baseline knowledge	Can you describe the following items?												
		A1. What is GIS (Geographic Information System)?	4	4	2	2	3	2	3	2	2			2.7
		A2. What are the advantages of using GIS?	4	4	4	4	4	4	4	4	3			3.9
		A3. What is attention of managing GIS in YCDC?	4	4	4	4	4	4	4	4	4			4.0
	Skill and experience	Do you have experience of the following items?												
		A4. Browsing and searching data in GIS.	4	4	3	1	4	1	4	1	1			2.6
		A5. Making GIS maps.	4	3	3	1	3	2	3	1	1			2.3
		A6. Building GIS Database (DB) on pipe-network.	4	4	4	4	4	3	4	4	1			3.6
		A7. Building DB on facilities and housings.	1	1	1	1	1	1	1	1	1			1.0
		A8. Building DB on house connections and customer meters.	4	1	4	1	4	1	1	1	1			2.0
B. Utilization to design and management of pipe-network	Skill and experience	Do you have experience of the following items?												
		B1. Building DB on pipe-network based on offset-survey* drawings. (*:result of field measurement)	4	1	1	1	1	1	1	1	1			1.3
		B2. Building DB on O&M of pipe-network. (ex. water pressure, leakage, history of repair work)	2	2	2	1	2	1	1	1	2	2		1.6
		B3. Customizing DB in itself. (ex. Addition or change of layers and attribute items)	4	4	4	1	4	4	4	1	1	4		3.1
		B4. Importing base maps* to GIS and building DB based on the maps. (*:road map, air photo and so on)	4	4	4	1	4	4	4	1	1	4		3.1
	Advanced utilization	Do you have experience of the following items?												
		B5. Aggregate calculation utilizing GIS. (ex. calculating leakage totals by each area)	4	4	4	1	4	4	4	1	1	4		3.1
		B6. Analysis of result of aggregate calculation. (ex. leakage hazard prediction)	2	1	1	1	1	1	1	1	1	1		1.1
		B7. Hydraulic analysis* utilizing GIS DB.	4	4	1	3	4	1	1	2	1	4		2.5

Category	Items	Mr. Zaw Win Aung	Mr. Ye Zay Ya	Ms.Tin Tin Win	Ms. Aye Myat Thu	Ms. Thin Win	Mr. Hlaing Win Ko	Mr. Nyein Chan Aung	Mr. Hein Htun	Mr. Aung Min Oo	Mr. Aung Kyaw Linn	Ms. Ohnmar Myint	**Average**
	(ex. EPA-NET)												
	B8. Design of pipe-line network based on hydraulic analysis.	4	3	1	1	3	3	1	1	1	2		2.0
	B9. Geographical analysis utilizing GIS DB. (ex. extraction of area lacking fire tape)	3	3	1	1	2	1	2	1	1	2	1	1.6
C. Utilization to customer management — Skill and experience	Do you have experience of the following items?												
	C1. Connection between GIS DB and Customer DB. (ex. Importing information on defective meters, non- paying customers to GIS)	3	1	3	1	3	1	1	1	1	1	1	1.5
	C2. Building DB on route and area of meter reading.	1	1	1	1	1	1	1	1	1	1	1	1.0
C. Utilization to customer management — Advanced utilization	Do you have experience of the following items?												
	C3. Aggregate calculation utilizing GIS. (ex. defective meter and customer claim by each area)	3	1	3	1	3	1	1	1	1	1	1	1.5
	C4. Geographical analysis utilizing GIS DB. (correlation between water pressure and tariff unpaid)	2	1	1	1	1	1	1	1	1	1	1	1.1
D. Utilization to asset management — Advanced utilization	Do you have experience of the following items?												
	D1. Management of current assets utilizing GIS DB.	1	1	1	1	1	1	1	1	1	1	1	1.0
	D2. Future forecast of assets based on the above analyses	1	1	1	1	1	1	1	1	1	1	1	1.0
	D3. Making long- term construction / replacement plan based on future forecast of assets	1	1	1	1	1	1	1	1	1	1	1	1.0

5.3.4 Overall Assessment and Approaches for Improvement

(NRW)

Concept of waterworks

Present capacity of understanding and knowledge of waterworks is inadequate. It is first step for every staff of YCDC to understand basis of waterworks, as example why water pressure is needed and what the mechanism of water pressure is. Moreover, pipeline design capacity is inadequate. To develop these capacity, periodically trainings are needed. Training and seminar for design will be held in our project. These trainings will continue by counterpart to keep and develop capacity for all YCDC staff.

Countermeasures against NRW

Capacity regarding Countermeasures against NRW is not adequate. There is a few opportunity to learn

countermeasures against NRW due to NRW section has not been established. On-site training is needed to develop the capacity of NRW.

Piping map creating and recording
Skill and experience are inadequate at the present stage. There is no scale map and piping map. C/Ps can gain skill and experience through NRW countermeasures activities in the pilot area.

(GIS)
Baseline knowledge and skills of GIS
Base knowledge and skill are inadequate at the present stage, but the staffs have good knowledge pertaining to advantages of using GIS. This result means expectation for effective utilization of GIS.

Utilization to design and management of pipe-network
Skill and experience are inadequate at the present stage, but some staffs have some experience through other projects as such as "Rehabilitation Program of Yangon Water Supply System –Pilot Project by EGIS-France" and "activities with the adviser dispatched form Fukuoka City Waterworks Bureau".
It becomes clear from the result of this questionnaire that GIS and hydraulic analysis are valuable for design and management of pipe-network.

Utilization to customer management and Utilization to asset management
The staffs have no experience of customer management and asset management with GIS.
The staffs have yet to recognize usefulness of it.

The C/Ps can gain skill and experience through NRW countermeasures activities in the pilot area to improve these capacities. In regard to the asset management, JICA Experts will prepare some case study of Japan. Because it's difficult to recognize it in the pilot area.

5.4 Water Quality Monitoring

5.4.1 Target of Assessment

Water quality monitoring section has 9 staffs (As of Dec. 2015). Assessment survey was done to all 9 staffs. Name, job title and role of laboratory operation of all staffs are shown in Table 5.13.

Table 5.13 List of staffs (As of Dec. 2015)

Name	Job title	Role of laboratory operation
Daw Ei Khaing Mon	AE	Section chief
Daw May Zin Oo	SAE	Deputy section chief
Daw Nwe Nwe Zin	SAE	Deputy section chief
Daw Thandar Myat	SAE	Deputy section chief
Daw Aye Aye Thu Zar	Flat	Laboratory assistant
Daw Hsu Myat Mon	Flat	Laboratory assistant
Daw Myat Su Mon	WA	Staff
Daw May Zin Oo	WA	Staff
U Nyein Htet	WA	Staff

Source: YCDC

5.4.2 Items of Assessment

Items of assessment are shown below. Individual technical capacity was assessed about 3 items. Assessment item and assessment criterion are shown in Table 5.14.

Table 5.14 List of assessment item

Category	Items	Remark (criteria)
A.	A1. Capacity of water quality analysis	[1. Never experienced,

Category	Items	Remark (criteria)
Knowledge of water quality management	(1) Appropriate use of analytical equipment (pH meter, EC meter, UV-vis spectrometer)	2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality., 5. Having experience teaching toothers.]
	A2. Capacity of water quality analysis (2) Appropriate use of grass ware for measurement (measuring frask, whole pipette, measuring cylinder)	
	A3. Capacity of water quality analysis (3) Appropriate washing of analytical equipment and grass ware (select of appropriate washing agent and rinse)	
	A4. Capacity of water quality analysis (4) Preparation of reagent (dilution of reagent)	
	A5. Capacity of water quality analysis (5) Preparation of sample (clean up and dilution of sample)	
	A6. Capacity of water quality analysis (6) Preparation of analytical curve	
	A7. Capacity of water quality analysis (7) Statistic calculation for accuracy management, e.g. average, standard deviation, CV-value, correlation)	
	A8. Capacity of water quality analysis (8) Aseptic manipulation for biological test	
	A9. Understanding of nature of sample, e.g. nitrogen compound in groundwater, EC or salinity in tidal river, fluctuation of turbidity in river water, etc.	
	A10. Analysis of water quality data, e.g. explain using appropriate table and graph, calculate significant correlation	
	A11. Understanding of SOPS and manuals	[1. No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others.]
	A12. Understanding of accuracy management	
	A13. Knowledge of water treatment process (water treatment technology in WTP, i.e. coagulation, sedimentation, sand filtration and chlorination, and change of water quality in water treatment process).	
B. Capacity of planning	B1. Capacity of planning of water quality analysis (1) Deside appropriate sampling point considering the purpose of analysis	[1. Never experienced., 2. Can do with advice., 3. Can do alone., 4. Can do alone in sufficient quality, 5. Having experience teaching toothers.]
	B2. Capacity of planning of water quality analysis (2) Select appropriate analysis item (Considering the characteristics of sample and purpose of analysis)	
	B3. Capacity of planning of water quality analysis (3) Making a work schedule considering work volume (number of sample, timerequired for sampling, time required for analysis work, number of staff, etc.)	
	B4. Knowledge of WSP（Water Safety Plan）	[1. No knowledge, Cannot understand at all, 2. Understanding a little, Can understand when was explained, 3. Understanding mostly, 4. Understanding sufficiently, 5. Having experience teaching to others.]
C. Problem-solving capacity	C1. Capacity of problem -solving to improvement of water quality (improvement of treated water quality, prevent a pollution in water distribution system, etc.)	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone in sufficient quality, 5. Having experience teaching toothers.]
	C2. Capacity of problem-solving in the situation of unusual water quality (water quality accident, high	[1. Never experienced, 2. Can do with advice, 3. Can do alone, 4. Can do alone

Category	Items	Remark (criteria)
	turbidity, etc.)	in sufficient quality, 5. Having experience teaching toothers.]

Source: JICA Expert

5.4.3 Results of Assessment

Summary of result of assessment is shown Table 5.15. Rader charts of individual assessment are shown in Figure 5.3.

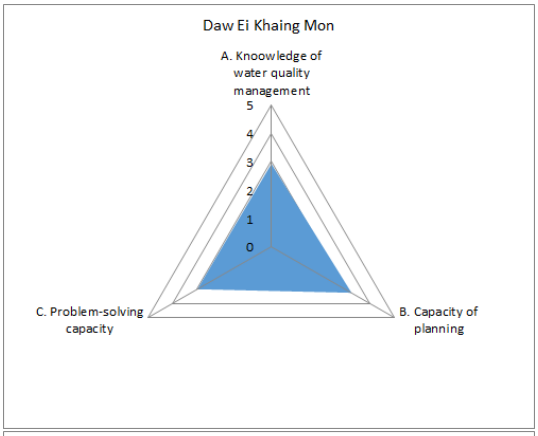
Summary of technical assessment is as follows;

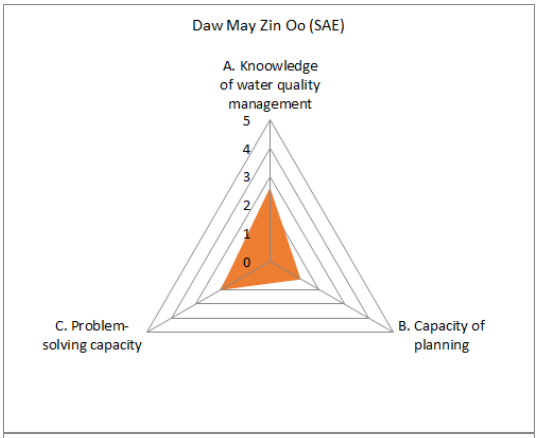
- All of the members have certain degree of knowledge about water sampling. However, knowledge about water quality data analysis has significant scope to continue to improve. (Ref; B. Capacity of planning)
- Capacity of analysis and explain of water quality data (Ref; A7and A10) has also significant scope to continue to improve.
- However, all staffs have high motivation to learn latest technology.

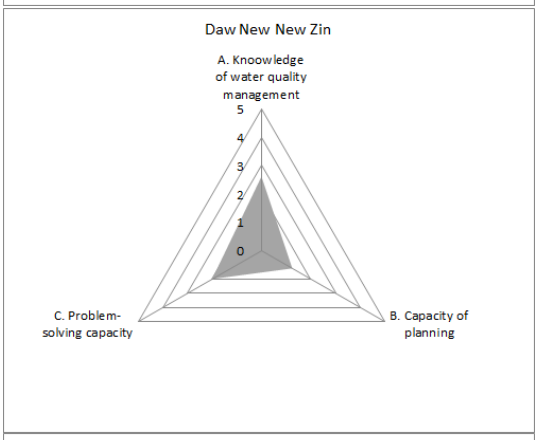
Table 5.15 Result of assessment (Summary)

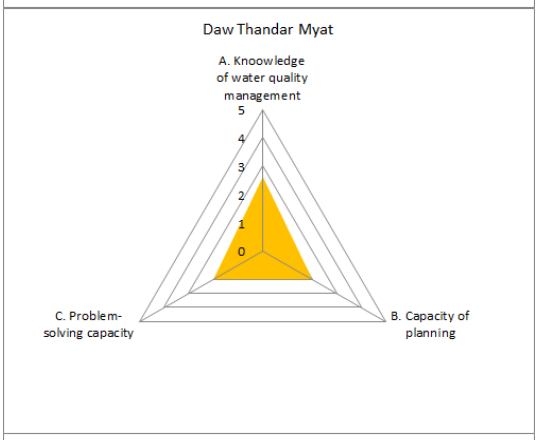
Category	Items	Daw Ei Khaing Mon	Daw May Zin Oo (SAE)	Daw New New Zin	Daw Thandar Myat	Daw Aye Aye Thu Zar	Daw Hsu Myat Mon	Daw Myat Su Mon	Daw May Zin Oo (WA)	U Nyein Htet	**Average**
A. Knowledge of water quality management	A1. Capacity of water quality analysis (1) Appropriate use of analytical equipment (pH meter, EC meter, UV-vis spectrometer)	3	3	3	3	3	3	3	3	3	**3.0**
	A2. Capacity of water quality analysis (2) Appropriate use of grass ware for measurement (measuring frask, whole pipette, measuring cylinder)	4	4	4	4	4	4	4	4	4	**4.0**
	A3. Capacity of water quality analysis (3) Appropriate washing of analytical equipment and grass ware (select of appropriate washing agent and rinse)	3	3	3	3	3	3	3	3	3	**3.0**
	A4. Capacity of water quality analysis (4) Preparation of reagent (dilution of reagent)	2	2	2	2	2	2	2	2	2	**2.0**
	A5. Capacity of water quality analysis (5) Preparation of sample (clean up and dilution of sample)	3	4	4	4	4	4	4	4	4	**3.9**
	A6. Capacity of water quality analysis (6) Preparation of analytical curve	2	2	2	2	2	2	2	2	2	**2.0**
	A7. Capacity of water quality analysis (7) Statistic calculation for accuracy management, e.g. average, standard deviation, CV-value, correlation)	1	1	1	1	1	1	1	1	1	**1.0**
	A8. Capacity of water quality analysis (8) Aseptic manipulation for biological test	4	3	3	3	3	3	3	3	3	**3.1**
	A9. Understanding of nature of sample, e.g. nitrogen compound in groundwater, EC or salinity in tidal river, fluctuation of turbidity in	3	2	2	2	2	2	2	2	2	**2.1**

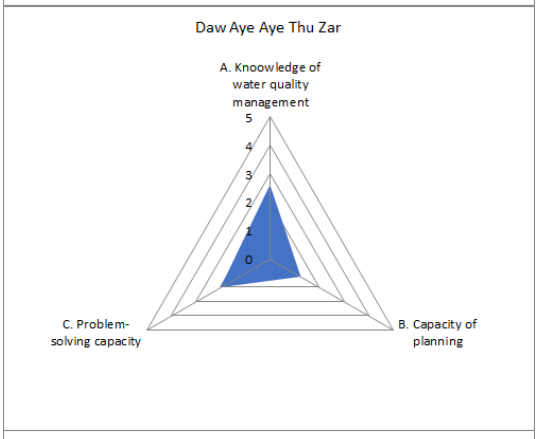
Category	Items	Daw Ei Khaing Mon	Daw May Zin Oo (SAE)	Daw New New Zin	Daw Thandar Myat	Daw Aye Aye Thu Zar	Daw Hsu Myat Mon	Daw Myat Su Mon	Daw May Zin Oo (WA)	U Nyein Htet	**Average**
	river water, etc.										
	A10. Analysis of water quality data, e.g. explain using appropriate table and graph, calculate significant correlation	3	2	2	2	2	2	2	2	2	**2.1**
	A11. Understanding of SOPS and manuals	4	3	3	3	3	3	3	3	3	**3.1**
	A12. Understanding of accuracy management	3	2	2	2	2	2	2	2	2	**2.1**
	A13. Knowledge of water treatment process (water treatment technology in WTP, i.e. coagulation, sedimentation, sand filtration and chlorination, and change of water quality in water treatment process).	3	3	3	3	3	3	3	3	3	**3.0**
B. Capacity of planning	B1. Capacity of planning of water quality analysis (1) Deside appropriate sampling point considering the purpose of analysis	3	1	1	2	1	2	2	1	2	**1.7**
	B2. Capacity of planning of water quality analysis (2) Select appropriate analysis item (Considering the characteristics of sample and purpose of analysis)	3	1	1	2	1	2	2	1	2	**1.7**
	B3. Capacity of planning of water quality analysis (3) Making a work schedule considering work volume (number of sample, timerequired for sampling, time required for analysis work, number of staff, etc.)	3	1	1	2	1	2	2	1	2	**1.7**
	B4. Knowledge of WSP（Water Safety Plan）	4	2	2	2	2	2	2	2	2	**2.2**
C. Problem-solving capacity	C1. Capacity of problem -solving to improvement of water quality (improvement of treated water quality, prevent a pollution in water distribution system, etc.)	3	2	2	2	2	2	2	2	2	**2.1**
	C2. Capacity of problem-solving in the situation of unusual water quality (water quality accident, high turbidity, etc.)	3	2	2	2	2	2	2	2	2	**2.1**


Daw Ei Khaing Mon
A. Knoowledge of water quality management
5
4
3
2
1
0
B. Capacity of planning
C. Problem-solving capacity


Daw May Zin Oo (SAE)
A. Knoowledge of water quality management
5
4
3
2
1
0
B. Capacity of planning
C. Problem-solving capacity


Daw New New Zin
A. Knoowledge of water quality management
5
4
3
2
1
0
B. Capacity of planning
C. Problem-solving capacity


Daw Thandar Myat
A. Knoowledge of water quality management
5
4
3
2
1
0
B. Capacity of planning
C. Problem-solving capacity


Daw Aye Aye Thu Zar
A. Knoowledge of water quality management
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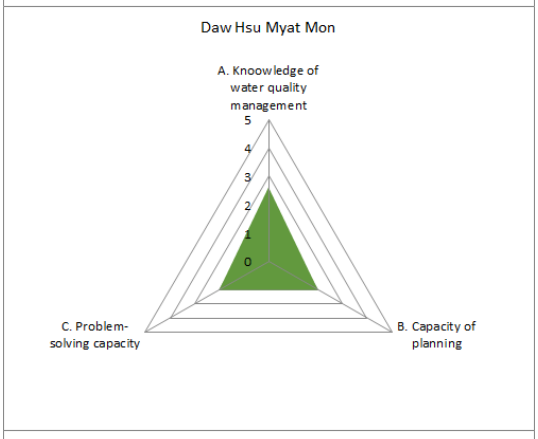
B. Capacity of planning
C. Problem-solving capacity


Daw Hsu Myat Mon
A. Knoowledge of water quality management
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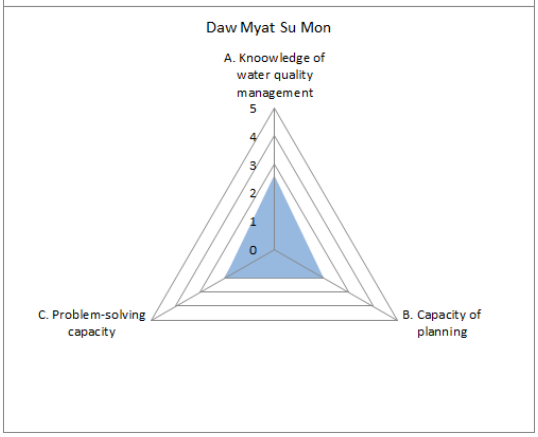
B. Capacity of planning
C. Problem-solving capacity


Daw Myat Su Mon
A. Knoowledge of water quality management
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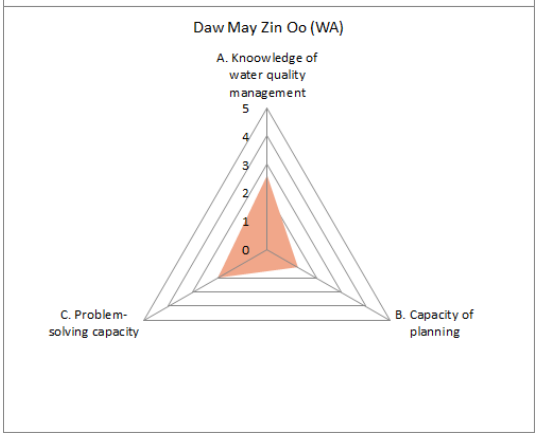
B. Capacity of planning
C. Problem-solving capacity


Daw May Zin Oo (WA)
A. Knoowledge of water quality management
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3
2
1
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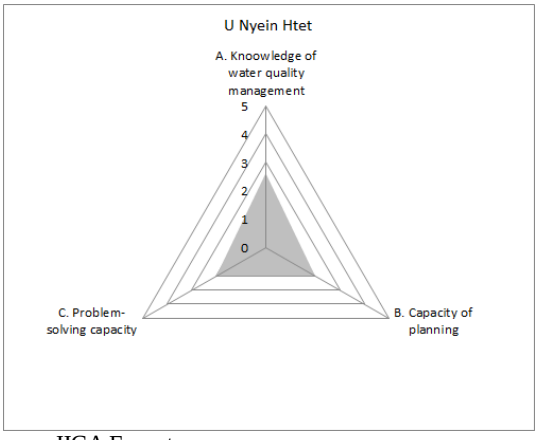
B. Capacity of planning
C. Problem-solving capacity



Source: JICA Expert

Figure 5.3 Result of assessment (Individual radar chart)

As the future goal of laboratory, section chief said that to become a core laboratory of YCDC, and to bring out a leadership to monitor and improve a water quality in Yangon city.
To actualize this resolution, interviewees have mentioned a notion to learn following items;

- Relationship among water quality parameters (e.g., relationship among NO_3, NO_2 and NH_4)
- Capacity of water quality management
- Water quality monitoring technology
- water quality data analysis
- Water treatment technology
- Accuracy control of water quality monitoring

5.4.4 Overall Assessment and Approaches for Improvement

Summary of training is shown in Table 5.4. Important issue is to enhancement water quality monitoring capacity. However, water quality monitoring section already starts a periodical water quality monitoring in Yangon city. Therefore, capacity development is done by OJT through this daily monitoring work. In addition, periodical technical seminar of basic knowledge of water quality monitoring is done to support OJT.
The other capacity to be developed is i) Data analysis and ii) Planning. These capacities are also developed by OJT and seminar.

Table 5.16 Summary of training

Topic		Main contents	Objectives	Training style
1.	Develop SOP	Develop SOP Revise SOP through monitoring work	To understand SOP development / revision skills	OJT
2.	Training of water quality monitoring skills	Water quality monitoring Data analysis Develop monitoring plan	To understand water quality monitoring skills	Seminar and OJT

Source: JICA Expert

5.5 Water Treatment

5.5.1 Target of Assessment

Interview survey of individual technical assessment was done 2 times. The 1st interview was done in Aug. 2015, and 2nd interview was done in Dec. 2015. However, in the 2nd interview, many staffs were

working in Lagunpin WTP construction site and other site, interviewee in 2nd survey was only 3 staffs.

Table 5.17 List of interviewee

Name	Job title	Role in WTP	1st interview	2nd interview
U Zaw Oo	AE	Manager	✓	✓
U Nye Nye Aung	AE	Deputy manager	✓	
U Thint Lwin	SAE	Electrical engineer	✓	
Daw Su Su Khin	SAE	Water quality monitoring		✓
U Moe Min Thein		Management of chemical injection	✓	
U Soe Paing		Management of sand filtration	✓	
Daw Htay Htay Win	Expert	Management of water distribution (Valve control)	✓	
Daw Thet Htet Myat	WA	Assistant of Manager	✓	
Daw May Thaw Tar Oo	WA	Administration Water quality monitoring	✓	✓

Source: JICA Expert

5.5.2 Items of Assessment

Assessment items of the 1st and 2nd interview are shown below. The 1st survey was preliminary survey. However, because 2nd survey couldn't collect enough interviewee, assessment is done using both (1st and 2nd) survey result.

(1)1st survey

In the 1st survey, assessment was done by following 4 categories;

A. Basic knowledge of water treatment and WTP operation
- A1: Water treatment process of Nyaunghnapin WTP
- A2: Operation manual
- A3: Operation record

B. Knowledge of facility and equipment of WTP
- B1-B2: Performance of Nyaunghnapin WTP (water quality and production)
- B3-B4: Change of raw water quality and operation procedure
- B5: Determination coagulant dosing
- B6: Management of water treatment chemical
- B7-B8: Management of coagulant-sedimentation process (flow control and chemical injection control)
- B9 - B10: Operation of sand filter
- B11 - B12: Water quality monitoring in WTP
- B13: Operation procedure in unusual water quality

C. Knowledge of Operation and Maintenance (O&M)
- C1: Internal rule of O&M
- C2: Preventive maintenance
- C3: O&M procedure
- C4: Procedure of urgent repair
- C5: Operation and maintenance record

D. Knowledge of facility, equipment and operation
- D1: Level of importance of equipment in WTP
- D2: Working report and repair report

Table 5.18 List of assessment item (1st survey)

Category	Items	Remarks (Criteria)
A. Basic knowledge of water treatment and WTP operation	A1. Explain about water treatment process in Nyaunghnapin WTP.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	A2. Explain contents of WTP operation manual.	
	A3. Explain about development of operation record.	[1.Never experienced., 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality., 5. Having experience teaching to others.]
B. Knowledge of facility and equipment of WTP	B1. Explain a treatment capacity (water quality) of Nyaunghnapin WTP ? (e.g. upper limit of turbidity, etc.)	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	B2. Explain a treatment capacity (production) of Nyaunghnapin WTP.	
	B3. Explain a fluctuation of raw water quality (e.g. difference of rainy season and dry season, water quality accident).	
	B4. Explain coping process to the fluctuation of raw water.	
	B5. Explain process of determination of coagulant dosing based on Jar test data and other water quality data.	[1.Never experienced., 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality., 5. Having experience teaching to others.]
	B6. Explain quality management of stored water treatment chemical.	
	B7. Explain process of flow control in treatment process.	
	B8. Explain operation process to produce appropriate flock formation.	
	B9. Explain operation procedure of sand filter.	
	B10. Explain operation procedure of backwashing of sand filter.	
	B11. Explain the necessity of water quality monitoring in WTP.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	B12. Explain sampling point and monitoring item of water quality monitoring in WTP.	
	B13. Explain operation procedure in unusual raw water quality (e.g. water quality accident, high turbidity, etc.)	[1.Never experienced., 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality., 5. Having experience teaching to others.]
C. knowledge of Operation and Maintenance (O&M)	C1. Explain internal rule of O&M.	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience teaching to others.]
	C2. Explain the concept of Preventive maintenance.	
	C3. Explain O&M procedure of reservoir, WTP and service reservoir.	
	C4. Explain procedure of urgent repair of facility and equipment.	
	C5. Explain development of operation and maintenance record.	[1.Never experienced., 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality., 5. Having experience teaching to others.]
D. Knowledge of facility, equipment and operation	D1. Explain the level of importance of equipment in WTP (What is the most important equipment in this WTP?)	[1.No knowledge, Cannot understand at all., 2. Understanding a little, Can understand when was explained., 3. Understanding mostly., 4. Understanding sufficiently., 5. Having experience

Category	Items	Remarks (Criteria)
		teaching to others.]
	D2. Explain development of working report and repair report.	[1.Never experienced., 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality., 5. Having experience teaching to others.]

Source: JICA Expert

(2) 2nd survey

In the 2nd survey, assessment was done about A: Administrative capacity and B: Operation of WTP. Each category contain sub categories;

Table 5.19 List of assessment item (2nd survey)

Category		Items	Remark (criteria)
A. Administ rative capacity	Knowledge about rule and manual	A1. Understanding of internal rule (rule of YCDC) of O&M.	[1.No knowledge, Cannot understand at all. 2. Understanding a little, Can understand when was explained. 3. Understanding mostly. 4. Understanding sufficiently. 5. Having experience teaching to others.]
		A2. Understanding of contents of O&M manual of each facility and equipment in WTP.	
		A3. Understanding of appropriate procedure of repair of facilities and equipment in WTP	
		A4. Understanding of contingency plan of WTP.	
	Document control	A5. Prepare documents of O&M report and repair report, etc. properly.	[1.Never experienced. 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality. 5. Having experience teaching to others.]
		A6. Understanding of document control system in WTP.	
	Knowledge of water treatment technology.	A7. Opportunity to receive a training course of water treatment technology.	[1.Never experienced. 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality. 5. Having experience teaching to others.]
		A8. Understanding of water treatment technology (1) Coagulation - sedimentation process	[1.No knowledge, Cannot understand at all. 2. Understanding a little, Can understand when was explained. 3. Understanding mostly. 4. Understanding sufficiently. 5. Having experience teaching to others.]
		A9. Understanding of water treatment technology (2) Sand filtration process	
		A10. Understanding of water treatment technology (3) Chlorination process	
		A11. Understanding of operation manual.	
	Procurement and purchase	A12. Understanding of procurement and purchase procedure (specific procedure in YCDC)	[1.Never experienced. 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality. 5. Having experience teaching to

Category		Items	Remark (criteria)
			others.]
B. Operation of WTP	Knowledge about ability of WTP	B1. Understanding of function of each facility and equipment. (1)Water intake facility	[1.No knowledge, Cannot understand at all. 2. Understanding a little, Can understand when was explained. 3. Understanding mostly. 4. Understanding sufficiently. 5. Having experience teaching to others.]
		B2. Understanding of function of each facility and equipment. (2)Receiving tank	
		B3. Understanding of function of each facility and equipment. (3) Coagulation tank	
		B4. Understanding of function of each facility and equipment. (4) Sand filtration tank	
		B5. Understanding of function of each facility and equipment. (5) Clear water tank	
		B6. Understanding of function of each facility and equipment. (6) Service reservoir	
		B7. Understanding of the ability of WTP (Ability of Nyaunghnapin WTP: water production, acceptable water quality).	
		B8. Understanding of fluctuation of raw water quality e.g. difference of water quality in rainy season and dry season, seasonal change or water quality accident.	
		B9. Understanding of proper WTP operation for the change of raw water quality	
	Handling of water purification chemical	B10. Understanding of operation manual of water purification chemical handling facility (chemical storage facility and chemical injection facility)	[1.No knowledge, Cannot understand at all. 2. Understanding a little, Can understand when was explained. 3. Understanding mostly. 4. Understanding sufficiently. 5. Having experience teaching to others.]
		B11. Understanding procedure of quality management of stock water purification chemical.	[1.Never experienced. 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality. 5. Having experience teaching to others.]
	Coagulation process	B12. Implement jar test properly, and decide coagulant injection ratio.	
		B13. Understanding of appropriate control technique to produce adequate (thick and large) flock.	
	Sand filtration	B14. Understanding of appropriate operation procedure of sand filtration pond (control of appropriate flow, etc.)	
		B15. Understanding of appropriate O&M procedure of sand filtration pond.	
		B16. Understanding of appropriate backwash operation, e.g. timing of start / stop backwash, adequate control of back wash flow.	

Category		Items	Remark (criteria)
		B17. Understanding of appropriate particle size distribution of sand filter	
	Water quality monitoring	B18. Understanding of the necessity of water quality monitoring.	[1.No knowledge, Cannot understand at all. 2. Understanding a little, Can understand when was explained. 3. Understanding mostly. 4. Understanding sufficiently. 5. Having experience teaching to others.]
		B19. Understanding of water quality analysis item and sampling point in WTP.	
		B20. Procedure of feedback of analyzed water quality data to WTP operation.	
	Chlorination	B21. Understanding of appropriate operation of chlorine injector (decide appropriate chlorine injection ratio) base on water quality data, e.g. raw water quality, residual chlorine concentration.	[1.Never experienced. 2.Can do with advice., 3.Can do alone., 4. Can do alone in sufficient quality. 5. Having experience teaching to others.]
	Unusual situation (accident, etc.)	B22. Understanding of appropriate WTP operation and water quality monitoring in the case of unusual water quality, e.g. water quality accident, high turbidity, etc.	

Source: JICA Expert

5.5.3 Results of Assessment

Result of 1st survey is shown Table 5.21 and Figure 5.4. This survey was implemented as preliminary survey; however, this survey could obtain data from a wide range of staffs.

Notable result is that knowledge and experience about chemical (coagulant) injection control is not enough (Question B4, B5, B7 ad B8). The reason of this result is expected that coagulant injection control was depending on automatic injection system until now. However, to implement an appropriate coagulant -sedimentation operation, fundamental capacity of coagulant injection control based on the jar-test and water quality data is necessary.

In addition, knowledge and experience of sand filter operation is also insufficient (Question B9 and B10).

In radar chart, few staffs showed comparatively high capacity in category D. "Knowledge of facility, equipment and operation". These staffs have longer experience in this WTP. Therefore, this result means that they understand the facility and operation of WTP in their experience.

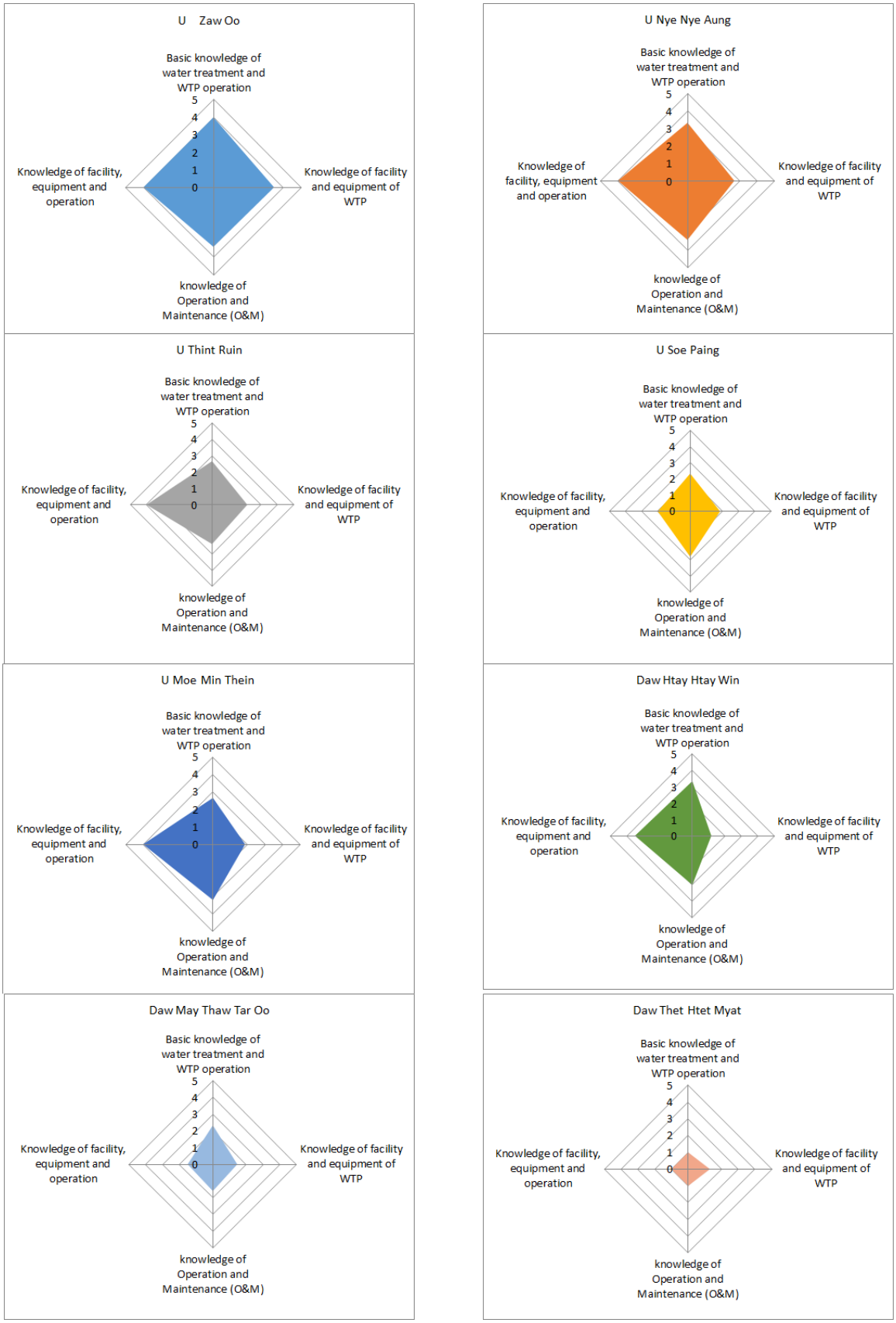
Result of 2nd survey is shown Table 5.22 and Figure 5.5. Interviewee was manager (AE), leader of water quality monitoring (SAE) and administration / water quality monitoring staff (Flat). Manager showed relatively high capacity about administrative capacity. In addition, manager showed comparatively high capacity. This is because of the experience of practice in WTP.

On the other hand, staffs which have little experience (SAE and Flat) showed lower capacity. From this result, it is pointed out that the necessity of implementation of adequate internal training.

Table 5.20 Table 5.21 Result of assessment (1st survey, summary)

Category	Items	U Zaw Oo	U Nye Nye Aung	U Thint Ruin	U Soe Paing	U Moe Min Thein	Daw Htay Htay Win	Daw May Thaw Tar Oo	Daw Thet Htet Myat	Average

Category	Items	U Zaw Oo	U Nye Nye Aung	U Thint Ruin	U Soe Paing	U Moe Min Thein	Daw Htay Htay Win	Daw May Thaw Tar Oo	Daw Thet Htet Myat	Average
A. Basic knowledge of water treatment and WTP operation	A1. Explain about water treatment process in Nyaunghnapin WTP.	4	4	3	3	3	3	2	1	2.9
	A2. Explain contents of WTP operation manual.	4	2	3	2	3	3	1	1	2.4
	A3. Explain about preparation of operation operating record.	4	4	2	2	2	4	4	1	2.9
B. Knowledge of facility and equipment of WTP	B1. Explain a treatment capacity (water quality) of Nyaunghnapin WTP ? (e.g. upper limit of turbidity, etc.)	3	2	3	2	2	1	2	1	2.0
	B2. Explain a treatment capacity (production) of Nyaunghnapin WTP.	3	2	3	1	2	1	2	1	1.9
	B3. Explain a fluctuation of raw water quality (e.g. difference of rainy season and dry season, water quality accident).	3	3	3	2	3	1	2	1	2.3
	B4. Explain coping process to the fluctuation of raw water.	3	3	3	2	1	1	1	1	1.9
	B5. Explain process of determination of coagulant dosing based on Jar test data and other water quality data.	1	1	3	1	3	1	1	1	1.5
	B6. Explain quality management of stored water treatment chemical.	4	1	3	1	3	1	1	1	1.9
	B7. Explain process of flow control in treatment process.	4	3	1	4	1	1	1	1	2.0
	B8. Explain operation process to produce appropriate flock formation.	4	4	1	3	1	1	1	1	2.0
	B9. Explain operation procedure of sand filter.	4	4	1	1	1	1	1	1	1.8
	B10. Explain operation procedure of backwashing of sand filter.	4	4	1	1	1	1	1	1	1.8
	B11. Explain the necessity of water quality monitoring in WTP.	4	4	2	3	1	3	3	4	3.0
	B12. Explain sampling point and monitoring item of water quality monitoring in WTP.	4	3	2	2	2	1	2	2	2.3
	B13. Explain operation procedure in unusual raw water quality (e.g. water quality accident, high turbidity, etc.)	4	1	2	1	3	1	1	1	1.8
C. knowledge of Operation and Maintenance (O&M)	C1. Explain internal rule of O&M.	4	4	1	4	4	3	3	1	3.0
	C2. Explain the concept of Preventive maintenance.	1	1	1	1	1	1	1	1	1.0
	C3. Explain O&M procedure of reservoir, WTP and service reservoir.	4	4	3	4	3	3	2	1	3.0
	C4. Explain procedure of urgent repairmen of WTP facility and equipment.	4	4	3	4	4	4	1	1	3.1
	C5. Explain preparation of operation and maintenance record.	4	4	4	1	4	4	1	1	2.9
D. Knowledge of facility, equipment and operation	D1. Explain the level of importance of equipment in WTP (What is the most important equipment in this WTP?)	4	4	4	3	4	3	2	1	3.1
	D2. Explain procedure of preparation of working report and repair report.	4	4	4	1	4	4	1	1	2.9



Source: JICA Expert

Figure 5.4 Result of assessment (1st survey, Individual radar chart)

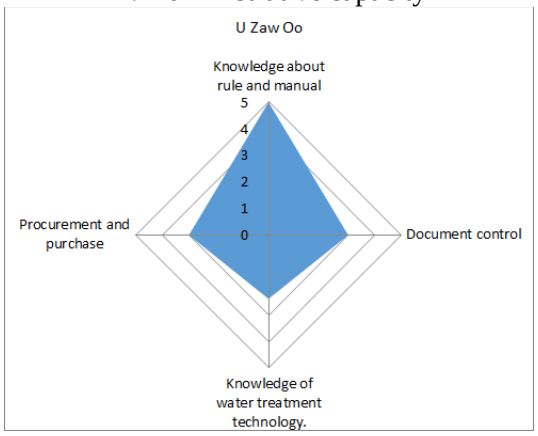
Table 5.22 Result of assessment (2nd survey, summary)

Category		Items	U Zaw Oo	Daw Thindar Su Su khin	Daw May Thar Oo	Average
A. Administrative capacity	Knowledge about rule and manual	A1. Understanding of internal rule (rule of YCDC) of O&M.	5	2	2	3.0
		A2. Understanding of contents of O&M manual of each facility and equipment in WTP.	5	2	2	3.0
		A3. Understanding of appropriate procedure of repair of facilities and equipment in WTP	5	2	2	3.0
		A4. Understanding of contingency plan of WTP.	5	3	2	3.3
	Document control	A5. Prepare documents of O&M report and repair report, etc. properly.	3	2	2	2.3
		A6. Understanding of document control system in WTP.	3	2	2	2.3
	Knowledge of water treatment technology.	A7. Opportunity to receive a training course of water treatment technology.	2	1	2	1.7
		A8. Understanding of water treatment technology (1) Coagulation - sedimentation process	2	2	2	2.0
		A9. Understanding of water treatment technology (2) Sand filtration process	3	2	2	2.3
		A10. Understanding of water treatment technology (3) Chlorination process	2	1	1	1.3
		A11. Understanding of operation manual.	3	3	3	3.0
	Procurement and purchase	A12. Understanding of procurement and purchase procedure (specific procedure in YCDC)	3	1	1	1.7
B. Operation of WTP	Knowledge of capacity of WTP	B1. Understanding of function of each facility and equipment. (1)Water intake facility	4	2	2	2.7
		B2. Understanding of function of each facility and equipment. (2)Receiving tank	4	3	2	3.0
		B3. Understanding of function of each facility and equipment. (3) Coagulation tank	4	3	2	3.0
		B4. Understanding of function of each facility and equipment. (4) Sand filtration tank	4	3	2	3.0
		B5. Understanding of function of each facility and equipment. (5) Clear water tank	4	3	2	3.0
		B6. Understanding of function of each facility and equipment. (6) Service reservoir	4	2	1	2.3
		B7. Understanding of the ability of WTP (Ability of Nyaunghnapin WTP: water production, acceptable water quality).	3	3	3	3.0
		B8. Understanding of fluctuation of raw water quality e.g. difference of water quality in rainy season and dry season, seasonal change or water quality accident.	3	3	2	2.7
		B9. Understanding of proper WTP operation for the change of raw water quality	3	3	1	2.3
	Handling of water	B10. Understanding of operation manual of water purification chemical handling facility (chemical	3	2	1	2.0

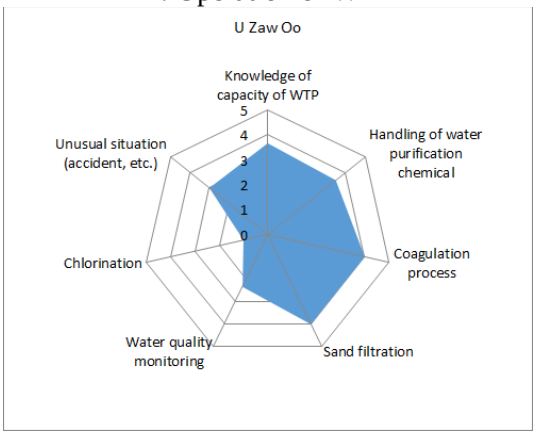
Category		Items	U Zaw Oo	Daw Thindar Su Su khin	Daw May Thar Oo	Average
	purification chemical	storage facility and chemical injection facility)				
		B11. Understanding procedure of quality management of stock water purification chemical.	4	2	1	2.3
	Coagulation process	B12. Implement jar test properly, and decide coagulant injection ratio.	4	3	1	2.7
		B13. Understanding of appropriate control technique to produce adequate (thick and large) flock.	4	1	1	2.0
	Sand filtration	B14. Understanding of appropriate operation procedure of sand filtration pond (control of appropriate flow, etc.)	4	2	1	2.3
		B15. Understanding of appropriate O&M procedure of sand filtration pond.	4	2	1	2.3
		B16. Understanding of appropriate backwash operation, e.g. timing of start / stop backwash, adequate control of back wash flow.	4	2	1	2.3
		B17. Understanding of appropriate particle size distribution of sand filter	4	2	2	2.7
	Water quality monitoring	B18. Understanding of the necessity of water quality monitoring.	3	2	3	2.7
		B19. Understanding of water quality analysis item and sampling point in WTP.	2	2	3	2.3
		B20. Procedure of feedback of analyzed water quality data to WTP operation.	2	2	3	2.3
	Chlorination	B21. Understanding of appropriate operation of chlorine injector (decide appropriate chlorine injection ratio) base on water quality data, e.g. raw water quality, residual chlorine concentration.	1	1	1	1.0
	Unusual situation (accident, etc.)	B22. Understanding of appropriate WTP operation and water quality monitoring in the case of unusual water quality, e.g. water quality accident, high turbidity, etc.	3	1	1	1.7

Source: JICA Expert

A. Administrative capacity



B. Operation of WTP



Source: JICA Expert

Figure 5.5 Result of assessment (2nd survey, Individual radar chart)

5.5.4 Overall Assessment and Approaches for Improvement

It is appeared that technical knowledge is insufficient. Therefore, the priority issue is an enhancement of technical capacity of WTP staffs on water treatment technology.

For the enhancement of technical capacity of staffs, at first, development of capacity of water treatment technology is important. For this purpose, periodical technical seminar is implemented.

In addition, to improve knowledge of water treatment technology, OJT including development SOPs, O&M training in Nyaunghnapin WTP are planned. Summary of training is shown in Table 5.23.

Table 5.23 Summary of training

Topic		Main contents	Objectives	Training style
1.	Training of water quality management knowledge	– Standard knowledge and technology of water treatment – Preventive maintenance of WTP – Record of operation and maintenance activity – O&M of chlorination facility	To understand standard knowledge and technology of water treatment	Seminar and OJT
2.	Review current situation and formulate phased countermeasures	– Review of each treatment process – Identify problem in a treatment process – Study improvement plan – Evaluation of improvement plan	To understand water treatment technology, operation and maintenance	Seminar and OJT
3.	Develop SOPs	– Develop SOP	To understand SOP	Seminar and OJT

Topic		Main contents	Objectives	Training style
		− Revise SOP through Operation & Maintenance work	development / revision skills	

Source: JICA Expert

CHAPTER 6. Summary and Recommendations

6.1 Summary of assessment

6.1.1 Core Capacity

6.1.1.1 Organizational Level

In general, WSD has set procedures and means of planning and budgeting and its execution monitoring. However, these are not committed and shared well by section level, and the authority is too concentrated to top management level. It is more effective if section level would be empowered with authority so as to be involved in planning and budgeting.

Planning and Monitoring: In WSD, annual implementation plan and budget plan is set annually, but these are not well committed and shared by section, branch level. For monitoring the progress of the plan, monthly and biweekly meeting is held. However, section level does not know how the report and progress is reflected to the plan. Although the progress of the activities is regularly compiled, quality of the report is needed to be improved in the manner to show and analyze the data.

Budgeting and monitoring of its execution is done regularly, and procedures are set firmly. However, the authority is concentrated to the higher position; few activities can be managed by section level. Decision making may take longer time, and it makes difficult to reflect real situation into the consideration. In Addition, budget execution is monitored but requires so complicated documents that staff should consume too much time for documentation.

Staffing: In most sections the number of staff is insufficient to implement the assigned duties, staff has not enough knowledge related to the duties, skilled labor is retiring, or WA and Flat turnover easily. Moreover, most sections do not have clear job descriptions of the both of section level and staff level.

Communication: Important information is shared in the regular meeting but the annual plan is not distributed in writing but reported orally to each section (Hierarchal communication). While small sections tend to have close communications among section members, In larger sections, information cannot be conveyed properly to lower staff than SAE level (Communication within section:). information is shared only in the regular meeting. Without it, information sharing is not officially established. In particular, branch officies, located not in head office, has difficulties to communicate with other sections. (Communication with related sections:)

6.1.1.2 Individual Level

Individual core capacity generally corresponds to job position of the C/Ps. C/Ps in higher position has experiences and capacity of management.

Awareness, leadership: Most staff provided higher mark regardless of the position. Some younger staff feels difficulty to apply what they learn to their job because they seem not to have enough experience to be able to link the theory learnt to practices.

Management: Staff in higher position has higher capacity. Younger staffs seem to be unfamiliar not only to make and work along work plan, but work closely with other sections. Even higher level officers have difficulties to make report in sufficient quality. The quality of report is needed to be improved at personal level and organizational level.

Problem solution: In present, the discretion is not well delegated to the worksite. Therefore, staff is not familiar to make plans by themselves. This type of capacity is limited to younger staff especially grasping and understand the problems. Ordinary staff does not have little opportunities to consider approaches for problem-solving. Once the direction to solve the issues is shown as work plan or order of a supervisor, most staff has self-confidence to implement it.

6.1.2 Technical Capacity

6.1.2.1 Organizational Level

Organization: Present organizational structure of WSD seems not to be the most efficient. Corresponding to current work flow, and demand of issues to be solved urgently, WSD needs to rearrange its organization including setting up new sections such as specialize in planning, HRD, NRW management, water treatment etc.

Information management: Information on existing facilities and assets are not managed well. Specifications and as-built drawings of facilities are lack, which are quite important for daily O&M. In addition, operation records are sometimes kept individually, but not accumulated or compiled as periodical report properly as a whole organization.

Manuals and SOPs: Manuals, SOPs and technical standards are limited. Most of all fields need to set standards, manuals and SOP. In case there is any standard or manual, staff of WSD does not know and understand its contents, so cannot apply them to their work.

6.1.2.2 Individual Level

Senior officers have higher core capacity with rich experience of the concerned work. S/he can accumulate experiences and practical knowledge through working. However, in many fields, many staffs seem not to have enough theoretical knowledge on their works and wide knowledge related to their works.

6.2 Recommendation

Based on the results of capacity assessment, YCDC counterpart members and JICA Experts made discussion for project activities. Each chapter of this report includes specific proposals "approaches to improve" from JICA Expert not only focusing on the activities conducted by the Project, but some proposals for future to be referred.

The Project activities were planed based on these proposals with priority which was considered through this capacity assessment.

To monitor capacity development of YCDC, it is recommended to conduct capacity assessment occasionally. For comparing the result of the assessment, it is noted that the assessment is made with not absolutely objective criteria, but relatively subjective view; therefore, the score difference among counterpart members or sections does not mean difference of capacity. For example, staff A has higher mark than staff B, which does not always mean staff A is higher capacity than staff B because staff A might be more strict to provide higher point to him, or his target level might be higher than staff B. It is more significant to compare changes over times of specific person or section.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE REPUBLIC OF THE UNION OF MYANMAR
YANGON CITY DEVELOPMENT COMMITTEE (YCDC)

REPORT ON CAPACITY ASSESSMENT
- At the Project End -

May 2021

PROJECT FOR IMPROVEMENT OF WATER SUPPLY MANAGEMENT OF YCDC

YCDC TECHNICAL COOPERATION COUNTERPARTS TEAM
AND
JICA EXPERT TEAM

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ABBREVIATION

ACE	Assistant Chief Engineer
AE	Assistant Engineer
CD	Capacity Development
CE	Chief Engineer = Head of Department
C/P	Counterpart
DMA	District Metered Area
DYCE	Deputy Chief Engineer
EDWS	Engineering Department (Water and Sanitation)
EE	Executive Engineer
FY	Fiscal Year
GIS	Geographic Information System
HRD	Human Resource Development
KPI	Performance Indicator
M&E	Mechanical & Electrical
MGD	Million Gallons per Day
MKPI	Management Key Performance Indicators
NRW	Non-Revenue Water
OJT	On-the-Job training
O&M	Operation & Maintenance
PCM	Project Cycle Management
PDCA Cycle	Plan-Do-Check-Action Cycle
PDM	Project Design Matrix
PI	Performance Indicator
P/S, PS	Pumping Station
SAE	Sub-Assistant Engineer
SOP	Standard Operation Procedures
T/S, TS	Township
UCSB	Union of Civil Service Board
WA	Work Authority (temporary staff of YCDC)
WQ	Water Quality
WRAWSA	Water Resource and Water Supply Authority
WSD	Water and Sanitation Department
WTP	Water Treatment Plant
YCDC	Yangon City Development Committee
YRG	Yangon Region Government

Abbreviation for the Relevant Studies

The Preparatory Study for Urban Development Programme in the Greater Yangon (JICA), 2012	JICA Urban Plan Study, 2012
Household Interview Survey (JICA), 2012	2012 JICA-HIS
The Study on Improvement of Water Supply System in Yangon City, 2002	2002 JICA-M/P
Preparatory Survey Report on the Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City in the Republic Of The Union Of Myanmar, March 2014	JICA M/P

UNIT

1 Gallon (British Gallon) = 4.546 liter
1 Acre = 4,047 m^2

CHAPTER 1. End-line Assessment of Water Supply Service in Yangon

This end-line survey is aimed at measuring the changes achieved as compared to the baseline survey, which was conducted in July-December 2016. At the beginning of the project, because the available quantitative date was limited, a concept of benchmarking system was newly established and the monitoring of water supply service was launched by the WRAWSA since FY2016/17. Thus, this end-line survey employed the quantitative Key Performance Indicators (KPIs) in FY2016/17 and compared it to that of FY2018/19 as the latest KPIs for measuring the changes.

1.1 Comparison of the WRAWSA's Performance on Water Supply Service between FY2016/17 and FY2018/19

Fifteen (15) important KPIs for the top management were selected as Management KPIs (MKPIs) in the project. The comparison of the MKPIs between FY2016/17 and FY2018/19 is shown in the summary table below.

Table 1.1 Comparison of MKPIs (FY2016/17, FY2018/19)

Sq/N	Symbol	Indicators	Unit	FY2016/17 (actual)	FY2018/19 (actual)
1. Water Supply Service					
1	S1	Service population	'000 inhabitants	1,392	1,928
2	S2	Total connections	Nb.	327,285	342,364
3	S28	Service coverage rate	%	30.1%	42.4%
		Service coverage rate	%		40.9%
2. Production & Transmission					
4	PT4-4	Daily average total production	m^3/day	761,255	795,909
3. Distribution & NRW					
5	D17	NRW	%		63.0
6	D23	The number of repaired pipe breaks per pipe length	Repaired Nb./km/year	0.28	0.32
4. Water Quality					
7	Q7-1-1	Compliance ratio of monthly water test in water facilities -treated water- (turbidity)	%	69.0	89.2
8	Q7-5-2	Compliance ratio of monthly water test at tap water in TS (Residual chlorine)	%	—	—
5. Sales & Collection					
9	C15-3	Operating metering ratio (by total connection)	%		72.9
10	C20-2	Collection ratio in amount	%	72.7	101.6
6. Finance					
11	F5	Operating ratio (Operating cost coverage)	%	63.7	68.1
12	F9	Average revenue per m^3 sold	Kyat/m^3 water sold	98	132
13	F12	Unit operational cost for water sold	Kyat/m^3 water sold	173	194
7. Administration & Human Resource					
14	H8	Training period*number of trainee/Total staff	Person*day	2.9	1.4
15	H11	Total staffs number/1000 connections	person/ 000 conn.	7.4	6.9

1.2 Main Findings by the Comparison of MKPIs

1.2.1 Number of Connection and Service Coverage

The number of connection shows an increase trend during three years from 327,285 connections in FY2016/17 to 342,364 connections in FY2018/19. Served population also increased from 1,391,626 to 1,928,093. Approximately 536,000 connection has been connected to the water system of EDWS.

As the results, water service coverage of EDWS increase from 30% in FY2016/17 to 42% in FY2018/19.

It needs an attention on the estimation method has been changed in FY2018/19. Served population is estimated by multiplying number of households (HH) by average number of persons per HH. In the estimation of FY2016/17, we utilized a uniform average value of 5 persons/HH for all township as a simple method. In FY2018/19, the average number of persons/HH was calculated in all townships and it was applied for the estimation of served population, since the average was varied township to township.

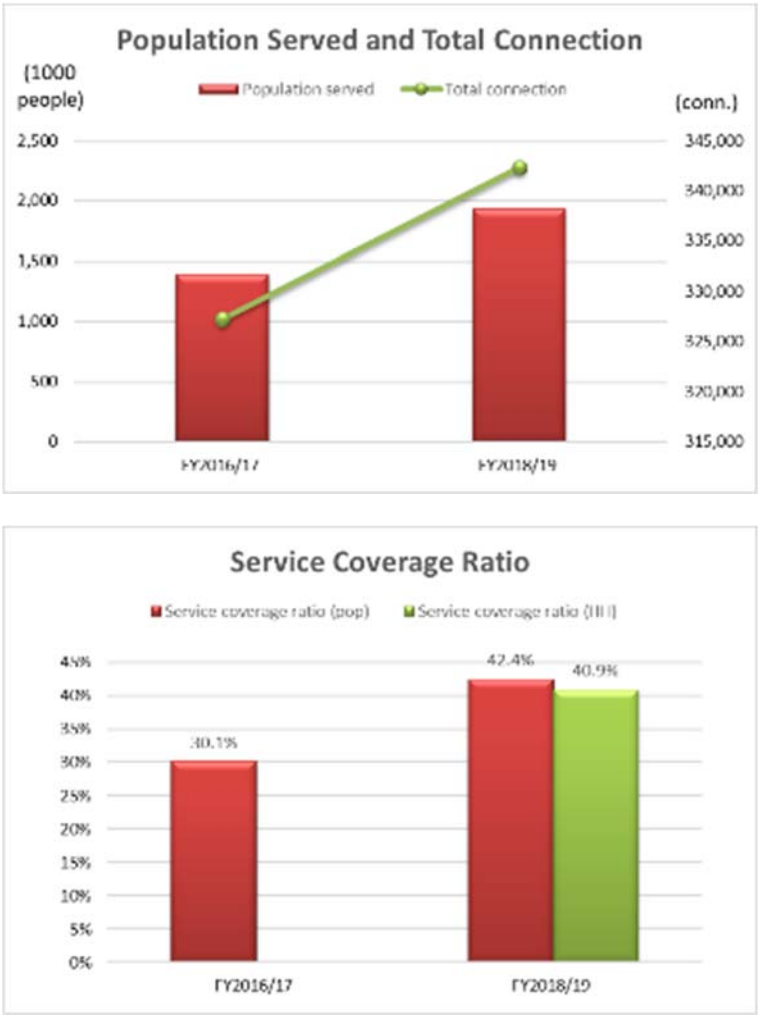


Figure 1.1 Population Served/ Total Connection (above) and Service Coverage Ratio (below)

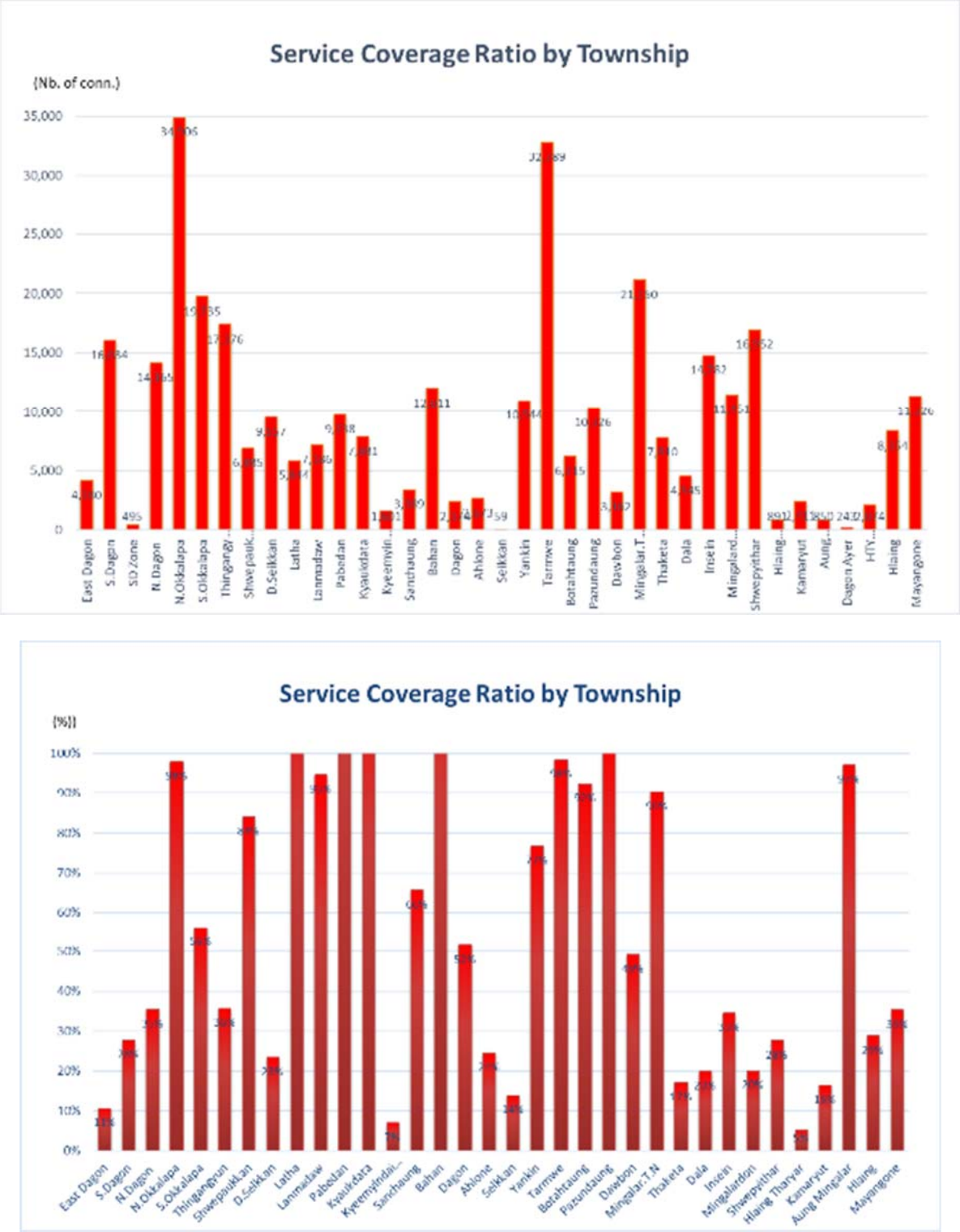


Figure 1.2 Connection Number by Township (above) and Service Coverage Ratio by Township (below)

1.2.2 Daily Average Total Production

Daily average total production increased from 761,255 m^3/day in FY2016/17 to 795,909 m^3/day in FY2018/19, by adding the production volume with 3,500 m^3/day. The production volume is expected to be increased after commencement of Lagyunpin WTP operation.

In FY2016/17, this volume was estimated by using pump capacity and operation hours. In FY2018/19, since

flow meters were installed in 21 main points which enable to estimate water flow volume more accurately, the production volume was estimated based on the available flow data of only one month. In the next year, an annual production data will be available, so that more reliable data will be obtained.

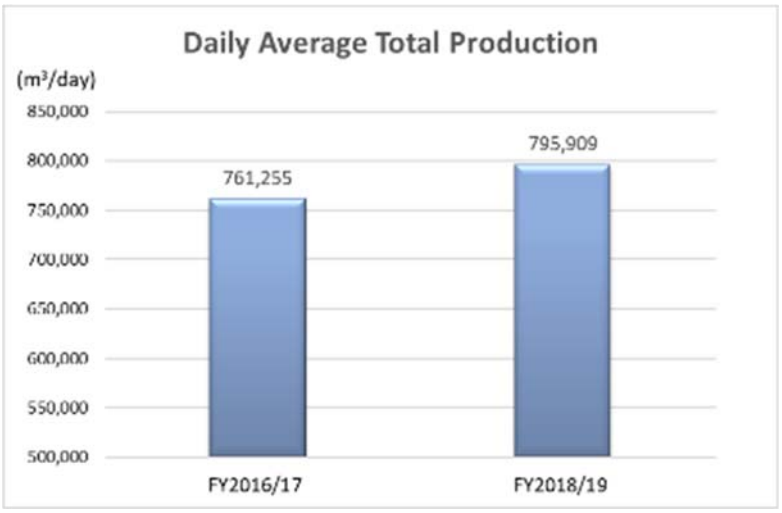


Figure 1.3 Daily Average Total Production

1.2.3 NRW Ratio

NRW ratio was estimated as 63% in FY2018/19, while the ratio was not indicated in FY2016/17 due to limitation of the information on water flow volume. Master Plan indicated NRW ratio as 66% in FY2011/12.

NRW ratio in FY2018/19 was estimated also based on the available flow data of one month, same as daily average production volume. Hence, In the next year, an annual production data will be available, so that more reliable data will be obtained.

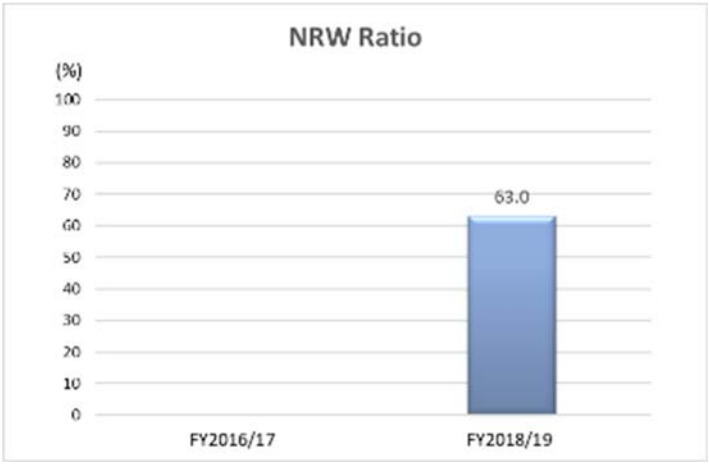
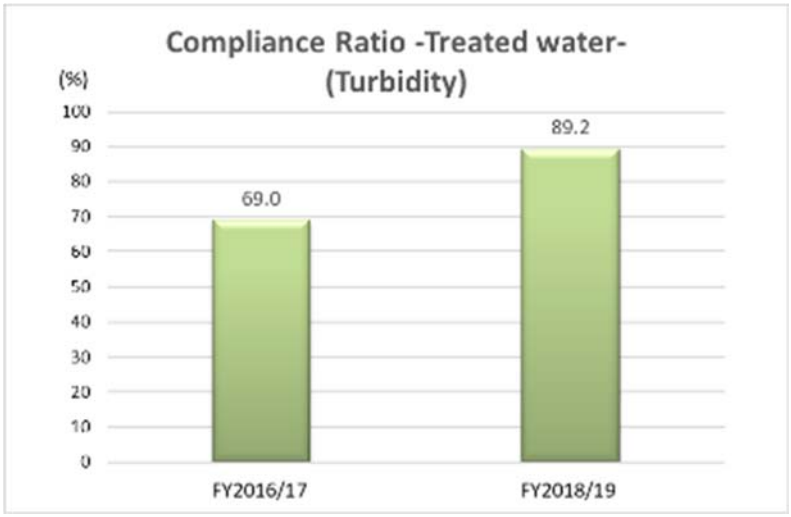


Figure 1.4 NRW Ratio

1.2.4 Compliance Ratio of Monthly Water Test in Water Facilities -Treated Water- (Turbidity)

Compliance ratio of turbidity for treated water with the required standard increased from 69.0% in FY2016/17 to 89.2% in FY 2018/19. It could be said that water quality of treated water has been getting improved. This could be attributed to improvement of operation practice of WTP, enrichment of water quality monitoring system and quality management. In the next year, compliance ratio of residual chlorine will be possible to be estimated after staring the operation of chlorine dozing facilities.



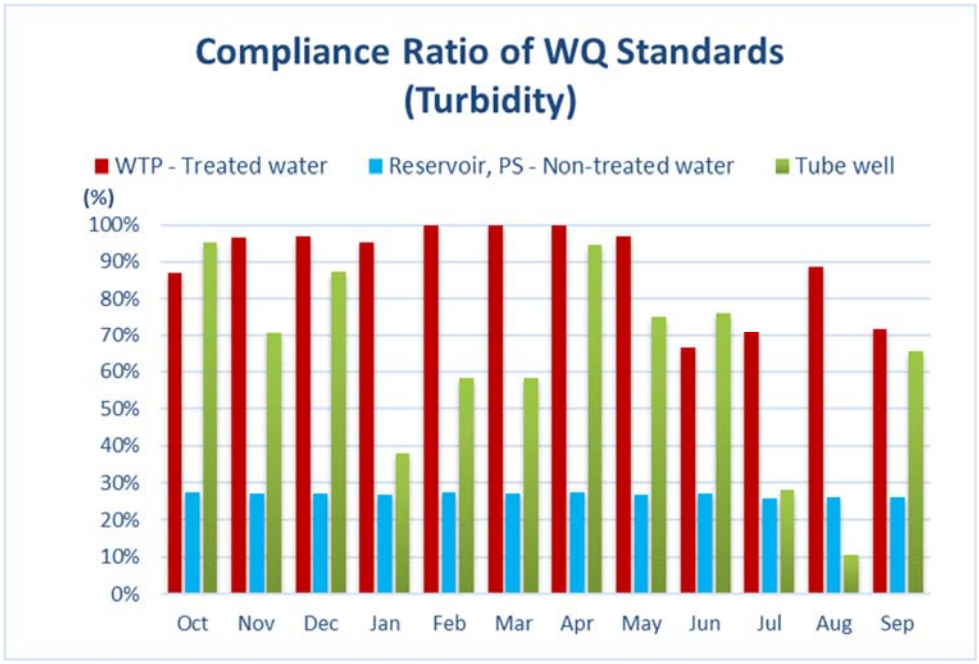
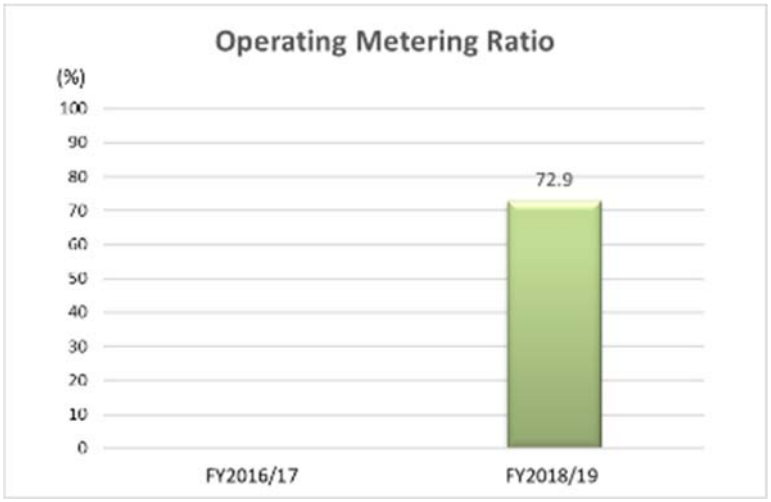


Figure 1.5 Compliance Ratio (Turbidity)(above) and Monthly Transition (below)

1.2.5 Operating Metering Ratio

Operating metering level in FY2018/19 is indicated as 72.9%. Since the ratio in FY2016/17 was not available, it is not comparable to the past performance. The judgement and counting for the number of operating meters depends on the assessment of township staffs by an instruction of Planning section. The challenge could be more standardize the assessment criteria comprehensively.

Looking at operating metering level by township base, the ratio of North District shows relatively high ratio, nearly 100%. While the ratio of North Okkalapa, South Dagon, Thaketa and Dagon townships are low at less than 50%.



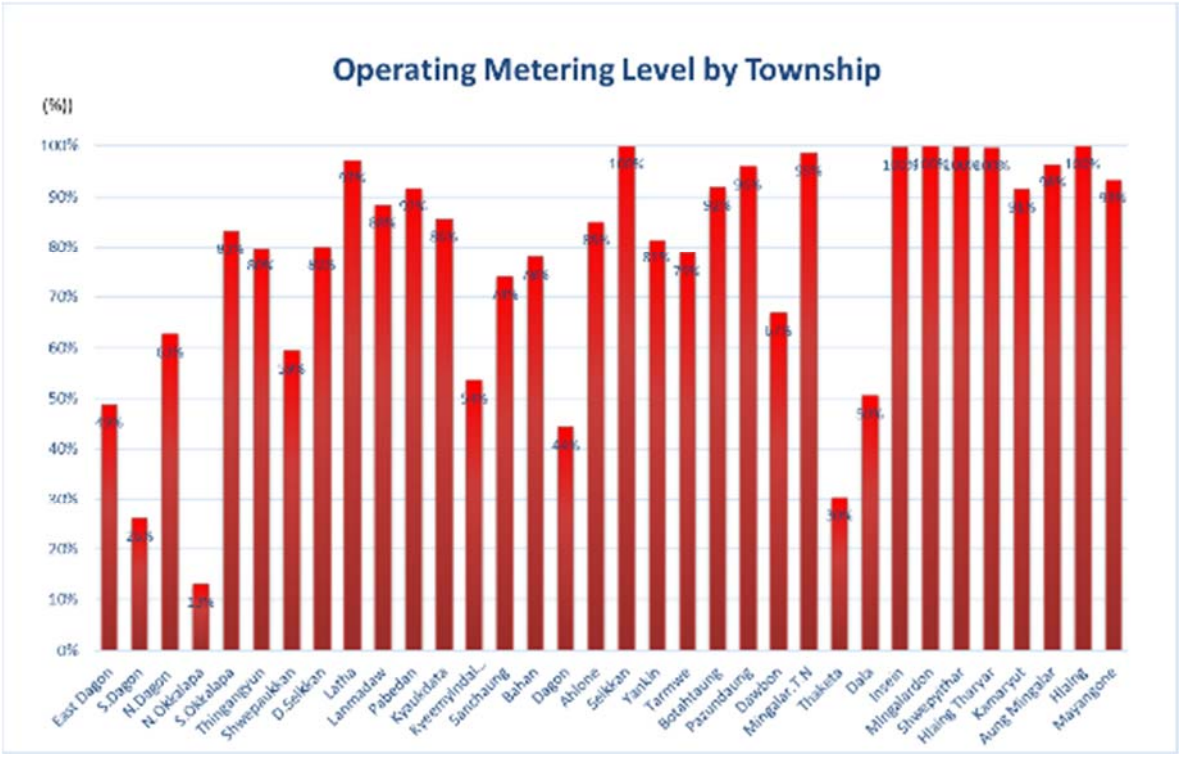
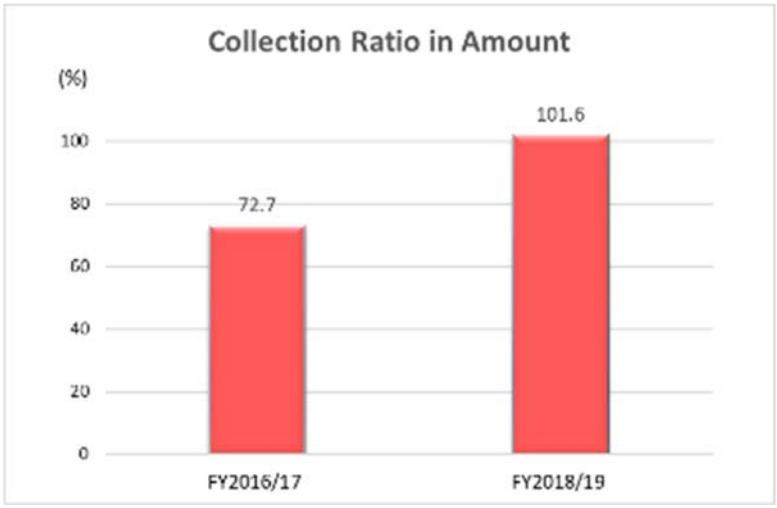


Figure 1.6 Operating Metering Ratio (above) and Operating Metering Ratio by Township (below)

1.2.6 Collection Ratio in Amount

Collection ratio in amount meets a dramatic increase from 72.7% in FY2016/17 to 101.6% in FY 2018/19. This is obvious improvement of the operation practice of township and district offices at the forefront, and it is also attributed to the top management efforts. Even if outstanding is occurred, the amounts tend to be usually collected during three or four months.

Looking at the ratio by township-base, the ratio of Dagon Seikkan, North Dagon, North Dagon townships are relatively low at less than 80%.



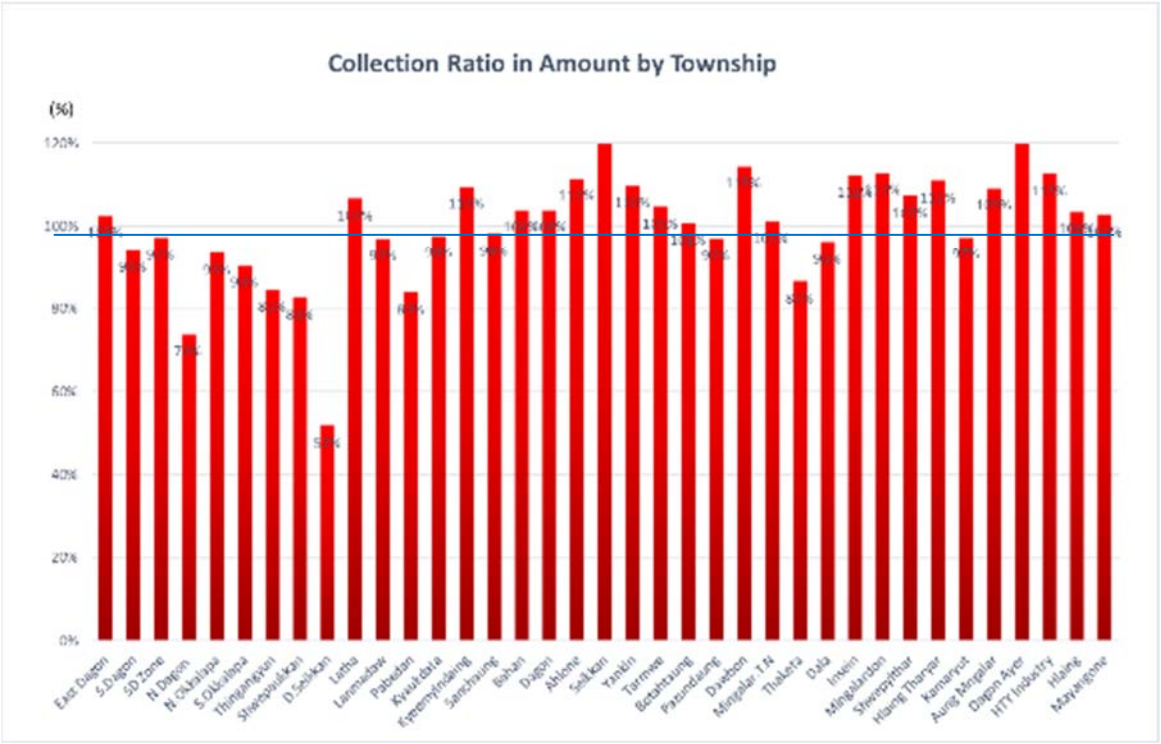


Figure 1.7 Collection Ratio and Collection Ratio (above) by Township (below)

1.2.7 Operating Cost Coverage Ratio

This ratio was calculated by annual operating revenue divided by annual operating costs. The indicator value less than 100% means that operating costs exceed operating revenue, hence the operating cost recovery should be a present target of EDWS.

The ratio shows an improvement of const coverage from 63.7% in FY 2016/17 to 68.1% in FY 2018/19.

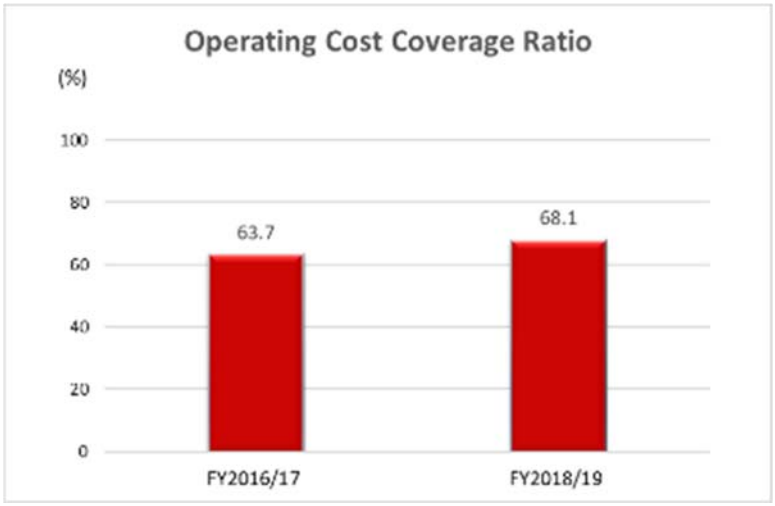


Figure 1.8 Operating Cost Coverage Ratio

1.2.8 Average Revenue per m^3 and Sold and Unit Operational Cost per m^3 Sold

Both of unit operating cost and average revenue per m^3 shows its increase trend from FY2016/17 to FY2018/19. Unit operating cost per m^3 still exceeds average revenue per m^3, however the ratio of gap between costs and revenue is getting small. The cost usually tends to be increased year by year, so that continuous efforts to take measure on revenue increase needs to be carried out.

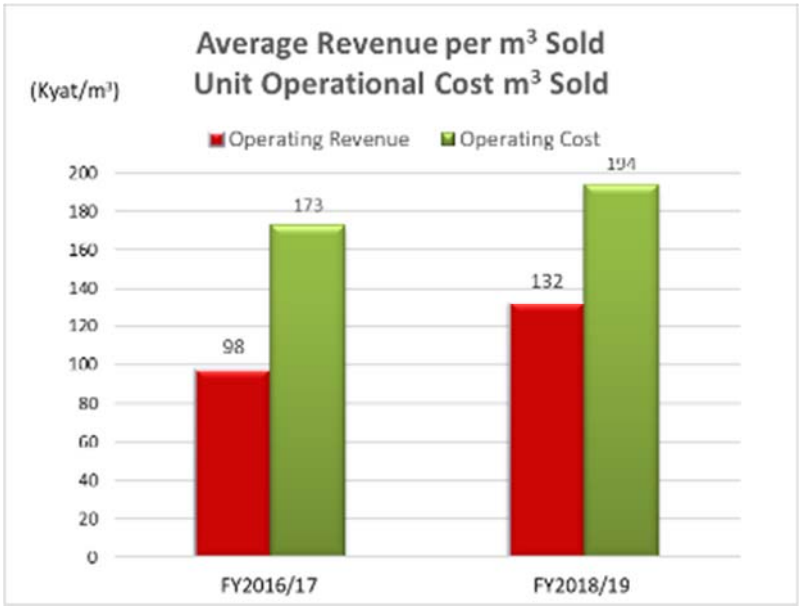


Figure 1.9 Average Revenue Water Sold and Unit Operational Cost Sold

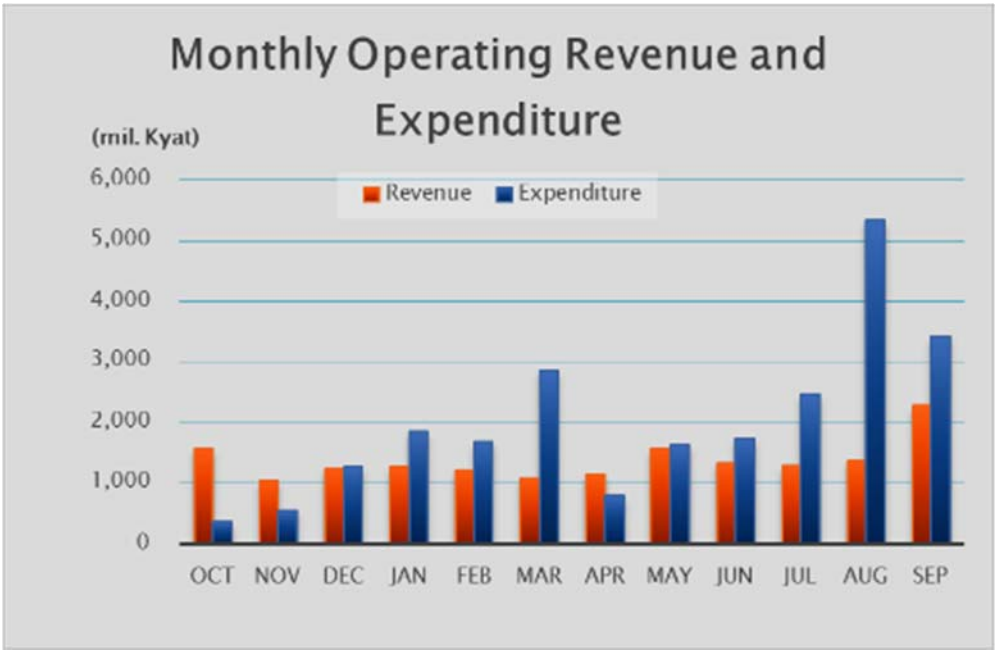


Figure 1.10 Monthly Operating Revenue and Expenditure

1.2.9 Training Opportunity per Staff

The ratio of training opportunity per staff decreased from 2.9 in FY 2016/17 to 1.4 FY 2018/19. It is assumed that the reason of relatively high ratio in FY2016/17 was attributed to increase of training opportunity associated with JICA technical assistant project, since the period in FY 2016/17 was the beginning stage of the project.

Figure 1.11 Training Opportunity per Staff

1.2.10 Total Staff Number per 1,000 Connection

Total staff number per 1,000 connection decreased from 7.4 in FY 2016/17 to 6.9 in FY 2018/19. It indicates a slight improvement of management efficiency of EDWS. Institutional reform of YCDC has been carried out, therefore the trend of this ratio should be carefully monitored after the reform.

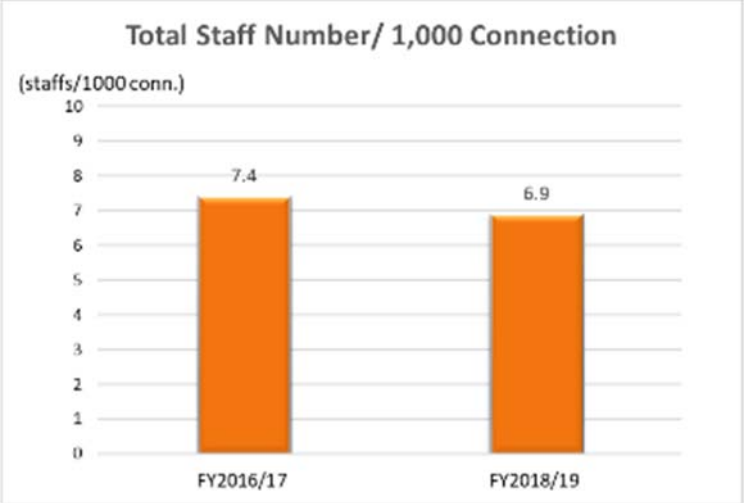


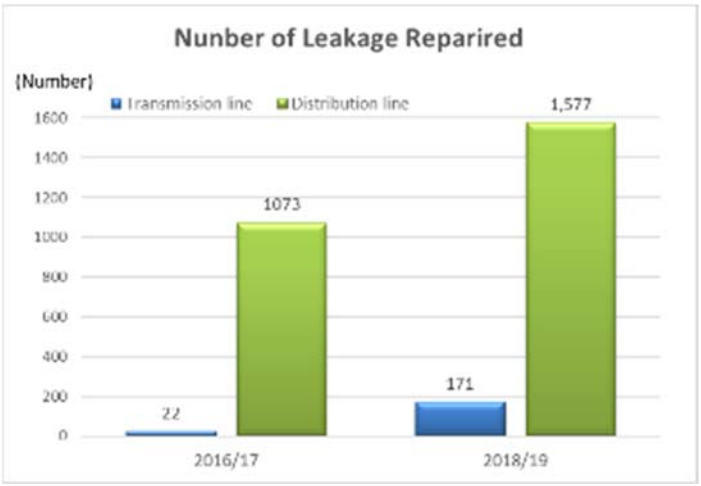
Figure 1.12 Total Staff Number per 1,000 Connections

1.3 Other KPIs

1.3.1 Number of Leakage Repaired

Number of leakage repaired both in transmission line and distribution line indicates the increased trend as 1.6 times from 1,095 in FY 2016/17 to 1,748 in FY 2018/19. Particularly number of leakage repaired in transmission pipe is assumed to be attributed to the aged pipe such as concrete pipe. The clear reason of this trend carefully needs to be identified in the monitoring report.

The number of leakage repaired for transmission and distribution seems to be constantly occurred every month.



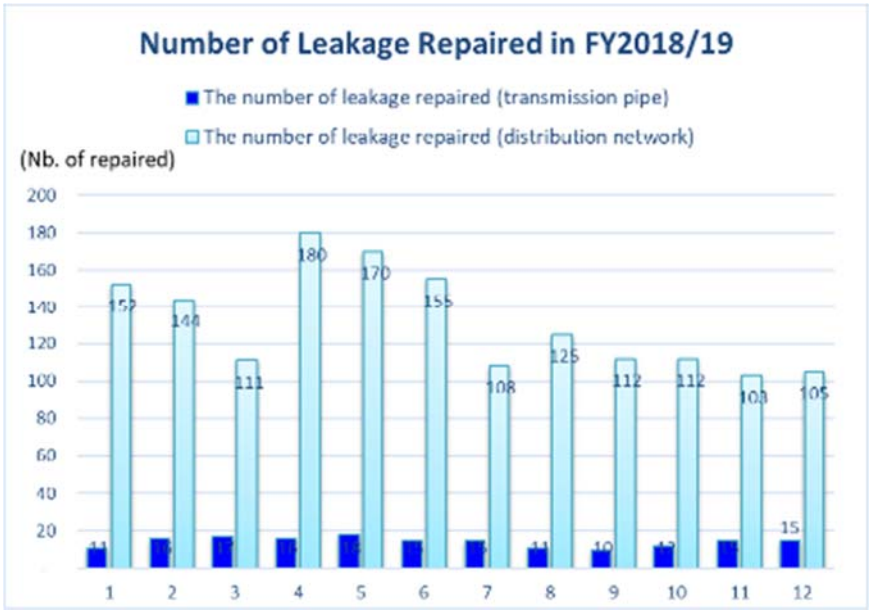


Figure 1.13 Number of Leakage Repaired and Its Monthly Trend

1.3.2 Number of Water Meter (New, Replace)

Number of water meter newly installed in FY2018/19 was 22,742 and number of water meter replaced in FY2018/19 was 14,014. The monthly average of new meter installation and meter replacement were 1,895 and 1,168 respectively.

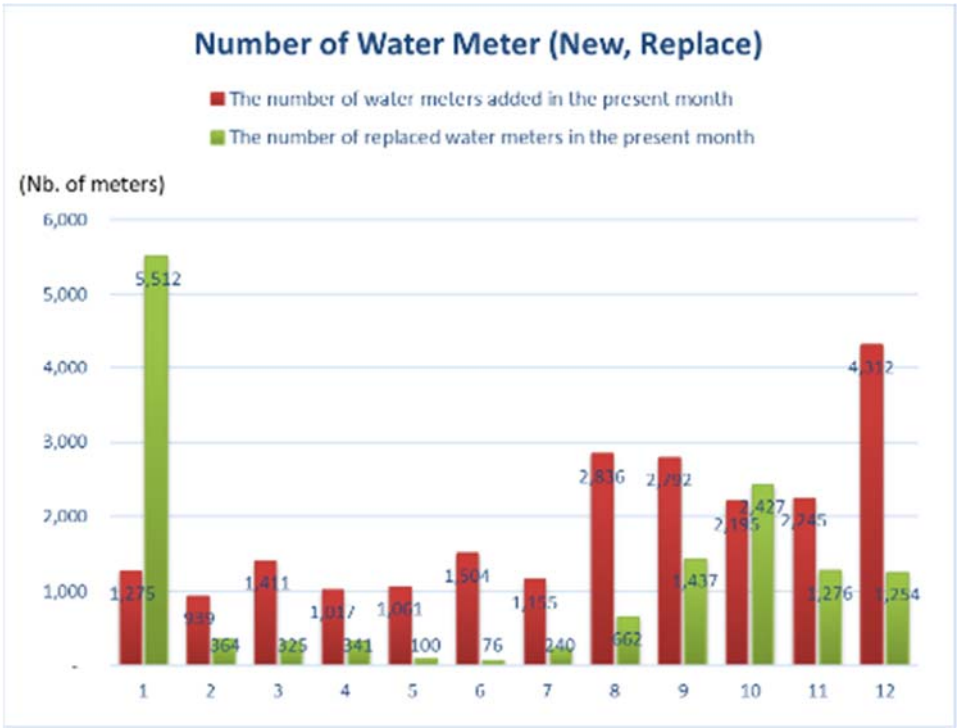


Figure 1.14 Number of Water Meter (New, Replace)

1.3.3 Composition of Revenue and Expenditure

In FY2018/19, the major part of revenue was Public Water Charge with 78% of the total, and followed by Departmental Water Charge with 10%. Hence, 88% of revenue depends on water charge for the supplied water.

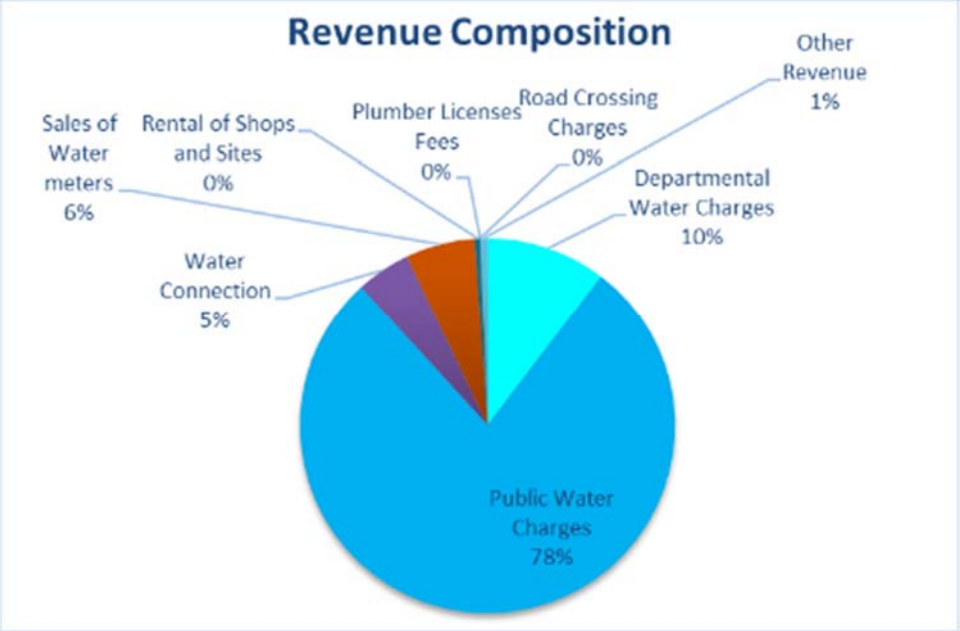


Figure 1.15 Revenue Composition

In 2018./19, the largest cost was electricity costs which remarkably shares 47% of the total expenditure. The following larger costs were material, repair and maintenance costs with 17% and operating materials including chemicals with 13%.

The trend of electricity expenditure including electricity tariff revision may have large impact on the operating balance of EDWS, it should be carefully monitored in the succeeding years.

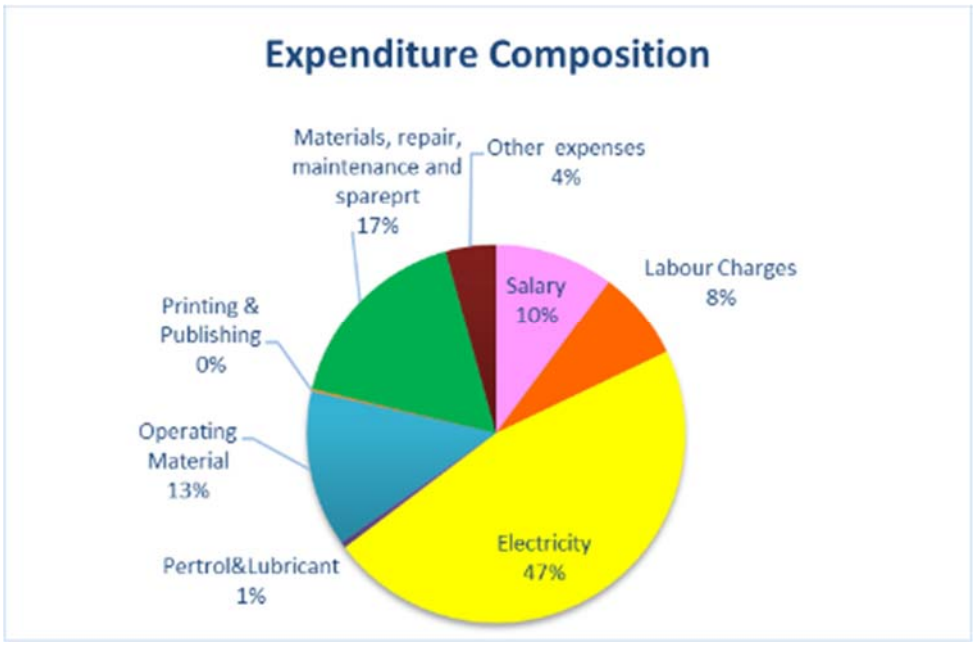


Figure 1.16 Expenditure Composition

CHAPTER 2. Procedures of Capacity Assessment

2.1 Background

The first capacity assessment was conducted in the end of. 2015, as a part of Baseline survey at the beginning of the Project. The results were compiled as Baseline Survey Report. This time is the second Capacity Assessment conducted after 4 years, in the end of 2019, as End line survey in order to make comparison between at the beginning stage and the final stage of the Project.

2.2 Methodologies of Assessment

Responding to its purpose, the assessment focuses on two levels of capacity; 1) individual level and 2) organization level, and two aspects of capacity; a) technical capacity and b) core capacity among three capacities defined by JICA as shown below, because these capacities mainly match scope of the Project and is expected to be improved through the Project

> **Aspect of capacity;** Capacity is broadly divided into two categories. These are **technical capacity** in the form of techniques and particular knowledge, and **core capacity** which utilizes technical capacity to independently resolve issues. Moreover, there is a need for a wider perspective of looking at the **enabling environment** in which efforts of C/P organizations lead to positive outcomes and solutions of problems.

Source; JICA (2008) "Capacity Assessment Handbook".

Capacity can be assessed through interview, questionnaire, examination, confirming related documents, etc. In this capacity assessment, mainly interview, group discussion and questionnaire were used as follows.

Table 2.1 Method of Assessment of Each Capacity

	Technical Capacity	Core Capacity
Organization Level	Assessment was made through discussions among C/P members and experts according to assessment items prepared by each output team.	Assessment was made according to the unified assessment items. At most targeted sections, section heads made discussion with experts to make assessment.
Individual Level	Assessment was made through individual interview or filling questionnaire by each C/P according to assessment items prepared by each output team.	Assessment was made according to the unified assessment items by self-assessment. All counterparts were requested to assess their own capacity according to the questionnaire, and describe their "advantages" and "points to be improved" on each item. After self-assessment, his/her supervisor confirmed to settle the results.

In the End line Survey, there are only few fields which can conduct assessment at individual level because it is difficult for many fields to assess capacity of individual level because many C/P members were transferred, left office or retired; hence many C/P members at End line did not sit for baseline assessment, resulting in difficulties of comparison.

Mostly, assessment was made in 5-scale. The highest score "Level 5" is considered to be a "model" referred by other utilities or staff.

Table 2.2 Assessment Indicator and Degree of Achievement

	Level 1	Level 2	Level 3	Level 4	Level 5
Degree of achievement	0 ～29%	30～59%	60～89%	90～100%	+α

CHAPTER 3. Organizational Core Capacity

3.1 Planning and Monitoring

3.1.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in Table 3.1.

Table 3.1 Assessment Results of Organizational Core Capacity (Planning and Monitoring)

Category	Items	Item	Base line	End-line
A. Planning, Monitoring	1. There is annual action plan of section	Annual action plan	1	4
	2. Planned activities are monitored regularly.	Plan monitoring system	1	3
	3. The business activities are compiled as a report periodically.	Periodical reporting	1	2
B. Budget management	1. Budget is requested based on planning.	Planned budget request	1	3
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	1	3
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	1	3
	2. Duties and responsibilities of each staff is clear.	Clear duties	1	2
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	1	3
	2. There is regular occasions to share information among the members.	Staff meeting	1	4
		Total Average Score	1.0	3.0

3.1.2 Comparison of the Results and Overall Assessment

The overall average score increases 2.0 points from 1.0 at the baseline and 3.0 at the end-line. The remarkable increase can be seen especially in the following area:

- (A-1) There is annual action plan of section
- (D-2) There is regular occasions to share information among the members.

It could be mentioned that all core capacity were developed and improved in overall, since there was no apparent functions of planning and monitoring, and organizational section and staff members before the project. In comparison to the beginning of the project, the core capacity of planning and monitoring system, reporting, budget planning and implementation, information sharing within the staff and staff meeting has been developed through the project activities.

Figure 3.1 Results of Organizational Core Capacity (Planning and Monitoring)

3.1.3 Approach for Further Improvement

In order to make a further improvement, the following issues are recommended. Some issues are the same described in the Technical Capacity section.

- To allocate more institutional power to the planning section within WRAWSA
- To strengthening institutional arrangement of the Planning and Monitoring Section to close to the ideal staffing and the duty demarcation plan proposed by the project
- To support smooth information collection, data collection and monitoring, preparation of Mid-term Management Plan and financial plan etc. by enhancing coordination with other relevant sections with the strong initiative of the top management of WRAWSA
- To support the staff capacity on regularly compiling a periodical monitoring report based on the PIs datasheets

3.2 Financial Management

3.2.1 Result of Assessment at the End

Regarding organizational core capacity of the Finance Section, the end-line assessment was evaluated as follows and is compared with the beginning of it. Some items are developed to be higher marks but some of them are staying the same in the absolute value.

Table 3.2 Assessment Results of Organizational Core Capacity (Financial Management)

Category	Items	Item	Base line	End-line
A. Planning, Monitoring	1. There is annual action plan of section	Annual action plan	4	4
	2. Planned activities are monitored regularly.	Plan monitoring system	3	4

	3. The business activities are compiled as a report periodically.	Periodical reporting	3	5
B. Budget management	1. Budget is requested based on planning.	Planned budget request	4	4
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	4	4
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	3	4
	2. Duties and responsibilities of each staff is clear.	Clear duties	2	3
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	3	3
	2. There is regular occasions to share information among the members.	Staff meeting	3	3

3.2.2 Comparison of the Results and Overall Assessment

The baseline assessment might contain some promising scores and the end one includes some challenging ratings, and consequently, the latter have not got much improved marks. However, the finance section has developed totally and in some points.

They had an annual schedule of the Finance Section such as making budget, monthly report, annual report and audit according to the YCDC rule. It is one of PDCA cycle for doing their jobs. They started to compile a financial situation report and share in WRAWSA periodically.

The number of staff is adequate but total capacity of the Finance Section is not enough to cope with present financial issues such as making financial projection or tariff raising plan. However, step by step, they have learned knowledge and other countries' experiences on the matters.

Staff members' responsibility is clear but they have not been allocated appropriate jobs to demonstrate their ability fully. A few C/Ps have been developed substantially but others a little.

Meeting is held at appropriate occasion and information is shared in the section but project information which affects the future financial situation is not shared in YCDC internally.

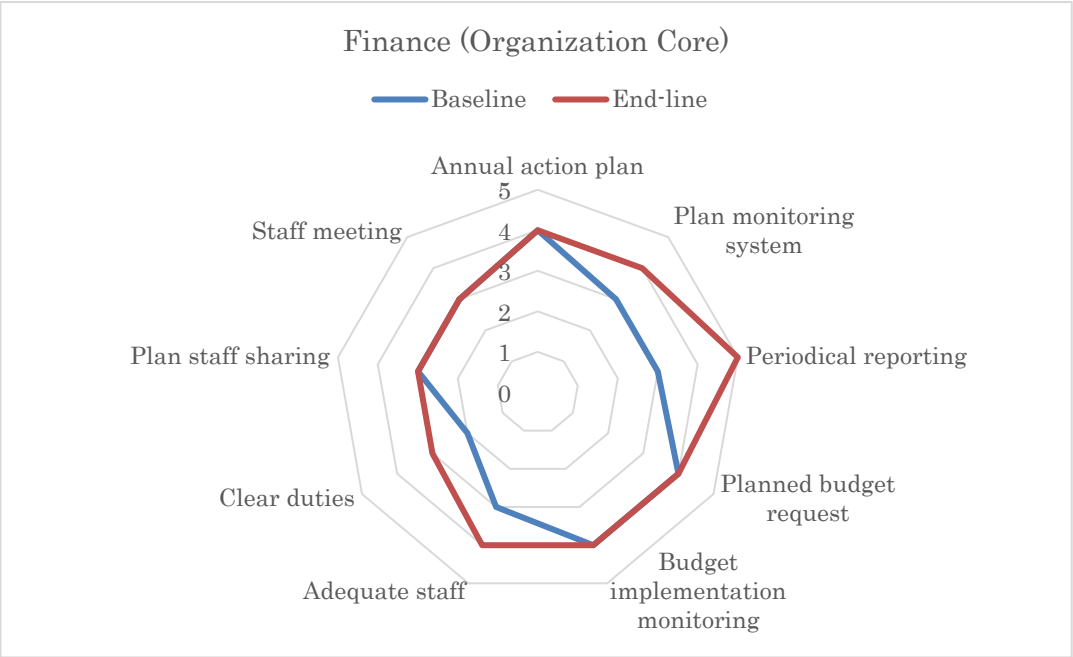


Figure 3.2 Results of Organizational Core Capacity (Financial Management)

3.2.3 Approach for Further Improvement

The Finance Section is a key section for utility management. In order to develop WRAWSA to be a financially sustainable entity, the section shall be informed more detailed project data and shall have more power to coordinate annual budget together with the Planning Section.

3.3 Customer Service

3.3.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in Table below.

Table 3.3 Assessment Results of Organizational Core Capacity (Customer Service)

Category	Items	Item	Base line	End line
A. Planning, Monitoring	1. There is annual action plan of section	Annual action plan	1	3
	2. Planned activities are monitored regularly.	Plan monitoring system	1	3
	3. The business activities are compiled as a report periodically.	Periodical reporting	1	3
B. Budget management	1. Budget is requested based on planning.	Planned budget request	1	3
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	1	4
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	1	3
	2. Duties and responsibilities of each staff is clear.	Clear duties	1	3
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	1	4
	2. There is regular occasions to share information among the members.	Staff meeting	1	4

3.3.2 Comparison of the Results and Overall Assessment

Customer database is budgeted as planned and it is presumed that this fact partly contributes to the score improvement in Budget management category.

In terms of Staffing category, the development of the business execution system, including the staffing and division of duties of the Customer Service Department is one of the evaluable results.

A T/S Director's Meeting was established, and since 2018, the T/S Director's Meeting hosted by the Customer Service Department has been held regularly about twice a month. This has enabled the main office and field offices to become more integrated and consistent in their business operations, rather than being driven by superior opinion.

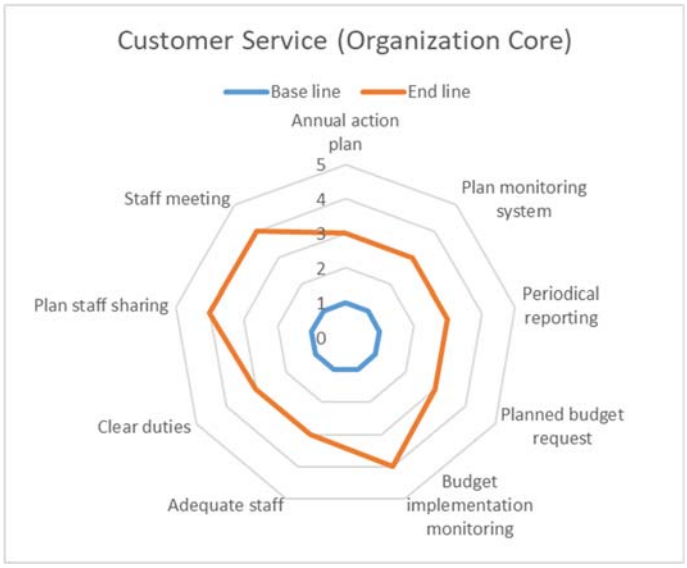


Figure 3.3 Results of Organizational Core Capacity (Customer Service)

3.3.3 Approach for Further Improvement

As for the staffing of the Customer Service Division, full-time staff have been assigned to the division, but it is desirable to secure personnel who are well versed in the field operations so that they can provide reliable operational guidance, especially for T/S.

In addition, it is expected that the T/S officers' meeting will be continued, and that information sharing and exchange of opinions will become more active in order to improve operations and ensure efficient and appropriate business management.

3.4 Public Relations

3.4.1 Result of Assessment at the End

The organizational core capacity of PR team was assessed as following:

Table 3.4 Assessment Results of Organizational Core Capacity (Public Relations)

Category	Items	Item	Base line	End line	Remarks
A. Planning, Monitoring	1. There is annual action plan of section	Annual action plan	1	3	There is the plan for the period of TA project, not annual.

	2. Planned activities are monitored regularly.	Plan monitoring system	1	3	Yes, implemented activities are monitored by team members when activities are implemented. But missed activities cannot be re-arranged for implementation.
	3. The business activities are compiled as a report periodically.	Periodical reporting	1	3	Complied activity report of June 2016 to July 2018 was prepared, but only one time. The complaint report (2018-2019) is also prepared.
B. Budget management	1. Budget is requested based on planning.	Planned budget request	1	3	Yes, some of the necessary budget is requested, such as logistic cost and PA system for school program.
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	1	1	The requested budget is not allocated to PR activities. Necessary cost can be reimbursed from budget of Department.
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	1	3	For current activities, part time staff is enough, full time staff is not required. However, the number of part time staff (five staff) needs to be increased.
	2. Duties and responsibilities of each staff is clear.	Clear duties	1	3	The duties and responsibilities is not clearly assigned to each staff, but the activities are implemented based on current chain of command.
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	1	3	Yes, the plan is prepared involving all members of PR team.
	2. There is regular occasions to share information among the members.	Staff meeting	1	3	The member have the meeting and share the information when the JICA Expert is in Yangon. When activities are implemented, PR members communicate and share the information by meeting or by phone/viber (not regular occasions).

3.4.2 Comparison of the Results and Overall Assessment

As shown the figure below, all the items in all categories in the end line survey are improved compared with the result of baseline survey, except one item (budget implementation monitoring). The score of budget implementation monitoring is same because the budget requested is not allocated to PR team and necessary cost is reimbursed from budget of the Department, when necessary, so that the monitoring is not implemented.

Figure 3.4 Results of Organizational Core Capacity (Public Relations)

3.4.3 Approach for Further Improvement

When the PR Team will be updated to Section, then the budget may be allocated. After that, the capacity of budget implementation monitoring needs to be strengthened.

3.5 Human Resource Management and Development

3.5.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in table below.

Table 3.5 Assessment Results of Organizational Core Capacity (Human Resource Management and Development)

Category	Items	Base line	End line	Remarks
A. Planning, Monitoring	1.There is annual action plan of section	3	4	Annual plan has been formulated in HRD Section since 2016.
	2.Planned activities are monitored regularly.	4	3	Top management does not support to implement planned activities.
	3.The business activities are compiled as a report periodically.	4	3	In present, HRD activities are reported in regular meeting of TA Project. After the Project finishes, reporting system should be considered. Regular reporting would be applied as other section does.
B. Budget management	1.Budget is requested based on planning.	4	4	Budget has been requested based on an annual plan. Only the fundamental budget was approved to implement annual plan. (not including training inviting outside trainer)
	2.Execution of budget is periodically monitored.	4	4	Whole EDWS monitors execution of budget periodically.
C. Staffing	1.The number of staff is adequate for assigned duties.	1	3	1 -2 more permanent staff is necessary for firm implementation of proposed HRD plan.
	2.Duties and responsibilities of each staff is clear.	1	4	For each training course implementation, duties are clearly assigned among staff.
D.	1.Annual action plan is shared	3	4	Annual training plan is shared among staff.

Communication	among members of the section/office.			
	2.There is regular occasions to share information among the members.	3	4	Information is shared daily communication in the section

3.5.2 Comparison of the Results and Overall Assessment

A. Planning, Monitoring: 3.7 points ⇒ 3.3 points
Planning was improved with annual training plan; however, its implementation and regular monitoring are still weak. This is mainly because of additional assignment of duties which had not been included in annual plan. This happened at not only in HRD Section but often happened in many offices in WRWSA.

B. Budget management: 4.0 points ⇒ 4.0 points
Based on the annual training plan, the necessary budget has been allocated and executed for HRD activities.

C. Staffing: 1.0 points ⇒ 3.5 points
With establishment of HRD Section, full-time staff have been assigned only for HRD based on duties and responsibilities of the Section. Although some full-time staff have left or transfer from the Section, the minimum number of staff required for training management have been secured.

D. Communication: 3.0 points ⇒ 4.0 points
Among staff of HRD Section, the information sharing works very efficiently. All members are involved in sorting and compiling the plans and information related to the duties, and organizing them at cabinets, where all staff can access.

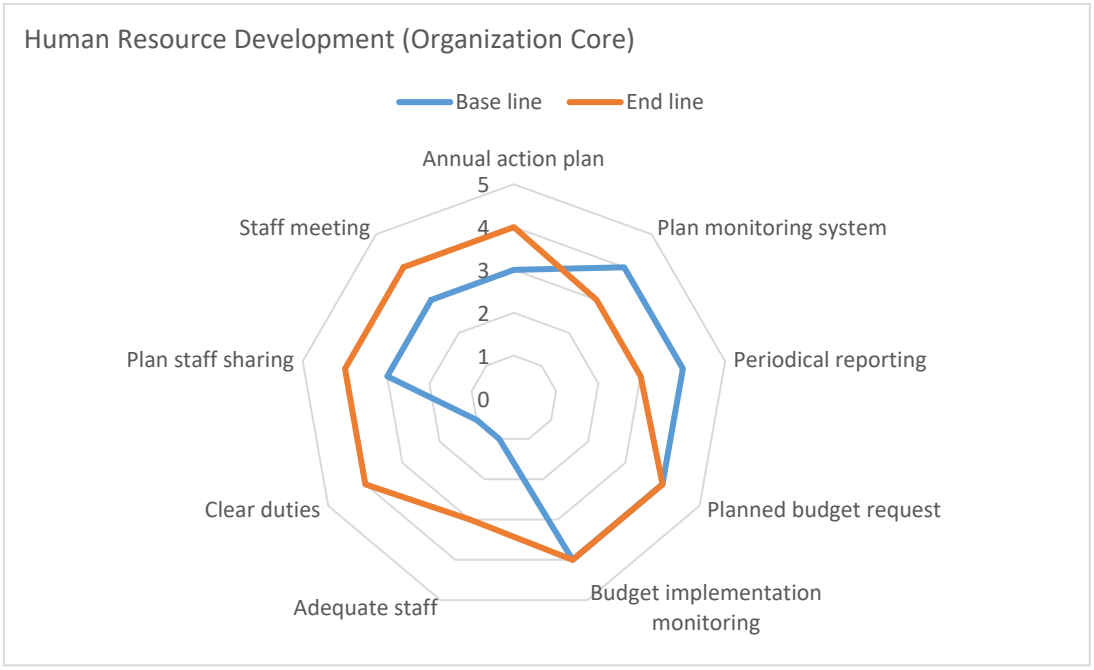


Figure 3.5 Results of Organizational Core Capacity (Human Resource Management and Development)

3.5.3 Approach for Further Improvement

Organizational capacity at the level of HRD Section has been remarkably improved. On to the contrary, there is still some room to be developed its capacity at the level of WRWSA, particularly for operation and management of the organization in accordance with plan.

3.6 Non-Revenue Water Management

3.6.1 Result of Assessment at the End

Currently, the NRW management section has not yet developed an annual action plan, most of current work relating to NRW reduction is based on direct instructions from CE.

However, since many activities based on the knowledge and technology learned from this technical support project are planned for the contents of that works instructed by CE. The NRW Management Section will utilize those experiences and be expected to work independent and to formulate a voluntary activity plan.

Table3.6 Assessment Results of Organizational Core Capacity (Non-Revenue Water Management)

Category	Items	Base line	End line	Remarks
A. Planning, Monitoring	1. There is annual action plan of section	1	3	Work directed by CE is always prioritized over voluntary action plans
	2.Planned activities are monitored regularly.	1	3	The content of the activity has not reached regular monitoring by revords.
	3.The business activities are compiled as a report periodically.	1	3	Only a limited number of staff are responsible for recording and reporting the content of business activities.
B. Budget management	1. Budget is requested based on planning.	1	2	Since most of the activities are directly instructed by the CE, business methods for voluntary activity proposals and budget requests have not been established.
	2.Execution of budget is periodically monitored.	1	4	Execution of the project budget is carried out smoothly because the section head has a wealth of knowledge regarding the estimation of project costs.
C. Staffing	1. The number of staff is adequate for assigned duties.	1	3	The number of staff is many, but the number of male staff who can perform technical work in the field is insufficient.
	2. Duties and responsibilities of each staff is clear.	1	2	Technically advanced work is concentrated on some highly qualified staff. The issue is the leveling of business content.
D. Communication	1. Annual action plan is shared among members of the section/office.	1	3	Information is shared within the section regarding the decided activities.
	2. There are regular occasions to share information among the members.	1	3	Share information as needed within the section.

3.6.2 Comparison of the Results and Overall Assessment

At the beginning of the project, there was no department in charge of NRW, and NRW management section, target section of this assessment, was newly established by this project. Therefore, all items in the baseline were set to 1. Since then, the overall level has been improved through pilot projects or NRW-related seminars. Particularly regarding “budget management”, the level marks 4 as end line assessment. An experienced staff member has been appointed as the section head so that budget management level is almost enough already. However, since NRW management plan based on proposal from NRW section has not been established, NRW management section could not act their role adequately so far. Even at the end of the project, many works were still concentrated on a few staffs of NRW management section. Staffing and work allocation are still insufficient.

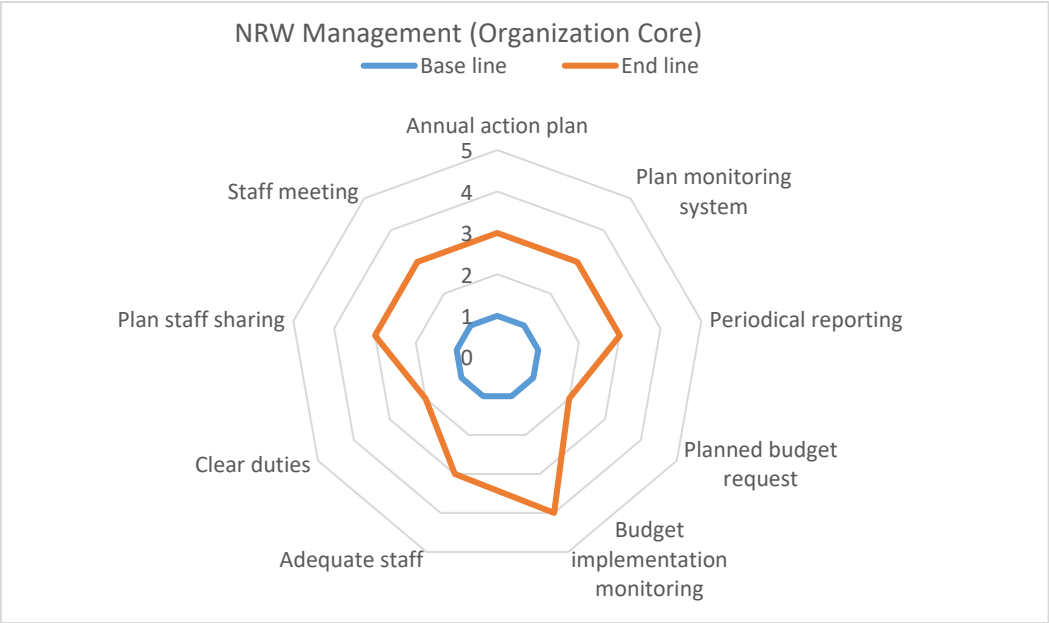


Figure 3.6 Results of Organizational Core Capacity (Non-Revenue Water Management)

3.6.3 Approach for Further Improvement

The department in charge of new pipeline design based on DMA construction and hydraulic analysis, and work related to leak detection and NRW management of exiting distribution pipes has not been clarified in WRAWSA. Currently NRW management section is in charge of most of them. It is urgent to establish the necessary sections by clearly defining the duties within WRAWSA so that NRW management section can concentrate on the duties that meet the original purpose.

3.7 Water Treatment

3.7.1 Result of Assessment at the End

Summary of organizational core capacity assessment results at the beginning and at the end are shown in Table 3.7, and radar chart is shown in Figure 3.7.

Table 3.7 Assessment Results of Organizational Core Capacity (Water Treatment)

Category	Items	Item	Base line	End line
A. Planning, Monitoring	1 There is annual action plan of section	Annual action plan	1	3
	2. Planned activities are monitored regularly.	Plan monitoring system	1	4.5
	3. The business activities are compiled as a report periodically.	Periodical reporting	2	4
B. Budget management	1. Budget is requested based on planning.	Planned budget request	1	4
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	3	3.5
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	2	2.5
	2. Duties and responsibilities of each staff is clear.	Clear duties	2	3
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	3	3.5
	2. There are regular occasions to share information among the members.	Staff meeting	3	4

3.7.2 Comparison of the Results and Overall Assessment

Evaluation of "Planning, Monitoring" category improved a lot, since their activity result has started to monitor by the water quality monitoring program through the year. The monitoring result reports periodically to the head quarter and annual report has made and circulated.

"Staffing" category is also improved, while it needs to assign some more permanent technical officers to the plant. It is essential to place enough number of officers to the plant not only for the operation and maintenance but also to inherit technical knowledge to the future.

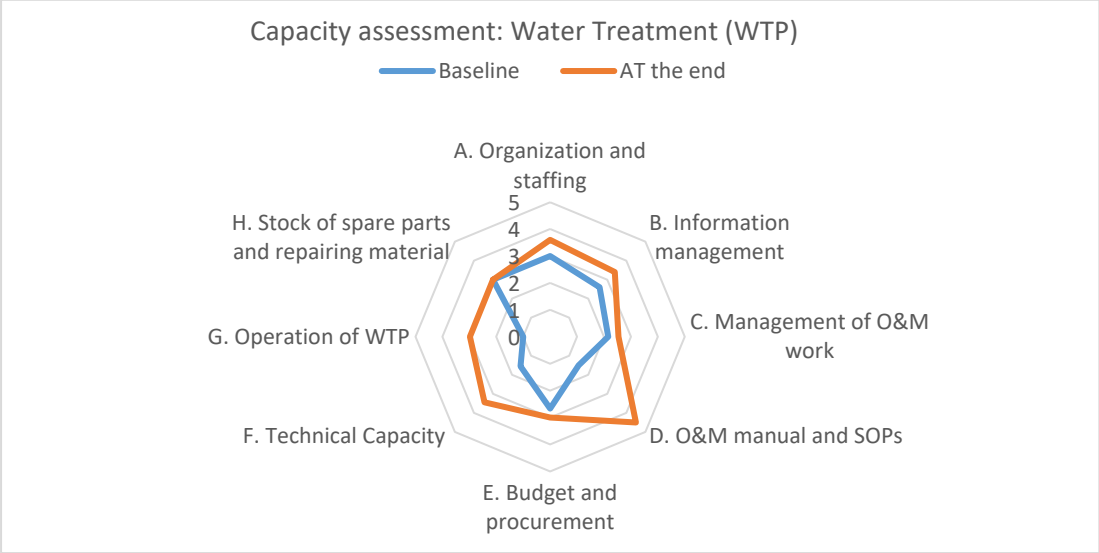


Figure 3.7 Results of Organizational Core Capacity at the baseline and the end（Water Treatment）

3.7.3 Approach for Further Improvement

Instead of a few numbers of officers in the plant, there are many numbers of field workers. It is necessary to set the specific duties and responsibilities to all such field workers.

It is desirable to apply a system that can flexibly allocate budget for repairing large-scale defects in facilities. Such spending is expected to have better effect to the future budget term. It is desirable to position such spending at the same level as the construction improvement cost.

3.8 Water Quality Monitoring

3.8.1 Result of Assessment at the End

The result is shown in Table 3.8. The organizational core capacity, the base line survey was done in 2014 and end line survey was done in 2019.

The "Outputs to be assessed" in the below table means specific outputs that serve as indicators for evaluating the performance in each evaluation item.

Table 3.8 Assessment Results of Organizational Core Capacity (Water Quality Monitoring)

Category	Items	Output to be assessed	Base line	End line	Corresponding activities in the water quality laboratory
A.Planning, Monitoring	A1. There is an annual action plan of section	Annual action plan or water quality monitoring plan	1	5	Central laboratory and mini laboratory already have a monitoring plan.
	A2. Planned activities are monitored regularly.	Plan monitoring system	3	5	Data of sampling date is including in the regular water quality monitoring data. Thus, planed activity is always monitored through analysis data management.
	A3. The business activities are compiled as a report periodically.	Periodical reporting	3	5	Water quality data is reported monthly to WRAWSA HQ
B. Budget management	B1. Budget is requested based on planning.	Planned budget request	3	3	Budget management is done in accordance with the rule of WRAWSA.
	B2. Execution of budget is periodically monitored.	Budget implementation monitoring	4	3	Budget management is done in accordance with the rule of WRAWSA.
C. Staffing	C1. The number of staff is adequate for assigned duties.	Adequate staff	1	2	Actual staff (as of Dec 2019) is 10. However, due to the installation of new water treatment plant laboratories (Lagunbin and Kokkowa) and the expansion of tap water quality monitoring activity, the central laboratory staff to supervise them needs to be further increase.
	C2. Duties and responsibilities of each staff is clear.	Clear duties	4	5	Central laboratory already decides following 3 small group: 1) Physicochemical analysis 2) Biological analysis 3) Data management For each of the above three groups, an organization has been set up, headed by an SAE and with several WAs and Flats.
D. Communication	D1. Annual action plan is shared among members of the section/office.	Plan staff sharing	4	5	Monitoring plan is shared among staffs. In addition, monitoring plan is revised periodically through staff meeting.
	D2. There are regular occasions to share information among the members.	Staff meeting	4	5	Staff meeting and discussion are held daily.

3.8.2 Comparison of the Results and Overall Assessment

Table 3.8 shows the actual activities corresponding to each assessment items. Activities were conducted for all assessment items except Category "B. Budget management".

Because category B is a budget-related item which is done according to WRAWSA rules, therefore, central laboratory cannot conduct its own activities.

The effect of capacity development was examined by comparing the baseline assessment with the end line assessment. The results of the assessment were shown in a score comparison (Table 3.7) and radar chart (Figure 3.7).

Category A Planning, monitoring
There was an increase in the scores in all items of "A. Planning and monitoring". Through the implementation of this technical assistant project, i) the development of water quality monitoring plan, ii) the management system of water quality data and iii) the periodical reporting system of water quality data have been established and are functioning well.

Category B Budget management
Planning and execution of budget is done in accordance with the rule of WRAWSA. For this reason, the score of category B has not changed.
However, the problem with WRAWSA's budget system is that it is not easy to implement a budget plan based on a long-term perspective. The reality is that the budget is obtained by applying for the necessary funds on a case-by-case basis.

Category C Staffing
"C2. Duties and responsibilities of each staff" had already been established before the start of this technical cooperation project when central laboratory was established in 2012. Through the implementation of this project, the duties and responsibilities of each staff was further clarified.
However, despite the expected expansion of the work of the central laboratory, sufficient staff were not added. This is a problem with the personnel system of the YCDC, which is heavily influenced by the decisions of the regional government.

Category D Communication
Since the central laboratory was established in 2012, communication within the staff has been very good. In the latter half of this project, communication was expanded to include a newly set established mini laboratory.

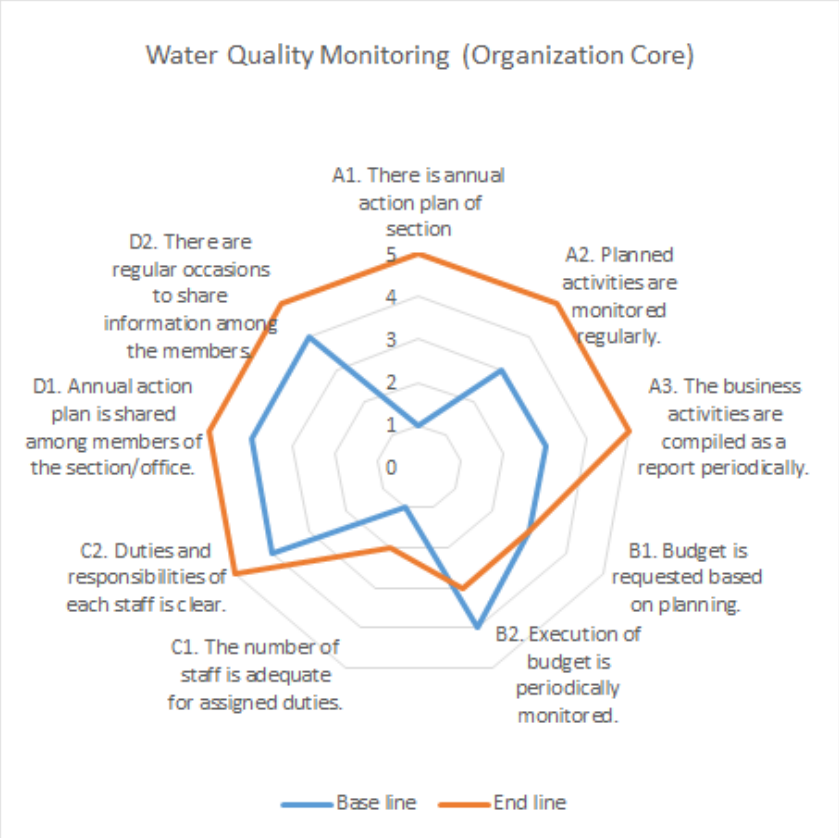


Figure 3.8 Results of Organizational Core Capacity at the baseline and the end (Water Quality Monitoring)

3.8.3 Approach for Further Improvement

The current challenges are i) operation of new laboratory at new WTP (Lagunpyin and Kokkowa), ii) water quality management in raw water reservoir and iii) monitoring and management of tap water quality.

In the med- long term plan (5-year and 10-year plan), the ii) water quality management in raw water reservoir will be implemented by strengthening the capacity of the mini laboratory staff, and iii) monitoring and management of tap water quality will be implemented by jointly with township (or district) office staff after capacity development.

However, for i) operation of new laboratory at new WTP, more SAE class staff who acts as leader should be recruited.

CHAPTER 4. Organizational Technical Capacity

4.1 Planning and Monitoring

4.1.1 Result of Assessment at the End

The assessment categories for planning and monitoring capacity are consisted of the following three areas: (A). Mid- and long- terms plan, (B). Short- term plan, (C). Benchmarking and Performance Indicators (PIs). The results of the assessment both at the baseline and the end-line are shown in Table 4.1.

Table 4.1 Assessment Results of Organizational Technical Capacity (Planning and Monitoring)

Category	Items	Base line	End line	Criteria
A. Mid-and Long-term Plan	A-1. Vision and the mission of WSD is set up	4	4	1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking
	A-2. The outline of mission and vision are understood by the WSD's staffs in what extent	3	3	1. Understood by 0-24% of employees, 2. Understood by 25-49% of employees, 3. Understood by 50-74% of employees, 4. Understood by 75-89% of employees, 5. Understood by 90-100% of employees
	A-3. A planning section to formulate mind- and long-term plan for WSD is established	1	3	1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking
	A-4. WSD has a mid- and long-term development plan except for JICA Master Plan	2	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-5. A mid- and long-term development plan is documented/or compiled in the report	3	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-6. Concrete target indicators are set up in the mid- and ling-term development plan.	2	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-7. Water demand projection is included in the mid- and long-term development plan. Also the plan is based on the projection.	2	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-8. The outline of a mid- and long-term development plan is understood by the WSD's staffs in what extent	2	3	1. Not understood、2. partially understood, 3. Understood some extent, 4. Understood sufficiently, 5.Can be a model for benchmarking
	A-9. The implementation progress of a mid- and long-term development plan is monitored and evaluated	2	2	1. Not monitored and evaluated, 2. Monitored and evaluated partially, 3. Monitored and evaluated some extent, 4. Monitored and evaluated sufficiently, 5. Can be a model for benchmarking
	A-10. A mid- and long-term development plan is revised and updated based on the results of	2	1	1. Not revised and updated, 2. Revised and updated partially, 3. Revised and updated some extent,

Category	Items	Base line	End line	Criteria
	monitoring and evaluation			4. Revised and updated sufficiently, 5. Can be a model for benchmarking
	A-11. A process (institutional system) for revision and updating of a mid- and long-term development plan is clearly established	1.3	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-12. A process for development of a mid- and long-term development plan is clearly established	1.3	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	A-13. A process for approval of a mid- and long-term development plan is clearly defined	1.3	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
B. Short-term Plan	B-1. WSD has a short-term plan for budgeting, and rehabilitation and updating of facilities	3	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	B-2.A short-term plan is documented/or compiled in the report	3	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	B-3. A short-term plan is understood by the WSD's staffs in what extent	2	4	1. Understood by 0-24% of employees, 2. Understood by 25-49% of employees, 3. Understood by 50-74% of employees, 4. Understood by 75-89% of employees, 5. Understood by 90-100% of employees
	B-4. Institutional capability for developing an effective short-term plan is secured	3	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	B-5. The implementation progress of a short-term plan is monitored and evaluated	2	3	1. Not monitored and evaluated, 2. Monitored and evaluated partially, 3. Monitored and evaluated some extent, 4. Monitored and evaluated sufficiently, 5. Can be a model for benchmarking
	B-6. A short-term plan is revised and updated based on the results of monitoring and evaluation	2	3	1. Not revised and updated, 2. Revised and updated partially, 3. Revised and updated some extent, 4. Revised and updated sufficiently, 5. Can be a model for benchmarking
	B-7. A process (institutional system) for revision and updating of a short-term plan is clearly established	1.7	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	B-8. A process for development of a short-term development plan is clearly established	1.7	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking

Category	Items	Base line	End line	Criteria
	B-9.A process for approval of a short-term plan is clearly defined	3	3	1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking
C. Benchmarking and PIs	C-1. Project monitoring by using PIs is regularly carried out.	2.3	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	C-2. Monitoring system for projects by using PIs is established	2.7	3	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	C-3. An importance of project monitoring by using PIs is understood by the WSD's staffs	2	3	1. Not understood、2. partially understood, 3. Understood some extent, 4. Understood sufficiently, 5.Can be a model for benchmarking
	C-4. Data of PIs is regularly collected without any delay	2	3	1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking
	C-5. A collection process of data for PIs is clearly established	2	4	1. Not existing, 2. Necessary for fundamental improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking
	C-6. PIs and data are analyzed	2	2	1. Not analyzed, 2. Partially analyzed, 3. Analyzed some extent, 4. Analyzed sufficiently, 5. Can be a model for benchmarking
	C-7. PIs are utilized for developing a future improvement plan of waterworks	1.7	3	1. Not utilized, 2. Partially utilized, 3. Utilized some extent, 4. Utilized sufficiently, 5. Can be a model for benchmarking
	Total Average Score	2.2	3.1	

4.1.2 Comparison of the Results and Overall Assessment

The overall average score increases 0.8 points from 2.2 at the baseline and 3.1 at the end-line. There is no significant difference of the assessment results between the categories (A)-(C). The remarkable increase can be seen in the following area:

- (A-3) A planning section to formulate mind- and long-term plan for WSD is established,
- (A-6) Concrete target indicators are set up in the mid- and ling-term development plan,
- (A-13) A process for approval of a mid- and long-term development plan is clearly defined
- (B-3) A short-term plan is understood by the WSD's staffs in what extent
- (C-5) A collection process of data for PIs is clearly established

The increase range of the score between at baseline and at end-line might be not so large. The possible reason is that the assessment results at the baseline would be a kind of positive evaluation with self-confidence before they got any training and knowledge on the relevant subjects. The C/Ps, however, mentioned that they actually realized the necessary knowledge and skills on planning and monitoring after the project activities, hence they could not put high scores in some extent in comparison to their own obtained knowledge and skills.

Another issue is that the C/P members have been changed during the project periods. The three young staffs newly joined in the Planning Section after three years of the project commencement, so that their activities periods for capacity development were limited to approximately two years. Also, the C/Ps who had capacity assessment at the baseline had been transferred to other sections.

However, if we consider that this planning and monitoring activity started completely from the ground zero without any section, members or functions, this assessment results of organizational technical capacity at the end-line could show a positive element.

Figure 4.1 Results of Organizational Technical Capacity (Planning and Monitoring)

4.1.3 Approach for Further Improvement

In order to make a further improvement, the following issues are recommended.

- To increase full-time staffs and to appoint the responsible person at more than ACE level as the section head
- To support smooth information collection, data collection and monitoring, preparation of Mid-term Management Plan and financial plan etc. by enhancing coordination with other relevant sections with the strong initiative of the top management of WRAWSA
- To prepare a monitoring report regularly and report to the top management of WRAWSA
- To monitor the MKPIs and confirm the progress against the targets in Mid-term management Plan annually
- To improve the quality of data and the timing submitted from the relevant sections
- To continuously optimize the data management system and the forms

4.2 Financial Management

4.2.1 Result of Assessment at the End

At the baseline assessment, 54 items of 7 categories were scored and rates of each item is listed here, which is compared with the end-line survey. Same as organizational core survey, some items are scored to be higher marks but some of them are the same in absolute value.

Table 4.2 Assessment Results of Organizational Technical Capacity (Financial Management)

Category	Items	Base line	End-line
A.	A1: Does WSD/YCDC have manuals and/or SOPs and they work	4	4

Budget Management **- Is the existing budget system (process) suitable for enhancing water supply situation in Yangon city?**	(function) well at the workplace? (in Budget system)		
	A2: To what degree WSD/YCDC is interested in independent management (separate from general budget of YCDC), and has already implemented some measures towards such directions? (in Budget system)	2	3
	A3: To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions?	2	3
	A4: To what degree WSD/YCDC is interested in overall financial balance which includes capital costs like depreciation (or repayment of loans/bonds) and interest, and has already implemented some measures towards such directions?	2	3
	A5: Does WSD/YCDC have a good budget control system to be an efficient and effective water supply utility?	3	3
	A6: Does WSD/YCDC have any improvement program for budget management system and does it functions (works) efficiently?	3	3
	A7: To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?	4	2
B. Accounting system **- Is the existing accounting system suitable for enhancing water supply situation in Yangon city?**	B1: Does WSD/YCDC have manuals and/or SOPs and they work (function) well at the workplace? (in Accounting system)	4	4
	B2: To what degree WSD/YCDC is interested in independent accounting system of water supply, and has already implemented some measures towards such directions? (in Accounting system)	2	2
	B3: To what degree WSD/YCDC is interested in total expenditure and revenue balance (O&M costs balance), and has already implemented some measures towards such directions? (in Accounting system)	2	4
	B4: Now WSD/YCDC implement government style accounting (single-entry bookkeeping), and to what degree WSD/YCDC is interested in double-entry bookkeeping system, and has already implemented some measures towards such directions? (in Bookkeeping system)	2	2
	B5: To what degree WSD/YCDC is interested in introduction of depreciation and fixed asset accounting, and has already implemented some measures towards such directions?	2	4
	B6: To what degree WSD/YCDC is interested in overall financial balance (including interest and repayment of loan/bond), and has already implemented some measures towards such directions?	2	4
	B7: To what degree WSD/YCDC is interested in overall cash management, and has already implemented some measures towards such directions?	2	3
	B8: To what degree WSD/YCDC gets information about revenues relating water services? (water tariff, connection fee, ?)	4	4
	B9: To what degree WSD/YCDC gets information about expenses relating water services? (salary, electricity fee, chemicals, stationery, pipes, valves, meters?)	4	4
	B10: To what degree WSD/YCDC is interested in independent annual financial report of water supply, and implements some measures towards such directions? (in Annual report)	2	4
	B11: Does WSD/YCD have any improvement program for accounting system already and does it function(work) efficiently?	3	4
	B12: To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement improvement program?	4	2
C. Management of Capital Finance **- Is the existing capital finance system suitable for enhancing**	C1: Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Management of Capital Finance)	4	4
	C2:To what degree WSD/YCDC is interested in independent capital investment budget of water supply (which includes both capital investment and its financial resources), and has implemented some measures already towards such directions? (in Budget system)	2	2
	C3: To what degree WSD/YCDC is interested in independent capital investment account of water supply (which includes both capital investment and its financial resources), and has implemented already	2	2

water supply situation in Yangon city?	some measures towards such directions? (in accounting system)		
	C4: To what degree WSD/YCDC gets information about capital investment expenses relating water services? (construction costs for replacement/rehabilitation, expanding, upgrading facilities, salary, electricity fee, stationery, pipes, valves, meters …..?)	3	4
	C5: Does WSD/YCDC gets all information regarding self savings, Government's subsidy, Loan from domestic bank, foreign/international grant aid, foreign/international loan, PFI	3	3
	C6: Does WSD/YCDC gets all information regarding debt services (repayment and interest for loan and/or bond) and including it on the capital finance management	3	4
	C7: Does WSD/YCDC have a capital improvement program which includes capital investment and their financial resources, and forecast of middle-term and long term balance of expense and income. The program shall include not only new construction for expanding area but also include construction of replacement, rehabilitation, and upgrading existing facilities.	3	3
	C8: Does WSD/YCDC have any improvement program for management of capital finance system already and does it functions (works) efficiently?	4	3
	C9: To what degree the management cycle (Plan -Do-Check-Act) has been introduced already to implement improvement program?	4	2
D. Financial Plan **- Is the existing financial planning system suitable for enhancing water supply situation in Yangon city?**	D1: Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Financial Plan)	3	4
	D2: To what degree WSD/YCDC is interested in independent and self-sufficient in finance, or WSD has implemented already some measures towards such directions? (in financial plan)	2	3
	D3: Does WSD/YCDC have annual, mid-term plan and long-term financial plan already and they works (functions) well at the workplace?	4	4
	D4: Does WSD/YCDC's financial plan includes various plans (Construction plan, Replacement plan, O&M plan, Personnel plan (staff position plan), Cost efficiency plan (costs-cut, save energy, etc.)) which concerns expenditures and incomes, Those plan forecast of middle-term and long term balance of expense and income.	3	2
	D5: Does WSD/YCDC have monitoring system for assessing the result of financial plan using Performance indicators.	3	3
	D6: Does WSD/YCDC have public and customer communication tools and implement such activities?	3	1
	D7: To what degree the management cycle (Plan -Do-Check-Act) is introduced to implement financial plan?	3	2
E. Tariff Setting **- Is the existing tariff setting system suitable for enhancing water supply situation in Yangon city?**	E1: Does WSD/YCDC have manuals and/or SOPs and they works (functions) well at the workplace? (in Tariff setting)	3	4
	E2: To what degree WSD/YCDC is interested in beneficiary pay principle or WSD has implemented already some measures towards such directions?	2	2
	E3: To what degree WSD/YCDC know that each customer pay all costs which used to supply water (provide service) to the customer (individual cost of service principle) or to each customer pay more/less costs which used to supply water (provide service) to the customer (cross-subsidies)	4	4
	E4:To what degree WSD/YCDC recover full costs; recover depreciation expenditure, recover interests?	2	2
	E5: To what degree WSD/YCDC is interested in customers' affordability to water tariff, or WSD/YCDC has implemented already some measures towards such directions?	3	2
	E6: To what degree the management cycle (Plan -Do-Check-Act) has been introduced to implement in tariff setting?	3	2
F. Institutional (Organization, Governance)	F1: To what degree WSD/YCDC has been interested in independent and/or self-sufficient utility, or WSD/YCDC has implemented already some measures towards such directions?	2	3
	F2: To what degree WSD/YCDC is interested in the management style	2	3

Arrangement **- Is the existing institutional (organizational, governance) system of YCDC suitable for enhancing water supply services in Yangon city?**	such as government style, corporation style etc, or WSD/YCDC has already implemented some discussion/survey about management style?		
	F3: To what degree WSD/YCDC is interested in private sector involvement, or WSD has implemented already some measures towards such directions?	2	4
	F4: To what degree WSD/YCDC is interested in organization structure such as centralized or de-centralized, or WSD/YCDC has already implemented some discussion/survey about this topic?	2	1
	F5: To what degree WSD/YCDC is interested in separation of policy and operation in water supply organization, or WSD/YCDC has already implemented some discussion/survey about this topic?	2	4
	F6: To what degree WSD/YCDC is interested in vertical separation (separate distribution from production and make an independent department) and/or horizontal integration (merge outside YCDC area) of water utility, or WSD/YCDC has already implemented some discussion/survey about this topic	2	3
G. Office Managementin Finance section and relating section **- Is the existing office management is suitable for enhancing efficiency of office**	G1: Does WSD/YCDC have the clear job description of individual members in Financial Division/Section and does it function(work) efficiently?	4	4
	G2: Does WSD/YCDC have reference documents (Law, Regulation, By-law Guideline, Standards) and all staff members can easily find around their desks, and efficiently functions (works)?	3	3
	G3: Does WSD/YCDC have manuals and/or SOPs and staff members can find them easily around their desks, and efficiently function (work)?	3	4
	G4: Does WSD/YCDC have the-state-of-the-art IT equipment and does it functions (works) efficiently?	3	3
	G5: Does WSD/YCDC have any improvement program for office management for Financial Division/section and does it functions (works) efficiently?	3	3
	G6: To what degree the management cycle (Plan-Do-Check -Act) is introduced to implement improvement program?	4	4
	G7: Does WSD/YCDC have the improvement plan of office management in accordance with WSD office moving to the new building in 2016	2	3
		2.7	3.2

4.2.2 Comparison of the Results and Overall Assessment

With respect to each item, “F. Institutional/governance arrangement” is scored high because C/P understood the necessity of individual and self-sufficient management in water utility. And regarding “B. Accounting system”, they have been eager to understand the fixed asset management and accounting and made manual which is the basic item of corporate accounting system.

Regarding “D. Financial Plan” and “E. Tariff Setting”, they have little responsibility for such work or limited information on the matter in YCDC organization that affected to get good score at the end-line. However, each member has made progress such as to make the mid-term financial plan with the Planning Section and made “Tariff Setting Guidebook”.

In the Finance Section, at the time of base-line assessment, two main members of C/P had prominent capacity in financial matters but each retired or transferred and new members have replaced them. If two members had stayed until the end, the score would have got better rate at the end.

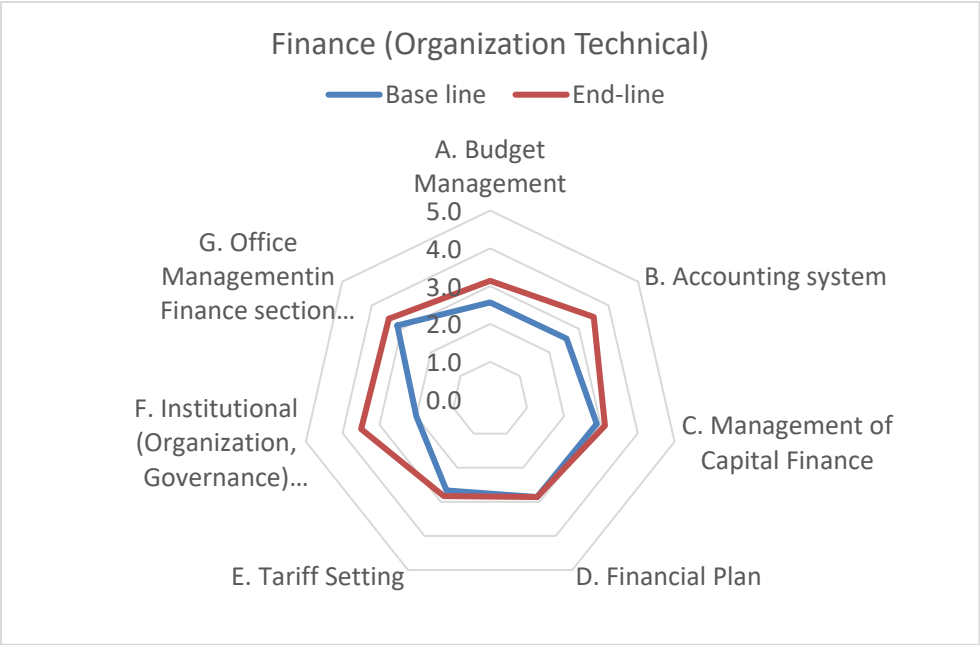


Figure 4.2 Results of Organizational Technical Capacity (Financial Management)

4.2.3 Approach for Further Improvement

The project adopted the future image as "independent and self-sufficient utility" which means the Finance Section shall have an important role. C/Ps need not only to learn financial matters but also to implement sustainable financial management. The future image shall be happened near future which may have a big impact on improving water supply in Yangon city.

4.3 Customer Service

4.3.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in table below.

Table 4.3 Assessment Results of Organizational Technical Capacity (Customer Service)

Category	Items	Remark (criteria)	Base line	End line
A. Customer Service Division	A1: Does WSD / YCDC have a customer service department that performs functions such as planning of customer service, supervision of fee collection work, and management and guidance of townships?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4
	A2: In the WSD / YCDC, the division of duties of the customer service departments is clearly defined, and are the respective departments fulfilling their roles properly?	[1. No, we do not have. 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]	1	3

	A3: Does WSD / YCDC establish a business execution system for the customer service department and are actively engaged in initiatives such as improving fee collection and supporting townships?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	3
	A4: Does WSD / YCDC have a manual for the operations of the customer service department?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4
	A5: Does WSD / YCDC provide guidance and support for townships (consultation support, visiting guidance, regular guidance, etc.)?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	3
	A6: Does WSD / YCDC collect customer information, the number of water supplies, the amount of water used, and statistical information on charges, and is it used effectively for operations related to charge collection and township operations?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4
B. Customer management and fee collection system	B1: Does WSD / YCDC have a customer management and fee collection system?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4
	B2: At WSD / YCDC, what is the level of mechanization of customer management and fee collection?	[1. Manual processing, 2. PC processing, 3. Batch processing for some tasks, 4. Batch processing for most tasks, 5. Online real-time processing.]	3	4
	B3: To what extent is the latest IT equipment introduced in WSD / YCDC?	[1. Deploy several units in each section of the head office,2. Several units are deployed in the township and each section of the head office,3. One staff per staff in each section of township and head office,4. Deploy several networked devices in townships and headquarters sections,5. One networked device is deployed to each staff at each section of the township and headquarters.]	4	4

	B4: At WSD / YCDC, what level of computer department staff use IT?	[1. Use of Word and PowerPoint, 2. Simple use of Excel, 3. Simple use of database, 4. Advanced use of Excel, 5. Advanced use of database.]	3	4
	B5: At WSD / YCDC, what is the level of IT use for general office staff assigned to townships and central government offices?	[1. Almost no use, 2. Use of Word and PowerPoint, 3. Simple use of Excel, 4. Advanced use of Excel, 5. Simple use of database.]	1	3
C. Township service (meter reading)	C1: Does WSD / YCDC have a manual for the meter reading work that the township is responsible for?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4
	C2: What does Township use as a meter reading book?	[1. Handwritten meter reading book, 2. Meter reading book created on PC, etc., 3. Using handy terminal, 4. Using smartphone, 5. Smart meter reading.]	1	1
	C3: Does WSD / YCDC clearly define the standards for water volume change survey (40% change from the previous period or the same period of the previous year) at the time of meter reading?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	4
	C4: Does the WSD / YCDC clearly define the water volume certification standards (previous period, same period last year, daily rate after replacement, 3-month average, etc.) for non-existence, meter abnormalities, etc. at the time of meter reading?	[1. No, we do not have. 2. Yes, we have, but it does not work (function), 3. Yes, we have, but it does not work (function), 4. Yes. we have and it works (functions) well, 5. Yes, we have and it can be one of the best practice.]	4	4
	C5: Does WSD / YCDC effectively implement unannounced inspections, regular audits, training, and on-site rotation as measures to ensure proper business execution?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	3
D. Township service (collection of fees)	D1: Does WSD / YCDC have a manual for the charge collection work that the township is responsible for?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	4

	D2: What is WSD / YCDC's approach to diversifying payment methods (delivery notice, fund transfer, credit payment, electronic money)?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	3
	C3: Does WSD / YCDC effectively implement unannounced inspections, regular audits, training, and on-site rotation as measures to ensure proper business execution?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	3
E. Township service (unpaid)	E1: Does WSD / YCDC have a manual for unpaid work that the township is responsible for?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	4	4
	E2: Does WSD / YCDC have any efforts to efficiently search, tabulate, and grasp the status of non-payers using a computer system?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	3
	E3: Does the WSD / YCDC standardize the operation of new taps and the collection cycle from meter reading to metering, billing, collection, notification and water supply suspension in all townships?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	4
F. Water Revenue Management	F1: Does WSD / YCDC have a manual for managing revenues specifically for water rates?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	3	4
	F2: Does WSD / YCDC have a computer system to manage and aggregate revenues dedicated to water bills?	[1. We are not interested in that. 2. We are interested in that but we have not took action, 3. We are interested in that and once we had taken some action., 4. We are interested in that and we take action towards that direction., 5. We are interested in that and our action towards that direction may be the best practice in the transition stage.]	2	4

4.3.2 Comparison of the Results and Overall Assessment

In the "Customer Service Division" category, four out of six items increased by two levels. This was due to the establishment of the Customer Service Division, the establishment of a system for the execution of operations, including the allocation of personnel and the division of duties, and the establishment of a customer information database system, which is essential for the preparation of manuals and SOPs for meter reading and billing collections, as well as for the preparation of statistical data.

In this way, the foundation for an office that oversees customer service operations has been steadily established.

In the area of "Customer management and fee collection system," the development of a customer information database system is underway, and Phase 1 has reached the stage where it is being tested in six T/Ss. In addition, the level of IT utilization is improving as a result of the Excel training provided to the staff of the main office and T/S, and the staff are now able to serve as instructors for the training.

In "Township service (meter reading)" and "D. Township service (collection of fees)", the preparation of operation manuals and SOPs has been promoted, and each T/S is now implementing operations based on these manuals and SOPs. In addition, a review of the manuals and SOPs has been started to adapt them to the current situation.

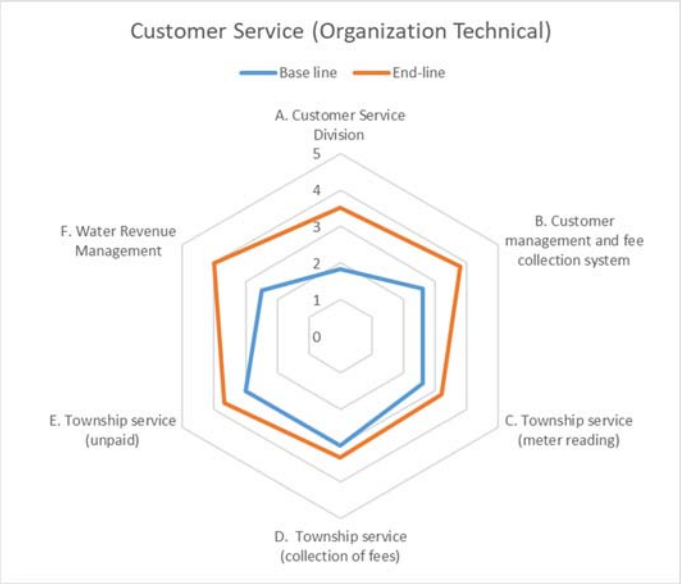


Figure 4.3 Results of Organizational Technical Capacity (Customer Service)

4.3.3 Approach for Further Improvement

The customer information database system, which will be the pillar of the modern billing collection system, is scheduled to be developed in Phase 1, which includes customer information search, inquiry, new registration, meter reading, and billing, followed by Phase 2. It includes bill collection, non-payment management, and statistics.

In addition, a certain level of work manuals and SOPs have just been developed. It is expected that they will be further revised and enhanced to a more detailed level in cooperation with each T/S.

4.4 Public Relations

4.4.1 Result of Assessment at the End

The results of Technical Capacity of PR team at the end of the Project is as follows:

Table 4.4 Assessment Results of Organizational Technical Capacity (Public Relations)

Category	Items	Base-line	End line	Remark (criteria)
A. Strategy, Plan, Manuals	A1: Does WSD/YCDC have any strategy for public relations and awareness activities?	1	2	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	A2: Does WSD/YCDC have any plan for public relations and awareness activities?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	A3: Does WSD/YCDC prepare PR activity report?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	A4: Does WSD/YCDC have any manual for public relations and awareness activities?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
B. Grievance/Complaint system	B1: Does WSD/YCDC have any system to reponde to public grievance/complaint?	3	4	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	B2: Does WSD/YCDC have any manual to respond to public grievance/complaint?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	B3: Does WSD/YCDC record the contents of public grievance / compalints and response by WSD/YCDC?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
C. Public Relations and Awareness Activities	C1: Does WSD/YCDC implement the public relations and awareness activities?	2	3	[1. Not implemented, 2. Impleented, but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
	C2: Does WSD/YCDC inform the public of water cut or disturbance or water supply service?	2	4	[1. Not implemented, 2. Impleented, but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Good as a model of benchmarking]
D. Materials for PR	D1: Does WSD/YCDC prepare the materials for PR?	1	3	[1. Not exiting, 2. Exiting but necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for

				modification, 5. Good as a model of benchmarking]

Most of items are assessed as 3 and 4, it means the technical capacity of these items are average and PR Team can implement by themselves, though some improvement is necessary.

The lowest item is strategy for public relations and awareness activities. The strategy for awareness activities was prepared by PR Team in cooperation with JICA Expert for the Project period, but that is not revised or modified to be used as WRAWSA's strategy on awareness activities before the end of the Project.

4.4.2 Comparison of the Results and Overall Assessment

The figure below shows the comparison between Base line and End line surveys. In all items of each category, the scores are improved, thus the technical capacity of PR Team is improved.

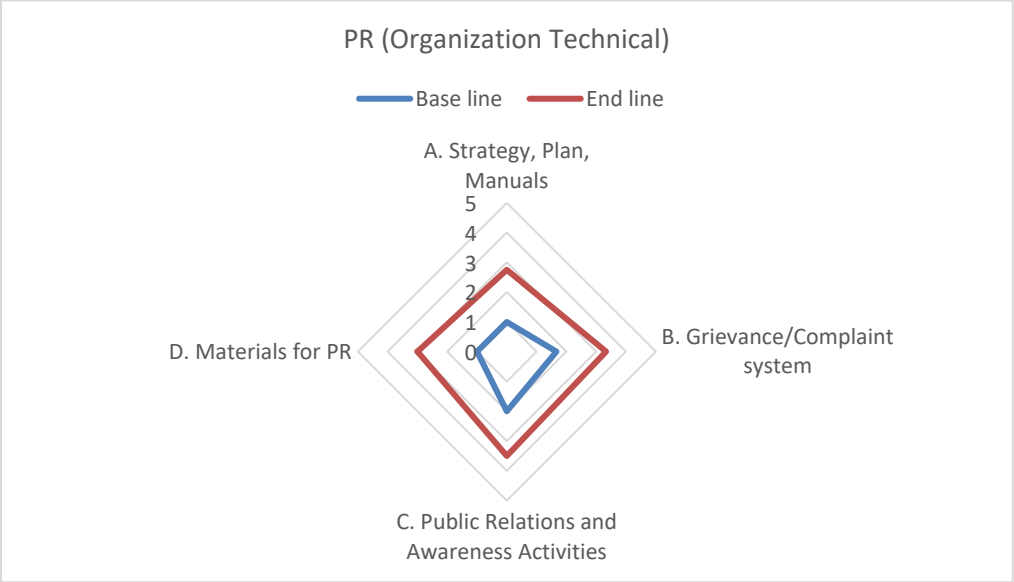


Figure 4.4 Results of Organizational Technical Capacity (Public Relations)

The increased rate is relatively higher in category D. Materials for PR, compared with other categories. At the beginning of the Project, the materials for school program were prepared, however, it was difficult for them to select the message to be delivered and create the story. When they needed to prepare the explanation poster on chlorination, they prepared the poster by themselves with small input from the JICA expert.

4.4.3 Approach for Further Improvement

The implemented activities can be continued by PR team alone, as they can improve the activities by their own now. The skill of preparation of strategy and plan needs to be strengthened.

4.5 Human Resource Management and Development

4.5.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in table below.

Table 4.5 Assessment Results of Organizational Technical Capacity (Human Resource Management and Development)

Category	Items	Base line	End line	Remark	Criteria
A. Recruitment, transfer, retirement	A1: Does WSD/YCDC have any **plan or regulation to control the number of staff** recruited or assigned in each office?	2	2	EDWS can only submit the proposal, has no authority to control.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	A2: Does WSD/YCDC have clear regulation on procedures of staff recruitment? (Is transparency secured?)	2	3	Currently, YCDC is working for its reform so as to improve transparency.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	A3: Does the **frequency and fields** of staff transfers in WDS/YCDC linked with developing staff capabilities?	2	1	Staff is transferred mainly when the vacancies occur due to retirement or promotion. There is no regular staff rotation aiming at HRD.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	A4. Is there any measure to retain staff of WDC/YCDC?	1	3	Social welfare for permanent staff has been improved.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
B. Duties and responsibilities, evaluation, incentives	B1: Are **responsibilities and duties divided** clearly defined for each office?	4	4	R&Ds of each office are clarified in the proposed organization for YCDC reform.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B2: Are **job description**s clearly defined for each staff position? (including managers, engineers, technicians, unskilled workers, administration staff of different kinds, etc.)?	4	3	Job descriptions are clarified in the proposed organization for YCDC reform.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B3: Does WSD/YCDC have a fair **evaluation system** for section/team performance?	3	3	Quarterly, whole EDWS has a regular monitoring of implementation of plan.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	B4: Does WSD/YCDC have an **annual appraisal and target setting** system for staff/managers?	1	3	The formal staff appraisal system started with written appraisal criteria, evaluation format, and periodical implementation.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B5: Are **individual performance-based incentives** working in WDS/YCDC (e.g. pay rises, promotions and bonuses based on individual performance)?	3	3	Only the promotion can work for incentive.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	B6: Is there any linkage between **capacity development of individual staff and improvement of his/her salary** or benefits?	1	1	Not existing.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 6. Can be a model for benchmarking]
	B7: Does WSD/YCDC have a **reward and recognition program** for all staff?	3	4	There are some systems such as appraisal for longer-service period, high mark at training.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	B8: Are there **any active criteria for promotion** to a management	4	3	Examination is conducted for	[1. Not existing, 2. Existing but not working, 3. Working to some

	position? (such as promotion tests, professional qualification requirements, achievement of target performance level, etc.)			promotion to officer level.	extent, 4. Working well, 5. Can be a model for benchmarking]
C.General HRD	C1: Does WSD/YCDC have any **HRD strategy / plan** for staff?	2	3	HRD Plan is at the approval stage.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	C2: Does your **human resources development plan meet the current needs** of the utility?	1	3	Need to be reviewed as necessary.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	C3: Are the **duties and responsibilities related to HRD of each office** clearly defined and regulated?	2	4	Through the discussions for formulating HRD plan, each stakeholder raised awareness about HRD, and their responsibilities are defined in the Plan.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	C4: Is **the supervisor responsible** for bringing up and training of the subordinates?	3	3	Managers are too busy to bring up their subordinates.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	C5: Is there any occasion for each staff to think of their **career path** in YCDC?	4	1	No official occasion.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	C6: Does the utility have **any Incentives** for lecturers, participants in training courses?	3	1&4	For a trainer, no incentive. For a training participant, they are motivated by certificate and prize of accomplishment.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
D. Training Management	D1: Does WSD/YCDC provide any training courses?	3	4	Trainings are provided regularly based on annual plan.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D2: Are training activities (planning, implementation, evaluation, making report) managed properly?	3	4	Trainings are properly managed after repeated implementation of pilot trainings with PDCA cycle.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D3: Is the procedures for implementing trainings defined?	2	4	All procedures are defined as SOP of training management.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
	D4: Are the procedures appropriate to select proper participants of training responding to the contents of the training.	3	4	HRD requested supervisors of the targeted training group to select proper participants, resulting in improving the selection gradually.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D5: Are the procedures appropriate to ensure the **programs and materials meet the training needs** (technical fields, administration and management fields)	3	3	No official procedures to improve training material quality.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	D6: Are the results of the exam which is taken by the trainee after	4	4	Utilized as a reference for selecting candidates	[1. Not existing, 2. Existing but not working, 3. Working to some

	training course referred and utilized?			of promotion and foreign training participants.	extent, 4. Working well, 5. Can be a model for benchmarking]
E. OJT &self-learning	E1: Is **OJT** (on-the-job training) carried out effectively, in terms of the number of experienced staff who can provide OJT, recognition of the importance of OJT, an organized approach for OJT, etc.?	2	2	OJT depends on each manager. Not in an organized way.	[1. OJT is not carried out, 2. Some OJT is carried out, but in an unorganized way, 3. Some OJT is carried out in an organized way, 4. OJT is a significant part of the organizational culture and it is carried out systematically]
	E2: Does WSD/YCDC have a **culture of knowledge-sharing** (senior or experienced staff teach junior or new staff and share experience and information?)	3	4	Each section/office has regular meeting, and it can work for knowledge sharing as well.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	E3: Does WSD/YCDC provide a supportive environment for the staff to undertake **self-learning** (e.g., access to learning materials, equipment, information, communication with other utilities, financial support, etc.)?	1	2	Not active enough to satisfy high demand.	[1. Necessary for fundamental improvement, 2, Necessary for major improvement, 3. Necessary for partial improvement, 4. Not necessary for modification, 5. Can be a model for benchmarking]
F. Resource	F1: Does WSD/YCDC have a **training center** for staff?	3	3	Training center has been just established. HRD Section has been functioning well since its launch.	[1. Not existing, 2. Existing but not working, 3. Working to some extent, 4. Working well, 5. Can be a model for benchmarking]
	F2: Is WSD/YCDC's **budget** for human resource development adequate?	2	3	7 million Ks/year for average. Not enough for inviting outside trainers and provides refreshment for participants.	[1. No specified budget, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F3: Does WSD/YCDC incorporate with **external training** (including those provided by private companies, development partners, and other authorities)?	3	4	More occasions including scholarship program, or seminars are provided.	[1. No information, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F4: Are there enough number of staff with teaching experiences in YCDC?	3	3	Some experienced trainers have been retired or transferred to other department.	[1. No information, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]
	F5: Are internal trainers capable enough of technical and/or communications skills.	2	3	Some less experienced trainers need to upgrade their skills.	[1. No information, 2. Not nearly adequate, 3. Less than adequate, 4. Adequate]

4.5.2 Comparison of the Results and Overall Assessment

Overall, it can be said that the capacity related to human resource development has been developed while the capacity related to personnel management remains behind.

In some items, the scores even decreased compared to the Baseline. This may happen because at the time of the Baseline, C/Ps were not aware of any issues with the existing system and felt that there were no significant problems, hence they gave a higher score than the actual situation. Through the implementation of the Project, C/Ps recognized the need for improvement.by gaining a better understanding of the related issues especially during the discussion for HRD Plan and learning about the cases of other waterworks through training in third countries and Japan, as well as seminars by Advisory Committee members.

A. Recruitment, transfer, retirement: 1.8 points => 2.3 points

This area is directly related to the personnel management system, especially the number of staff recruitment (item A1), recruiting procedures (item A2), personnel transfers (item A3), and staff retention measures (item A4), which are proposed by WRAWSA, confirmed by YCDC, and approved by YRG. The approval process makes it difficult for WRAWSA to improve the system. Although the importance of the issues and the necessity for improvement have been shared with the YCDC management level during the discussion for formulating HRD Plan, the overall system has not been significantly improved.

B. Duties and responsibilities, evaluation, incentives: 2.9 points ⇒ 3.0 points
This area evaluates the clear setting of duties & responsibilities, its implementation, and the staff appraisal and salary system based on it. Compared to the Baseline, no major changes in the system have been observed.

The scores in the clear definition of job descriptions for each staff (item B2) and the existence of criteria for promotion to management positions (item B8) were lower than Baseline. As mentioned above, the reason for the lower scores can be assumed that the C/Ps learned about the examples of other countries and felt the need for improvement in this issue. Although the capacity of the system has not changed, this can be considered as a sign that the capacity of the C/Ps at the individual level has improved.

Regarding the personnel appraisal system (item B4), at the time of the Baseline, there were no periodical staff appraisal or written evaluation criteria, and managers made subjective judgments. However, WRAWSA launched a periodical appraisal system with unified evaluation criteria, of which each office must submit evaluation sheets periodically. This can contribute to improve the fairness and transparency of evaluations were greatly.

C. General HRD: 2.5 mark ⇒ 2.8 mark
It can be evaluated that the capacity has improved in many items. However, the score for career path opportunities (item C5) has declined from 4 points at Baseline to 1 point. Since 2017, there has been a significant delay in the promotion of young staff to permanent positions, which has seriously worsened the situation where younger staff are unable to consider a career within the organization.

D. Training Management: 3.0 points ⇒ 3.8 points
It can be said that the capacity on training management has improved and reached to a satisfactory level in all respects. Through the implementation of pilot training courses, providing training programs in wide range of fields (D1), improving training management (D2), developing training materials (D5), and establishing these training management procedures as a SOP (D3). At the same time, the selection of appropriate training participants (D4) has also improved as office managers' understanding of HRD has enhanced.

E. OJT＆self-learning: 2.0 points ⇒ 2.7 points
As managers became more familiar with HRD, their mindsets toward the importance of OJT in the workplace changed better. As for the improvement of the knowledge-sharing culture in workplace (E2), it is possible that 5S and Kaizen activities targeting all sections contributed to the enhancement of communication in the workplace.

F. Resource: 2.6 points ⇒ 3.2 points
Mainly due to the understanding and support of the WRAWSA top management for HRD, the necessary staff, budget (F2) and equipment have been allocated, and even new training center (F1) was constructed. The most significant improvement, although not reflected in the scores, was the availability of internal trainers. Since many officers have become internal trainers, though many senior officers retired during the five years of the project, the internal trainers have greatly improved in terms of both their teaching capability (F5) and number (F4).

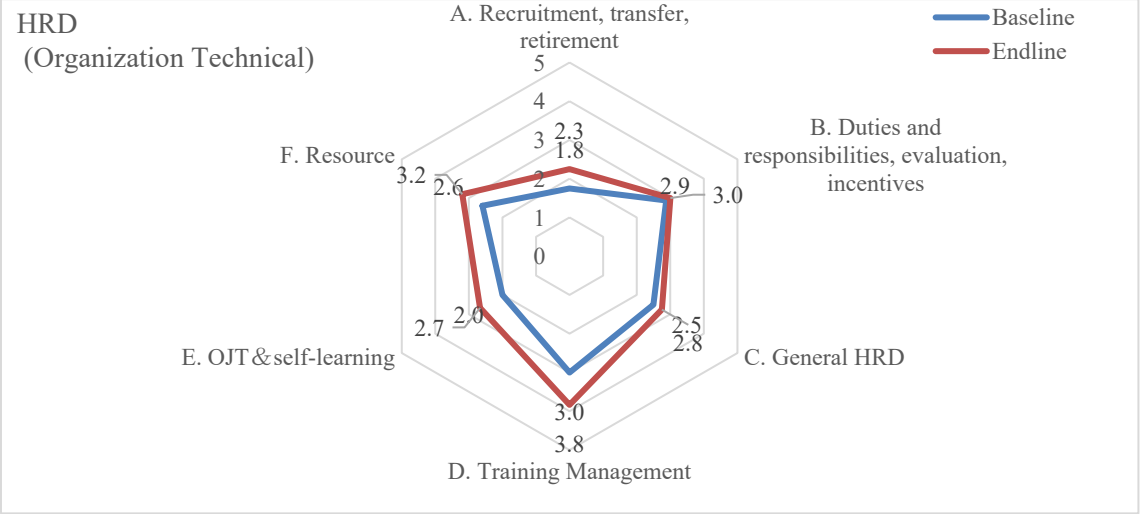


Figure 4.5 Results of Organizational Technical Capacity (Human Resource Management and Development)

4.5.3 Approach for Further Improvement

When considering long-term HRD, it is necessary to develop capacities in the areas of personnel management. During the project period, activities were mainly focused on setting up of training programs, developing long-term plan, and strengthening HRD Section. Those are likely to be implemented within WRAWSA, and the related capacity were developed accordingly.

In order to improve the personnel management system, including the proper number of recruits and better treatment of staff, it is necessary to continue explaining to YCDC management and make them understand the necessity to improve the unified system for all national civil service. Also, within WRAWSA, they can clarify duties and responsibilities and allocate staff based on it for efficient operation of the organization.

The turnover of young staff has become an urgent issue, and as measures can be taken within WRAWSA, it is recommended that more training opportunities be provided and OJT be strengthened in order to manage the motivation of young staff.

4.6 Non-Revenue Water Management

4.6.1 Result of Assessment at the End

Regarding organizational capacity of the NRW management section, the end -line assessment was evaluated as follows and is compared to the baseline. At the level of organizational capacity,. the hydraulic analysis and design drawing methods required for pipeline design were provided. In addition, after the start of pipeline renewal work, NRW-Section was equipped with knowledge and skills regarding proper civil engineering work such as management of equipment and materials, jointing of pipes, and backfilling. The Section has been equipped with a water pressure inspection method and implementation technology that can confirm in advance whether or not there is a leak that causes non-revenue water.

At the level of individual capacity, knowledge and practical skills related to non-revenue water have hardly been cultivated so far, but the training conducted in this project will provide the skills and skills to prevent the occurrence of non-revenue water.

Table 4.6 Assessment Results of Organizational Technical Capacity (Non-Revenue Water Management)

Category	Items	Base line	End line	Criteria
A. Material Standard	A1. Material standard for newly pipe laying and repairing is established.	4	4	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
	A2. Inspection of procured materials.	4	4	[1. Unnecessary, 2. Never implemented, 3.Conducting when its needed , 4. Inspect all the procured materials , 5. Inspect & record all the procured materials]
B. Design Standard	B1. Design standard for newly pipe laying and repairing is established.	4	4	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
C. Estimation Standard	C1. Estimation standard for newly pipe laying and repairing is established.	4	4	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
D. Construction Standard	D1. Construction standard for newly pipe laying and repairing is established.	4	4	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
E. Inspection Standard	E1. Completion inspection standard for newly pipe laying and repairing is established.	3	3	[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]
F. Technical Training	F1. Training for design, estimation, etc. are implemented.	3	4	[1. Not existing, 2. Training for new employees, 3. Occasionally, 4. Implement if it necessary 5. Implement according to training plan.]
	F2. Technical training for construction are implemented.	3	4	
	F3. Training for leak detecting are implemented.	3	4	
	F4. Training for measuring leakage volume are implemented.	1	4	
G. Information Management	G1. Grasp the information (pipe position, material, laying date, etc.) of the area in charge.	3	5	[1. No record, 2.No record (but necessary), 3. Grasp information of the area in charge, 4. Record on piping map, 5.Making a ledger and record on it]
	G2. Pipe information is recorded accurately	2	4	[1. No record, 2.Recorded (entrusted by the person in charge), 3. Record with memory 4. Recording regularly, 5.Recording regularly with construction record]
H. Equipment	H1. Equipment for pipe laying and	4	5	[1. Nothing, 2. Using old equipment, 3. Procure when it necessary, 4. Essential

	repairing is prepared.			equipment is prepared 5. Up-to-date equipment]
I. Technical Level	I1. Technical level of workers	1	5	[1. Only Field survey 2. Basic planning&design 3. Detail design & estimation 4. Define a diameter with hydraulic analysis, 5. Making DMA & Distribution Network]

4.6.2 Comparison of the Results and Overall Assessment

Training on how to formulate a NRW management plan based on logical thinking, such as creating maps by field surveys and designing pipelines by hydraulic analysis based on water pressure measurement of exiting pipelines, training on making a daily record of construction progress and inventory management of materials, training on selection of kinds of pipe materials according to the conditions of the construction site, and training on appropriate jointing method for each pipe material type were held. Through a series of training activities in the project, SOPs related to each work for design to material management, construction, and inspection required to suppress the generation of non-revenue water have been prepared for township engineers by NRW-Section, etc. It has become possible to carry out technical guidance and training on non-revenue water.

Regarding inspection work, the YCDC inspection department has been involved confirming construction design and approving construction fee expenditures, but now that the inspection department does not have technical staff who understand water supply technology. CE has decided to set up an inspection team within WRAWSA to carry out inspection based on a certain technical level.

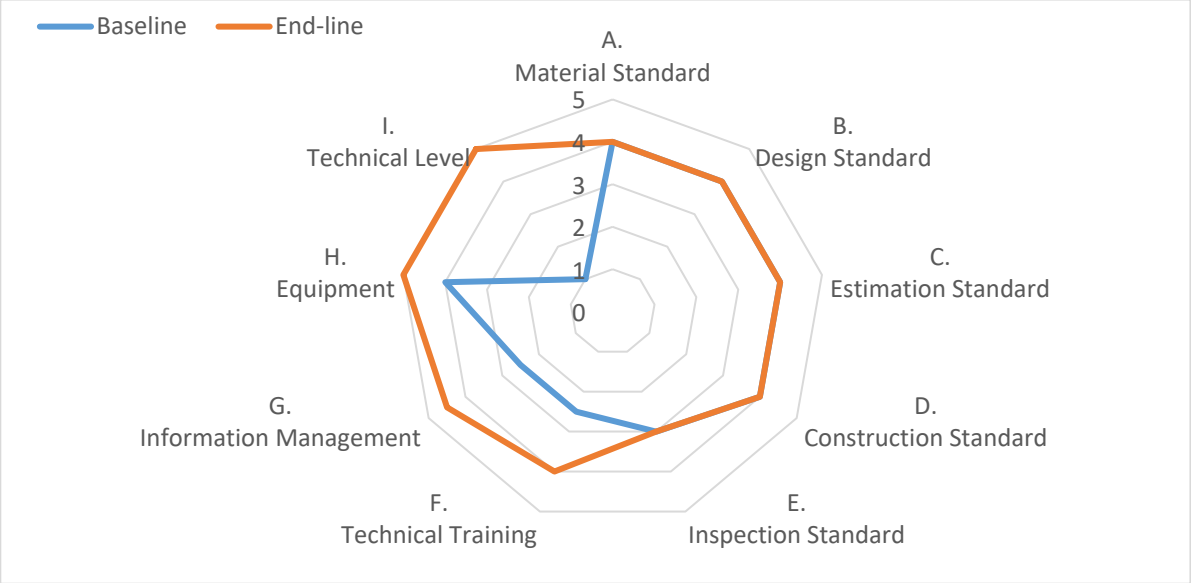


Figure 4.6 Results of Organizational Technical Capacity (Non-Revenue Water Management)

4.6.3 Approach for Further Improvement

In the future, it will be necessary to establish material standards to ensure the quality of water distribution pipes and to thoroughly inspect construction completion. In addition, by utilizing the training yard and training room, staff of WRAWSA will acquire knowledge about the planning and design of water distribution pipelines, create step test procedure manuals that will be a specific method for leak areas, and maintain pipelines and branch connections of water service pipes. It is indispensable to build a system to systematically implement training based on the technical standards and manuals required for.

4.7 Water Treatment

4.7.1 Result of Assessment at the End

Summary of organizational technical capacity assessment result at the end is shown in table below, and radar chart is shown in Figure 4.7.

Table 4.7 Result of organizational technical capacity assessment at the baseline and the end

Category	Items	Base line	End line
A. Organization and staffing	A1. Organization of management section of WTP (number of staff, chain of order, duty and power).	3	4
	A2. Organization of maintenance and repair section of WTP (number of staff, chain of order, duty and power).	3	3
	A3. Specialized section for operation and maintenance of electrical equipment.	3	4
	A4. Specialized section for operation and maintenance of mechanical equipment.	3	4
	A5. Rule of staff recruitment of WTP.	3	3
B. Information management	B1. Document control and data management system in WTP is established.	3	4
	B2. Preparation and store keeping of design drawing and layout drawing of facilities and equipment.	3	3
	B3. Preparation and store keeping of tabulated list of specification of facilities and equipment.	3	3
	B4. Technical information management (obtain, arrangement and storekeeping of technical information) of mechanical and electrical service	2	3
	B5. Technical information management (obtain, arrangement and storekeeping of technical information) of water treatment and water quality management (e.g. water treatment technology, water quality equipment, etc.)	2	4
C. Management of O&M work	C1. Annual plan of O&M (e.g. chemical procurement, water quality monitoring, periodical inspection, etc.)	**3**	**4**
	C2. Management system of O&M work (Store keeping of O&M record, confirmation of planned O&M activity, establishment of O&M plan, etc.)	3	4
	C3. Organization plan and manual of repair	2	2
	C4. Internal rule (rule of YCDC) of O&M.	1	1
	C5. Rules of procurement and purchase of spare parts, chemical, etc.	3	3
	C6. Preparation of O&M report	3	4
	C7. Development and recordkeeping of O&M report	3	4
	C8. Preparation of repair report	3	3
	C9. Development and recordkeeping of repair report	3	3
	C10. Registration of facility and equipment.	1	2
	C11.Track record of facility and equipment from installation.	1	1
	C12. Outsourcing of O&M work (what kind of outsourcing work)	1	1
	C13. Rules of outsourcing of O&M work.	1	1
D. O&M manual and SOPs	D1. O&M manual and SOPs of facility and equipment. (1) Raw water pump	1	5
	D2. O&M manual and SOPs of facility and equipment. (2) Coagulation tank	1	5
	D3. O&M manual and SOPs of facility and equipment. (3) Coagulant injection facility and coagulant injector	1	5
	D4. O&M manual and SOPs of facility and equipment. (4) Sedimentation tank	1	5
	D5. O&M manual and SOPs of facility and equipment. (5) Sand filtration tank and backwashing facility	1	5
	D6. O&M manual and SOPs of facility and equipment. (6) Chemical storage facility	3	3
	D7. Procedure of making, review and storekeeping of operation manual and SOPs	2	4

Category	Items	Base line	End line
	D8. Procedure of preparation and storekeeping of operating record.	2	4
E. Budget and procurement	E1. Responsible person of budget (cost estimation) for O&M	3	3
	E2. Internal rule for procurement and purchasing spare parts, chemicals, etc.	3	3
	E3. Understanding of domestic and overseas supply situation of equipment, spare parts, chemicals, etc.	2	3
F. Technical Capacity	F1. Operator's understanding of water treatment technology for WTP operation (e.g. coagulation-sedimentation, sand filtration, chlorination)	2	4
	F2. Opportunity to receive training about water treatment technology (in house training of YCDC).	1	3
	F3. Opportunity to obtain the latest water treatment technology (receive training, attend seminar, etc.).	1	4
	F4. Contents of instruction to site operator (intelligibility of operator, specific suggestion is necessary or not)	3	4
	F5. Understanding of concept of preventive maintenance.	1	3
	F6. Capacity operating ratio of WTP (actual water production / designed water production)	3	2
	F7. Understanding of WTP's ability of water treatment (degree of turbidity reduction, etc.).	1	3
	F8. Understanding of trend of raw water quality.	1	4
	F9. Understanding of planned value ant trend of treated water quality.	1	4
G. Operation of WTP	G1. Priority level of facility and equipment (Facility and equipment which should be kept the function to maintain the function of WTP)	1	1
	G2. Operating plan including quantity of water intake, production volume, water transmission volume (daily, hourly) ,etc.	1	4
	G3. Recorded operation parameter (daily, weekly, monthly). e.g. water production, number of operating sedimentation pond, number of operating filtration pond, etc.	1	4
	G4. Preparation and store keeping of operation record	1	4
	G5. Preparation and reporting (to YCDC HQ) of periodical operation report.	1	4
	G6. Periodical inspection plan of WTP	1	3
	G7. Item of periodical inspection	1	2
	G8. Record and store keeping of periodical inspection report.	1	2
	G9. Contingency plan including electric outage, malfunction of equipment, anomaly of water treatment, etc.	1	4
	G10. Control of chemical injection	1	4
	G11. Determination of chemical injection volume	1	4
	G12. Monitoring of injection ratio	1	4
	G13. Installation of backup equipment	1	4
	G14. Establishment of operation manual of chemical injection	1	3
	G15. Purchase schedule of water purification chemicals.	1	3
	G16. Problems about acquisition of water purification chemical (date required, buying procedure, etc.)	1	3
	G17. Reserved amount of water purification chemicals .	1	3
	G18. Storage condition of each water purification chemicals (temperature control, ventilation, with or without of shading device)	1	2
	G19. Quality control system of storage water purification chemicals	1	2
	G20. System of injection control and monitoring of each water purification chemicals.	1	3
	G21. Record of chemical injection control (kind of chemical, injection rate (ppm), injection period)	1	3
	G22. Usage of chemical injection record.	1	3
	G23. Location of flowmeter	1	3
	G24. Control method of treated water volume	1	2

Category	Items	Base line	End line
	G25. Location of water-level gage	1	3
	G26. Operation control of flush mixing (adjust flow rate, adjust G value, etc.)	1	3
	G27. Operating condition of flush mixing facility (flow rate, G value)	1	3
	G28. Operation control of slow mixing (adjust flow rate, adjust G value, etc.)	1	3
	G29. Operating condition of slow mixing facility (flow rate, G value)	1	3
	G30. Condition of flocculation (size, sedimentation property)	1	3
	G31. Frequency of sludge withdraw of sedimentation tank	1	2
	G32. Turbidity after sedimentation process (Target value: 5NTU)	1	3
	G33. Operating control of filtration tank (adjust flow rate, etc,)	1	2
	G34. Operating condition of filtration tank (flow rate, filter run time, maintenance schedule)	1	2
	G35. Operating control of back washing (adjust backwashing rate, backwashing period, etc.)	1	2
	G36. Condition of backwashing (procedure of backwashing, backwashing rate, condition of start and stop of backwashing)	1	2
	G37. Periodical inspection of backwashing rate and condition of filtration media.	1	2
	G38. Periodical supply (refill) of filtration media	1	2
	G39. Making and storekeeping of operation record of filtration tank.	1	2
	G40. Periodical cleaning of clear water tank	1	3
	G41. Operating plan of water transmission pump	1	4
	G42. Making and storekeeping of operation record.	1	4
	G43. Usage of operation record of water transmission pump	1	3
	G44. Location and of water quality monitoring in water purification process	1	4
	G45. Water quality monitoring item	1	3
	G46. Making and store keeping of water quality monitoring data.	1	4
	G47. Usage of water quality data	1	4
H. Stock of spare parts and repairing material	H1. Stock of spare parts and repairing material	3	3

4.7.2 Comparison of the Results and Overall Assessment

Table 4.8 and Figure 4.7show the organizational technical capacity assessment result at the baseline and the end. It is evaluated that all assessment categories except “Stock of spare parts and repairing material” are improved. Among the improved categories, the “O&M manual and SOPs” category improved a lot and its numerical value increased from 1.5 to 4.5, it gets almost full evaluation. This is because Naunghnapin water treatment plant created many SOPs which instruct to all workers in the plant’s operational and maintenance procedures of the water treatment system and facilities. Not only SOPs documents, but SOPs operational system is created in the whole WRAWSA organization and all sections in WRAWSA made SOPs of their section.

As both “Technical Capacity” and “Operation of WTP” improved greatly, the former gets more than double numerical value and the latter gets triple numerical value from the viewpoint of improvement rate, since their evaluation were low at the baseline assessment. During the project, C/Ps learned the importance of understanding the technological things. They also learned to recognize technical evidence when they create operation procedures for the treatment process or plan new facilities. Even though they are improved, still there is a room to improve. This is the challenge into the future of them.

Evaluation of “Stock of spare parts and repairing material” category remains the same at the baseline and the end, of which their numerical value of evaluation result is “3”.

Table 4.8 Result of organizational technical capacity assessment by category (Water Treatment)

Category	Baseline	At the end
A. Organization and staffing	3.0	3.6
B. Information management	2.6	3.4
C. Management of O&M work	2.2	2.5
D. O&M manual and SOPs	1.5	4.5
E. Budget and procurement	2.7	3.0
F. Technical Capacity	1.6	3.4
G. Operation of WTP	1.0	3.0
H. Stock of spare parts and repairing material	3.0	3.0

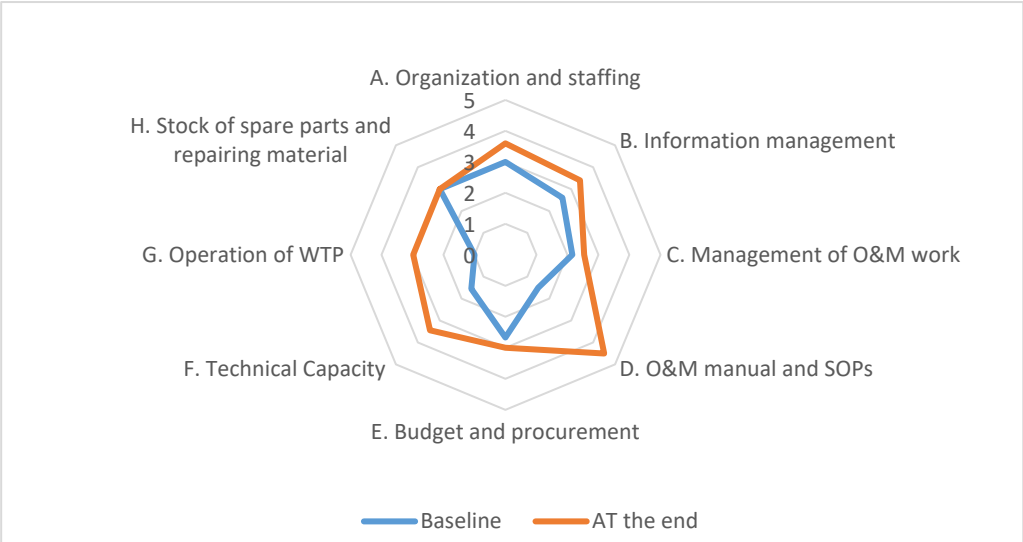


Figure 4.7 Results of Organizational Technical Capacity at the baseline and the end（Water Treatment）

4.7.3 Approach for Further Improvement

Even though the SOP operation system established in WRAWSA, the system needs some more parts to develop. For maturing the contents of all SOPs, it is essential to maintain and improve the SOP system of the organization. It also needs to establish a PDCA cycle of the system operation.

Final report of the Project describes that Nyaunghnapin plant has some facilities and equipment to be improved. The 5-year and 10-year water quality management plan shows facilities and equipment which is necessary to improve and it also shows time schedule. C/Ps are requested to take a part of improvement work, so that they can get more technological knowledge and develop their technical capacity.

4.8 Water Quality Monitoring

4.8.1 Result of Assessment at the End

The results of the assessment both at the baseline and the end line are shown in table below.

Table 4.9 Result of organizational technical capacity assessment (Water Quality Monitoring)

Category	Items	Score		Score increase / decrease
		Base line	End line	
A. Technical knowledge	A1. Planning of water quality monitoring	2	4	2
	A2. Knowledge of water treatment technology	2	3	1
	A3. Opportunity to obtain the new technical knowledge	1	3	2

Category	Items	Score		Score increase / decrease
		Base line	End line	
B. Administrative rules and record keeping	B1. Administrative rule of monitoring equipment and reagents.	1	5	4
	B2. Administrator of monitoring equipment and reagent.	3	5	2
	B3. Procedure of monitoring equipment and reagent procurement.	4	4	0
	B4. Recordkeeping of purchase, and disposal of monitoring equipment.	4	5	1
	B5. Recordkeeping of purchase, and disposal of reagent.	4	5	1
C. SOPs and manual	C1. SOPs for water quality analysis	3	5	2
	C2. SOPs for data quality management	1	3	2
	C3. Procedure SOPs management (document control and revision)	1	4	3
	C4. Manual for accident response in sampling work	1	4	3
	C5. Procedure of disposal of experimental waste	1	3	2
D. Operation	D1. Number of analytical items	3	3	0
	D2. Procedure of development of monitoring plan.	3	3	0
	D3. Procedure of sample storage	1	5	4
	D4. Data format and data management procedures	1	5	4

4.8.2 Comparison of the Results and Overall Assessment

The effect of capacity development was examined by comparing the baseline assessment with the end line assessment. The results of the assessment were shown in a score comparison (Table 4.9) and radar chart (Figure 4.8).

Category A. Technical knowledge

"A1. Planning of water quality monitoring" was enhanced. Central laboratory staffs have been able to develop monthly water quality monitoring plan using the experience and knowledge they have gained. On the other hand, the score increases in "A2. Knowledge of water treatment technology" 2 was smaller, but this can be seen as an indication that they recognize that they still have much to learn.

In the end line survey, score of "A3. Opportunity to obtain the new technical knowledge" was increased. In Yangon, the opportunity to obtain new knowledge is still limited. However, they make an effort to obtain new knowledge by attending training courses and using the internet.

Category B. Administrative rules and record keeping

In the end line survey, the score increases in "B1. Administrative rule of monitoring equipment and reagents" was the largest. This may be the effect of the development of SOPs and the clarification of the various rules.

As a result of the SOP development, the responsibility for the management of monitoring equipment and chemicals ("B2. Administrator of monitoring equipment and reagent") has been clarified. In addition, the responsibility for record keeping ("B4. Recordkeeping of purchase, and disposal of monitoring equipment" and "B5. Recordkeeping of purchase, and disposal of reagent") has also been clarified.

However, the score for 'B3. monitoring of procedures for the procurement of equipment and reagents" did not improve. Central Laboratory already have a capacity to plan the procurement of equipment and

reagents. However, the procurement procedure is done based on WRAWSA rules, it is considered that they did not perceive any improvement in their procurement capacity.

Category C. SOPs and manual

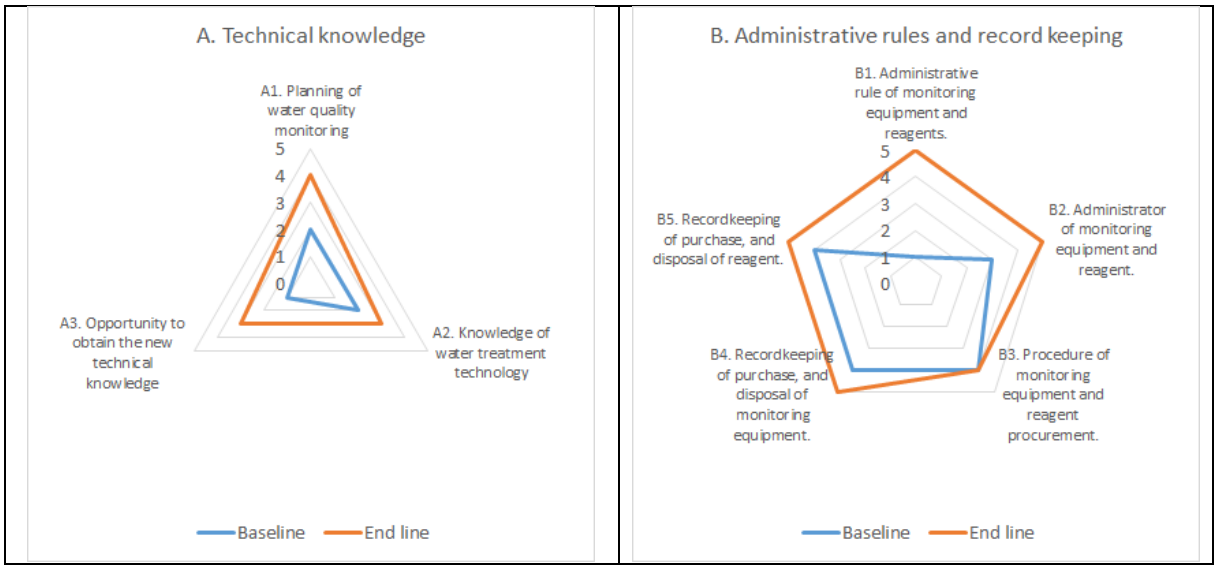
Because of the systematic development of SOPs, capacity in Category C has improved in whole. However, "C2. SOPs for data quality management" and "C5. Procedure of disposal of experimental waste" are still need to be improved.

For "C2. SOPs for data quality management", the data quality management method has been introduced in the seminar. It is hoped that this will become a standard method in central laboratories and that SOPs will be developed. On the other hand, experimental waste management ("C5. Procedure of disposal of experimental waste") is carried out according to the YCDC rules. However, the YCDC waste management rules themselves are not perfect, and the disposal of reagents in particular needs further investigation.

Category D. Operation

"D3. Procedure of sample storage" and "D4. Data format and data management procedures" have been largely improved by the development of SOPs. On the other hand, there was no change in "D1. Number of analytical items" and "D2. Procedure of development of monitoring plan". For item "D1", the central laboratory has started to introduce standard test methods and upgrade equipment to meet the requirements of MNDWQS. Therefore, it is expected to be able to carry out more extensive water quality monitoring in the future.

The assessment of "A1" showed an improvement in capacity in the development of water quality monitoring plan. However, the meanings of the response on item D2 may reflect the fact that it is not possible to develop an ideal monitoring plan due to the constraints of the monitoring items that can be carried out and the manpower available.



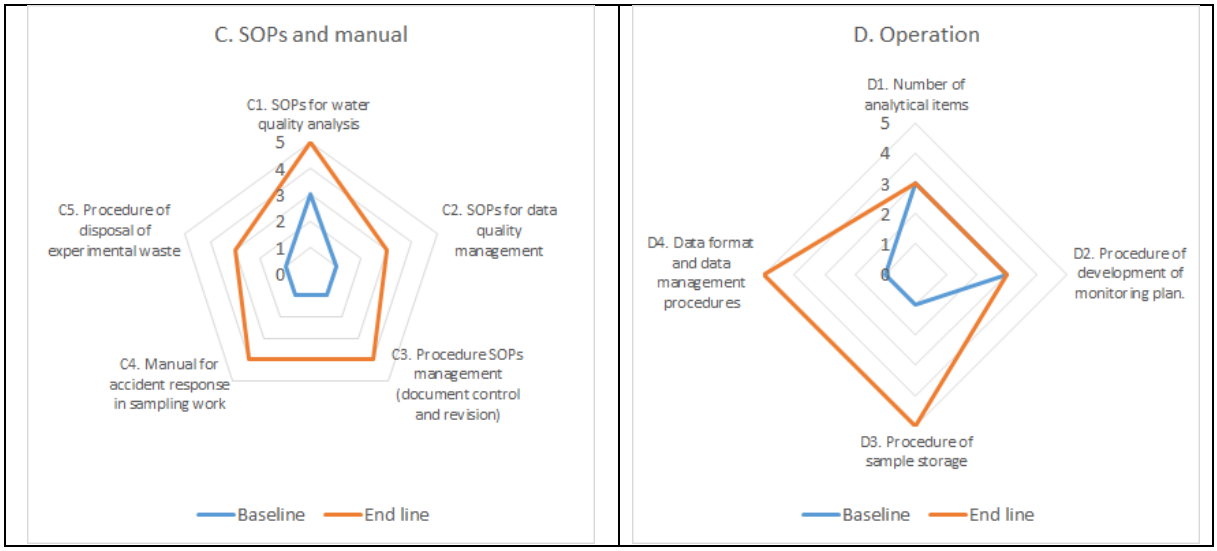


Figure 4.8 Results of Organizational Technical Capacity at the baseline and the end（Water Treatment）

4.8.3 Approach for Further Improvement

It can be said that the organization's technical capacity has improved through this project. In this project, the development of SOPs has resulted in a variety of work procedures and rules being put into writing. It is said that this process has played a major role in the development of technical capacity. However, improvements in procurement and waste management that have been implemented in accordance with WRAWAS rules will have to wait for the relevant rules to be improved.

Future technical challenges include i) Improvement of water quality test methods in accordance with the MNDWQS, ii) Increasing the number of water quality test item and iii) Improvement of data quality management capacity. Improvements in these challenges have been initiated during the implementation of this project, therefore, it is expected that the central laboratory will make efforts to improve these challenges on its own initiative.

CHAPTER 5. Individual Technical Capacity

5.1 Water Quality Monitoring

5.1.1 Target of assessment

The list of assessment target is shown in table below. The survey was conducted with 8 staffs who have been in the central laboratory since 2014.

Table 5.1 List of survey participants

Position	Number of participants
AE	1
SAE	3
WA and Flat	4

5.1.2 Assessment item

A list of assessment item is shown in table below. Since C/P's capacity had enhanced through this project, some of the questions in the end line survey were modified.

Table 5.2 List of assessment item

Category	Item
A. Capacity of water quality analysis	A1. Correct operation of measurement equipment
	A2. Correct handling of laboratory grass ware
	A3. Correct maintenance of measurement equipment
	A4. Correct preparation of reagent
	A5. Correct sample storage and preparation
	A6. Understanding of SOPs and manuals
B. Data analysis and data quality management	B1. Interpretation of water quality data
	B2. Utilization of data quality management tool
	B3. Data quality control during analysis operation
	B4. Understanding of water quality data management system
C. Planning of water quality monitoring	C1. Understanding of the meaning of water quality items
	C2. Appropriate select of sampling site
	C3. Appropriate select of analysis items
	C4. Designing an appropriate research plan
D. Water quality problem solving capacity	D1. Problem solving capacities to improve water quality
	D2. Problem solving capacities for planning water quality incidents

5.1.3 Result of Assessment and End

The effect of capacity development was examined by comparing the Baseline assessment (2014) with the End-line assessment (2019). The evaluation results are expressed as averages of AE + SAE (total of 4 participants) and WA + Flat (total of 4 participants).

The results of the assessment were shown in a score comparison (Table 5.3, Table 5.4, Table 5.5, and Table 5.6) and radar chart (Figure 5.1, Figure 5.2, Figure 5.3, and Figure 5.4) for each category.

Assessment

Category A: Capacity of water quality analysis

The results of score comparison (Table 5.3) showed an improvement in "A4: Correct preparation of reagent" for both "AE and SAE" and "WA and Flat". This improvement can be attributed to the introduction of standard test method and the introduction of SOPs.

On the other hand, there was a decrease in scores for "A2: Correct handling of laboratory grass ware", "A3: Correct maintenance of measurement equipment" and "A5: Correct sample storage and preparation". These results can be interpreted that they were able to recognize their own problems as they learned correct experimental methods based on SOPs. In this sense, the decrease in scores is not due to a decrease in the capacity, but to an increase of knowledge and experience.

Table 5.3 Comparison of average assessment score of each position: Category A

Assessment item	AE and SAE			WA and Flat		
	Score		Score increase / decrease	Score		Score increase / decrease
	Base line	End line		Base line	End line	
A1. Correct operation of measurement equipment	3.0	4.0	1.0	3.0	3.8	0.8
A2. Correct handling of laboratory grass ware	4.0	3.3	-0.7	4.0	3.3	-0.8
A3. Correct maintenance of measurement equipment	3.0	3.0	0.0	3.0	2.5	-0.5
A4. Correct preparation of reagent	2.0	3.7	1.7	2.0	3.8	1.8
A5. Correct sample storage and preparation	3.8	3.7	-0.1	4.0	3.0	-1.0

A6. Understanding of SOPs and manuals	3.3	4.0	0.8	3.0	4.0	1.0

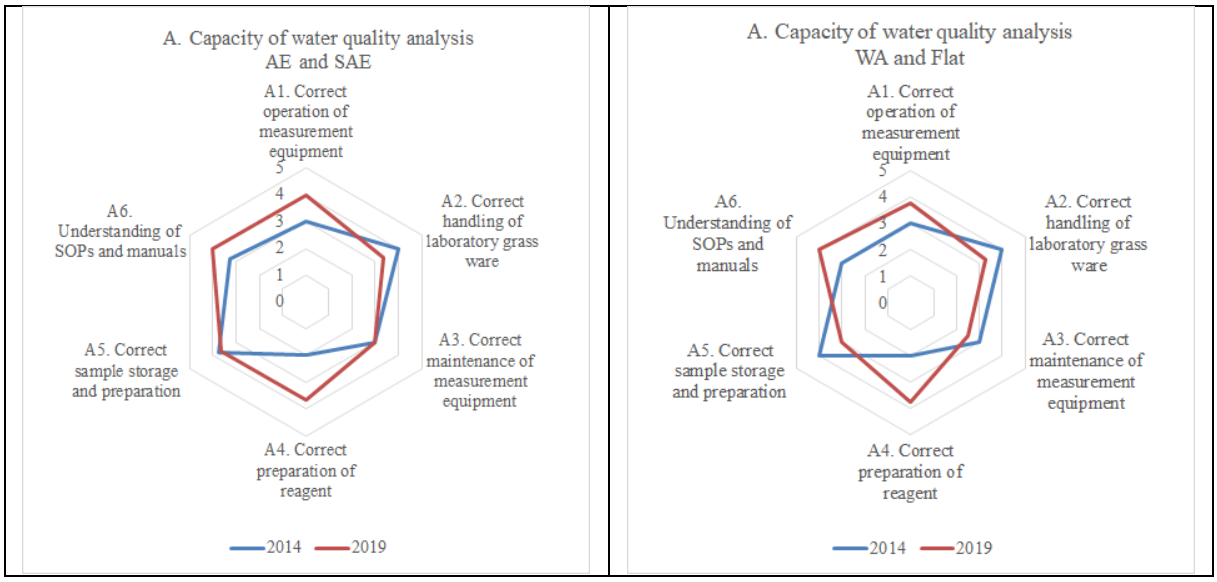


Figure 5.1 Comparison of radar chart: Category A

Category B: Data analysis and data quality management

In the latter half of this technical assistance project, lectures and practical training were given to build capacity in data accuracy control methods.

The improvement of capacity "B2: Utilization of data quality management tool" is the result of this activity. However, improvement in the scores of "B3: Data quality control during analysis operation" and "B4: Understanding of water quality data management system" was no observed. Items B3 and B4 are the capacity gained through the application of knowledge from B2. Therefore, the capacity of B2 may be not yet fully developed.

The capacity increase in "B1: Interpretation of water quality data" was low. However, as C/P conducts internal discussions and study groups on water quality issues, it is expected that their capacity will gradually improve as their experience and knowledge increases.

Table 5.4 Comparison of average assessment score of each position: Category B

Assessment item	AE and SAE			WA and Flat		
	Score		Score increase / decrease	Score		Score increase / decrease
	Base line	End line		Base line	End line	
B1. Interpretation of water quality data	2.3	2.7	0.4	2.0	2.5	0.5
B2. Utilization of data quality management tool	1.0	2.0	1.0	1.0	2.5	1.5
B3. Data quality control during analysis operation	2.0	2.3	0.3	2.0	2.0	0.0
B4. Understanding of water quality data management system	2.3	2.0	-0.3	2.0	2.0	0.0

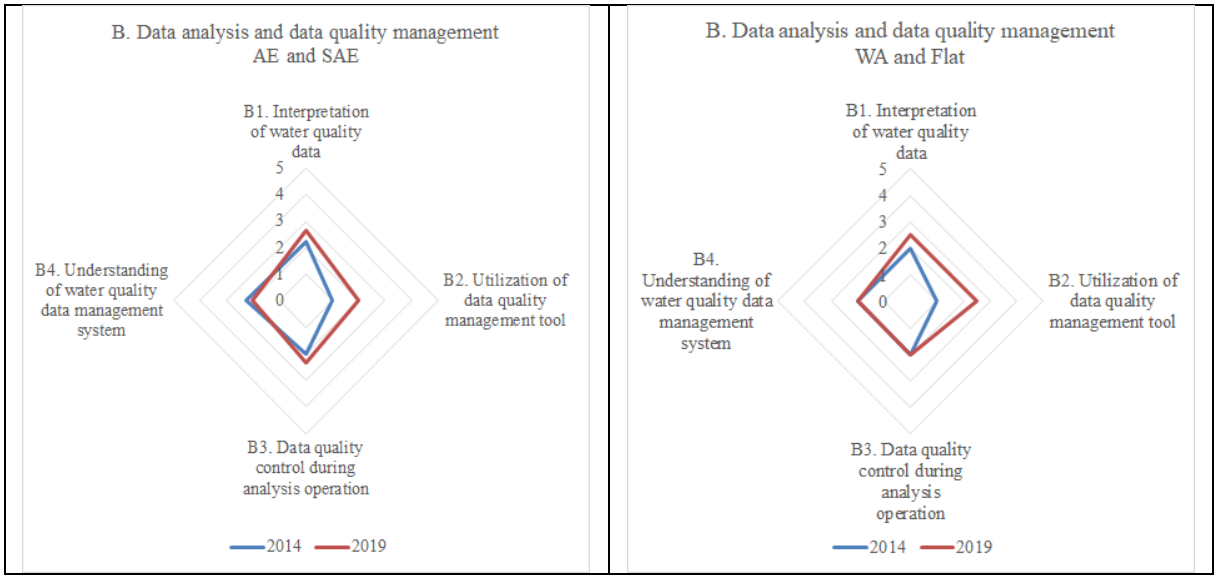


Figure 5.2 Comparison of radar chart: Category B

Category C: Planning of water quality monitoring

"C2: Appropriate select of sampling site", "C3: Appropriate select of analysis items" and "C4: Designing an appropriate research plan" are the capacity for planning of water quality monitoring.

There was an increase in scores for both "AE and SAE" and "WA and Flat". In particular, "AE and SAE" increased their scores because they have a roll of leader in planning of water quality monitoring.

On the other hand, "C1: Understanding of the meaning of water quality items" was not enhanced. This question asks about the chemical meaning of water quality monitoring items and is related to the knowledge in "B1: Interpretation of water quality data ".

The knowledge of B1 and C1 will be improved through analysis of actual water quality data rather than through desk-based learning. Therefore, it is expected that the knowledge and experience will be improved through the continuation of future activities.

Table 5.5 Comparison of average assessment score of each position: Category C

Assessment item	AE and SAE			WA and Flat		
	Score		Score increase / decrease	Score		Score increase / decrease
	Base line	End line		Base line	End line	
C1. Understanding of the meaning of water quality items	2.3	2.0	-0.3	2.0	2.0	0.0
C2. Appropriate select of sampling site	1.8	2.7	0.9	1.5	2.0	0.5
C3. Appropriate select of analysis items	1.8	3.3	1.6	1.5	2.0	0.5
C4. Designing an appropriate research plan	1.8	3.3	1.6	1.5	2.3	0.8

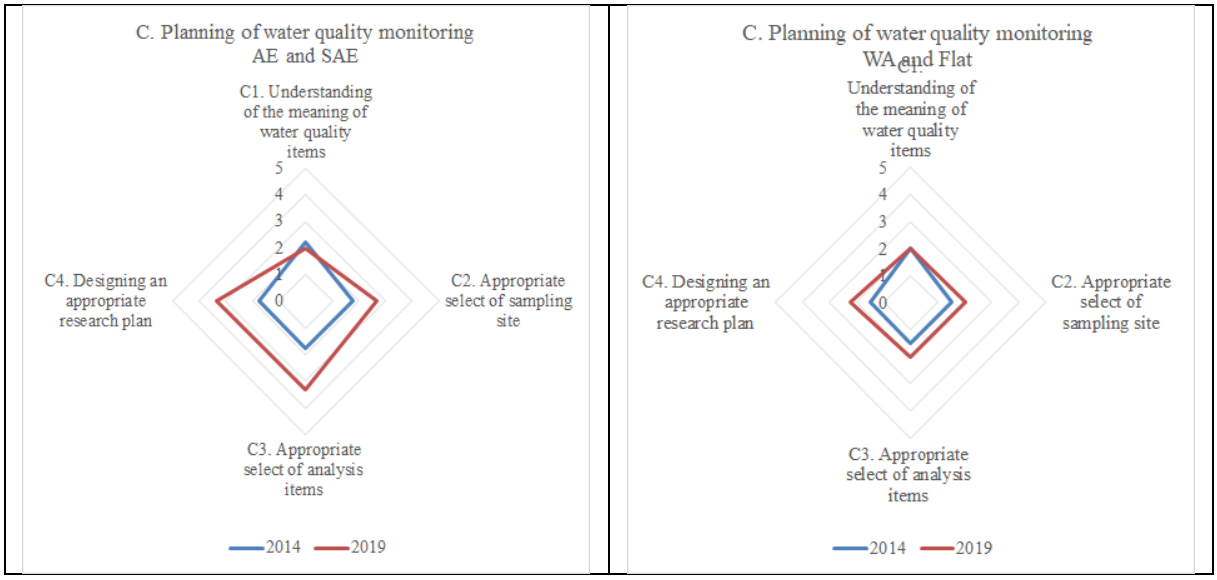


Figure 5.3 Comparison of radar chart: Category C

Category D: Water quality problem solving capacity

Capacity of category D is developed through the application of knowledge from B1 and C1. As mentioned above, the increase in scores for B1 and C1 was low and therefore the increase in scores for Category D was also low.

C/Ps are still inexperienced in water quality improvement activities and water quality incident response. Therefore, it is expected that the knowledge and experience will be improved through the continuation of future activities.

Table 5.6 Comparison of average assessment score of each position: Category D

Assessment item	AE and SAE			WA and Flat		
	Score		Score increase / decrease	Score		Score increase / decrease
	Base line	End line		Base line	End line	
D1. Problem solving capacities to improve water quality	2.3	2.0	-0.3	2.0	2.3	0.3
D2. Problem solving capacities for planning water quality incidents	2.3	2.7	0.4	2.0	2.3	0.3

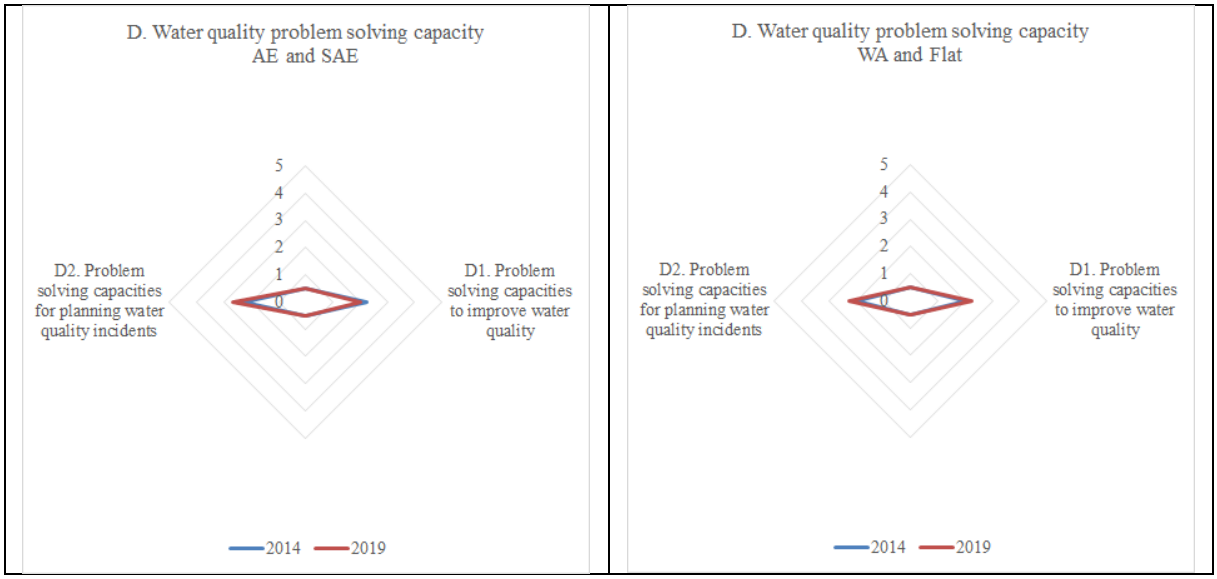


Figure 5.4 Comparison of radar chart: Category D

5.1.4 Approach for Further Improvement

As a result of the activities of this technical assistance project, the central laboratory staffs have been instructors in the training of new WRWSA employees. In addition, they also conduct voluntary internal study sessions and provide technical guidance to mini laboratories. It is hoped that these activities will continue in the future.

The challenges at the end of the project are i) the lack of staff to cope with the growing workload and ii) improvement of capacity of water quality data assessment for water quality improvements.

These issues have been identified in the mid-term and long-term plan (5-year and 10-year improvement plan). Therefore, it is hoped that improvements will continue to be made in line with the timetable of the mid-term and long-term plan.

CHAPTER 6. Summary and recommendations

6.1 Core Capacity

6.1.1 Summary of assessment

Overall

On the whole, comparing with the Baseline data, the End-line scores increased in almost all items in each section. The overall average of the Baseline score was 1.9 points, but it improved to 3.4 points at the End-line, which finally increased by 1.5 points after conducting the project for capacity development.

Table 6.1 Summary of Assessment Results of Organizational Core Capacity

Categories	Items	Planning	Finance	Customer Service	HRD	PR	NRW	WQ Monitoring	WTP	Average
【Baseline】										
Planning and Monitoring	Annual action plan	1	4	1	3	1	1	1	1	1.6
	Plan monitoring system	1	3	1	4	1	1	3	1	1.9
	Periodical reporting	1	3	1	4	1	1	3	2	2.0
Budgeting Management	Planned budget request	1	4	1	4	1	1	3	1	2.0
	Budget implementation monitoring	1	4	1	4	1	1	4	3	2.4
Staffing	Adequate staff	1	3	1	1	1	1	1	2	1.4
	Clear duties	1	2	1	1	1	1	4	2	1.6
Communication	Plan staff sharing	1	3	1	3	1	1	4	3	2.1
	Staff meeting	1	3	1	3	1	1	4	3	2.1
Average		1.0	3.2	1.0	3.0	1.0	1.0	3.0	2.0	1.9
【End-line】										
Planning and Monitoring	Annual action plan	4	4	3	4	3	3	5	3	3.6
	Plan monitoring system	3	4	3	3	3	3	5	4.5	3.6
	Periodical reporting	2	5	3	3	3	3	5	4	3.5
Budgeting Management	Planned budget request	3	4	3	4	3	2	3	4	3.3
	Budget implementation monitoring	3	4	4	4	1	4	3	3.5	3.3
Staffing	Adequate staff	3	4	3	3	3	3	2	2.5	2.8
	Clear duties	2	3	3	4	3	2	5	3	3.1
Communication	Plan staff sharing	3	3	4	4	3	3	5	3.5	3.6
	Staff meeting	4	3	4	4	3	3	5	4	3.8
Average	Average	3.0	3.8	3.3	3.7	2.8	2.9	4.2	3.6	3.4

Figure 6.1 Summary of Organizational Core Capacity

Planning and Monitoring :

In almost all sections, the score for each item improved except for the scores for 'Plan Monitoring System' and 'Periodical Reporting' in Human Resource Management and Development, decreasing 1 point each from the Baseline score.

In terms of average increase in score, 'Annual Action Plan' is the most remarkable, which increased 2 points on average. It is followed by 'Plan Monitoring System' and 'Periodical Reporting' showing average increase of score, 1.7 points and 1 point respectively.

Budgeting Management :

The score for 'Budget Implementation Monitoring' in Water Quality Monitoring is the only score which decreased from the Baseline. The average increase in score for 'Planned Budget Request' is 1.3 points and that for 'Budget implementation monitoring' is 0.9 points. The increase in scores for both items can be seen in general, though there is no fluctuation in the scores in Finance and Human Resource Management and Development, which originally showed high scores (4 points) at the baseline.

Staffing :

In completely all sections, the scores improved for both items. Especially, the scores in Customer Service, Public Relations and Human Resource Management and Development improved remarkably. The scores in Customer Service and Public Relations increased 2 points for both items. Also, the score for 'Adequate Staff' in Human Resource Management and Development increased from 1 to 3 points, and the score for 'Clear Duties' improved 3 points. These three sections were newly established by the recommendation of the Project, and supported its strengthen through project activities.

Communication :

Score increase can be seen in overall, though there was no improvement in scores of Finance. On the other hand, in Customer Service, the scores for both items increased 3 points, which showed the most remarkable improvement of all. In terms of average increase of score, that for 'Staff Meeting' is 1.6 points, which is slightly higher than for 'Plan Staff Sharing' whose average increase of score is 1.4.

6.1.2 Recommendations

In general, no matter how big or small, the scores of core capacity increased in each section in last five years. Project activities were carefully designed not only to transfer technologies efficiently, but to empower each workplace through developing core capacity. However, there are still some sections or some fields in which the impacts of the capacity development project are too limited to generate positive outcomes. Clearly, further

capacity developments need to be conducted to promote more comprehensive improvement.
To achieve further improvements, the followings are recommended as possible measures.

- To allocate more institutional discretion in each section to strengthen institutional capacity to execute their own measures.
- To indicate a clear job description for each staff to promote the level of fundamental competence of each section
- To promote the coordination with other relevant sections with strong and clear initiatives from the top management to support the efforts for data collection and monitoring of implementation of progress of important institutional decisions such as Mid-term Management Plan and Financial Plan, etc

6.2 Technical Capacity

6.2.1 Summary of assessment

There was significant capacity improvement in all areas and in all technical categories; the results of the assessment are summarized below from the perspective common to each area of Technical Capacity.

Organization: Based on the proposal of the Organizational Improvement Plan, many sections such as Planning Section, Customer Service Division, Public Relation Section, Human Resource Development Section, NRW Management Section, Water Treatment Section, etc. were newly established during the project period with staff assigned as well as clear duties and responsibilities. With the implementation of regular duties and project activities, the necessary knowledge and skills related to the work have been accumulated, and many sections have greatly increased their capacity from where there was no responsible section at the time of the Baseline survey. Meanwhile, work that requires coordination and cooperation with other sections, such as data collection related to PIs, inspection work related to NRW, and T/S Officer meetings for customer service, was evaluated as requiring improvement.

Working procedures: The development of SOPs, promoted in entire WRAWSA, has resulted in defining work procedures and has enabled efficient and unified work procedures. By utilizing SOPs, many sections have observed a significant improvement in their capacity to perform regular works. Yet, it has been pointed out that continuous capacity development is necessary for further review of SOPs and planning of strategies in the future.

Office management: Many sections have made significant improvements in their annual plans and in the management and handling of various data. In particular, the collection of data for KPIs introduced to monitor water utility services has improved the accuracy of data handling in each section, and has also been a factor in establishing regular data management. On the other hand, areas such as budget and stock management, personnel management, and waste management, which are strongly influenced by YCDC and other higher authorities, were evaluated as requiring continued improvement.

6.2.2 Recommendations

As a result of the above evaluation, it is recommended to strengthen Technical Capacity as follows.

- ✓ For regular work, ensure the firm implementation of SOPs, and in the future, revise SOPs and examine the detailed description.
- ✓ Continue to make suggestions to top management on how to improve operations in order to ensure the necessary budget and personnel allocation and to strengthen information sharing among sections within WRAWSA.
- ✓ In addition to regular work, continue to improve technical capacity by studying for the realization of the future vision, planning future strategies, and committing to more specialized work.