# WASMIP Model and Materials

September 2013

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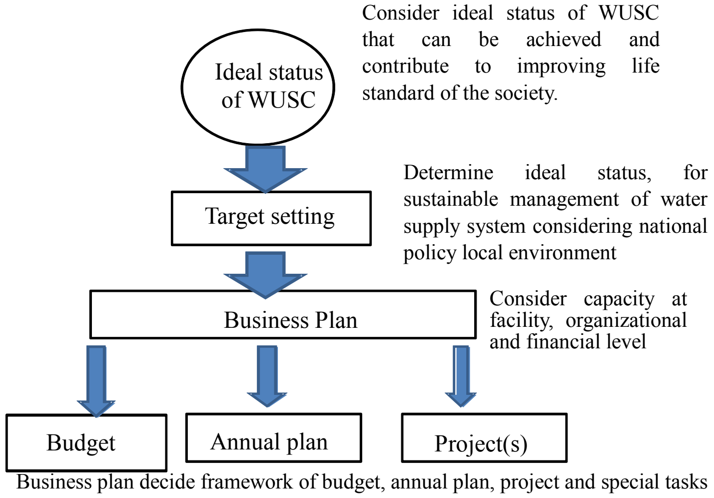
# Small and Medium-Sized Water Supply Management and Support Models September 2013

The Project for Capacity Development on Water Supply in Semi-Urban Areas, nicknamed as Water Supply Management Improvement Project (WASMIP), implemented in 20 water supply utilities in Jhapa and Morang districts has produced two models for water supply service improvement in semi-urban areas in Nepal. One is "Small and medium sized water supply management model", under which WUSCs operate and manage water supply systems to provide water services to the citizens. The other is "Small and medium sized water supply support model", under which DWSS provides supports to WUSCs to perform service improvement activities.

## Small and medium sized water supply management model:

WUSC management model simply sets the concept of an ideal status of water supply services in the future by WUSCs and designs the way to achieve such status through business plan and SOPs. Strengthening sufficient institutional, functional and financial capability through technical and financial support from stakeholders, WUSCs can implement the business plan and achieve that ideal status.



Business plan decide framework of budget, annual plan, project and special tasks

At first, WUSC has to imagine an ideal status of water supply system for sustainable services. This status can be determined with targets. This is called target setting. Then WUSC must arrange required means to realize the ideal status. Such means can be the business plan which is implemented through annual plans and projects. Status of such implementation of the business plan and SOPs is monitored and evaluated for maintaining implementation on right track. If WUSC can perform these activities, then they can certainly achieve the target and realize the ideal status.

In the business plan, WUSC must consider three capabilities (1) capacity of water supply facility for realizing the targets in terms of water quality, affordability (consumption), stability of water supply and service coverage, (2) organizational capability (institutional set up, functional capability), and (3) financial capability for operation and maintenance in the longer term.

*(1)Water Supply Facility and its Capacity*

Future capacity of water supply facility should be designed and scheduled for meeting water demand. This plan is called technical plan, and is a part of business plan for realizing targets of safe, affordable and stable water to maximum people within acceptable NRW. Normally, technical plan starts with water demand analysis and projection of water demand regarding quality and volume. Then, considering capacity of facility, determines when and what capacity of facility enhancement is necessary to meet water demand.

The business plan considers on maintaining the capacity of facility more than water demand. Water demand is projected with population to be served (calculated target service coverage) and consumption per day per capita. Capacity of facility should be calculated considering capacity of intake facility, loss during transfer to purification facility (Water Treatment Plant: WTP), capacity of purification facility, loss and consumption ~~of~~ in purification facility and loss during distribution. Water Safety Plan should be properly applied for safety of supplied water through systematic process like hazard control and water quality monitoring.

*(2)Organizational capability*

Organizational capability is essential to ensure operation of facility and organization for sustainable water supply as well as high quality services to users. Strengthening organizational capability would be achieved with fine institutional set up, strengthening functional capability, strengthening leadership and problem solving capability and improving speed and accuracy of business transaction with computerization. Strengthening of functional capability may be possible mainly through standardizing operational process and training for enhancing minimum required skill to carry out standard operational process. Sufficient organizational capability would be guaranteed and achieved when NRW becomes the part of management efficiency target, collection efficiency target, labor efficiency target, and user service quality target are set.

How to strengthen organizational capability is also part of business plan, which includes mainly administrative plan (Human Resources Development and Human Resources Management) and technical plan on standardizing facility operation process.

*(3)Financial capability*

Financial capability is simply determined as the availability, of sufficient amount of cash in WUSC's account or credit to pay cost for implementing the business plan. Normally, WUSC is requested to arrange necessary money as revenue from sales of water and services to users, and if shortage, arrange with grant, subsidy or loan, or increasing water tariff. Sufficient financial capability would be guaranteed and achieved when cost recovery target and financial stability target (working ratio, operating ratio, cash balance) are set.

Financial capability should always exceed financial demands. Financial demands include mainly capital cost, rehabilitation and renovation operational costs. These financial demands must be covered by revenues (revenue from sales of water and services, grant and subsidiary). Revenue from sales of water and service relies on water rate and collection efficiency, and totally relies on accounting accuracy. Tariff should be fixed based on cost of investment (if any), O&M cost, cost of implementing water safety plan, water source conservation cost and cost of sustaining water supply system. If tariff is going to be very high to cover all of above costs, the government needs to provide support on some of the fix cost.

***Monitoring and Evaluation***: WUSC, WSSDO and DWSS together should conduct monitoring of the implementation of the business plan and evaluate achievement status. The business plan should include monitoring and evaluation activities also. Some targets need evaluation and some need just watching. If the target mentioned on the business plan is achieved, or exceeded, then it is evaluated as good, and continued implementing. If any of the targets is not achieved, then underlying reasons are identified and appropriate measures shall be taken. For monitoring and evaluation purpose, this document recommends to use monthly data sheet and annual report. Monitoring is done against performance indicators related to technical, management and financial performances. With the use of such indicators, WUSC can do self monitoring itself.

| SN | Performance Indicators | Unit | Base line 2013 | 2016 | 2019 | 2022 | 2025 |
|---|---|---|---|---|---|---|---|
| A | Technical | | | | | | |
| 1 | Coverage | % | | | | | |
| 2 | Population served | No. | | | | | |
| 3 | Production | $m^3/d$ | | | | | |
| 4 | Average consumption per connection | $m^3/m$ | | | | | |
| 5 | Active connections | No. | | | | | |
| 6 | Unaccounted for Water(UFW) | % | | | | | |

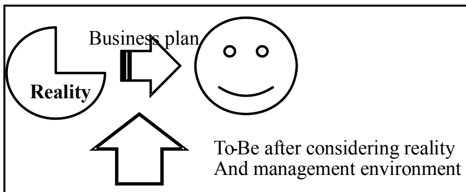
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | Non Revenue Water(NRW) | % | | | | | |
| 8 | No. of pipe breaks | No./year/km | | | | | |
| 9 | Sample meeting WQ standard | % | | | | | |
| 10 | Service hours | hr/day | | | | | |
| B | Management | | | | | | |
| 1 | Number of Staff | No. | | | | | |
| 2 | Number of connection per staff | No. | | | | | |
| 3 | Collection efficiency | % | | | | | |
| 4 | Consumer complains | No./month | | | | | |
| C | Financial | | | | | | |
| 1 | Revenue collection from operations | Rs/year | | | | | |
| 2 | Expenditure for operation | Rs('000/yr) | | | | | |
| 3 | Cash balance | Rs/year | | | | | |
| 4 | Operational cost | Rs/ $m^3$ | | | | | |

***Coordination and WUSC conference***: This assumes an annual conference of WUSC at regional level. Purpose of such conference is to provide a platform for sharing project operation and management experiences among WUSCs, to build the system of mutual support and cooperation among WUSCs and to learn from the experiences and best practices of others. Conference committee will be established at regional level. Members of the conference committee shall comprise of representatives from WUSCs, WSSDOs, RMSO and DWSS. The Conference will be organized once in a year. DWSS can assign expert/s for observation and review of conference activities.

***Documentation:*** The Water Supply Management Model requires various documents for systematic operation of the water supply system. Some documents will be provided by DWSS as model and some need to be developed by WUSCs themselves to deal with their specific process. Such documents include guidelines, business plan, operational manuals, SOPs and others. The WUSCs should utilize these materials in their operation to ensure proper water supply management.These documents are also useful when DWSS plans to strengthen the organizational capability of WUSC, especially to strengthen the function of WUSC through training.

## Small and medium sized water supply support model:

"Small and medium sized water supply support model" provides a guideline for DWSS/WSSDO on how to support WUSCs for their organizational, technical and financial capacity development required for sustained service. This support model is for supporting and enhancing management capabilities of WUSCs. The main concept of support model is to support WUSCs in technical and financial areas to implement business plan for realizing the ideal status. Thus, it is very essential for WUSCs to prepare their business plan, and for DWSS to be well acquainted of it. DWSS provides technical and financial supports to WUSCs on the basis of their business plans.




Support to WUSC:

1. Guide to optimize institutional system
2. Provide training to enhance knowledge of staff
3. Provide OJT to strengthen skills and knowledge of staff
4. Provide opportunity for sharing and exchange information between water supply service providers
5. Provide financial resources
6. Provide material support

The supportive role of DWSS is very important on realizing the ideal status of any of the WUSCs. However, the support from DWSS depends on the business plan of WUSCs. So, at first, WUSCs themselves has to initiate the process analyzing their weakness and capacity and making an improvement plan. DWSS technical team can suggest and propose their standard ideas and information for strengthening organizational capability of targeted WUSCs.

Based on the management model, DWSS may suggest on setting targets in their business plans considering how to realize such targets while considering standard. When the targets set in the business plan are achieved, organizational capability of the WUSC is assumed to be strengthened. Capacity of WUSC is judged in terms of achieving revenue production target, water quality target, customer satisfaction target, management efficiency target, and financial target. Qualitative, indicators such as motivation of staff, attitudes of staff and leadership of manager can also be used for the judgment of capacity improvement. DWSS needs to develop a standard of service for uniformity and quality.

**Maintenance Inspection Team (MIT):** Purpose of Maintenance Inspection Team (MIT) is to make aware WUSCs on preventive maintenance and enhance their capacity on solving problems themselves on-site. It also helps to build a bond and to extend cooperation among authorities to provide better water services. MIT facilitates to have an access to the experts on the repair and maintenance of the equipment and on the operation of water supply and water treatment process. MIT also helps to solve the problem unsolved due to lack of knowledge or awareness and enhance preventive maintenance process. The effectiveness of MIT depends on the evaluation indicators; ease on maintenance support and sharing of information.

***Management Advisory Team (MAT):*** Purpose of Management Advisory Team (MAT) is to assist WUSCs on management of water supply system to provide sustainable and safe water at affordable cost to the maximum people within their jurisdiction. On the request of WUSCs, MAT advises them on setting and revising targets and provides suggestions on attaining those targets. The Team shall be composed of three experts from management, technical and financial areas. The Team member can be either staff from DWSS and WSSDO or outsourced under special support.

***Monitoring Evaluation Team (MET):*** Objective of Monitoring and Evaluation Team (MET) is to reconfirm target and monitoring indicators and to keep watching achievement by monthly report and annual report. Joint monitoring and evaluation of WUSCs regarding M&E performance indicators, targets and achievement are recommendable. Based on the M&E, DWSS may enforce on the improvement of management capability or efficiency. Monitoring Evaluation Team (MET) comprises of representative of DWSS, RMSO, WSSDO and concerned staff of WUSC.

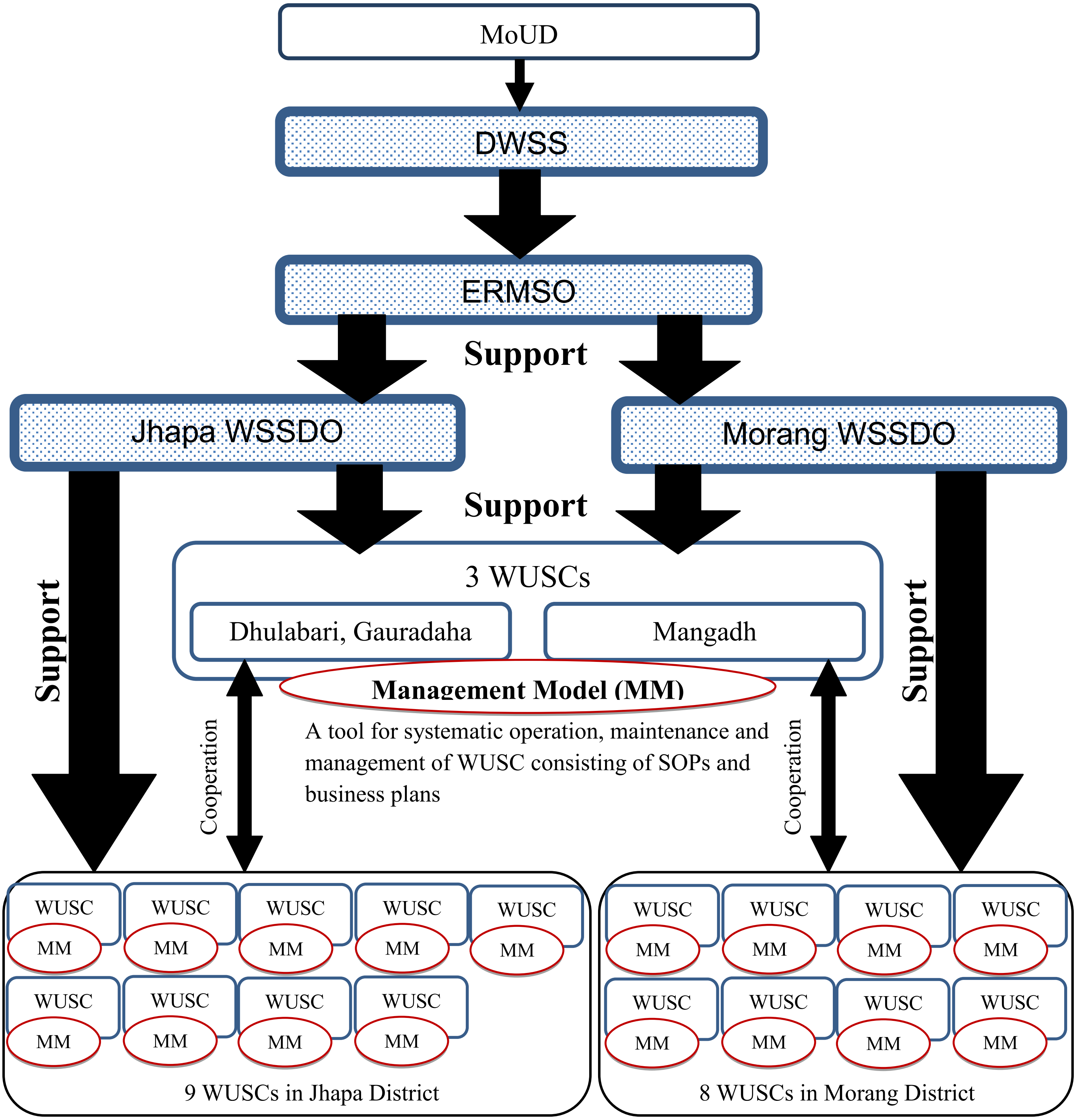
## Annex: Roles of Supporting Teams

| Support Model | | | | |
|---|---|---|---|---|
| **Items** | **Monitoring Evaluation Team (MET)** | **Management Advisory Team (MAT)** | **Maintenance Inspection Team (MIT)** | **Practical Training** |
| **Responsible Organization** | DWSS, ERSMO, WSSDOs | WSSDOs, WUSCs | WSSDOs, WUSCs | DWSS, WSSDOs, WUSCs |
| **Objectives** | • Evaluate the technical and management capacity of WUSCs | • Provide advice for the business management | • Provide advice for the operation and maintenance (O&M) of water supply facilities<br>• Ensure implementation of the regular routine work of the facilities | • Provide training based on the needs identified through the activities of MET, MAT and MIT |
| **Roles** | • Evaluate technical and administrative management capacity of WUSC and its staff<br>• Collect key Performance Indicators (PIs) | • Provide assistance in the formulation of a business plan<br>• Check the implementation status of a business plan<br>• Reflect MIT's recommendation on facility improvements on a business plan<br>• Provide instruction on the preparation of a monthly report including management indicators | • Provide directions for record keeping of O&M<br>• Provide directions for the facility inspection and implementation of preventive maintenance<br>• Provide directions of water quality management<br>• Evaluate existing facilities<br>• Make recommendations of the facility improvement<br>• Share the information with MAT | • Provide training on O&M based on the Standard Operational Procedures (SOPs)<br>• Provide training on the preventive maintenance<br>• Provide assistance in the formulation of a business plan<br>• Provide directions for revising the SOPs to suit each WUSC's condition |
| **Activities (Frequency)** | • Site Visit for the Monitoring of Operation and Management<br>• (1 time/year)<br>• Joint M&E Conference(1 time/year)<br>• Evaluation Report (1 time/year) | • Site Visit for Business Planning (1 time/year)<br>• Activity Report (1 time/year) | • ・Site Visit for the Facility Inspection (4 times/year)<br>• Activity Report (4 times/year)<br>• O&M Monitoring Workshop (1 time/year) | • Practical Training (at least 1 time/year and as needed) |

# Support Model

DWSS' technical support system to WUSCs consisting of:

1. Monitoring Evaluation Team (MET), 2. Management Advisory Team (MAT),
3. Maintenance Inspection Team (MIT), 4. Practical Training



# Support Model

| Items | Monitoring Evaluation Team (MET) | Management Advisory Team (MAT) | Maintenance Inspection Team (MIT) | Practical Training |
|---|---|---|---|---|
| **Responsible Organization** | DWSS, ERSMO, WSSDOs | WSSDOs, WUSCs | WSSDOs, WUSCs | DWSS, WSSDOs, WUSCs |
| **Objectives** | • Evaluate the capacity improvement effect of WUSCs | • Provide advice for the business management | • Provide advice for the operation and maintenance (O&M) of water supply facilities<br>• Ensure implementation of the regular routine work of the facilities | • Provide training based on the needs identified through the activities of MET, MAT and MIT |
| **Roles** | • Evaluate technical and administrative management capacity of WUSC and its staff<br>• Collect key Performance Indicators (PIs) | • Provide assistance in the formulation of a business plan<br>- Check the implementation status of a business plan<br>- Reflect MIT's recommendation on facility improvements on a business plan<br>• Provide instruction on the preparation of a monthly report including management indicators | • Provide directions for record keeping of O&M<br>• Provide directions for the facility inspection and implementation of preventive maintenance<br>• Provide directions of water quality management<br>• Evaluate existing facilities<br>• Make recommendations of the facility improvement<br>• Share the information with MAT | • Provide training on O&M based on the Standard Operational Procedures (SOPs)<br>• Provide training on the preventive maintenance<br>• Provide assistance in the formulation of a business plan<br>• Provide directions for revising the SOPs to suit each WUSC's condition |
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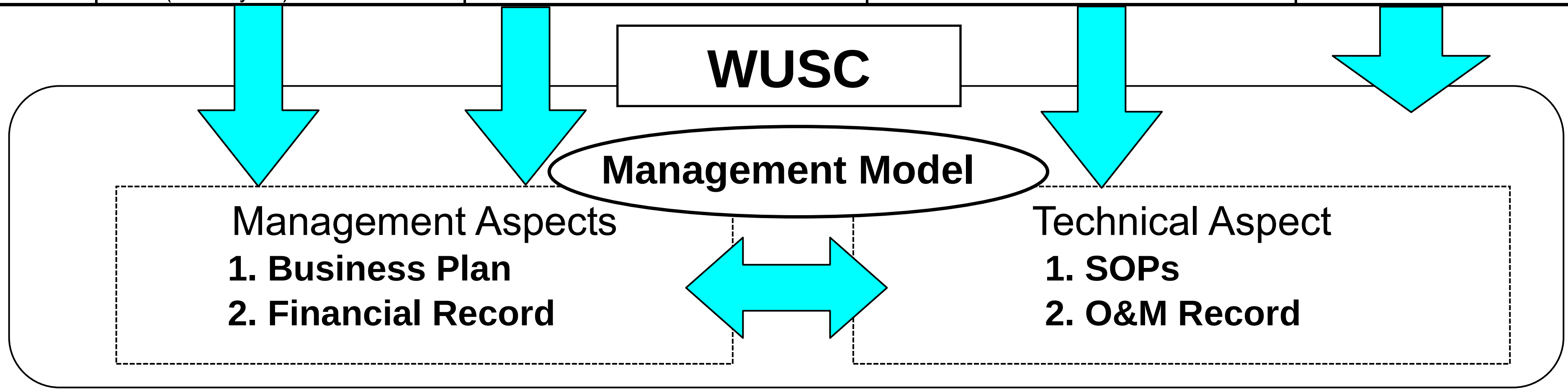

# Small and Medium-Sized Water Supply Management Models (Summary)

The Project for Capacity Development on Water Supply in Semi-urban Areas, nicknamed as Water Supply Management Improvement Project (WASMIP) implemented in 20 water supply utilities in Jhapa and Morang districts has produced two models for Water Supply service improvement in semi-urban areas in Nepal. One is "Small and medium sized water supply support model", under which WUSCs operate and manage water supply systems to provide water services to the citizens. The other is "Small and medium sized water supply support model", under which DWSS provides supports to WUSCs to perform service improvement activities.

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In the business plan, WUSC must consider three capabilities (1) capacity of water supply facility for realizing the targets in terms of water quality, affordability (consumption), stability of water supply and service coverage, (2) organizational capability (institutional set up, functional capability), and (3) financial capability for operation and maintenance in the longer term.

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Japan International Cooperation Agency

# The Project for Capacity Development on Water Supply in Semi-urban Areas In Nepal

# Small and Medium-Sized Water Supply Management Model

## Final Draft

**WASMIP**

September 2013

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Abbreviation and Definition

CAD: Computer Aided Design, computer software for drawing engineering chart

DWSS: Department of Water Supply and Sewerage

ERP: Enterprise Resources Planning, total package software covers almost all functions in company

HRD: Human Resource Development

HRM: Human Resource Management

LWUA: Local Water Utility Association, government agency for supporting rural water supply in Philippines

M&E: Monitoring and evaluation

MIS: Management Information System, system to collect and edit necessary management data and information

NRW: Non-revenue Water

O&M: Operation and maintenance

OJT: On the Job Training

PCM: Project Cycle Management, methodology for managing planning cycle

PDCA: Plan, Do, Check and Act, methodology of managing planning cycle

PDM: Project Design Matrix, summary of plan

QC: Quality Control, techniques and activity for improving quality of works with team work method developed in Japan and sometimes called Kaizen.

SAP: System Application & Products One of major IT companies produces ERP (Enterprise Resource Planning) package, and brand name of their products

SOP: Standard Operation Procedure, sort of engineering manual

TOC: Theory of Constraint, methodology of finding and solving bottleneck of business flow for improving efficiency and effectiveness.

TQC: Total Quality Control, advanced quality controlling method developed in Japan

WD: Water District, municipal level public company for water supply in Philippines

WHO: World Health Organization

WSSDO: Water Supply and Sanitation Division/Sub-Division Office

WUSC: Water Users and Sanitation Committee

UFW: Unaccounted for water

USA: United States of America

# Introduction

The Project for Capacity Development on Water Supply in Semi-urban Areas, nicknamed as Water Supply Management Improvement Project (WASMIP) and implemented in 20 water supply utilities in Jhapa and Morang districts, developed two models for water supply service improvement in Semi-urban Areas in Nepal. One is “Small and medium sized water supply management model”, under which WUSCs operate and manage water supply systems to provide water services to the citizens. The other is “Small and medium sized water supply support model”, under which DWSS provides supports to WUSCs to perform service improvement activities. These two models are developed based on experience gained while strengthening technical, managerial and financial capacities of the three WUSCs by JICA Experts team and other seventeen WUSCs by DWSS through WSSDOs with the support of JICA Experts team in Jhapa and Morang districts. These two models will be introduced in other WUSCs all over the country. In the context of these models, "Small and medium sized water supply " means a water supply system with less than 3000 connections and operated by a local WUSC with less than 20 staff.

**“Small and medium sized water supply management model”** is defined as the desirable state of management of WUSCs for providing the sustainable and safe water supply services to the users. The model concentrates on the management of water supply utilities addressing the issues of business management, operation and maintenance of physical facilities, water quality management and facilities planning, etc. This model contains of six chapters: model descriptions, strengthening organization and water supply facilities, WUSC's conference, M&E and documentation for standard process.

Chapter 1. **“Water supply management model**” explains the concept of ideal status of WUSCs. WUSCs must imagine their future for achieving an ideal status of water supply services and set it as their future target. Then WUSCs must prepare means to achieve that through business planning. Then, they implement business plan keeping the latter on the right track by monitoring and evaluating periodically. WUSC which can do that, that can achieve the target and realize the ideal status.

However, WUSC may need to strengthen its institutional, functional, and financial capabilities. For enhancing these capabilities standardizing business process may be helpful.

Chapter 2. **“Organizational capacity”** explains management structures of WUSC and need of strengthening in four areas: institutional, functional, problem solving and computerization for the improvement of organizational capacity of WUSCs.

Chapter 3. **“Capacity of facilities”** focuses on the required knowledge and experiences for strengthening capacity of water supply facilities and its operation and maintenances.

Chapter 4. **“Monitoring and Evaluation”** emphasizes on the importance of monitoring and communication between WUSCs and DWSS and on the importance of the verification of the status of

WUSC by both WUSC and DWSS side. It helps WUSCs to be cautious and to become confirmed that the implementation of the business plan is on the right track towards achieving the set target, which also supports on the realization of national target regarding access of safe water and sanitation to the people.

Chapter 5. **“Coordination and WUSC Conference”** gives outline of the conference to build the system of information sharing and establishing mutual supportive relations among WUSCs to identify and solve problems by themselves.

Chapter 6. **"Supporting documents**” introduces key documents that WUSCs need to maintain and follow for the standard operation. These include workshop materials, guideline, sample of business plan and Standard Operation Procedure (SOP). These are placed as an element of the Management Model as they are self help tools for WUSCs and training tools for DWSS for strengthening organizational capability of WUSCs.

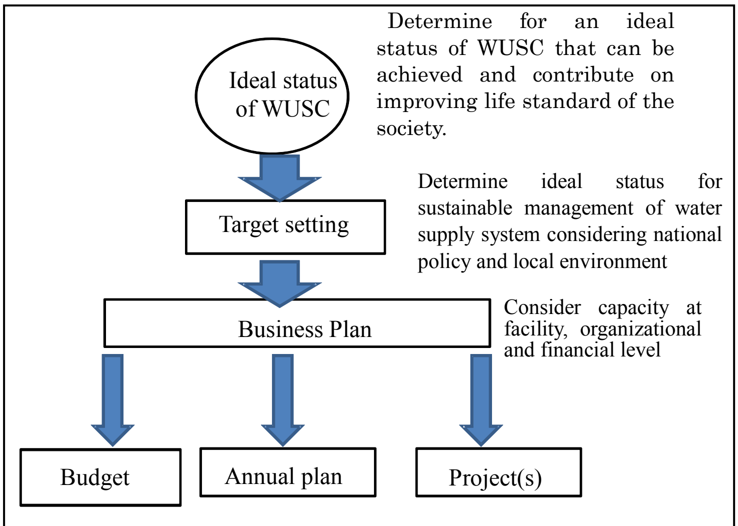
# Chapter one: Water Supply Management Model

Water Supply Management Model simply sets the concept of an ideal status of water supply services in the future by WUSCs. It designs the way to achieve such status through business planning. Strengthening sufficient institutional, functional and financial capability through technical and financial support from stakeholders, WUSCs can implement the business plan and achieve that ideal status.

At first, WUSC has to imagine an ideal status of water supply system for sustainable services. This status can be determined with targets. This is called target setting. Then WUSC must arrange required means to realize the ideal status. Such means can be the business plan which is implemented through annual plans and projects. Normally, business plan is divided into an annual plan and a budget, or projects, or special tasks. Status of such implementation of the business plan is monitored and evaluated for maintaining implementation on right track. If WUSC can perform these activities, then they can certainly achieve the target and realize the ideal status.

In the business plan, WUSC must consider three capabilities (1) capacity of water supply facility for realizing the targets in terms of water quality, affordability (consumption), stability of water supply and service coverage, (2) organizational capability (institutional set up, functional capability), and (3) financial capability for operation and maintenance in the longer term.

### Target setting



Business plan decide framework of budget, annual plan, project and special tasks

Ideal status of WUSC can be expressed in terms of what it would be or what it should be, say in the next ten years. This status is normally indicated in mission and vision statement. The mission statement mentions what WUSC must do, and vision statement explains what WUSC wants to be. For example mission statement normally says “provide safe water affordably, with stable manner and at reasonable cost to maximum people in the jurisdiction”. The vision statement looks like “the WUSC will be the best service provider in Nepal and will care for managing environment and contributing development of local society, and assisting improvement of people’s life standard”.

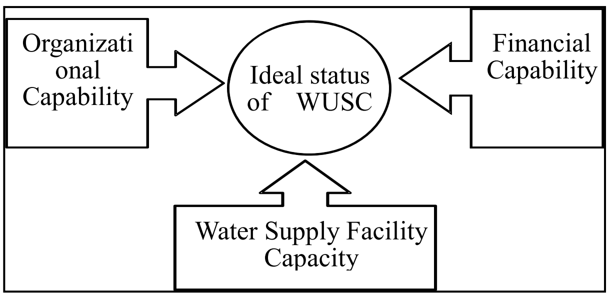
Normally both mission and vision statement does not include quantitative figures. For example, the mission statement looks like “provide safe water to maximum people in the jurisdiction”. However, WUSC must determine ideal status with both quantitative and qualitative figures. For example, the ideal status after 10 years is “provide safe water to 75% of people in the jurisdiction”. Stating mission in such a way that both quantitative and qualitative figures are mentioned is termed as the "target setting". A few more examples of target setting for ideal status of WUSC in 5 to 10 years time are given below:

| Area | Targets |
|---|---|
| Safe water: | • Quality of water meets Nepal standard.<br>• WUSC has facility and capability for monitoring water quality<br>• WUSC applies Water Safety Plan for continuous safety of water |
| Affordability: | • Consumption per capita per day of user meets national standard.<br>• 85 litter per day per capita or 100 liter per day per capita or more<br>• WUSC follows water tariff guideline set by Water tariff Fixation Committee<br>• Water rate is fair enough for achieving cost recovery as well as affordable to poor people |
| Stability: | • WUSC provides water for 24 hours a day and 12 months a year<br>• WUSC provides water with sufficient pressure in pipelines? (Range from 5 to 20 meter)<br>• Water facility has sufficient capability for providing water in a sustainable way |
| Service coverage | • Service coverage ratio meets with national standard<br>• Up to 90% of the service area is covered by 2020 |

WUSC can also set additional quantitative and qualitative targets for determining ideal status.

## Business plan

Management model requires setting targets for achieving ideal status. WUSC can achieve this status with their business plan. The business plan basically aims at strengthening or enhancing three areas: (1) Service facility capability, 2) Organizational capability and 3) Financial capability. Business plan focuses on strengthening these three areas within a time frame such as next 5 to 10 years.




The business plan determines a framework of annual plan, budget, project and special tasks, and with such plans, the business plan is implemented on annual basis. In other word, the annual plan and budget must follow the business plan.

1) Water Supply Facility and its Capacity

Water Demand ≦ Capacity of facility

Service coverage
Population service
Consumption per capita per day

Water resources
Capacity of intake facility
Capacity of purification facility
Capacity of pipe networks
Leakage and loss
NRW/UFW

Future capacity of water supply facility should be designed and scheduled for meeting water demand. This plan is called technical plan, and is a part of the business plan for realizing targets of safe, affordable and stable water to maximum people within acceptable NRW. Normally, technical plan starts with water demand analysis and a projection of water demand regarding quality and volume. Then, considering capacity of facility, determines when and what capacity of facility enhancement is necessary to meet water demand.

The business plan considers on maintaining the capacity of facility more than water demand. Water demand is projected with population to be served (calculated target service coverage) and consumption per day per capita. Capacity of facility should be calculated considering capacity of intake facility, loss during transfer to purification facility (Water Treatment Plant: WTP) capacity of purification facility, loss and consumption in purification facility and loss during distribution. Water Safety Plan should be properly applied for safety of supplied water through systematic process like hazard control and water quality monitoring.

2) Organizational capability

Organizational capability is essential to ensure operation of facility and organization for sustainable water supply as well as high quality services to users. Strengthening organizational capability would be achieved with fine institutional set up, strengthening functional capability, strengthening leadership and problem solving capability and improving speed and accuracy of business transaction with computerization. Strengthening of functional capability may be possible mainly through standardizing operational process and training for enhancing minimum required skill to carry out standard operational process. This idea has been further discussed in "organizational management" in chapter 2. Sufficient organizational capability would be guaranteed and achieved when NRW becomes the part of management efficiency target, collection efficiency target, labor efficiency target, user service quality

Demand of organizational capability ≦ Organizational capability

- Institutional demand
- Functional demand
- Demand on leadership, negotiation and problem solving skill
- Demand on business transaction management regarding speed, timeliness, accuracy and handling large volume transaction

- Fine institutional set up
- Strengthening functional capability, business process standardization, training for skill enhancement
- Strengthening leadership skill
- Computerization for improving accuracy, speed and capability for handling large, volume business transaction as well as business process standardization

target are set.

How to strengthen organizational capability is also a part of the business plan, which includes mainly administrative plan (HRM and HRD) and technical plan on standardizing facility operation process.

3) Financial capability

Financial capability is simply determined as the availability of sufficient amount of cash in WUSC's account or credit to pay cost for implementing the business plan. Normally, WUSC is requested to arrange necessary money as revenue from sales of water and services to users, and if shortage, arrange with grant, subsidy or loan, or increasing water tariff. Sufficient financial capability would be guaranteed and achieved when cost recovery target and financial stability target (working ratio, operating ratio, cash balance) are set.

| Financial Demand | $\leqq$ | Financial capability |
|---|---|---|
| (Capital cost)<br>- Cost for fixed asset<br>- Cost of construction project<br>- Cost of vehicles<br>(Operational cost)<br>- Salaries and wages<br>- Power<br>- Chemical<br>- Repair and maintenance<br>- Office management<br>- Financial cost, if any | | - Revenue from sales of water and service<br>Water rate<br>Collection efficiency<br>- Revenue from annual membership due<br>- Grant and subsidiary<br>- Deposit<br>- Accounting accuracy<br>- Loan if any |

Financial capability should always exceed financial demands. Financial demands are mainly capital cost including facility construction, pipeline expansion, rehabilitation and renovation. It also includes office furniture, vehicles and computer. Second category of financial demand is operational cost including salaries and wages, power cost, chemical cost, spare parts, repair and maintenance cost, office management cost, and financial cost, if any. These financial demands must be covered by revenues (revenue from sales of water and services, grant and subsidiary). Revenue from sales of water and service relies on water rate and collection efficiency, and totally relies on accounting accuracy. Tariff should be fixed based on cost of investment (if any), O&M cost, cost of implementing water safety plan, water source conservation cost and cost of sustaining water supply system. If tariff is going to be very high to cover all of above cost, the government needs to provide support on some of the fix cost.

The concept behind business planning is PDCA cycle management. The PDCA stands for Plan, Do, Check and Act, and simply, planning, implementing, monitoring and evaluating, and take necessary action if necessary to keep implementation on right track.

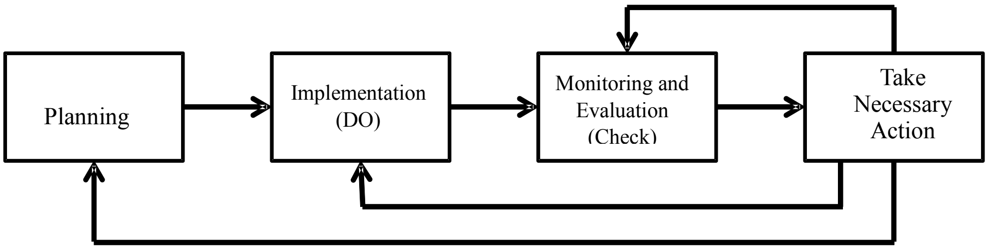



Figure 2-2: PDCA cycle management

**Planning:** Planning includes collection of data and analysis. First step of planning is assessment with necessary data, and then analyze these data and find issues and problems. Planning comes as a business plan which includes technical plan, customer service plan, administrative plan, financial plan and monitoring and evaluation plan.

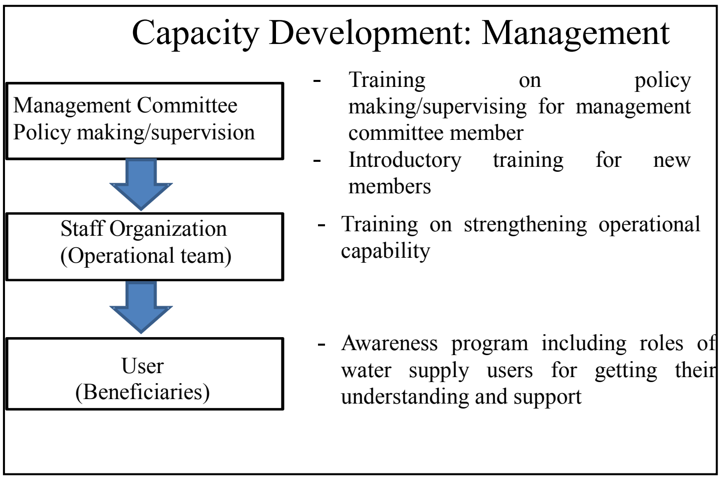
**Implementation:** Important thing is implementing the plan. The business plan includes implementation schedule for carrying different activities. Activities are implemented based on a planned schedule mentioned on the business plan. However, as mentioned earlier, business plan may be divided into annual plan, budget, project and special tasks. Under the control of budget, activity in the annual plan is conducted. Or, under the control of budget, the project is conducted.

**Monitoring and evaluation:** WUSC and DWSS together should conduct monitoring of the implementation of the business plan and evaluate achievement status. The business plan should include monitoring and evaluation activities also. Some targets need evaluation and some need just watching. If the target mentioned on the business plan is achieved, or exceeded, then it is evaluated as good, and continued implementing. If any of the targets is not achieved, then underlying reasons are identified and appropriate measures shall be taken. (1) If it is possible to achieve with simple adjustment in schedule or input, then make adjustment and continue. (2) Sometimes it may be necessary to adjust and change plan itself. In such case, change target, or change activity, or make different plan. Or sometimes it may be necessary to (3) change monitoring and evaluation system, which might be change in important indicators or change in method of evaluation or change in organizational structure for monitoring and evaluation. For monitoring and evaluation purpose, this document recommends to use monthly data sheet and annual report.

**Take necessary action:** In any of the situations mentioned in (1), (2) or (3) take necessary action: change plan, change implementation schedule or alignment of resources, or change monitoring and evaluation system.

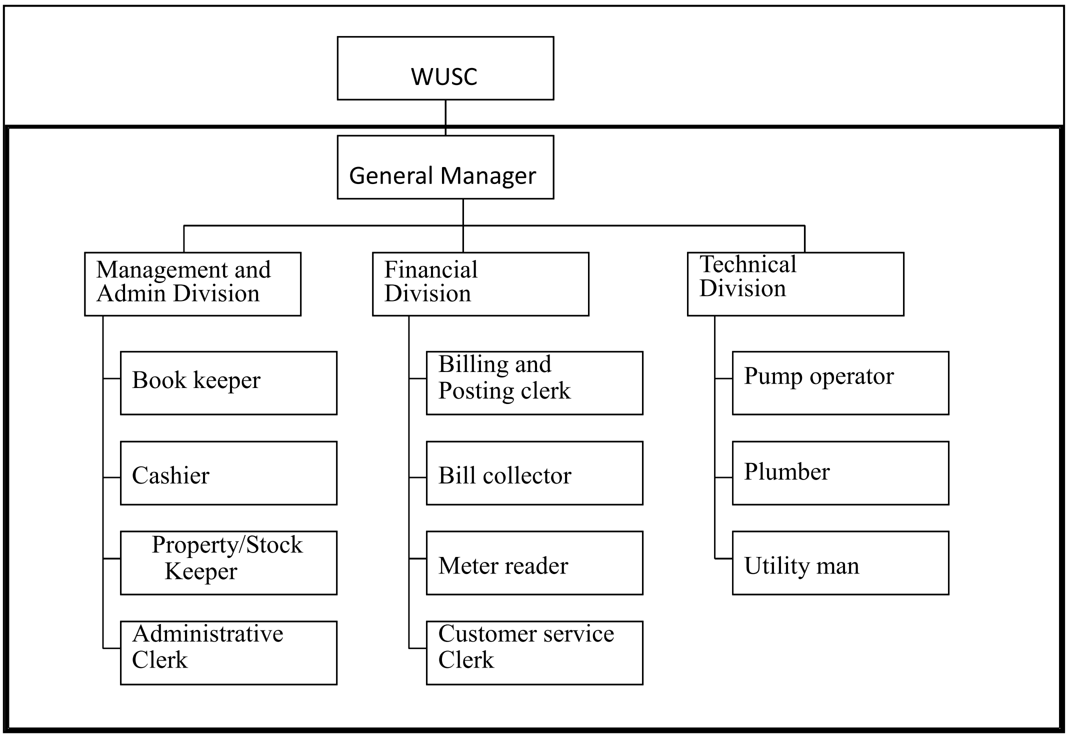
# Chapter two: Organizational management

WUSC can realize ideal status envisaged by setting targets with strengthening organizational capacity, facility capacity and financial capacity. This chapter explains organizational management capacity of WUSC. Management structures of WUSC consist of three layers: Users Committee (Management Committee), Operational Management Team (staff organization), and users. User's Assembly is always on top that endorse all policies and plans.




For sufficient enabling management environment for WUSC, the following conditions need to be fulfilled.

- Management committee has sufficient functionality for policy making, decision making and governance over their staff organization.
- Staff organization has sufficient functional capability to carry out daily operational works, to produce and supply safe water affordably to maximum people in the jurisdiction within reasonable price. It also has sufficient practical knowledge, practical experience and practical skills.
- Users understand importance of good hygiene practice and importance of safe water, and support WUSC including on time water bill payment.

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**Standard Organization Structure for small to medium water supply system with 5 to 20 staff**

An ideal status of operational organization shall be:

- Well set up institutional system and fully utilized employees for management,
- Strengthened functional capability
- Competent mental skills on management including leadership, coaching and problem solving etc.
- Computerization and standardization for improved, prompt, précised and well managed large volume transaction

1) Institutional system

Institution mentioned here means organizational system for governing activity and employee in the organization. It may be in two stages; first developed and prepared sufficient institutional system. Normally, framework of organization and activities, roles and responsibilities of WUSC are determined by-law. Based on the rules and regulations set out, job description and staff regulation should be prepared and staff should be managed accordingly. Quality of works conducted by staff should be guided by guidelines and manuals. Regarding progress, the plan should be prepared and controlled accordingly. The major controller shall be the business plan which covers entire activity of the organization. However, activities carried out as per business plan may be more precise if they are conducted individually as engineering plan, customer service plan, administrative plan and financial plan.

The activity should be monitored by many kinds of activity reports, such as monthly report, financial report and annual report.

Second stage is governing and controlling activity using institutional system effectively. For example, using performance appraisal system and punish/awarding rules in the staff regulation may be utilized for motivating staff and enhance labor efficiency. Timely reports may be very useful to find problems and bottleneck of business flow.

Organizational capability in institutional view may indicate how well institutional system has been prepared to cover all important activities, and how the organization has utilized institutional system for controlling quality of work.

WUSC need to follow appropriate manuals, guidelines and standard operating procedures (SOPs). These documents must have sufficient level of quality. There should be logical consistency, mutual consistency and topics should be aligned on streamline of logic both in manuals and guidelines, as well as in total structure of institutional system. The total structure of institutional system should be consistent with structure of functional organization, job allocation for standardizing business process and quality control.

2) Functional

Functional view is also essential for assessment of organizational capability. Normally, organizational structure is designed based on the purpose of the business and necessary function for achieving that purpose of the business and conducting the business. Therefore, almost all organization adapt functional view concept.

Standard organizational structure of small and medium size water supply system consists of three functional areas: technical, commercial and administrative. Technical functions can be further divided into O&M, Demand and Supply Management, Water Safety Plan and Monitoring and Evaluation. The O&M includes function of pump operation, plumbing works and utility works. Commercial function may be divided into billing, bill collection, meter reading and customer services. Administrative functions can be divided into book keeping, cashier's work, procurement and stock control and miscellaneous administrative works.

Organizational functions should cover standardizing the job process and the staff. Staff involved in the job should have sufficient capability determined with experience and skill for carrying on the job. No necessary to say, but these functionalities should be supported and controlled by institutional system mentioned previously in term of the job standardization and the quality control.

3) Mental and problem solving skill

It is recommended to guide and couch mental skills such as leadership, negotiation skills, conflict mitigation skills, problem solving technique, motivating staff, risk management, contingency planning, critical and logical thinking and PDCA cycle management, which are mostly needed to the manager. In this field, this document does not distinguish between technical and non-technical, but it makes manager to think and act.

4) Computerization

This document recommends to computerizing for standardizing quality and process of works of water supply business as well as for enhancing speed, accuracy and efficiency of the works. Computerization also helps to standardize the job process. Computer applications can be used for accounting system, human resource management, technical data analysis, Management information system etc.

If there are chances for computerizing, software may be available in following areas. There could be three types of three types of software: ***ERP: Enterprise Resources Planning*** which covers all functions or specific independent software developed for specific purpose. ERP is a sort of whole package software which may cover all functions in the organization including production, billing and collection, customer database, stock control, payroll and human resources management and accounting. However, ERP is very expensive and have so many functions that it may not be needed for the small and medium sized water supply system. ***SAP and Oracle Solution*** is available as typical ERP system.

Independent software is specific for management of particular functions, such as accounting, billing and collection, engineering design, network and hydraulic analysis. Packaged software of accounting or billing software is relatively cheap but such software is developed in English. Typical accounting software of such kind is ***Peach Tree.*** Developing software for specific purpose depends on quality of system engineer, but normally it is not so expensive.

How to strengthening organizational capability

As already mentioned, first is standardizing to standard operational procedure in the area of facility operation and engineering. Second is training to staff or hire capable person for enhancement of minimum skill requirement for carrying on standard operational procedures (SOPs).

Standardization is also effective for institutional set up and computerization. However, standardization may not always be effective for strengthening mental skill. Strengthening in this area requires experience by practice.

# Chapter three: Physical facilities management

As stated earlier, the Management Model is regarded as an ideal status of water supply utilities. However, as the management environment is different among WUSCs, a realistic management model which can be adapted by the target WUSCs needs to be considered. Also, the Management Model accompanies with proper business operation activities. Table 3-1 shows the realistic goals of the target WUSCs in each management area, precisely, the status that should be attained by water supply management of the target WUSCs.

**Table 3-1 Goals of Target WUSCs as the Physical facilities Management Model**

| **Management Areas**<br>Detail Points to be Checked | **Baseline (Status at the beginning of the Project)** | **Goals of the target WUSCs (Status what the Management Model should be)** | **Means of Verification** |
|---|---|---|---|
| **1.0. O&M of Water Supply System** | | | |
| -Documentation management | | -To keep all necessary documentations including manual and SOP for O&M.<br>-To revise the documents when necessary. | -Keeping status of manual and SOPs |
| -Formats | | -To prepare formats with the consideration of what to be analyzed and to be evaluated.<br>-To prepare equipment inspection format. | -Equipment inspection format prepared.<br>-Contents of record filled in the operation format |
| -Treatment process Understanding | | -To execute operation in accordance with the water quality and quantity and process evaluation. | -Check of understanding of treatment process<br>--Contents of record filled in the operation format |
| -Safety operation | | -To take safety measures in O&M work and use appropriate tools and equipments | -Possession status of gloves, glasses and boots<br>-Clothes for O&M work |
| -Tools management | | -To fix the place to keep the tool box.<br>-To maintain appropriate tools, considering what tools are necessary.<br>- To procure necessary tools | -Keeping and management status of tools |
| -Regular inspection of mechanical equipment (Preventive maintenance) | | -To prepare the formats and manual<br>-To implement regular inspection and recording<br>-To make a plan of preventive maintenance<br>-To establish maintenance team | -Equipment list prepared<br>-Inspection record format prepared<br>-Keeping and management status of tools |
| -Regular inspection of electrical equipment (Preventive maintenance) | | -To prepare the formats manual<br>-To implement regular inspection and recording<br>-To make a plan of preventive maintenance<br>-To establish maintenance team | -Equipment list prepared<br>-Inspection record format prepared<br>-Keeping and management status of tools |
| -Repair works | | -To prepare spare-parts ledger<br>-To clarify the in-house to outsourcing on repair/replacement of equipment works | -Equipment repair record prepared |
| -Data management | . | -To prepare monthly report | -O&M record prepared |

| | | | |
|---|---|---|---|
| | | -To prepare efficient annual report by using concrete data<br>-To Analyze technical data analysis<br>-To maintain daily record | |
| **2.0 O&M of Water Distribution Facilities** | | | |
| ・ Regular inspection of water distribution facilities such as pipelines, valves, air valve, washout, fire hydrant and elevated tank. | . | ・ To prepare inspection formats (check sheets) of the facilities.<br>・ To conduct regular inspection and record<br>・ To make a survey team and inspection and maintenance schedule<br>・ Creation of information map of distribution facility for maintenance and it should meet the facility lists to the map.<br>・ To understand facility locations and their statuses<br>・ To clean a pipe/an elevated tank and drain regularly at end points | -Inspection formats (check sheets) prepared<br>-Inspection record implemented |
| **3.0 Water Meter Calibration/Management** | | | |
| ・ Measurement of Malfunction and repair work | | ・ To conduct meter installation, control, calibration properly and check the inadequate meter installation at the site.<br>・ To conduct meter calibration at the site when receiving the complaints from customers and change the meter if necessary.<br>・ To keep the record of complaints and measures taken and report to board members. | ・ Meter installation rate (target 100%)<br>・ Complaints solving rate on meter related matters (target 100%) |
| **4.0 Emergency Countermeasures** | | -To build liaison system in emergency between WUSC and residents.<br>-To build internal liaison system in WUSC. | -SOP for emergency response |
| **5.0 Water Quality Management** | | -To understand principles and limitations of simple analysis kits, what to pay attention, and meanings of parameters, treatment process.<br>-To establish accuracy traceability system with the help of internationally accredited or authorized laboratories.<br>-To apply Water Safety Plan | -Understanding on simple analysis<br>-Water quality of supplied water (target: rate of meeting standards 95%) |
| **6.0 Billing and Collection** | | -Billing and collection as per standard process<br><br>-Introduction of computerized system is desirable in the future. | -Tariff collection rate (target: 95%) |
| **7.0 Customer Ledger** | . | -To keep manual ledger. | -Items filled in the ledger |

| | | | |
|---|---|---|---|
| **Management** | | -Introduction of computerized system is desirable. | |
| **8.0 Claim Handling** | | - System is established<br>- Monitoring performance<br>- Feedback for finding bottleneck and lead to solution | -Complaints solving rate (target: 95%) |
| **9.0 Preparation of Annual Report** | | -Annual report prepared and shared<br>-Report summary in websites | -Standard form of Nepal national standard |
| **10.0 Preparation of Business Plan** | | -To develop business plan<br>- To implement the plan<br>- Monitoring and evaluating time to time | -Status of business plan development |
| **11.0 Educational Campaign to Public** | | -To develop program and material<br>-To conducting program to promote user's understanding on wiliness to support activity of WUSC | -Implementation status of educational campaign program |
| **12.0 Monitoring & Evaluation** | | -To decide the parameters for monitoring/evaluation.<br>-To conduct monitoring /evaluation. | -Monitoring parameters prepared |
| **2.8 Accounting system** | | -Accounting system in place<br>-Introduction of computerized system is desirable in the future. | -Procedures of accounting work |
| **2.9 Monthly report** | | -Monthly report produced and shared with users and places in websites<br>. | -Standard form of Nepal national standard |

# Chapter four: Monitoring and Evaluation

Objective of the monitoring and evaluation is to watch the achievement reported through monthly and annual reports and reconfirm the target and monitoring indicators. Monitoring is done on the basis of key performance indicators relating to technical, management and financial areas. The table below shows baseline or present status and target for 12 years from year 2014 to 2025. This document recommends WUSCs to use the Table and to conduct self monitoring and evaluation themselves.

| SN | Performance Indicators | Unit | Baseline 2013 | 2016 | 2019 | 2022 | 2025 |
|---|---|---|---|---|---|---|---|
| A | Technical | | | | | | |
| 1 | Coverage | % | | | | | |
| 2 | Population served | No. | | | | | |
| 3 | Production | $m^3/d$ | | | | | |
| 4 | Av consumption per connection | $m^3/m$ | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | Active connections | No | | | | | |
| 6 | Unaccounted for Water(UFW) | % | | | | | |
| 7 | Non Revenue Water(NRW) | % | | | | | |
| 8 | No of pipe breaks | No./yr/km | | | | | |
| 9 | Sample meeting WQ standard | % | | | | | |
| 10 | Service hours | hr/day | | | | | |
| B | Management | | | | | | |
| 1 | Number of Staff | No. | | | | | |
| 2 | Number of connection per staff | No. | | | | | |
| 3 | Collection efficiency | % | | | | | |
| 4 | Consumer complains | No./m | | | | | |
| C | Financial | | | | | | |
| 1 | Revenue collection from operations | Rs/year | | | | | |
| 2 | Expenditure for operation | Rs('000/yr | | | | | |
| 3 | Cash balance | Rs/yr | | | | | |
| 4 | Operational cost | Rs/ $m^3$ | | | | | |

*Joint monitoring and evaluation*

It is recommended to conduct the joint monitoring and evaluation of WUSCs regarding M&E performance indicators, target and achievement. Based on the joint M&E, DWSS might recommend or enforce an improvement in the management capability or efficiency.

*Monitoring and evaluation schedule*

This document recommends monitoring every month and evaluating every year. Of course, WUSC can update target as well as key performance indicators and DWSS can advise to update target and key performance indicators for accelerating implementation, or adjust change of management environment based on monthly monitoring results given in the reported monthly report. This guideline also recommends to WUSCs and DWSS for scheduling annual joint evaluation meeting.

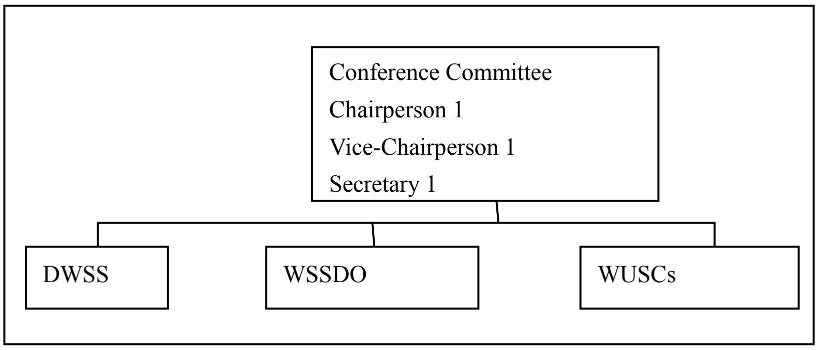
# Chapter five: Coordination and WUSC conference

This assumes annual conference of WUSC at regional level. Purpose of such conference is:

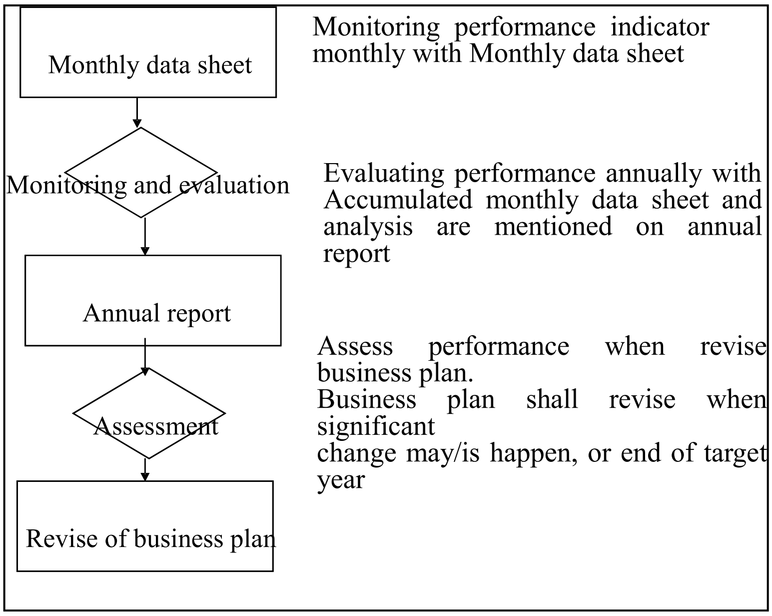
- To share project operation and management experiences among WUSCs
- To build the system of mutual support and cooperation among WUSCs
- To learn from experiences and best practices of others

Organization of Conference: Conference committee will be established within a region. The chairperson, vice chairperson and secretary will be selected by participating WUSCs. Members of the conference committee will comprise of

- Chairperson and Secretary from WUSCs
- Regional Chief of RMSO
- Division Chiefs of WSSDOs
- Representative from DWSS




Time: The conference will be organized once in a year. The conference duration will be decided by the committee based on the agenda. DWSS can appoint experts for views and review of conference activities.




# Chapter six: Documentation

The Water Supply Management Model requires various documents for systematic operations of the water supply system. Some documents will be provided by DWSS as model and some need to be developed by WUSCs for their specific process. Guidelines, Business Plan, Operational Manuals and SOPs are the key documents. The WUSCs should utilize these documents in their operation to ensure proper water supply management. These documents are also useful when DWSS plans to strengthen the organizational capability of WUSCs, especially to strengthen the function of WUSCs with training.

(1) Standard Operation Procedures (SOPs)

- Standard Operation Procedure on O&M of Water Distribution Facilities
- Standard Operation Procedure on New Planning Formulation of Water Distribution Facilities
- Standard Operation Procedure on Water Meter Reading and Meter Calibration Control
- Standard Operation Procedure of Water Treatment Plant Operation and Maintenance (Water Quality Management)

(2) Documents for capacity development

Water treatment facility management

Water Safety Plan

Water Supply Facility Maintenance

Meter maintenance

Management

- Problem solving technique
- Negotiation process
- Customer complaints management system
- Awareness program
- Customer Ledger and Billing System
- Monthly report
- Annual report
- Business plan
- WUSC management model and supporting model

(3) Guidelines

(4) Manuals

# Appendix to Management Model

Concept of WUSC management model simply sets ideal status of water supply services in the future by WUSC and designs the way to achieve such status through business plan. With strengthening sufficient institutional and functional, and financial capability through technical and financial support from stakeholders, WUSC can implement the business plan and achieve that ideal status. Management model for WUSC has been described in main document. This appendix is aid document including presentation on model, SOP on O&M of water supply facilities, calibration and maintenance of water meters and model business plan based on work of Dhulabari, Gauradaha and Mangadh

***Model Presentation:*** This part of appendices contains 22 slides which describe management models. These slides contain introduction to model; concept of financial, technical and institutional capacity of users committee; list of monitoring and evaluation indicators; concept of coordination and conference, and Documentations.

***Slide presentation for Installation and calibration of water meter:*** There is slide presentation for installation and calibration of water meters. It also contains slide presentation for water meter calibration training conducted.

**1. Concept and Objective of Business Plan**

This part of appendices contains 58 slides. These slides contain introduction to formulate a business plan, its procedure contains Technical plan, Commercial Plan, Administrative Plan and Financial Plan.

**1-1** ***Draft Business Management of Dhulabari, Gauradaha and Mangadh Water Supply and Sanitation Committee:*** It describes business plan of Dhulabari, Gauradaha and Mangadh as example. It contains executive summary of long term, medium term and short term plan. There is time bound business plan in terms of service connections, financial performance, water demand, engineering plan, costumer's service plan, water rate improvement plan and monitoring indicators. Detail business plan contains Vision, mission, target, and plan to achieve targets.

**2.** ***Standard Operating procedures of Water Treatment O&M (Water Quality Management):*** This part of appendix describes SOP for purification process management including maintenance. There is SOP for water quality analysis including criteria, sampling, frequency, analysis, data management, and information sharing.

**3.** ***Standard Operating procedures on O&M of Water Distribution facilities:*** This part of appendix describes typical components of water supply facilities; causes of and correction to malfunctioning of each component and checklist for their surveys. It also describes checklist for inspecting each components.

There is guidance for planning, designing and O&M of facilities in case addition or extension of facilities are required. Design guideline covers type of facilities, quantities, service hours, network system, and design criteria for hydraulic analysis, pipe sizing and selection. There is process of pipe laying and jointing.

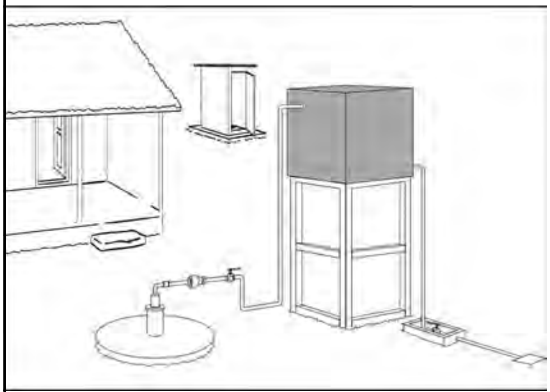
**3-1** ***Slide presentations for SOP***: This part of appendix contains slide presentation for SOP for O&M of distribution, SOP for planning of new distribution system, Process for making sockets manually and problems found in distribution pipes.

**4. *Standard Operating procedures on Meter reading and Meter Calibration Control***: This part of appendix describes procedure of water meter maintenance, its type, precaution for installation, outline for meter reading and responsibility of users committee and users.

It describes accuracy of water meter and equipment required for managements. It describes tolerance limit, checking process, examination and out of order situations, instance and measures as well.

**4-1 *Slide presentation for Installation and calibration of water meter:*** There is slide presentation for installation and calibration of water meters. It also contains slide presentation for water meter calibration training conducted.

# Management Model for Water Supply System in Semi Urban Area



Presented by:

2013

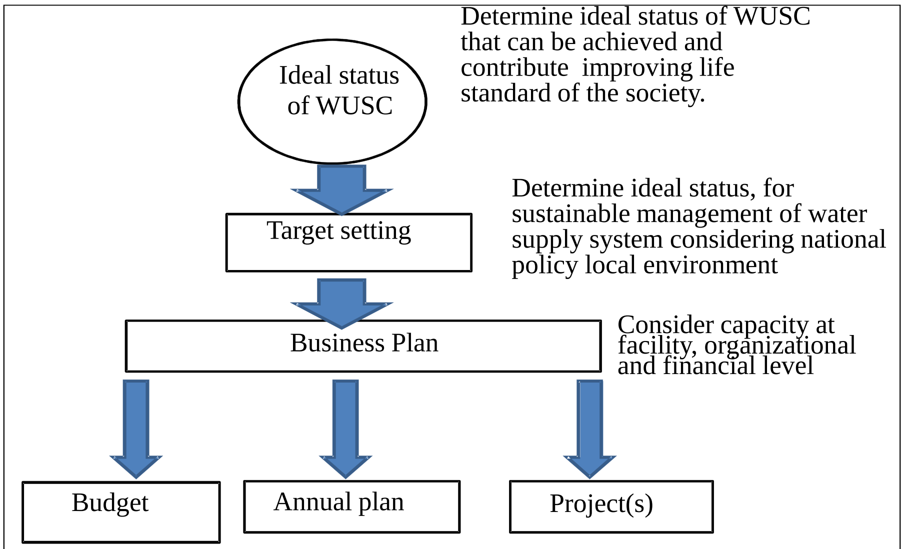
## Background

- JICA supported for Capacity Development on Water Supply in Semi-urban Areas (WASMIP)
- "Small and medium sized water supply management model", under which WUSCs provide water supply services to citizens
- Small and medium sized water supply support model", under which DWSS conducts technical support for WUSCs

## Management Model: Introduction

- Management model simply sets ideal status of water supply services in the future by WUSC called target setting
- Designs the way to achieve such status called business plan.
- WUSC can achieve target with strengthening sufficient institutional and functional, and financial capability
- DWSS need to provide technical and financial support
- WUSC can implement the business plan and achieve that ideal status.

## Management Model: Structure

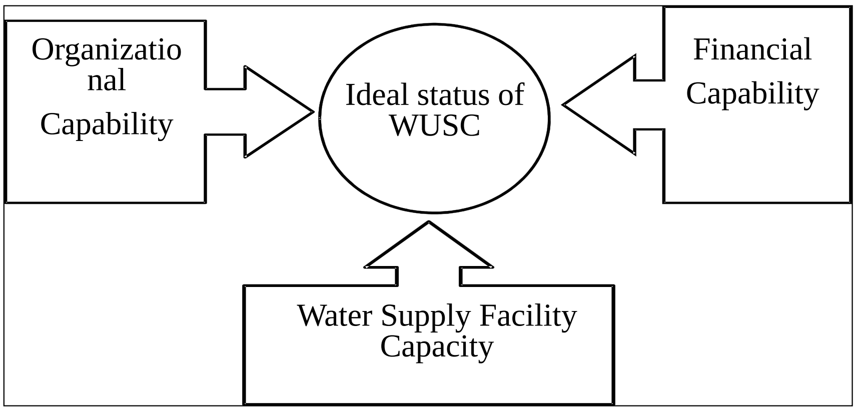



Business plan decide framework of budget, annual plan, project and special tasks

## Management Model: Target Example

| Area | Targets |
|---|---|
| Safe water: | • Quality of water meets Nepal standard.<br>• WUSC has facility and capability for monitoring water quality<br>• WUSC applies Water Safety Plan for continuous safety of water |
| Affordability: | • Consumption per capita per day of user meets national standard.<br>• 85 litter per day per capita or 100 liter per day per capita or more<br>• WUSC follows water tariff guideline set by Water tariff Fixation Committee<br>• Water rate is fair enough for achieving cost recovery as well as affordable to poor people |
| Stability: | • WUSC provides water for 24 hours a day and 12 months a year<br>• WUSC provides water with sufficient pressure in pipelines? (Range from 5 to 20 meter)<br>• Water facility has sufficient capability for providing water in a sustainable way |
| Service coverage | • Service coverage ratio meets with national standard<br>• Up to 90% of the service area by 2020 |

## Management Model: Required capacity



## Management Model: Organization Capacity

| Demand of organizational capability | ≦ | Organizational capability |
|---|---|---|
| -Institutional demand<br>-Functional demand<br>-Demand on leadership, negotiation and problem solving skill<br>-Demand on business transaction management regarding speed timeliness, accuracy and handling large volume transaction | | -Fine institutional set up<br>-Strengthening functional capability, business process standardization, training for skill enhancement<br>-Strengthening leadership skill<br>-Computerization for improving accuracy, speed and capability for handling large, volume business transaction as well as business process standardization |

## Management Model: Facility capacity

| Water Demand | ≦ | Capacity of facility |
|---|---|---|
| Service coverage<br>Population service<br>Consumption per capita per day | | Water resources<br>Capacity of intake facility<br>Capacity of purification facility<br>Capacity of pipe networks Leakage and loss<br>NRW/UFW |

## Management Model: Financial facility

Financial Demand ≦ Financial capability

(Capital cost)

-Cost for fixed asset

-Cost of construction project

-Cost of vehicles

(Operational cost)

-Salaries and wages

-Power

-Chemical

-Repair and maintenance

-Office management

-Financial cost, if any

-Revenue from sales of water and service

Water rate

Collection efficiency

-Revenue from annual membership due

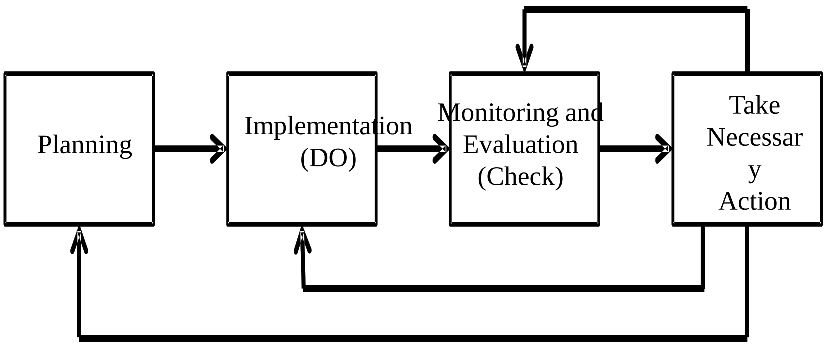
-Grant and subsidiary

-Deposit

-Accounting accuracy

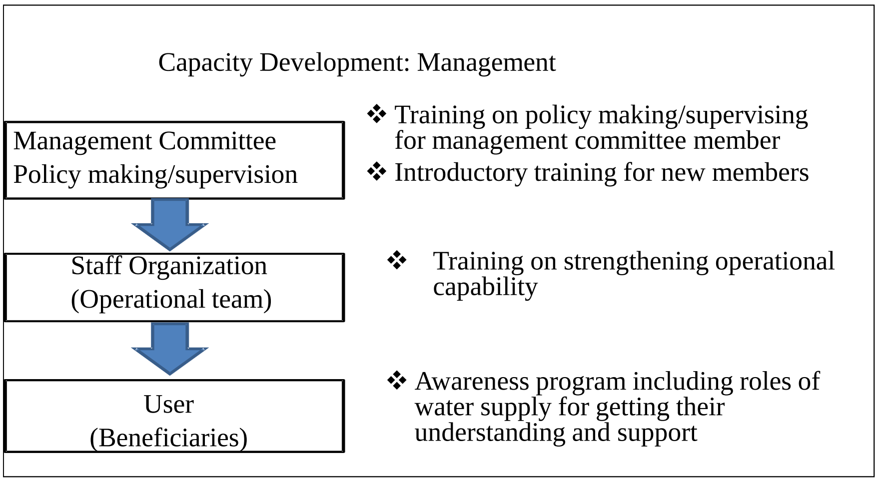
-Loan if any

## Management Model: PCDA

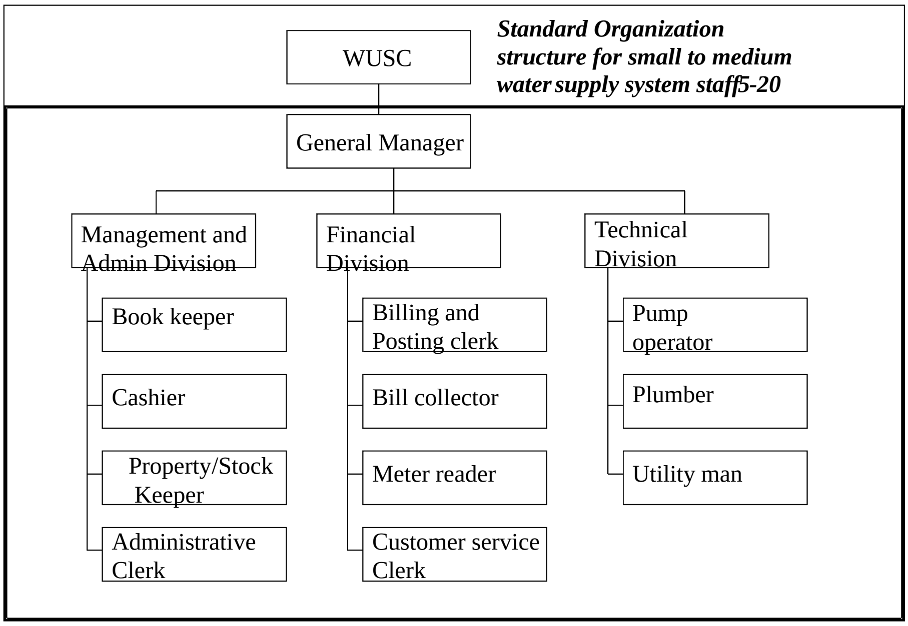


## Organization management: Structurure

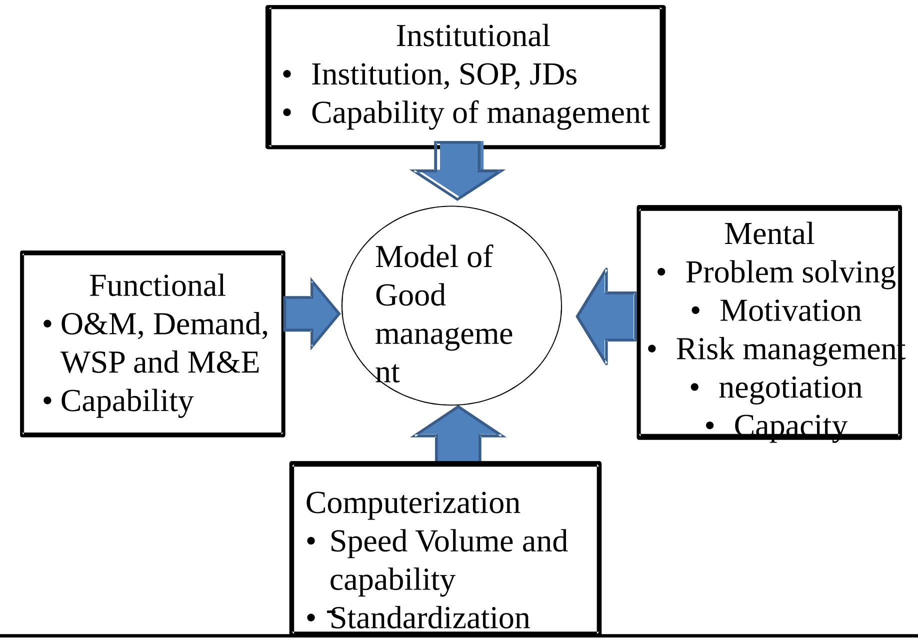
Management structures of WUSC consist of three layers:




## Organization management: function/Staff



## Organization management: function/Staff




## Physical Facilities Management:

| **Management Areas**<br>Detail Points to be Checked | **Baseline (Status at the beginning of the Project)** | **Goals of the target WUSCs (Status what the Management Model should be)** | **Means of Verification** |
|---|---|---|---|
| **1.1 O&M of Water Treatment Plant** | | | |
| -Documentation management | | -To keep all necessary documentations including manual and SOP for O&M.<br>-To revise the documents when necessary. | -Keeping status of manual and SOPs |
| -Formats | | -To prepare formats with the consideration of what to be analyzed and to be evaluated.<br>-To prepare equipment inspection format. | -Equipment inspection format prepared.<br>-Contents of record filled in the operation format |
| -Treatment process Understanding | | -To execute operation in accordance with the water quality and quantity and process evaluation. | -Check of understanding of treatment process<br>--Contents of record filled in the operation format |

## Physical Facilities Management:

| |
|---|
| 3.1 O&M of Water Treatment Plant |
| 3.2 O&M of Water Distribution Facilities |
| 3.3 Water Meter Calibration/Management |
| 3.4 Emergency Countermeasures |
| 3.5 Water Quality Management |
| 3.6Billing and Collection |
| 3.7 Customer Ledger Management |
| 3.8 Claim Handling |
| 3.9 Preparation of Annual Report |
| 3.10 Preparation of Business Plan |
| 3.11 Educational Campaign to Public |
| 3.12 Monitoring & Evaluation |
| 3.13 Accounting system |
| 3.14 Monthly report |

## Monitoring and Evaluation: Concept

- keep watching achievement by monthly report and annual report.
- Joint monitoring and evaluation to WUSC regarding M&E performance indicators, target and achievement is recommendable
- Use Indicators for monitoring
- Set target for evaluations
- Make monitoring schedules

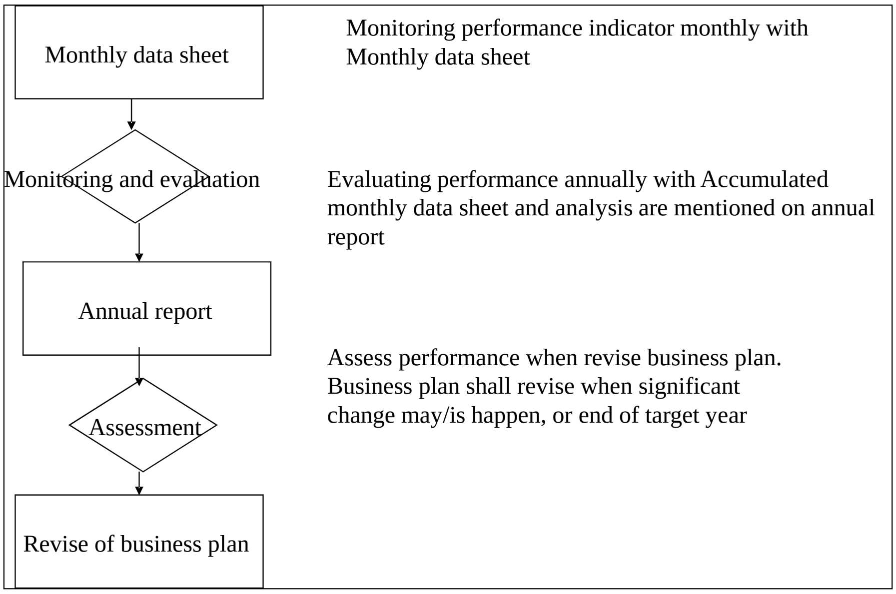
## Monitoring and Evaluation: Indicators

| SN | Performance Indicators | Unit | Base line 2013 | 2016 | 2019 | 2022 | 2025 |
|---|---|---|---|---|---|---|---|
| A | Technical | | | | | | |
| 1 | Coverage | % | | | | | |
| 2 | Population served | No | | | | | |
| 3 | Production | $m^3$ /d | | | | | |
| 4 | Av consumption per connection | $m^3$ /m | | | | | |
| 5 | Active connections | No | | | | | |
| 6 | Unaccounted for Water(UFW) | % | | | | | |
| 7 | Non Revenue Water(NRW) | % | | | | | |
| 8 | No of pipe breaks | No/Yr /km | | | | | |
| 9 | Sample meting WQ standard | % | | | | | |

## Monitoring and Evaluation: Indicators

| SN | Performance Indicators | Unit | Base line 2013 | 2016 | 2019 | 2022 | 2025 |
|---|---|---|---|---|---|---|---|
| 10 | Service hours | hr/day | | | | | |
| | | | | | | | |
| B | Management | | | | | | |
| 11 | Number of Staff | No | | | | | |
| 12 | Number of connection per staff | No | | | | | |
| 10 | Collection efficiency | % | | | | | |
| | Consumer complains | No/m | | | | | |
| | Financial | | | | | | |
| 11 | Revenue collection from operations | Rs/Yr | | | | | |
| 12 | Expenditure for operation | Rs('000/Yr | | | | | |
| 13 | Cash balance | Rs/Yr | | | | | |
| 14 | Operational cost | Rs/ $m^3$ | | | | | |

## Monitoring and Evaluation: M&E Flow




## Coordination and conference:

Purpose of such conference are:

- ❖ To share project operation and management experiences among WUSCs
- ❖ To build the system of mutual support and cooperation among WUSCs
- ❖ To learn from experiences and best practices of others

## Coordination and conference:

Organization of Conference: Conference committee will be established within a region. The Chairperson, vice chairperson and secretary will be selected by participating WUSCs.

Members of the conference committee will comprise of:

-Chairperson and Secretary from WUSCs ,

- Regional Chief of RMSO

-Division Chiefs of WSSDOs ,

- Representative from DWSS

## Documentation:

- ❖ The Water Supply Management Model requires various documents for systematic operations of the water supply system.
- ❖ Some documents will be provided by DWSS as model and some need to be developed by WUSC for their specific process.
- ❖ Guideline, Business plan, Operational manual and SOPs are the key documents.
- ❖ The WUSCs should utilize these documents in their operation to ensure proper water supply management.
- ❖ Useful when DWSS plans to strengthen the organizational capability of WUSC, especially to strengthen the function of WUSC with training.

# Small and Medium-Sized Water Supply Support Models (Summary)

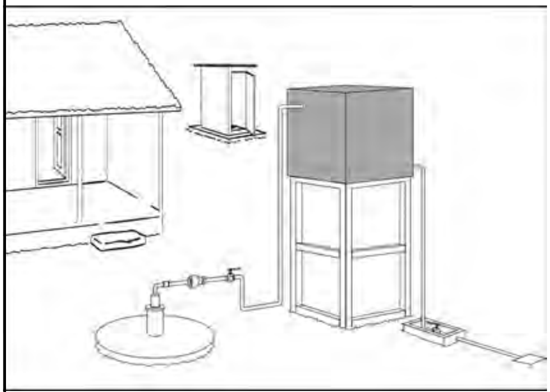
The Project for Capacity Development on Water Supply in Semi-urban Areas, nicknamed as Water Supply Management Improvement Project (WASMIP), implemented in 20 water supply utilities in Jhapa and Morang districts has produced two models for water supply service improvement in semi-urban areas in Nepal. One is “Small and medium sized water supply support model”, under which DWSS provides supports to WUSCs to perform service improvement activities. The other is “Small and medium sized water supply management model”, under which WUSCs operate and manage water supply systems to provide water services to the citizens.

“Small and medium sized water supply support model” provides a guideline for DWSS/WSSDO on how to support WUSCs for their organizational, technical and financial capacity development required for sustained service. This support model is for supporting and enhancing management capabilities of WUSCs. The main concept of support model is to support WUSCs in technical and financial areas to implement business plan, to operate and maintain WUSC’s water facilities properly to realize the ideal status. Thus, it is very essential for WUSCs to prepare their own business plan and SOPs (Standard Operational Procedure) for DWSS to be well acquainted of it. DWSS provides technical and financial support to WUSCs on the basis of their business plans and SOPs (Standard Operational Procedures).

The supportive role of DWSS is very important on realizing the ideal status of WUSCs. However, the support from DWSS depends on the business plan of WUSCs. WUSCs themselves have to initiate the process analyzing their weakness and capacity and making an improvement plan. DWSS technical team can suggest and propose their standard ideas and information for strengthening organizational capability of targeted WUSCs. Every WUSC will have their own management model and targets in line with key concept of management model.

There are mainly four ways that DWSS can support WUSC called (1) Maintenance Inspection Team (MIT), (2) Management Advisory Team (MAT), (3) Monitoring and Evaluation Team (MET) and (4) Practical trainings. Objectives, roles and activities of the teams are summarized in the table. MET and MAT generally supports for Business Plan and Financial Records. MIT supports for SOPs and O&M records. Practical training is for overall capacities under Management models of WUSC

# Support Model for Water Supply System in Semi Urban Area



Presented by:

2013

## Background

- ❖ JICA supported for Capacity Development on Water Supply in Semi-urban Areas (WASMIP)
- ❖ "Small and medium sized water supply management model", under which WUSCs provide water supply services to citizens
- ❖ Small and medium sized water supply support model", under which DWSS conducts technical support for WUSCs

## Management Model: Introduction

- Management model simply sets ideal status of water supply services in the future by WUSC called target setting
- Designs the way to achieve such status called business plan.
- WUSC can achieve target with strengthening sufficient institutional and functional, and financial capability
- DWSS need to provide technical and financial support
- WUSC can implement the business plan and achieve that ideal status.

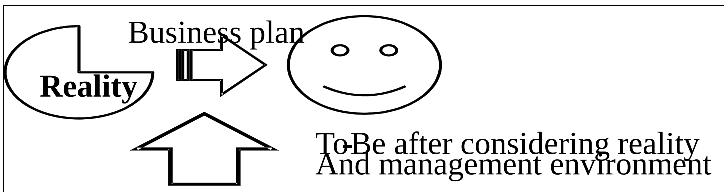
## Support model: Structure

- **"WUSC support model"** explains what DWSS can do on the realization of WUSC's dream through their business plans.
- **"Maintenance Inspection Team (MIT)"** explains about support system to be arranged in WSSDOs for assisting WUSCs on O&M of water supply systems.
- **"Management Advisory Team"** highlights the aspects of assistance to administrative management of WUSCs through support system established in WSSDOs.
- "**Monitoring and Evaluation**" introduces ways for monitoring and communication between WUSCs and DWSS.

## Support model: WUSC capacity

- WUSC has sufficient functionality of policy making, decision making and governance for its operation
- WUSC has sufficient capacity for carrying out sustained operational works for producing adequate and safe water which is affordable to maxim number of people in the service area.
- WUSC has sufficient financial capacity to operate, maintain and sustain water supply services for longer period
- Users understand importance of good hygiene practice and roles of water supply, and support activity of WUSC.

## Support model: Support Areas




Support to WUSC:
1.Guide to optimize institutional system
2.Provide training to enhance knowledge of staff
3.Provide OJT to strengthen skills and knowledge of staff
4.Provide opportunity for sharing and exchange information between water supply service providers
5.Provide financial assistance
6.Provide material support

# Support model: Support strategy

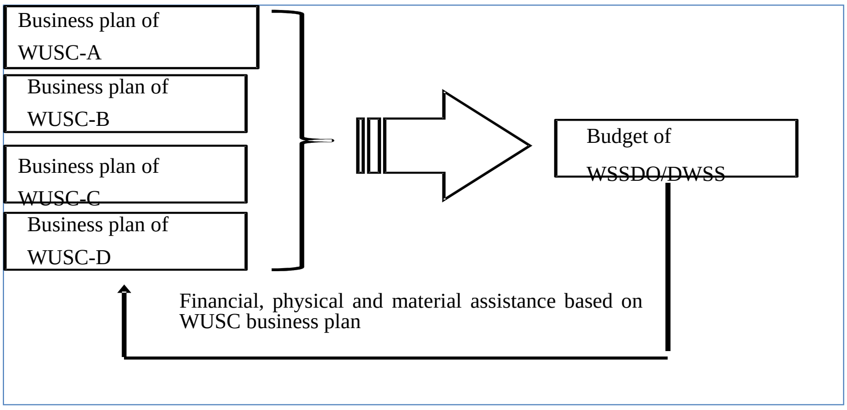
| Support Area | Operational strategy | Responsibilities/Frequency |
|---|---|---|
| 1. Guide to set-up institutional system | # Provide guidance to develop statute and registration of WUSC<br># Incentives for best performance of WUSC<br># Tie-up with VDC/DDC<br># Encourage to place right man at right place<br># # provide operational and maintenance manual/guidelines | -In the beginning of project set up and then refreshment periodically |
| 1. Provide training for capacity of staff | # Organize technical training for maintenance workers, pump operators, meter readers, plumber Organize training on Water Safety Plan<br># Organize training on Sanitation<br># Organize training on Computer, Electro-mechanical and Plumbing<br># Organize management training for WUSC and managers | -Based on capacity development plan of WUSC |
| 1. Provide OJT to ensure skills of staffs | # Preconstruction training<br># Maintenance Workers training<br>#Plumbing training<br>#Pump operator, meter reading, leak detection training<br># water quality testing and water safety plan<br># Treatment plant operator, disinfection training<br># Management training | - Based on annual plan of DWSS |

# Support model: Support strategy

| Support Area | Operational strategy | Responsibilities/Frequency |
|---|---|---|
| 1. Provide an opportunity for information exchange between WUSC | # Exchange visit for management committee & staffs<br># publication and distribution of booklets, brochure and news letters<br># liaison conference<br>#Establishment of websites | - Based on annual plan of DWSS and |
| 1. Provide financial resources | # Provide financial support and loan arrangement for new project and rehabilitation project<br># provide resources for maintenance and capacity development based on need performance | - Based on Business plan |
| 1. Provide physical facilities and materials resources | # Provision of pipes, fittings, tools to WUSC<br># Computer, equipments<br># Lab equipments<br># Guidelines and manuals | - Based on business plan and joint monitoring and commitment on conference |

## Support model: Support strategy

- Document suggests DWSS for assisting WUSC based on their business plan
- Confirm the need and eligibility of assistance.
- Align the need of assistance in their annual budget accordingly.




## Maintenance Inspection Team(MIT): Purpose

- Purpose of Maintenance Inspection Team(MIT) is to enhance WUSC's capacity on solving problems themselves on-site.
- MIT facilitates to have access to the experts on the repair and maintenance of the equipment and on the operation of water supply and water treatment process.
- MIT also helps to solve the problem unsolved due to lack of knowledge or awareness and enhance preventive maintenance process.
- Effectiveness of MIT depends on evaluation indicators, ease on maintenance support and sharing information.

## Maintenance Inspection Team: Function

- ❖ Evaluating performance in terms of operation of system, equipment and quality of water.
- ❖ Provide environment to WUSCs to solve problems on site.
- ❖ Encourage preventive maintenance
- ❖ Observe maintenance records
- ❖ Provide easy maintenance support

## Maintenance Inspection Team: Team

**Team composition**

MIT is joint team of WSSDO staffs and WUSC's operators. Sometime DWSS staffs and external resource persons as expert can be also included for special purpose.

1. Team Leader – Engineer from WSSDO
2. Assistant team Leader – Sub-Engineer from WSSDO
3. Member – On-site operator in charge of corresponding WUSC

## Management Advisory Team: Purpose

- Purpose of Management Advisory Team(MAT) is to assist WUSCs on the management of water supply system to ensure sustainable and safe water at affordable cost to the maximum people within their jurisdictions.

## Management Advisory Team: Team

Composition of Management Advisory Team

- The Team shall be composed of three experts :-
  - management,
  - technical and
  - financial areas.

- The Team can be staff from DWSS and WSSDO or outsourced under special provision.

## Management Advisory Team: Management Advisor

- ❖ The Chief of WSSDO or external can play roles of management advisor.
- ❖ Providing management advice (regarding number of connection, water rate improvement, recruitment of staff, management efficiency, training of staff, etc.),
- ❖ Monitoring management performance of WUSCs monthly
- ❖ Evaluating management performance annually with other team members and WUSC
- ❖ Doing necessary arrangement on technical and financial support to WUSC

## Management Advisory Team: Technical Advisor

- ❖ An Engineers of WSSDO or external can play roles of technical advisor.
- ❖ Providing technical advices (regarding, water demand projection by WUSC, facility improvement planning by WUSC,
- ❖ Advise on basic design of facilities, advise on cost estimation of facility improvement planning,
- ❖ Advise/training of WUSC staff for facility operation and maintenance, and WSP
- ❖ Review implementation of business plan

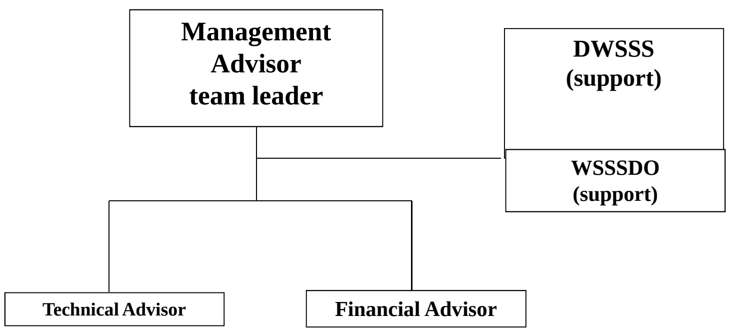
## Management Advisory Team: Financial Advisor

❖ An Engineers or chief of WSSDO or external can play role of financial advisor. Roles of Financial advisor are:

❖ Providing financial advices to WUSCs regarding water tariff setting, financial planning and financial resources arrangement.

❖ Reviewing implementation of the business plan with WUSC annually and providing advises on update, if necessary

## Management Advisory Team: Chart




- ❖ Providing advises on management of WUSC upon their request
- ❖ Monitoring management performance of WUSC based on trimester report submitted by WUSC
- ❖ Conducting annual joint evaluation on implementation of business plan.

# Monitoring and Evaluation

- Joint monitoring and evaluation to WUSC regarding M&E performance indicators, target and achievement is recommendable.
- Suggested performance indicator would be mentioned on section of M&E.
- Based on the M&E, DWSS may recommends enforcement of management capability or efficiency.

# Monitoring and Evaluation: Indicators

| A | Technical | Unit | Baseline | Target | Achievement |
|---|---|---|---|---|---|
| 1 | Coverage | % | | | |
| 2 | Population served | No | | | |
| 3 | Production | $m^3/d$ | | | |
| 4 | Av consumption per connection | $m^3/m$ | | | |
| 5 | Active connections | No | | | |
| 6 | Unaccounted for Water(UFW) | % | | | |
| 7 | Non Revenue Water(NRW) | % | | | |
| 8 | No of pipe breaks | No/Yr/km | | | |
| 9 | Sample meting WQ standard | % | | | |

# Monitoring and Evaluation: Indicators

| SN | Performance Indicators | Unit | Base line 2013 | Target | Achieveme nt |
|---|---|---|---|---|---|
| 10 | Service hours | hr/day | | | |
| | | | | | |
| B | Management | | | | |
| 11 | Number of Staff | No | | | |
| 12 | Number of connection per staff | No | | | |
| 10 | Collection efficiency | % | | | |
| | Consumer complains | No/m | | | |
| | Financial | | | | |
| 11 | Revenue collection from operations | Rs/Yr | | | |
| 12 | Expenditure for operation | Rs('000 /Yr) | | | |
| 13 | Cash balance | Rs/Yr | | | |
| 14 | Operational cost | Rs/$m^3$ | | | |

# Appendix to Support model

"Small and medium sized water supply support model" provides guideline for DWSS/WSSDO on how to support WUSCs for their organizational, technical and financial capacity development required for sustained service. This support model is for supporting and enhancing management capability of WUSCs. The main concept of support model has been described in the main document. This is aid document including model presentation and working formats. Working formats includes Function of Monitoring Evaluation Team (MET), Management Advisory Team (MAT) and Maintenance Inspection Team (MIT). It also provides working formats for inspection, maintenance and recordings.

***Model Presentation***: This part of appendices contains 21 slides which describe support model. Slides contain introduction to model; model structures and expected capacity of users committee. It presents six support areas and strategy. There is presentation on Maintenance Inspection Team (MIT), Management Advisory Team (MAT) and Monitoring Evaluation Team (MET) and their purpose, structure and tasks.

## Maintenance Inspection Team (MIT)

***Function of Maintenance Inspection Team (MIT)***: This contains structures, document and proposed work flow for maintenance records.

***Evaluation sheet:*** This sheet contains breakdown of evaluation like water quality, water distribution, water meter, mechanical and electrical equipment etc. This provides space for recording issues, comments, measures and teams.

1) ***Maintenance Inspection sheet (water quality):*** This sheet provides inspection checklist for various aspects of water quality management. Checklist includes SOP, Operational records, analysis of materials and parameters, etc. Sheet includes checklist, check, situation, causes and countermeasures.

2) ***Maintenance Inspection (water distribution and water meter):*** This sheet provides inspection checklist for various parts of distribution and water meters. Sheet includes checklist, check, situation, causes and countermeasures.

***3) Maintenance Inspection sheet (mechanical& electrical):*** Maintenance inspection sheet provides checklist for inspection of various parts of the system including mechanical& electrical. Sheet includes checklist, check, situation, causes and countermeasures.

3-1 ***Preventive maintenance record for mechanical equipment:*** This sheet provides status of various operational and maintenance parameters of various mechanical equipment.

3-2 ***Preventive maintenance record for electrical equipment:*** This sheet provides specification and current status of various parameters of various electrical equipment.

## Management Advisory Team (MAT)

**Function *of Management Advisory Team (MAT):*** This sheet includes structure, scope, roles of team members and content.

***Annual Plan for MAT activity:*** This sheet includes annual plan of key MAT members for Jhapa and Morang as an example.

***Monthly Record:*** This sheet provides model format for plan, for target indicators for a year.

Japan International Cooperation Agency

# The Project for Capacity Development on Water Supply in Semi-urban Areas In Nepal

# Small and Medium-Sized Water Supply Support Model

## Final Draft

**WASMIP**

**June 2013**

## Abbreviation and Definition

CAD: Computer Aided Design (computer software for drawing engineering chart)

DWSS: Department of Water Supply and Sewerage

ERP: Enterprise Resources Planning, total package software covers almost all functions in company

HRD: Human Resources Development

HRM: Human Resources Management

LWUA: Local Water Utility Association (government agency for supporting rural water supply in Philippines)

M&E: Monitoring and Evaluation

MIS: Management Information System, system to collect and edit necessary management data and information

NRW: Non-revenue Water

O&M: Operation and Maintenance

OJT: On the Job Training

PCM: Project Cycle Management, methodology for manage planning cycle

PDCA: Plan, Do, Check and Act, methodology of manage planning cycle

PDM: Project Design Matrix, summary of plan

QC: Quality Control, techniques and activity for improving quality of works with team work method developed in Japan and sometimes called Kaizen.

SAP: System Application and Products One of Major IT Company produces ERP (Enterprise Resource Planning) package, and brand name of their products.

SOP: Standard Operation Procedure (sort of engineering manual)

TOC: Theory of Constraint, (methodology of finding and solving bottleneck of business flow for improving efficiency and effectiveness)

TQC: Total Quality Control (advanced quality controlling method developed in Japan)

WD: Water District, municipal level public company for supply water in Philippines and USA

WHO: World Health Organization

WSSDO: Water Supply and Sanitation Division/Sub-Division Office

WUSC: Water Users and Sanitation Committee

UFW: Unaccounted for water

USA: United States of America

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(2) Provide training for capacity building of WUSC staff .......... 6

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(4) Provide opportunity of information exchange between WUSCs .......... 7

(5) Provide financial assistance .......... 7

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# Introduction

The Project for Capacity Development on Water Supply in Semi-urban Areas, nicknamed as Water Supply Management Improvement Project (WASMIP) and implemented in 20 water supply utilities in Jhapa and Morang districts, developed two models for water supply service improvement in Semi-urban Areas in Nepal. One is “Small and medium sized water supply management model”, under which WUSCs operate and manage water supply systems to provide water services to the citizens. The other is “Small and medium sized water supply support model”, under which DWSS provides supports to WUSCs to perform service improvement activities. These two models are developed based on experience gained while strengthening technical, managerial and financial capacities of the three WUSCs by JICA Experts team and other seventeen WUSCs by DWSS through WSSDOs with the support of JICA Experts team in Jhapa and Morang districts. These two models will be introduced in other WUSCs all over the country. In the context of these models, "Small and medium sized water supply " means a water supply system with less than 3000 connections and operated by a local WUSC with less than 20 staff.

**“Small and medium sized water supply support model”** provides a guideline for DWSS/WSSDO on how to support WUSCs for their organizational, technical and financial capacity development required for sustained service. This support model is for supporting and enhancing management capabilities of WUSCs. The main concept of support model is to support WUSCs in technical and financial areas to implement business plan for realizing the ideal status. Thus, it is very essential for WUSCs to prepare their business plan, and for DWSS to be well acquainted of it. DWSS provides technical and financial supports to WUSCs on the basis of their business plans.

This document comprises of four chapters: Model Description, Concept of Maintenance Inspection Team (MIT), Concept of Management Advisory Team (MAT) and Monitoring and Evaluation (M&E).

Chapter 1: **“WUSC support model**” explains what DWSS can do on the realization of WUSCs' dream through their business plans.

Chapter 2: **“Maintenance Inspection Team (MIT)”** explains about support system to be arranged in WSSDOs for assisting WUSCs on O&M of water supply systems.

Chapter 3: **“Management Advisory Team”** highlights the aspects of assistance to administrative management of WUSCs through support system established in WSSDOs.

Chapter 4: “**Monitoring and Evaluation**” introduces ways for monitoring and communication between WUSCs and DWSS.

# Chapter1: WUSC support model

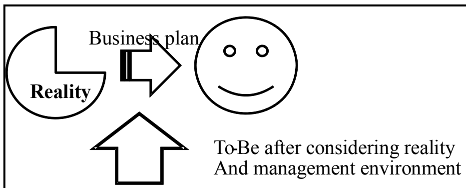
The Support Model highlights the methods of support to WUSCs that DWSS needs to endeavor to realize ideal status of WUSC with the use of Water Supply Management Model.

As described in Water Supply Management Model, WUSC will attain ideal status when:

- It has sufficient functionality for policy making, decision making and governance of its operation
- It has sufficient capacity for carrying out sustained operational works for producing adequate and safe water which is affordable to maximum number of people in the service area.
- It has sufficient financial capacity to operate, maintain and sustain water supply services for longer period
- Users understand the importance of good hygiene practice and roles of water supply, and support the activity of WUSC.

For achieving such status, the supportive role of DWSS is very important. At first, WUSCs themselves has to initiate the process analyzing their weakness and capacity and making an as improvement plan, as the support from DWSS depends on the business plan of the WUSC. DWSS technical team can suggest and propose their standard ideas and information for strengthening organizational capability of targeted WUSCs.

Based on the management model, DWSS may suggest on setting the targets in their business plans considering how to realize such targets while contemplating the standard also. When the targets set in the business plan are achieved, organizational capability of the WUSC is assumed to be strengthened. Capacity of WUSC is judged in terms of achieving revenue production target, water quality target, customer satisfaction target, management efficiency target, and financial target. Qualitative indicators such as motivation of staff, attitudes of staff and leadership of manager can also be used for the judgment of capacity improvement. DWSS needs to develop standard of service for uniformity and quality.




Support to WUSC:

1. Guide to optimize institutional system
2. Provide training to enhance knowledge of staff
3. Provide OJT to strengthen skills and knowledge of staff
4. Provide opportunity for sharing and exchange information between water supply service providers
5. Provide financial assistance
6. Provide material support
7. Provide material support

**Figure 1.1: WUSC Support Model**

Engineering standards may be mentioned in SOPs. However, there are some other standards too which also may be the target for improvement. DWSS should have national standards regarding the indicators of customer service, management efficiency and financial stability.

Customer services

- Coverage ratio: This should be based on national water policy, normally more than 50% and ideally more than 75%.
- Consumption per capita per day: This should be based on national water policy, normally recommended more than 80 liters per capita per day.
- Service hour: This should be continuous for 24 hour or for maximum number of hours as far as possible.

Management efficiency

- NRW: This should be based on national water policy, normally it should be less than 25%
- Collection efficiency: Normally it should be more than 95%
- Connection per staff: Normally more than 150 connections for a total of 1,000 to 2,000 connections and more than 200 for over 2,000 connections. However, this number should be based on available facility, location and work load.

Financial stability indicators

- Balance: Expenditure should be less than revenue and balance should be sufficient to meet future need.
- Water tariff meets financial requirement and users' expectations.

DWSS may support WUSCs in six ways as mentioned in the Figure 1.1.

### (1) Guide to optimize institutional System

Assistance for institutional build up may be provided through basic theory of organization, sample of institutional system and advices for optimization of their institutional set up.
However, more important thing is guiding WUSCs for mobilizing institutional system effectively to their governance and management. For example, performance appraisal system would be useful tools to motivating their staff.

In addition, it is necessary to provide management advisory services regarding engineering issues (such as population projection, water demand projection, cost estimation etc.), management issues (such as customer services, water rate setting, HRM, HRD, administrative services, bookkeeping and accounting), and financial issues (such as financial planning and arrangement of financial resources for capital investment)

### (2) Provide training for capacity building of WUSC staff

DWSS can provide training to introduce new technology and to enhance knowledge, or for renewing skill of WUSC's staff. The guideline recommends for developing standard training, training materials and SOPs for such training to WUSC personnel and their staff . DWSS through CHRDU can organize such type of training.

### (3) Provide OJT: On the Job Training

OJT is most powerful tool to enforce and ensure functional skills of WUSC's staff . Expert of DWSS could visit WUSCs and provide guidance to their activity based on SOPs they are practicing.

### (4) Provide opportunity for sharing and exchange information among WUSCs

DWSS should organize exchange visits for WUSCs for exposing them with and to other water supply systems within and beyond the region. Joint training or open training for WUSCs conducted through WSSDOs may provide an opportunity to assist on their socialization activity.

### (5) Provide financial assistance

There is a normal practice to provide financial assistance to WUSCs for extension and rehabilitation of the system. Though it is not clear whether such financial assistance considers the business plan and financial capability of WUSC or not. It has been observed that one WUSC has been succeeded to get financial or physical support while another WUSC has not been able to get such a chance. It has also been observed that the WUSCs having sufficient financial capability to bear full cost recovery have become successful in getting financial assistance from DWSS for additional capital investment. While providing financial assistance to WUSCs, their financial capability should be considered, however, provision of financial assistance should be based on the concrete business plan and should be provided within stipulated terms and conditions.

There might be two kinds of financial assistance: 1) financial assistance to capital investment of WUSCs in order to rehabilitate existing physical facility, to extend of pipeline or to construct additional new facility, and 2) financial assistance to their operation of business, especially at initial stage for formulation and starting of the business. It has been observed that DWSS is providing such financial assistances in many of such cases. However, it would have been better to set a financial mechanism with the provision of interest zero loan or low interest loan. In order to reduce the burden of DWSS and to improve financial independency of WUSCs, this guideline recommends introducing full cost recovery concept gradually. DWSS should provide financial assistance too, but only considering the financial capability of the WUSCs, especially their business plan.

### (6) Provide Physical and material assistance

Physical assistance means providing water supply facility materials to produce and distribute safe water free of cost. At present, DWSS is providing grants for physical facility of water supply systems and also providing chemicals for purification of water free of charge. This guideline suggests to provide such grants based on financial capability and the business plan of WUSCs. There may be some difficulties on acquiring chemicals, however, WUSCs should also incur at least some costs of the chemicals if they are capable. Table 1-1 shows operational strategy for supporting WUSC by DWSS

**Table 1-1 Operational Strategy in each Support Area to WUSCs**

| Support Area | Operational strategy | Responsibilities/Frequency |
|---|---|---|
| 1. Guide to set-up institutional system | # Provide guidance to develop statute and registration of WUSC<br># Incentives for best performance of WUSC<br># Tie-up with VDC/DDC<br># Encourage to place right staff at right place<br># # provide operational and maintenance manual/guidelines | - In the beginning of a project set up and then refreshment periodically |
| 2. Provide training for capacity of staff | # Organize technical training for maintenance workers, pump operators, meter readers, plumber Organize training on Water Safety Plan<br># Organize training on Sanitation<br># Organize training on Computer, Electro-mechanical and Plumbing<br># Organize management training for WUSC and managers | - Based on capacity development plan of WUSC |
| 3. Provide OJT to ensure skills of staffs | # Preconstruction training<br># Maintenance Workers training<br>#Plumbing training<br>#Pump operator, meter reading, leak detection training<br># water quality testing and water safety plan<br># Treatment plant operator, disinfection training<br># Management training | - Based on annual plan of DWSS |
| 4. Provide an opportunity for information exchange among WUSCs | # Exchange visit for management committee & staffs<br># Publication and distribution of booklets, brochure and news letters<br># Liaison conference<br>#Establishment of websites | - Based on annual plan of DWSS |
| 5. Provide financial resources | # Provide financial support and loan arrangement for new project and rehabilitation project<br># provide resources for maintenance and capacity development based on need performance | - Based on Business plan |
| 6. Provide physical facilities and materials resources | # Provision of pipes, fittings, tools to WUSC<br># Computer, equipment<br># Lab equipment<br># Guidelines and manuals | - Based on business plan and joint monitoring and commitment on conference |

Each and every WSSDOs must collect business plan of WUSCs seeking assistance through them. WSSDOs further confirm the need and eligibility of assistance and align the need of assistance in their annual budget accordingly. In order to secure the budget and avoid difficulties in providing adequate financial and physical assistance to WUSCs, WSSDO may ask WUSCs for postponement on their capital investment or for adjustment in their business plan for aligning with the budget ~~of~~ available to WSSDO.

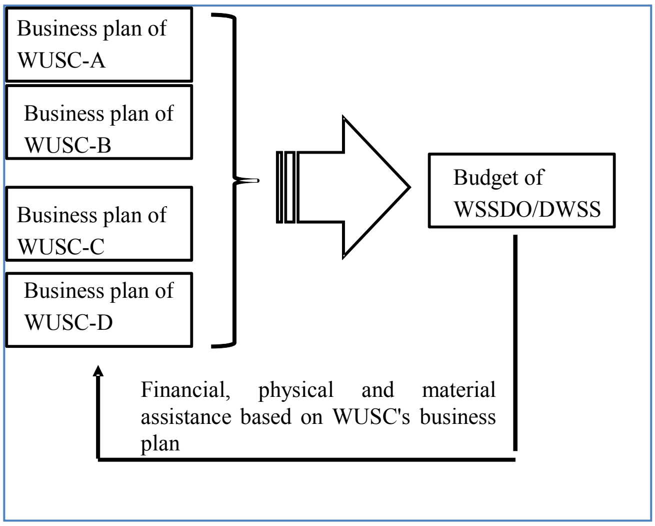



**Figure 1.2: Concept to Support WUSC**

# Chapter 2: Maintenance Inspection Team

Purpose of Maintenance Inspection Team (MIT) is to enhance WUSC's capacity on solving problems themselves on-site It also helps to build up a bond and to extend cooperation among authorities to provide better water supply services. MIT facilitates to have an access to the experts on the repair and maintenance of the equipment and on the operation of water supply and water treatment process. MIT also helps to solve the problem unsolved due to lack of knowledge or awareness and enhance preventive maintenance process. The effectiveness of MIT depends on the evaluation indicators, ease on maintenance support and sharing of information.

**Function of the Team & Attainment of Target**

- Evaluate performance in terms of operation of system, operation of equipment and quality of water. Provide environment to WUSCs to solve problems on-site.
- Encourage preventive maintenance
- Observe maintenance records
- Provide easy maintenance support

**Team composition**

MIT is a joint team of WSSDO staff and WUSC's operators. The composition of the team shall be as follows:

1. Team Leader – Engineer from WSSDO
2. Assistant team Leader – Sub-Engineer from WSSDO
3. Member - On-site operator in charge of corresponding WUSC

Sometimes, DWSS staff and/or external resource persons can also be included in the team as experts for specific purpose.

**Time schedule**

MIT shall carry out inspection regularly in every three month during intensive support period and then twice a year in normal period. The team shall submit evaluation report to WSSDO and to WUSC with feedback for necessary improvement. Common issues shall be addressed in annual workshops organized in the region in which WUSCs needs to shall also present their annual reports.

**Sample of Inspection Sheet is shown in the next page.**

# ~ Evaluation Sheet ~

Total Score

The (1st・2nd・3rd・4th) Inspection, ______(year)   Date :

WUSC

( "....................."   District

＜Breakdown of Evaluation＞

**- Water Quality -**

- Standard Operation Procedure
- Operation Record
- Analysis kits & Material Management
- Water Quality Analysis by accredited laboratory
- Improvement, Attitude to on-site issues

Sub Total 0 / pt.

**- Water Distribution -**

- Maintenance Records
- Quality of the Record
- Preventive Maintenance (Distribution & Service Pipes)

**- Water Meter -**

- Store & Customer Records
- Treatment of Customer Complaints & Records

Sub Total 0 / pt.

**- Mechanical & Electrical -**

- Maintenance Record
- Quality of the Record
- Preventive Maintenance
- Maintenance tools, & Spare parts
- Improvement, Attitude to on-site issues

Sub Total 0 / pt.

**~ Score Calculation ~**

| Section | Actual Score | Maximum Score |
|---|---|---|
| Water Quality | 0 | 0 |
| Water Distribution & Water Meter | 0 | 0 |
| Mechanical & Electrical | 0 | 0 |
| Total | 0 | 0 |

$$= \frac{\text{Total Actual Score}}{\text{Total Maximum Score}} \times 100$$

= ##### Pt.

《 Issues 》

《 Counter Measures

- Comments -

Evaluated by MIT ".............................."

TL :

SL :

TL: Team Leader, SL: Sub Leader

*Signature*

Team Leader of Maintenance Inspection Team

# Chapter 3: Management Advisory Team

Purpose of Management Advisory Team (MAT) is to assist WUSCs on the management of water supply system to ensure sustainable and safe water at affordable cost to the maximum people within their jurisdiction. On the request of WUSCs, MAT advises them on setting and revising targets and provides suggestions on attaining those targets.

Composition of Management Advisory Team:

- The Team shall be composed of three experts with one from management, one from technical and one from financial areas.
- The Team member can be either staff from DWSS and WSSDO or outsourced under special provision.

Roles and responsibilities of team members:

(1)Management advisor

The Chief of WSSDO or an external can play the roles of management advisor. The roles of Management Advisor are:

- Providing management advices to WUSC regarding number of connection, water rate improvement, recruitment of staff, management efficiency, and training of staff, etc.
- Monitoring management performance of WUSCs monthly
- Evaluating management performance annually with other team members and WUSC
- Doing necessary arrangement on technical and financial support to WUSC

(2) Technical advisor

An Engineers of WSSDO or an external can play the roles of technical advisor. The roles of Technical Advisor are:

- Providing technical advices to WUSC regarding water demand projection, facility improvement planning, basic design of facilities, cost estimation of facility improvement planning, training for staff for facility operation and maintenance and water quality control
- Arranging technical training course for WUSC's staff
- Monitoring implementation of the technical plan of the business plan regarding projection of water demand, preparation of technical project, progress of construction and evaluation of technical project
- Reviewing implementation of the technical plan of the business plan with WUSC annually, and provide advises on update, if necessary

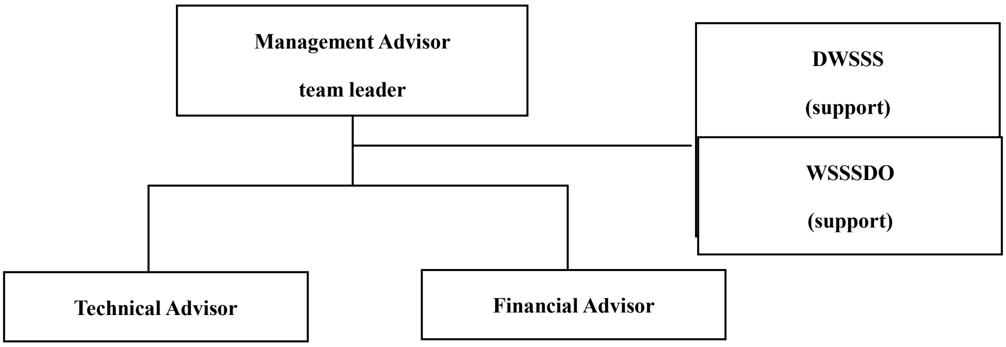
- (3) Financial advisor

An Engineers or Chief of WSSDO or an external can play the role of financial advisor. The roles of Financial advisor are:

- Providing financial advices to WUSC regarding (after tariff setting, financial planning and financial resources arrangement

- Monitoring implementation of the financial plan of the business plan regarding revenue and expenditure, progress of financial arrangement annually with WUSC
- Reviewing implementation of the financial plan of the business plan with WUSC annually and providing advises on update, if necessary

-




The core activity of the team includes:

- Providing advices on management of WUSC upon their request
- Monitoring management performance of WUSC based on trimester report submitted by WUSC them
- Conducting annual joint evaluation together with WUSC on the implementation of business plan.

# Chapter 4: Monitoring and Evaluation

Objective of Monitoring and Evaluation Team (MET) is to reconfirm target and monitoring indicators and to keep watching achievement through monthly and annual reports. Joint monitoring and evaluation of WUSCs regarding M&E performance indicators, targets and achievement are recommendable. Based on the M&E, DWSS may recommend or enforce for the improvement of management capability or efficiency. Monitoring Evaluation Team (MET) comprises of representative of DWSS, RMSO, WSSDO and concerned staff of WUSC.

Table below shows sample of key performance indicator for monitoring and evaluation. The joint monitoring team evaluates current achievement against targets and come out with area of improvements.

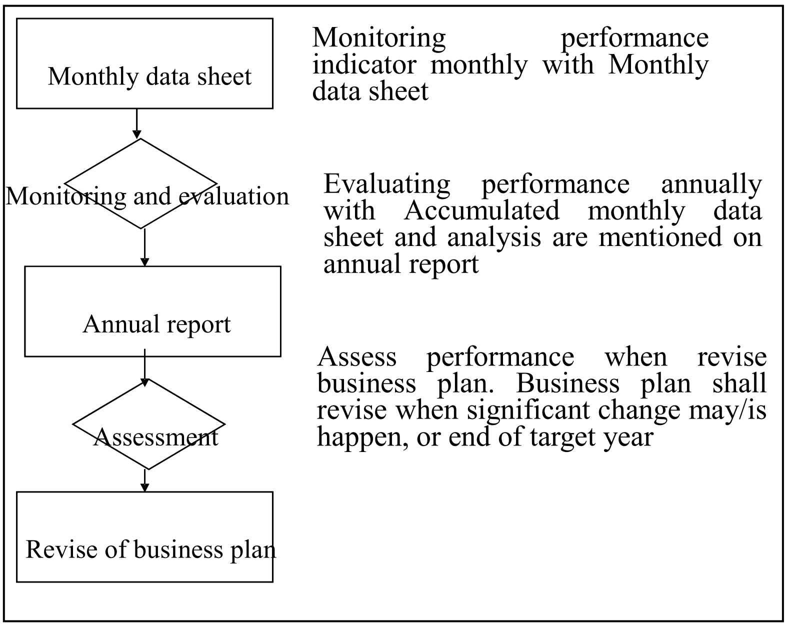
| SN | Performance Indicators | Unit | Baseline 2013 | Target of Current year | Achievement of Current year |
|---|---|---|---|---|---|
| A | **Technical** | | | | |
| 1 | Coverage | % | | | |
| 2 | Population served | No. | | | |
| 3 | Production | $m^3/d$ | | | |
| 4 | Av consumption per connection | $m^3/m$ | | | |
| 5 | Active connections | No | | | |
| 6 | Unaccounted for Water(UFW) | % | | | |
| 7 | Non Revenue Water(NRW) | % | | | |
| 8 | No of pipe breaks | No./yr/km | | | |
| 9 | Sample meting WQ standard | % | | | |
| 10 | Service hours | hr/day | | | |
| B | **Management** | | | | |
| 1 | Number of Staff | No. | | | |
| 2 | Number of connection per staff | No. | | | |
| 3 | Collection efficiency | % | | | |
| 4 | Consumer complains | No./m | | | |
| C | **Financial** | | | | |
| 1 | Revenue collection from operations | Rs/year | | | |
| 2 | Expenditure for operation | Rs('000/yr) | | | |
| 3 | Cash balance | Rs/yr | | | |

| | | | | | |
|---|---|---|---|---|---|
| 4 | Operational cost | Rs/cm | | | |

Monitoring and evaluation schedule:

It is recommended to conduct monitoring every month and evaluation once a year. WUSCs can update target as well as key performance indicators themselves. DWSS also can advise to update target and key performance indicators for accelerating implementation or to adjust change of management environment based on the result of monthly monitoring. It is also recommended to schedule annual joint evaluation meeting by both WUSCs and DWSS together.

Evaluation simply confirms the level of achievement of the target and aptness of key performance indicators. If WUSC has not been able to achieve the target, MET may find reasons and may recommend for necessary improvements or solve the problems.




The typical tips which can be used for evaluation are given on the following Table.

| SN | Evaluation points | Result |
|---|---|---|
| 1 | Achievement to previous plan<br>- Construction, Connection, Water consumption, Water quality | |
| 2 | Improvement of efficiency target<br>- Water quality, NRW, connection per staff, collection efficiency, User complaints response rate | |
| 3 | Judgment<br>- Efficiency of implementation, Effectiveness of implementation to long term goal, Impact to improvement and demands, relevance with other plans, policy and programs, sustainability of results | |
| 4 | Issues and problems<br>- Issues and problems solved, Issues and problems still not solved, Emerged new issues and problems | |
| 5 | Lesson learned | |

| | | |
|---|---|---|
| | - Insight and lessons learned for feedback to next phase planning | |

WUSCs must be committed to achieve the target. They must conduct monitoring regularly and judge the achievement based on the key performance indicators. DWSS should also motivate WUSCs through awarding best practices during annual conference.

# Annex: Roles of Supporting Teams

| Support Model | | | | |
|---|---|---|---|---|
| **Items** | **Monitoring Evaluation Team (MET)** | **Management Advisory Team (MAT)** | **Maintenance Inspection Team (MIT)** | **Practical Training** |
| **Responsible Organization** | DWSS, ERSMO, WSSDOs | WSSDOs, WUSCs | WSSDOs, WUSCs | DWSS, WSSDOs, WUSCs |
| **Objectives** | • Evaluate technical and management capacity of WUSCs | • Provide advice on the business management | • Provide advice on the operation and maintenance (O&M) of water supply facilities<br>• Ensure compliance on the regular routine work of the facilities | • Organize training based on the needs identified by MET, MAT and MIT |
| **Roles** | • Evaluate technical and administrative management capacity of WUSCs and their staff<br>• Collect key Performance Indicators (PIs) | • Provide assistance in the formulation of ~~a~~ business plan<br>• Check implementation status of the business plan<br>• Reflect MIT's recommendations for facility improvements on the business plan<br>• Provide instruction on the preparation of ~~a~~ monthly reports including management indicators | • Provide guidance for record keeping of O&M<br>• Provide guidance for carrying out facility inspection and preventive maintenance<br>• Provide guidance on water quality management<br>• Evaluate existing facilities<br>• Provide recommendations on the improvement of facilities<br>• Share the information with MAT | • Provide training on O&M based on the Standard Operational Procedures (SOPs)<br>• Provide training on the preventive maintenance<br>• Provide assistance in the formulation of business plan<br>• Provide guidance on the improvements of SOPs to suit each WUSC's condition |
| **Activities (Frequency)** | • Site visit for monitoring of operation and management<br>• Joint M&E Conference (1 time/year)<br>• Evaluation Report (1 time/year) | ・ Site Visit for Business Planning (1 time/year)<br>・Activity Report (1 time/year) | • ・Site Visit for the Facility Inspection (4 times/year)<br>• Activity Report (4 times/year)<br>• O&M Monitoring Workshop (1 time/year) | • Practical Training (at least 1 time/year and as needed) |

**SOP (Standard Operation Procedure) of WTP O/M (Water Quality Management)**

**1. Water Quality Management**

Water Quality Management consists of Water Quality Analysis and quantitative purification process control.

**2. Contents of SOP**

In 2010 five copies of Nepali version of Operation of Water Treatment Plant and Maintenance Manuals (O/M manual) for Mangadah, Gauradaha and Dhulabari WUSC were distributed at each 3 WUSC. (Appendix 1, 2 ad 3)
Basically, O/M shall be conducted by the manuals above.

Therefore, this SOP of Water Quality Management is prepared by gathering and the summarizing the materials used for the set of trainings for 3 (three years) at DWSS Central Laboratory, 2 WSSDO (Morang and Jhapa) and 3USCs (Mangadh, Gauradaha and Dhulabari).supplementary as the key points of water quality management、including design and evaluation of the Water Purification Plant shall be added here.

This SOP shall include the followings;

**A. SOP for Water Purification Process Management**

A-1 Water treatment process and equipment/facilities which consist of process
1. Coagulation-sedimentation-rapid filtration.
   (1) Alum dosing rate
   (2) Rapid Mixing Basin and Flocculation Basin with gentle mixing
   (3) Sedimentation Basin
   (4) Rapid Filter
2. Iron Removal Plant with Manganese Sand
3. Slow Sand Filtration System

A-2 Maintenance of the equipment/facilities
A-3 Flow management
A-4 Record Formats for Water Quality Management
A-5 Trouble shooting: Refer to manual of each equipment

**B. SOP for Water Quality Analysis**

B-1 Purpose of water quality analysis
B-2 Water quality criteria
B-3 Sampling
B-4 Frequency of water quality analysis
B-5 Water quality analysis methods
B-6 Data management
B-7 Disclosure of information
B-8 Closing

And these items are not independent from view point of process control/quantitative process control or quantitative operation which based on current quantity and quality.

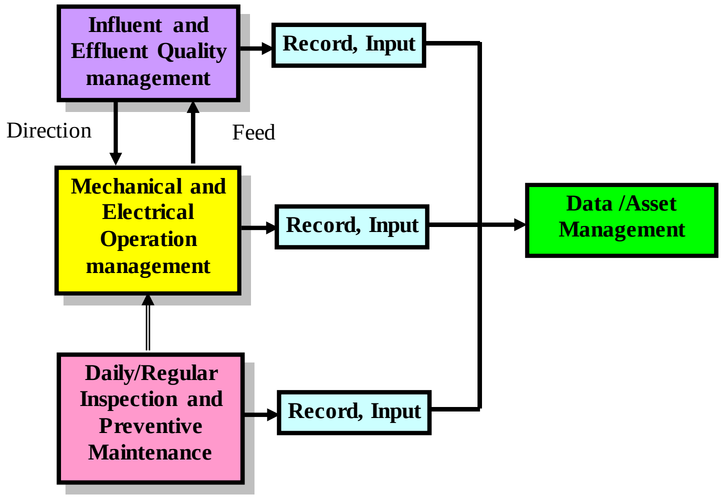



**Figure-1 Concept of Quantitative Operation**

## A. SOP for Water Purification Process Management

### A-1 Water treatment process and equipment/facilities which consist of process

There are some water treatment processes.

### 1. Coagulation-sedimentation-rapid filtration.

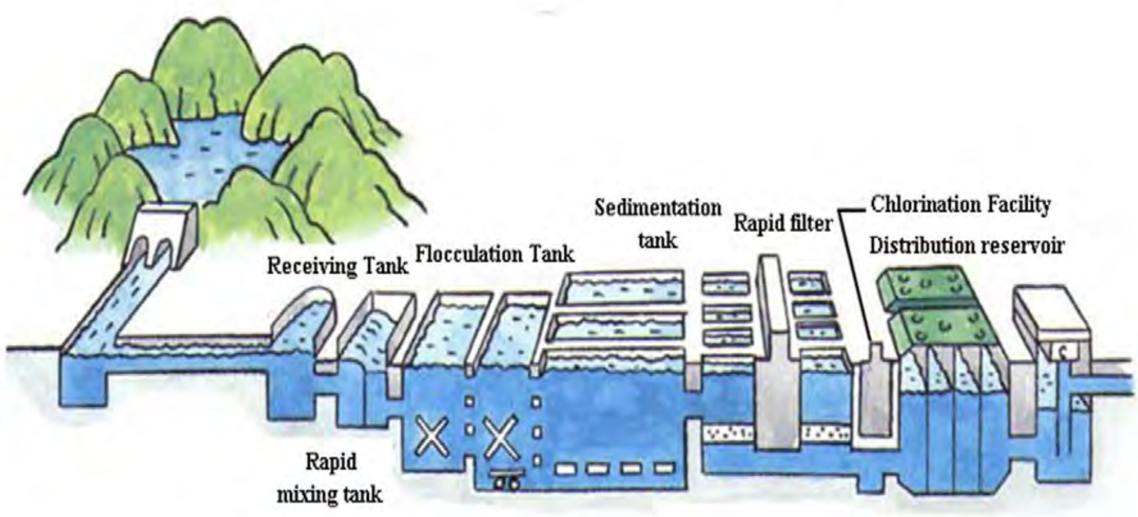



**Figure 2: Conceptual figure of drinking water purification plant**

This process is used for the raw water with relatively high turbidity.
At first small particle is coagulated by adding coagulant like alum to form floc and most of flocculated particles are removed at sedimentation tank. The rest small particles are removed by rapid filter.

The ley points of this process are;

**(1) Alum doing rate P (mg/L).**

$P \approx 2 \times \{6 + 2 \times (T)^{1/2}\}$

T: Turbidity (NTU)

**(Example 1)**

Turbidity = 360 NTU,

$P \approx 2 \times \{6 + 2 \times (360)^{1/2}\} = 2 \times (6+2\times60) \approx 250$ mg/L = 250 g/m$^3$

**(Remarks)**

- Turbidity can be measured by digital turbidity meter at DWSS Central Laboratory.
- Lots of alum feeding rate cause pH drop. To compensate. sodium carbonate ($Na_2CO_3$) is used in proportion to alum doing rate x 0.48
- Jar test is used to determine the most appropriate alum dosing rate with the conclusive considerations of particle sinking velocity, supernatant and filtrate quality, generated sludge volume, supernatant filtration velocity, etc. If necessary ask DWSS Central Laboratory.
- Regular backwash of filter is necessary. In general back wash velocity filter is 30 -36 m/hour and 18-20 m/hour for sand and anthracite, respectively.

**(2) Rapid Mixing Basin and Flocculation Basin with gentle mixing**

- Retention time of flocculation basin: 20 -40 minutes
- Flocculation
  - Mixer type: 15 -80 cm/second of peripheral speed
  - Vertical baffled channel type: 15-30 cm/second of average velocity

- G and GT value

  GT is an indicator to form good flocks and calculated by mixing gradient (or mixing intensity G value ) x retention time. Optimum G and Gt for flocculation are 30 to 60 (1/s) and 23,000 -210,000, respectively. .

  $G = (p/\mu)^{1/2}$

  Where;

  P: Power consumption per water volume

  μ: Viscosity of water

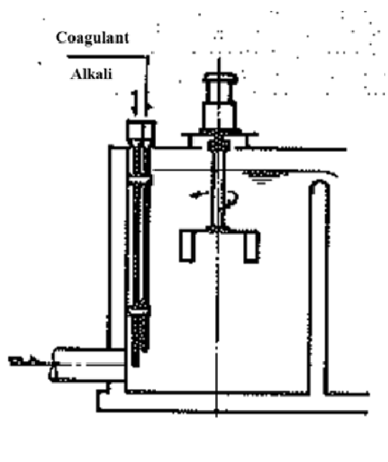
- In flocculation basin, G and Gt values are 30 to 60 (1/s) and $10^4$ to $10^6$, respectively, in flocculation basin, Maximum and minimum required unit shaft power per treatment volume per sec (P/Q) are 6.0 and 0.3 (kW/m$^3$/sec)

**(Example 2)**

**(a) Rapid mixing basin**

(General Conditions)

- Necessary shaft power: 2. 5 (kW/(m$^3$/sec)
- Retention time of rapid mixing basin: 1 to 2 minutes
- Mixing velocity: more than 1.5 (m/s)
- The shape of rapid mixing basin: Square or




Voltex type Rapid mixing basin

rectangular close to square

- Effective depth of the basin: Close to edge length

(Design condition)

- Treated water volume: 50,000 ($m^3$/day)
- Efficiency of reduction gear: 85 %
- Retention time of basin: 1 minute
- Water temperature: 20 ºC

(Answer)

- Necessary basin volume =50,000 ($m^3$/day)/1,440 (minutes/day) x 1minute = 34.7 ($m^3$)
- Dimension of basin = 3.5$m^W$ x 3.5$m^L$ x 3 $m^H$-effective depth = 36.8 $m^3$
- Necessary shaft power = 50,000($m^3$/day)/ 86,400 (sec/day) x 2.5$^{(Note)}$ (kW/$m^3$/sec) =1.47 (kW)
- Motor output= 1.45/0.85 = 1.7 kw ⇒use 2.2 kW
- G = $(p/\mu)^{1/2}$

  Where;

  P: Power consumption per water volume = 2.2 x 0.85 ($m^2$・kg/$S^3$ x $10^3$)/36.8 ($m^3$)

  μ: 1 (cP) = $10^{-3}$(kg/m/s) at 20 ºC

1 kW = J/s = kg・$m^2/s^3$ x$10^3$

- G = ［(2.2 x 0.85 x$10^3$/(36.8 x $10^{-3}$)］$^{1/2}$=225 (1/s), For rapid mixing, optimum G is more than 100 (1/s).
- $G_t$ = 225 x 36.8x 86,400/50,000 = 1.43 x $10^4$ (-)

**(b) Flocculation Basin**

**(Example 3).**

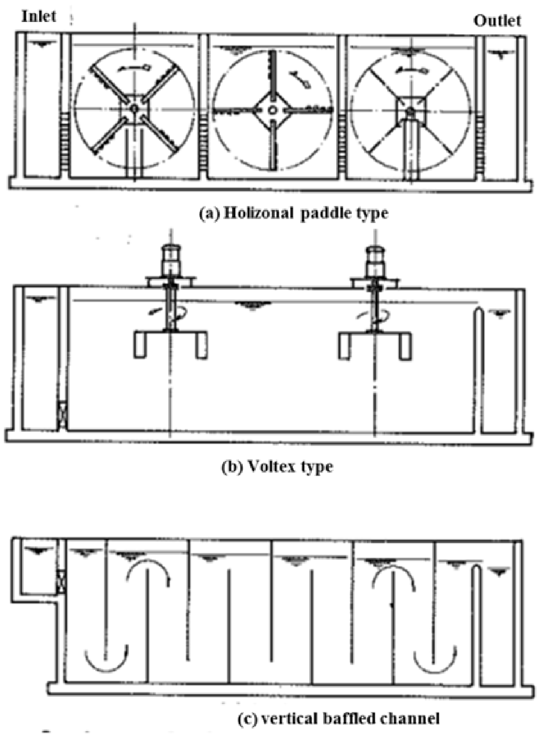
(Design condition)

- Q = 50,000 ($m^3$/day)
- Number of basins: 2
- Install 2 (two numbers) of vertical stirring blade in each basin
- Retention time: 30 minutes
- Efficiency of decelerator and transmission, 0.9 and 0.8, respectively
- Water temperature: 20 ºC

(Answer)

- Necessary volume of unit basin = 50,000 x 30/(2 x1,440) = 520 ($m^3$)

- Dimension of the unit basin: 18 (m)W x 9 (m)L x 3.5 (m)H = 567 ($m^3$)
- Necessary unit shaft power = 50,000($m^3$/day) x 6.0 (kW/$m^3$/sec)/(2x2x 86,400(sec/day)) = 0.87 (kW)
- Required unit motor output= 0.87/(0.9x 0.8) = 1.21 (kW) ⇒1.5 (kW)
- Unit retention time = 567/50000/1440 = 980 seconds
- $G = [\,(1.5 \times 0.9 \times 0.8 \times 10^3/(567 \times 10^{-3})\,]^{1/2} = 44$ (1/s)
- $Gt = 44 \times 980 = 4.3 \times 10^4$ (-)



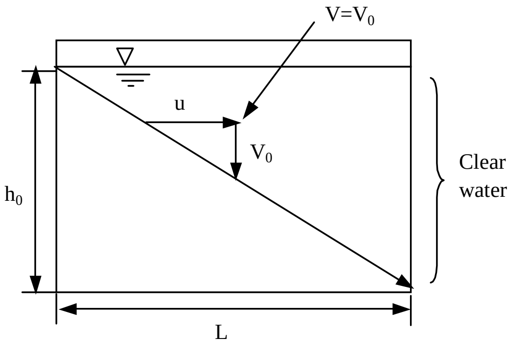

**Type of Flocculator**

**(3) Sedimentation Basin**

The key point of design and evaluation of sedimentation basin are the folowings.

- Average velocity
- Surface area load

Surface water load: $V_0 = Q/A$



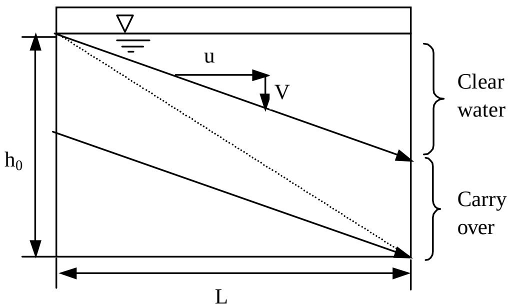

Inflow Q, Velocity u, water depth $h_0$
Sinking area A, Width of pond B, Length of pond L

$V_0 = h_0/L/u$  $Q = B*h_0*u$  $A = B*L$

$V_0 = Q/A$

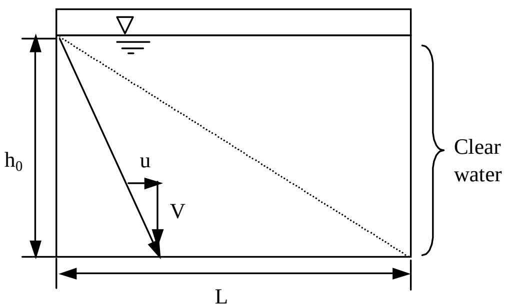
Removal rate :100 %

(1) Sinking velocity of particle $V = V_0$




Removal rate :$V/V_0$

(2) Sinking velocity of particle $V < V_0$




Removal rate :100 %

(3) Sinking velocity of particle $V > V_0$

- To improve the performance of sedimentation basin
  - Increase of surface area loading : by inclining plate, two story sedimentation
  - Increase sinking velocity of flock : high rate sedimentation
  - Decrease inflow Q
- Surface water load is recommended 5 to 10 mm/min and 15 to 30 mm/min for plain without chemicals and chemical sedimentation with chemicals, respectively for rectangle sedimentation basin. However, particle sinking velocity with chemical should be checked by jar test.

- Average velocity u is recommended less than 0.3 m/min.

**(Example 4).**

(Design condition)

- Q = 4,200 ($m^3$/day)
- Width: 10 (m), Length: 40 (m), Effective water depth (H): 3.5 (m)

(Answer)

- Q = 4,200 ($m^3$/day) = 175 ($m^3$/hour) = 2.92 ($m^3$/min)
- Retention time = 10 (m) x40 (m) x 3.5 (m)/175 ($m^3$/hour) = 8 (hours)
- Average velocity = 2.92 ($m^3$/min)/(10 (m) x3.5 (m)) = 0.0835 (m/min) = 8.35 (cm/min)
- Surface area loading = 4,200 ($m^3$/day)/(10(m) x40 (m)) = 10.5 (m/day) = 7.3 (mm/min)

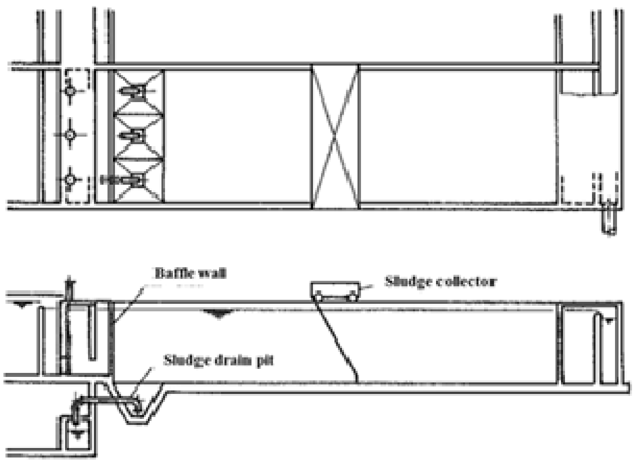
**(Example 5).**

(Design condition)

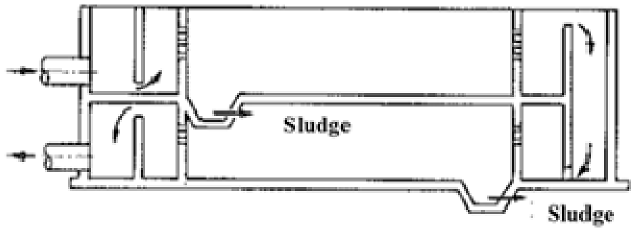
- Particle sinking velocity = 20 mm/min by Jar test with alum and polymer
- Q = 4,200 ($m^3$/day) = 175 ($m^3$/hour) = 2.92 ($m^3$/min)
- Retention time = 3.0 hour Guideline 3 to 5 hours)
- Factor from jar test to design of surface area loading: 0.6
- Length: Width = 5:1 (Guideline 3:1 to 8:1)

(Answer)

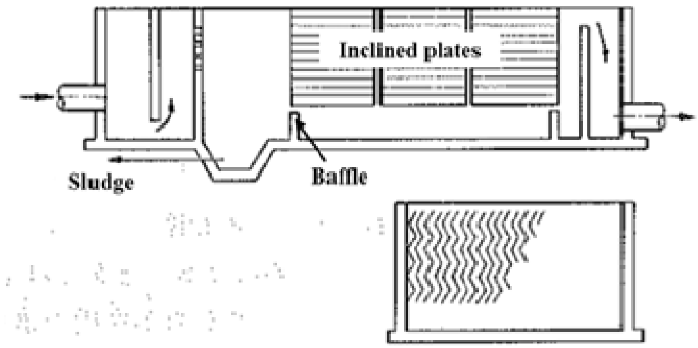
- Surface area loading = 20 x 0.6 (mm/min) = 12 (mm/min) = 0.012 (m/min)
- Surface area = 2.92 ($m^3$/min)/0.012 (m/min) = 243 ($m^2$)
- Effective depth (m) = 175 ($m^3$/hour) x3.0 (hour) /243 ($m^2$) = 2.2 m (Guideline 3 to 4 m) →2.5 m
- Width = 7 m, Length = 35 m
- Average velocity = 2.92 ($m^3$/min)/7 (m)/2.5 (m) = 0.17 (m/min) (Guideline less than 0.4 m/min)
- Actual retention time = 243 ($m^2$) x 2.5 (m)/175 ($m^3$/hour) = 3.5 hours




**Rectangular Sedimentation**




(a) Double deck clarifier




(b) Inclined plate clarifier

**(Example 5).Sludge generation**

- Q = 4,200 ($m^3$/day) = 175 ($m^3$/hour) = 2.92 ($m^3$/min)
- Inflow SS= 100 mg/L (Including SS from alum)
- SS removal rate at sedimentation = 85 %
- Sludge concentration = 2.5 %

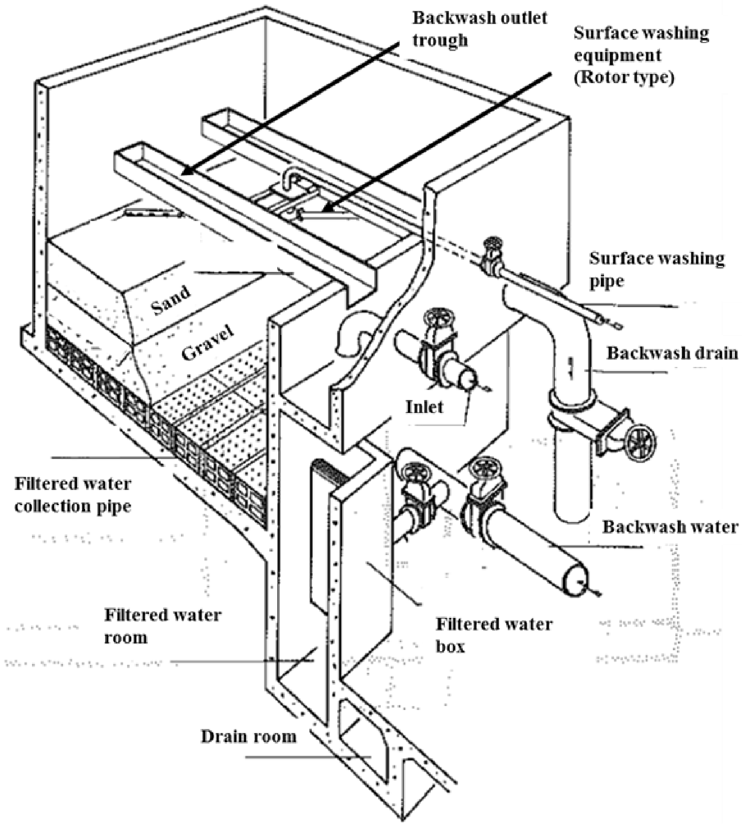
(Answer)

- SS generation = 4,200 ($m^3$/day) x 100 (g/$m^3$) x 0.85/1000 (kg/g)/1000 (ton/kg) = 0.357 ton/day = 0.357 x 100/2.5 = 14.3 ($m^3$/day)

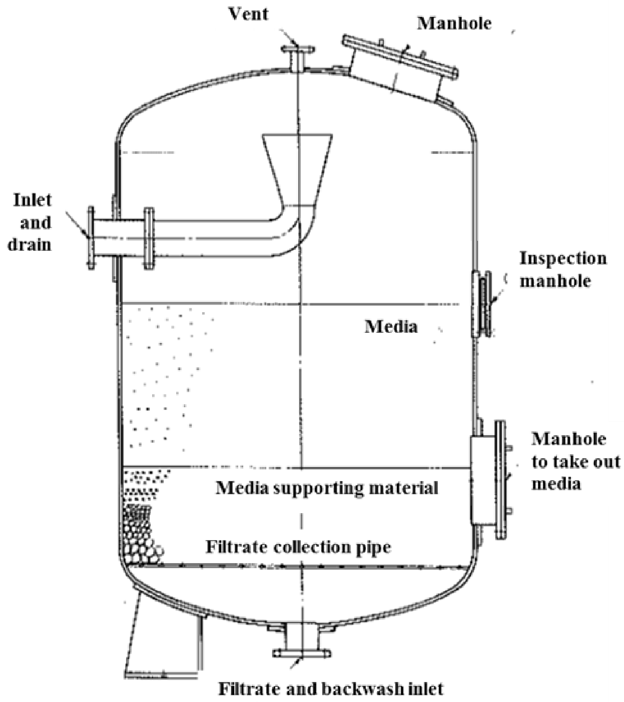
### (4) Rapid Filter

Key points of rapid filter are the followings.

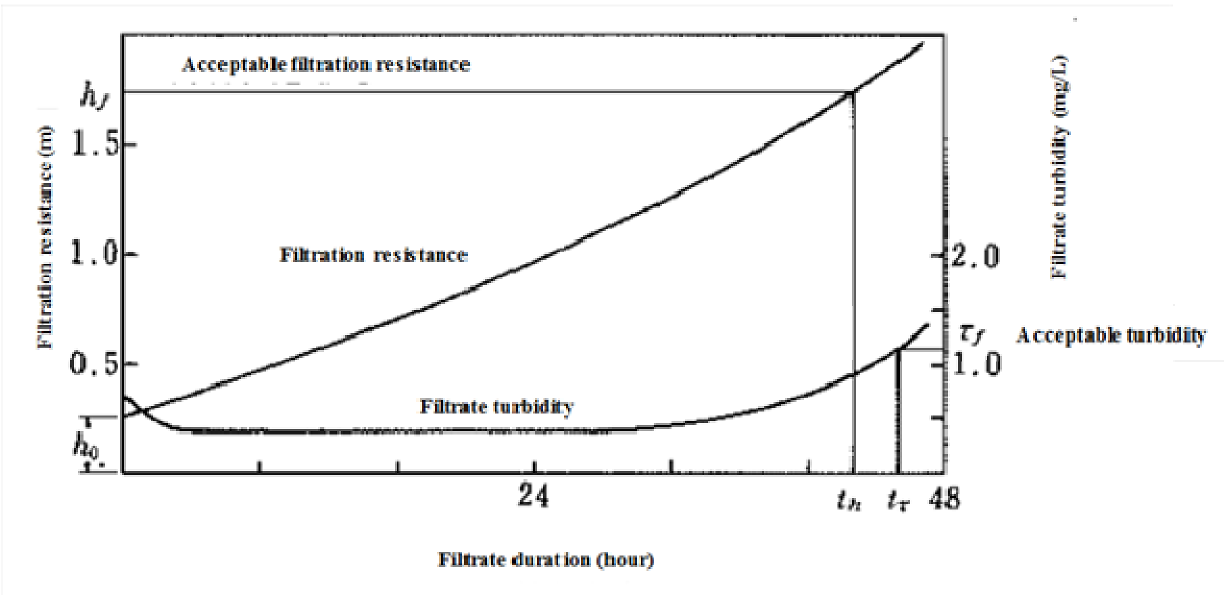
- Effective size, Uniformity coefficient, Harmonic mean size of media
- Filtration velocity
- Optimum backwash velocity and timing of backwash



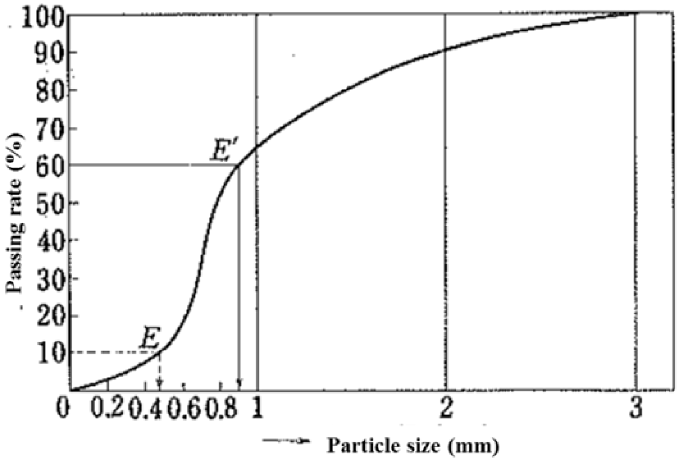

Gravity sand filter



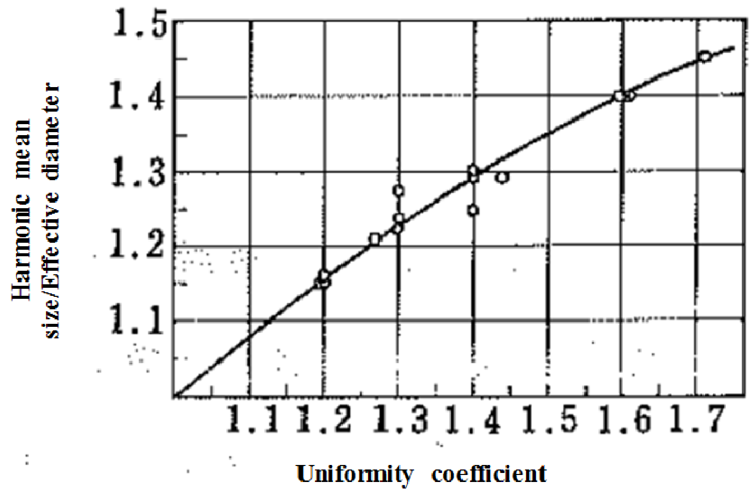

Pressurized Rapid Filter



- Effective size, Uniformity coefficient, Harmonic mean size of media




- Effective size ($E_{10}$): 10 % of passing rate = 0.48 mm
- 60 % of passing rate ($E_{60}$) = 0.90 mm
- Uniformity coefficient = $E_{60}/E_{10}$ = 0.90/0.48= 1.88 (not suitable for rapid sand filter: Guideline : less than 1.7, Slow sand filter: less than 2.0)




**(Example 6) Minimum depth of media**

(Answer)

- In case of uniformity coefficient = 1.5, Harmonic mean size/effective diameter = 1.35
- If effective size = 0.52 mm (Guideline 0.45- 0.7 mm)
- Harmonic mean size = 1.35 x 0.52 = 0.70 mm ,Use it for theoretical calculation)

$L/D \geq 800$

Where;

L: Media depth (m)

D: Harmonic mean size of the media (m)

$L \geq 0.70 \times 800 = 560$ mm (Guideline: 600 to 700 mm)

-

- Filtration velocity = Q ($m^3$/day/A ($m^2$-filter area)
  - Filtration velocity of rapid filtration: 120 – 150 (m/day), in general. It is possible to adopt the velocity of 400 (m/day) in two-layer filtration.
  - Unit filtration area: 150 ($m^2$/filter) considering backwash

- Optimum backwash velocity

**(Example 6) Minimum depth of media**

(Conditions)

- Water temperature: 20 ℃
- Density of sand: 2,630 kg/$m^3$

(Answer)

- Density and viscosity of water at 20 ℃ are 1,000 kg/$m^3$ and $10^{-3}$ (kg/m/s)
- Most appropriate back wash velocity: u

$u_t = \{4/225 \times (\rho_s - \rho_F)^2 g^2 / \rho_F\ \mu\}^{1/3} \times D$

Where;

$u_t$: Sinking velocity of unit particle (m/s)

$\rho_{s:}$ Density of media (kg/$m^3$) = 2,630

$\rho_{F:}$ Density of water (kg/$m^3$) = 1,000

g: Gravitational acceleration = 9.8 ($m/s^2$)

$\mu$: Viscosity of water at 20 ℃ = $10^{-3}$ (kg/m/s)

$\therefore u_t = 0.10$ (m/s)

- $u \approx {}_{ut}/10$ (m/s) = 0.10/10 = 0.01 (m/s) = 0.6 (m/min) = 36 (m/hour)

  u: Most appropriate backwash velocity (m/s) for sand

- Most appropriate backwash velocity of anthracite, $\rho_s$ = 1,550 (kg/$m^3$)

By solving with the same procedure, u = 0.005 (m/s) = 0.3 (m/s) = 18 (m/hour)

**(Example 7) Timing of backwash from by SS caught on the surface of filter media**

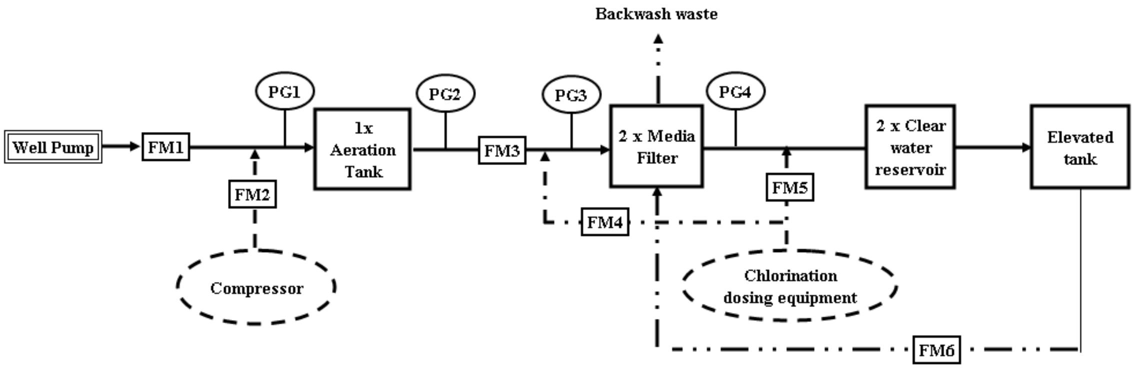
- Inflow = 4,200 $m^3$/day
- SS inlet (outlet from sedimentation tank) = 15 mg/L
- Effluent SS = 2 (mg/L)
- Filtration velocity = 120 (m/day) = 5 (m/hour)

(Answer)

- Filter area = 4,200 ($m^3$/day)/120 (m/day) = 35 ($m^2$)
- Removed SS = 4,200 ($m^3$/day) x (15-2) (g/$m^3$)/1000 (kg/g) = 54.6 (kg-SS/day)
- Limit SS load = 1.0 kg-SS/$m^2$ = 1.0 (kg-SS/$m^2$) x 35 ($m^2$) = 35 (kg-SS)
- Timing of backwash time = 35(kg-SS)/54.6 (kg-SS/day) x 24 (hour/day) = 15.4 (hour)

## 2. Iron Removal Plant with Manganese Sand

The following conceptual flow sheet shows the purification process to remove iron and manganese at Mangadh and Gauradaha WUSC.




Legend

| | |
|---|---|
| FM1 | Inflow volume to aeration tank |
| FM2 | Air flow volume for oxidation of ferrous |
| FM3 | Inflow volume to media filter |
| FM4 | Chlorine dosing flow for chlorination |
| FM5 | Chlorine dosing flow for disinfection |
| FM6 | Backwash flow volume |
| PG1 | Inlet pressure of aeration tank |
| PG2 | Outlet pressure of aeration tank |
| PG3 | Inlet pressure of media filter |
| PG4 | Outlet pressure of media filter |

**Figure 3: Conceptual Flow Sheet of Iron Removal Process (Mangadh and Gauradaha)**

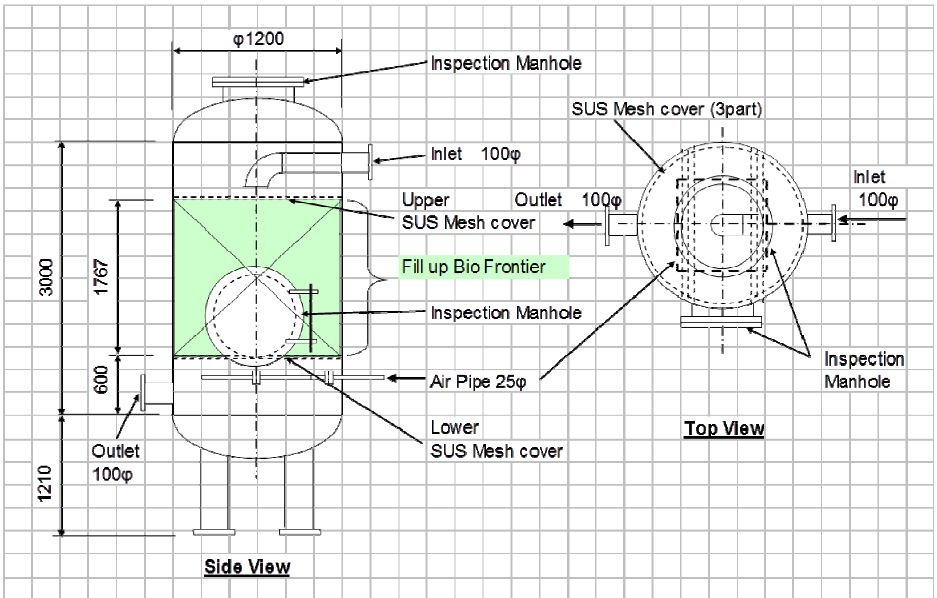
### (1) Explanation of Iron Removal Process:

1) Iron in deep ground water exists in the form of the ferrous ($Fe^{2+}$) -soluble. It can't be removed by conventional water purification process which basically consists of liquid-solid separation.
2) Soluble ferrous changes to solid ferric hydrate (Fe $(OH)_3$) by oxidation. Compressor or chlorine is used for oxidation that's why there are two lines in the flow-sheet. (Figure -2)
3) After the oxidation, solid ferric hydrate (Fe $(OH)_3$) is removed by dual media filter; anthracite and manganese green sand. (Media filter- Iron removal tank) Almost oxidized iron is removed by anthracite layer.
   Remained soluble ferrous iron and manganese are removed by manganese sand.

### (2) Key points of Operation of iron removal plant

1) Air supply
   Usually air is used to oxidize ferrous iron.

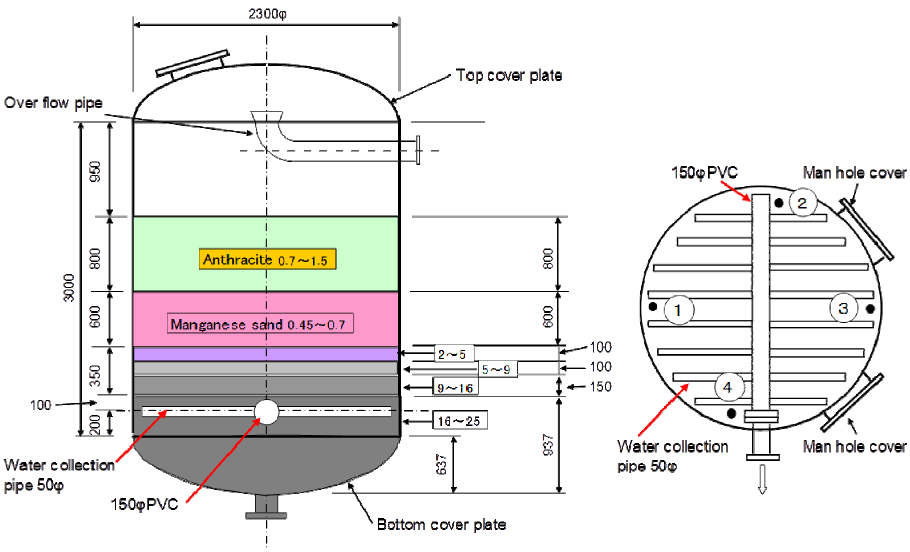
   Necessary air volume is calculated as below. Packed media is to increase oxygen transfer rate.




Bio frontier laying

| No. | Description | Design | Result | Evaluation |
|---|---|---|---|---|
| 1 | Fill up Bio frontier Polypropylene | 4500 liter | | |

**Figure 4: Structure of Aeration Tank (Gauradaha)**




Filter media laying

| S.No. | Name of Filter media & Size | Filling Height (mm) | Top level from bottom of top cover | Total Volume ($m^3$) |
|---|---|---|---|---|
| 1 | Gravel 16～25 | *1 937 | 2700 | 5.30 |
| 2 | Gravel 9～16 | 150 | 2550 | 1.14 |
| 3 | Gravel 5～9 | 100 | 2450 | 0.76 |
| 4 | Gravel 2～5 | 100 | 2350 | 0.76 |
| 5 | Manganese sand | 600 | 1750 | 4.53 |
| 6 | Anthracite | 800 | 950 | 6.04 |

*1 Filling level is 300mm from top of bottom cover

**Figure 5: Structure of Iron Removal Filter**

**(Example 8: Calculation of necessary air supply)**

(Conditions)

**A. Without media**

| | | |
|---|---|---|
| 1) Influent flow | 1,100 | $m^3$/day |
| 2) Inlet iron concentration | 8 | mg/L |
| | 8 | g/m3 |
| 3) Inflow total iron: 1) x 2) | 8,800 | g/day |
| 4) Unit required oxygen to oxidize iron | 0.6 | g-oxygen/g-iron |
| 5) Necessary oxygen: 3) x 4) | 5,280 | g-oxygen/day |
| | 5.28 | kg-oxygen/day |

Necessary air ($m^3$/day) = Necessary oxygen (kg-oxygen/day) x 3.6 ($m^3$/kg-oxygen) x 100/$\eta$

$\eta$: Oxygen transfer rate into water %

| | | |
|---|---|---|
| 6) Assuming $\eta$ (without media) | 2 | % (less than 5 %) |
| 7) Estimation of necessary air: 5) x 3.6 x 100/6) | 950 | $m^3$/day |
| 8) Operation time | 24 | hours/day |
| | 1,440 | minutes/day |
| 9) 7)*1000/8) | 660 | L/minute |

**B. With media: 1) – 5) and 8) same as above**

| | | |
|---|---|---|
| 10) Assuming $\eta$ (With media) | 6 | % (5 – 15 %) |
| 11) Estimation of necessary air: 5) x 3.6 x 100/10) | 317 | $m^3$/day |
| 12) 11)*1000/8) | 220 | L/min |

- Air flow should be in accordance with necessary air flow estimated like above.
- Adjust necessary air flow by needle valve amounted on air compressor and air reducer valve
- Open and close the valve slowly.

  Some time will be necessary to get the designated air flow volume.
- Check aeration tank if there is water leakage from the top of aeration tank.

2) Manganese green sand

Manganese greensand is used as the filter media. It is capable of removing remained ferrous iron, manganese which is hard to be oxidized by aeration at neutral pH, and hydrogen sulfide from water through oxidation and filtration.

Manganese and soluble iron are oxidized and precipitated by contact with higher oxides of manganese on the greensand granules. The hydrogen sulfide is eliminated by oxidation to sulfate and an insoluble precipitate.

Greensand is considered sufficient for normal regeneration. It is advisable to vigorously backwash and to re-generate the bed with a weak potassium permanganate in solution, when it is placed in service and before the oxidation capacity of it totally is exhausted.
Chlorine feeding is favorable for life extension.

To operate the bed after its oxidation capacity is exhausted may reduce its service life.
When properly cared for and regularly backwashed, the green sand filter performance will last for many years.
However, generally, 5 % of manganese green sand is supplemented every year to supplement manganese green sand lost by backwashing and replaced all every five 5 years.

When oxidation capacity of it totally is exhausted, effluent iron concentration increases.
To confirm, refer to “How to check residual ferrous iron” in page 16.

**General specifications of manganese greensand**

1) Capacity:
   - Iron alone--550 gr/$m^3$
   - Iron and Manganese--400 gr/$m^3$
   - Hydrogen Sulfide - 175 gr/$m^3$
2) Conditions for operation:
   - Raw Water pH - 6.2 - 8.8
   - Maximum Practical Limit of Iron ($Fe^{2+}$) or Manganese ($Mn2^{+}$) : In Raw Water - 15 mg/L.
   - Maximum Practical Limit of Hydrogen Sulfide ($H_2S$) - 5 mg/L

- In case of insufficient oxidation to change ferrous iron to ferric hydroxide to be removed by Anthracite layer, ferrous iron is removed by manganese sand which will result in frequent backwash and deterioration of the function of manganese sand.
- Insufficient oxidation comes from low oxygen transfer rate when packed media volume in aeration tank is reduced because the media is used to keep high oxygen transfer rate with sufficient retention time to anthracite layer.
- In case of reduction of oxygen transfer rate by air, chlorine is used to use anthracite layer more effectively and reduce load to manganese sand.

3) Filtration velocity and backwash velocity (Refer to Record Format: Appendix 1)
- Filtration velocity: 5 to 6 m/hour/filter
- Backwash velocity: around 20 m/hour

4) Timing of Backwash
- Allowable differential pressure (App. Maximum 0.07MPa)
- Total filtration time (maximum 24 hrs.)
- Filtrate water treated quality; more than 0.3 mg/L as total Fe or more than 5 NTU as Turbidity, others)
- By estimation as Example 9

**(Example 9: Estimation of backwash frequency**
(Conditions)

| | | | |
|---|---|---|---|
| 1) | Influent flow | 650 | $m^3$/day |
| 2) | Inlet ferrous iron concentration | 8 | mg/L |
| | | 8 | g/$m^3$ |
| 3) | Outlet of ferrous iron | 6 | g/$m^3$ |
| 4) | Inflow ferric hydroxide: 1) x 3) | 3,900 | g/day |
| | | 3.9 | kg/day |
| 5) | Unit SS generation by changing solid ferric hydroxide from soluble ferrous iron | | |
| | | 1.9 | g-SS/ferrous iron |
| 6) | SS generation by oxidation: 4) x 5) | 7.5 | kg-SS/day |
| 7) | Limit unit SS capture capacity by anthracite | 1.0 | kg-SS/$m^2$-anthracite |
| 8) | Dimension of anthracite layer: | φ2.3 mH x 0.8 mH | |
| 9) | Unit area of anthracite layer: 2.3 x 2.3 x 0.785 | 4.15 | $m^2$ |
| 10) | Number of filter | 2 | |
| 11) | Total area of anthracite layer: 9) x10) | 8.3 | $m^2$ . |
| 12) | Limit SS load to anthracite layer: 11) x 7) | 8.3 | kg-SS |

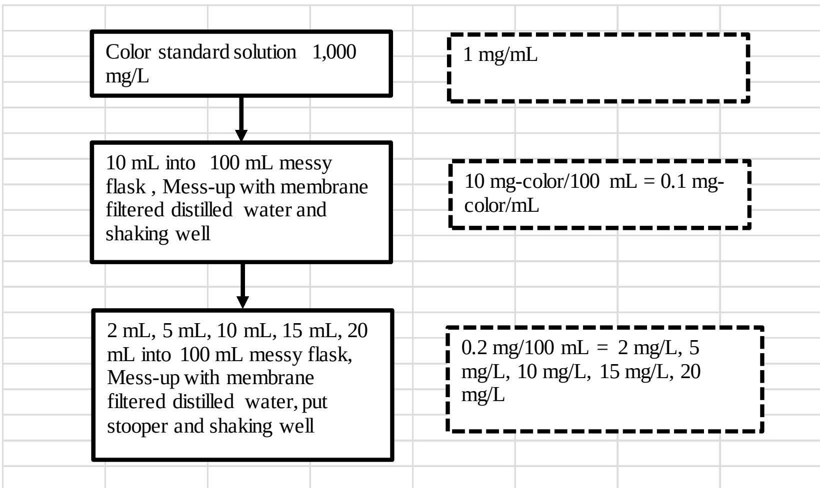
| | | | |
|---|---|---|---|
| 13) | Back wash timing: 12)/6) | 1.1 | day |
| 14) | Remained ferrous iron: 2)-6) | 2 | $g/m^3$ |
| 15) | Load to manganese sand: 1) x 14) | 1,300 | g/day |
| | | 1.3 | kg/day |
| 16) | Dimension of manganese green sand layer: | φ2.3 mH x 0.6 mH | |
| 17) | Volume of manganese green sand layer: 11) x 0.6 | 4.98 | $m^3$ |
| 18) | Unit capacity of manganese green sand to remove iron and manganese | | |
| | | 400 | $g/m^3$ |
| | | 0.4 | $kg/m^3$ |
| 19) | Limit capacity of manganese greensand: 18) x 17) | 1.99 | kg-iron |
| 20) | Backwash timing: 19)/15) | 1.5 | day |

In this situation, 1 to 2 times of backwash is necessary every day.

**(Reference-1) How to check residual ferrous iron**

1) Take 1 cup of sample (almost 200 mL) of effluent of iron removal tank
2) Add a few drops of 1 % chlorine solution, stir and confirm free chlorine concentration. (Feel the smell of chlorine)
3) Take 100 mL of the mixed sample 2) to 100 mL of glass tube and compare color with pure or mineral water (Use R.O membrane mineral water in market)
   If you can recognize the yellow color clearly, it means effluent ferrous iron concentration is more than 0.3 mg/L. (1mg/L ferrous iron and manganese are almost equivalent to 50 and 100 mg/L, respectively.)

**(Reference-2) How to make dilute color standard solution**




**(Key points of operation)**

- Keep water flow meters clean. When they are polluted by iron, clean them with weak organic acid such as vinegar or lemon water after cleaning with brush.
- Don't open valves related to backwashing quickly to avoid flowing out anthracite.
- Continue backwashing until backwash water becomes clear.
- Try to run the plant continuously. If you want to stop the plant, implement regular backwashing and stop.

- ➢ Iron is used as a coagulant to make small particles bigger. Once deposition of ferric hydroxide starts on the surface of filter media, the deposited ferric hydroxide coagulates each other and finally coagulates filter media as the result of its bridge effect.
- ➢ Coagulation or bridge effect prefers to slow filtration or stop of operation. To avoid this problem, try to run the plant continuously by adjusting the valve before aeration tank to reduce stop operation time and implement regular backwashing. This also contributes longer retention time in aeration tank, by which ferric hydroxide is easily caught at anthracite layer.

(3) Chlorine dosing rate

- Chlorine dosing rate should be determined by analyzing free residual chlorine concentration at the tap to secure more than 0.2 mg-free residual chlorine (FRC)/L.

**(Note)**

- FRC concentration is recommended 0.2- 0.4 mg/L. It is said and confirmed in many countries that fecal coliform is not detected under the condition of more than 0.2 mg/L of FRC.
- Chlorine dosing rate (mg/L) = 0.56 x [$Fe^{2+}$] (Ferrous iron) + 1.3 x [Mn] (Manganese) + 7. 7 x [$NH_3$] (Ammonia) + 0. 5

**(Example 10) Calculation of required chlorine dosing rate)**

(Conditions)

| | | | |
|---|---|---|---|
| 1) | Inflow | 1,000 | $m^3$/day |
| 2) | Operation hours | 24 | hours |
| 3) | Ferrous iron | 1 | mg/L |
| 4) | Manganese | 0.5 | mg/L |
| 5) | $NH_3$ | 0.24 | mg/L |
| 6) | Chlorine solution | 1 | w/v % |
| 7) | Effective chlorine | 30 | % |

(Answer)

| | | | |
|---|---|---|---|
| 8) | Chlorine dosing rate= 0.56 x3) + 1.3 x 4) + 7.7 x 5) + 0.5 | 3.6 | mg/L |
| 9) | Required chlorine (g/hour): 1)/2 x 6) | 150 | g/hour |
| 10) | Effective chlorine: 7)/100 x 6) | 0.3 | w/v % |
| | | 3 | g/L |
| 11) | Required chlorine (L/hour): 9)/10) | 50 | L/hour |

.

**<u>(Pay attention to chlorine solution handling).</u>**

Chlorine has toxicity. Chlorine exposure causes serious damage to body, in particular, eyes.
To avoid the accident, the followings should be paid to attention to;

- Install water washing pipe line in chlorine dosing room
  - By by-passing the existing water introduction line to bleach dissolving tank. to wash body, in particularly, eye, in case of chlorine exposure
  - At least, always put two bucketful waters near in the chlorine room.
- In handling chlorine, work together with another worker.
- Wear eyeglasses, rubber gloves, mask and hat with brim.
- Don’t wash eyes with polluted hands polluted by chlorine.

## 3. Slow Sand Filtration System

Purification process of Dhulabari WUSC is a slow sand filtration system.

(1) Features of Slow Sand Filter

- Slow filtration rate: need large area
- Biological treatment processes rather than physical filtration
- Possible to remove soluble substances such as manganese, iron, ammonium nitrogen, etc.
- Very low disinfectant levels thereby reducing chlorine dosing rate
- Slow sand filter is not backwashed; it is maintained by having the top layer of sand scraped off when flow is eventually obstructed by biological growth.

Table 1 shows the features of Slow Sand Filter and Rapid Sand Filter.

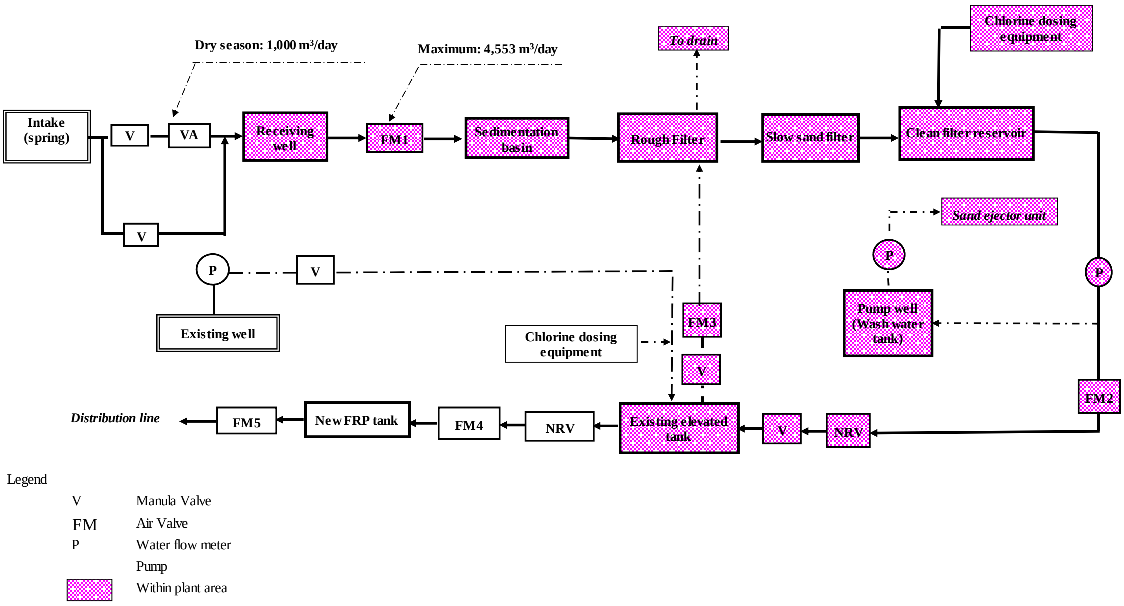



**Figure 6: Conceptual Flow Sheet of Slow Sand Filter (Dhulabari)**

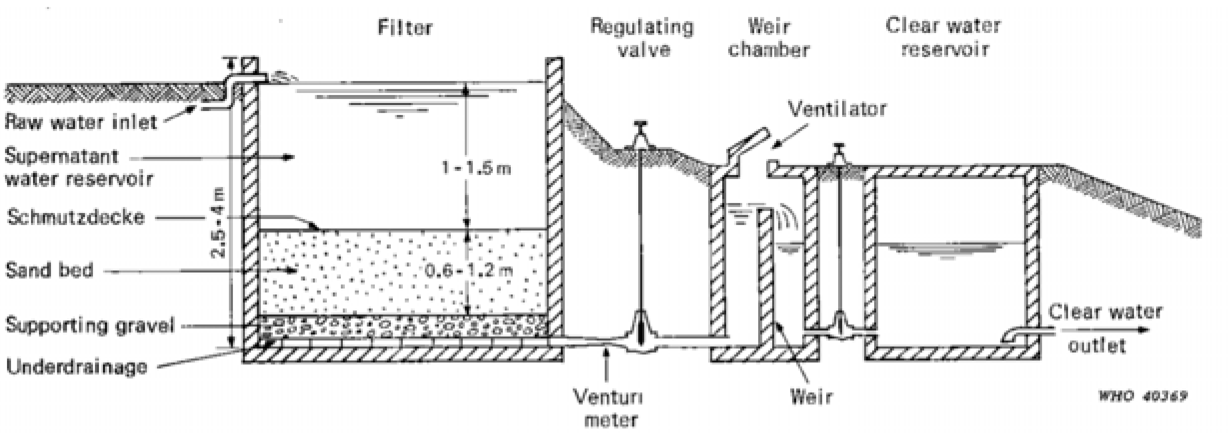



**Figure 7: Structure of Slow Sand Filter**

In general, slow sand filtration system consists of plain sedimentation and rough filter before slow sand filter to keep 30 NTU of turbidity before slow sand filter, to avoid high turbidity, in particularly during flood season.

(2) The key points of operation of each facility

1) Selection of facility

- Manage flow control and maintain balance depending on water demand and available amount of water from intake by;
  - controlling valves,
  - checking and monitoring flow meter and water level at sedimentation basin and overflow weir
- Follow O/M manual for typical selection mode to meet seasonal operation

2) Receiving well

- Clean bucket strainer when water flow decreases with overflow from receiving well
- Control the inlet valve when water flow rate increases

3) Plain Sedimentation Basin

- Design mean velocity is less than 0.3 m/min, in Dhulabari 0.17 m/min
- Design of surface area load and mean velocity shall be followed by Example 4. (In design of Dhulabari, retention time: 2hours, Surface area load: 36 m/day = 25 mm/min )

To design surface area load shall be decided by settling test by using 1,000 mL Messzylinder. Ask the Central Laboratory to measure sinking velocity.

Once getting the velocity, design surface area load and dimensions, following Example 5.

**(Key points of daily operation of Plain Sedimentation Basin)**

- Floating scum shall clean regularly
- In case growing of water bloom, discharge water and clean
- If drainage pipe chocked, clean the pipe with lot of water and pump out all the water then clean the bottom

**Table 1: Features of Rapid and Slow Sand Filter**

| Item | Slow Sand Filter | Rapid Sand Filter |
|---|---|---|
| Pre treatment | Not required except plain sedimentation | Coagulation, Flocculation and Sedimentation |
| Base materials | Gravel base of 30 to 75 cm depth with 3 to 65mm size graded gravel. | Gravel base of 45 to 50 cm depth with gravel size varies from 3 to 50 mm in 4 or 5 layers |
| Filter sand<br>▪ Effective size<br>▪ Uniformity coefficient<br>▪ Thickness of sand bed | <br>▪ 0.25 to 0.35 mm<br>▪ 3 to 5.0<br>▪ 80 to 100 cm | <br>▪ 0.45 to 0.70 mm<br>▪ 1.2 to 1.7<br>▪ 60 to 75 cm |
| Under drainage system | Open jointed pipes or drains covered with perforated blocks | Perforated pipe laterals discharging into main header |
| Size of each unit | 50 to 200 sq.m | 10 to 100 sq.m |
| Rate of filtration | 100 to 200 Lph/sq.m | 4800 to 7200 Lph/sq.m |
| Cost<br>▪ Installation<br>▪ O&M | <br>▪ High<br>▪ Low | <br>▪ Low<br>▪ High |
| Efficiency<br>▪ Turbidity of feed water<br>▪ Removal of bacteria | <br>Low; < 30 NTU<br>98 to 99% | <br>Any level of turbidity of feed water; (with pre-treatment)<br>80 to 90% |
| Suitability | For water supply to rural areas and small town | For public water supply to towns and cities |
| Post treatment | Slight disinfection | Complete disinfection is a must |
| Ease of construction | Simple | Complicated; |
| Skilled supervision | Not essential | Essential |
| Loss of head<br>▪ Initial<br>▪ Final | <br>▪ 10c m<br>▪ 80 to 120 cm | <br>▪ 30 cm<br>▪ 250 to 350 cm |
| Method of cleaning | ▪ Scrapping and removing *Schmutzedecke* and 1.5 to 3 cm thick sand layer<br>▪ Laborious | ▪ Back washing with or without compressed air agitation<br>▪ Simple and easy |
| Quantity of wash water required | 0.2 to 0.5% of total water filtered | 1 to 5% of the total water filtered |
| Cleaning Interval | Three to four months | One to two days |

4) Rough filter

- Design mean water filtration rate is 36 m/day (1.5m / hour, in case of 24 hours/day operation) (Refer to Appendix -1: Record Formats)
- If this rough filter is used in slower rate, then water bloom (green algae) will grow and it will choke the surface of sand layer and it is difficult to remove this type of algae. So the filter rate of this rough filter should maintain the design filter rate by adjusting the number of operation. The rest of rough filter shall be used by turn.

- Backwash of rough filter

① When to back wash

- Once 3 ~ 4 days (24 hour operation)
- Water level reach to high water level
- Abnormal chocking, settlement of dirt, and algae, aqua habitats
- Outlet water quality is more than 10 NTU as turbidity

② Backwash condition

- ➢ 7~25 $m^3$/minute for 4~7 minutes every 2~4 days
- ➢ If the backwash water quantity is more than specified value, the filter media can push out to the trough.
- ➢ Continue until clean water at trough is observed (Turbidity is less than 10 NTU)

**（Remarks）Backwash of Rough filter）**

- Make sure back wash water volume at trough weir is even. If water is coming only from some surface then check the under drain strainer and its gravel and replace or repair as required.
- When backwash water is not clean, then make sure to open basin drain valve to clean up under the drain chamber
- When backwash is not successful, check the filter media under drain or wash again.
- If filter media chocked, water level will rise then open the drain valve to maintain water level
- After backwash, feed water slowly to the normal water flow level. Check for even or uneven in level at inlet weir water

5) Slow sand filter

- An effective slow sand filter may remain in service for many weeks or even months if the pre-treatment is well designed and produces water with a very low available nutrient level which physical methods of treatment rarely achieve.
- Very low nutrient levels allow water to be safely sent through distribution system with very low disinfectant levels thereby reducing consumer irritation over offensive levels of chlorine and chlorine by-products.
- Slow sand filters are not backwashed; they are maintained by having the top layer of sand scraped off when flow is eventually obstructed by biological growth.
- It is natural to generate algae on the surface of slow sand filter because its purification principal is a biological treatment. To prove this, pH showed increase after slow sand filter due to algae generation.
- Generated algae supplies oxygen to the sand layer to keep aerobic bacteria in the sand layer, which contributes the performance of slow sand filtration, however excess algae accumulated on the surface hinders the function because it decays and discharge soluble nutrients and turns sand layer anaerobic. Therefore, excess algae shall be removed by net, although complete removal is a little bit difficult because the size of algae itself is less than 1 μm.
- Filtration velocity of slow sand filter is designed less than 5 m/day. Too small filtration velocity will promote algae growth. In this case, number of filters shall be reduced to meet the design value.

The most important key points of slow sand filter operation are the followings.

① Restoring of slow sand filter

- ➢ Before backfilling of water, make sure that the water level rise slowly up to 200 mm above the sand layer surface by using filtered water through common valve to connect the next filter tank by up-flow with the flow of 2.0 m/day.

② Then fill the water from inlet valve by down-flow at about 3.0 m/day.

③ Timing of sand scraping

Sand layer shall be scrapped when the following things happen.

- Treated water quality become difficult to meet the Nepal standard.
- Water level in the chamber increases by increasing resistance of filter
- Uneven level of sand (break through) is seen.
- Accumulation of dirt layer or algae-growing is seen.
- Abnormal condition in sand filter is seen.

Although depending on water quality, scraping sand layer will be conducted every 3 months or as required.

④ How to scrap and maintain the quality of sand filter: Refer to Appendix-2: O/M manual of Dhulabari WTP

**1. Before cleaning**
**The state of lack of filtration due to mad or algae**

**2. Clearing of walls**
**Removing dirt on the walls**

**3. Scrapping dirted sand**
**Scrapping dirty parts on the surface of the sand layer**

**4. Cleaning with sand washer**
**Cleaning the scrapped sand by sand washer with high pressure water**

**5. Preparing the surface evenly**

**6. Completion of the works**

**Figure-8: Example of Sand Scraping Works in Japan**

⑤ Washing filter sand: Refer to O/M manual of Dhulabari
- Washing filter sand should be performed as soon as possible after filter sand scrapped off is transferred to filter sand storage house before it becomes dry.
- Continue washing filter sand until it is clean, check if the turbidity of washed water below 10~30 NTU.
- Washed filter sand is transferred to storage yard.

⑥ To start again normal slow sand filter operation
- Start filtration at 1.0 m /day and shall reach to full operation of 5.0m/day in one

month time. It may require 7-10 days to become the filter effective for bacteria free.

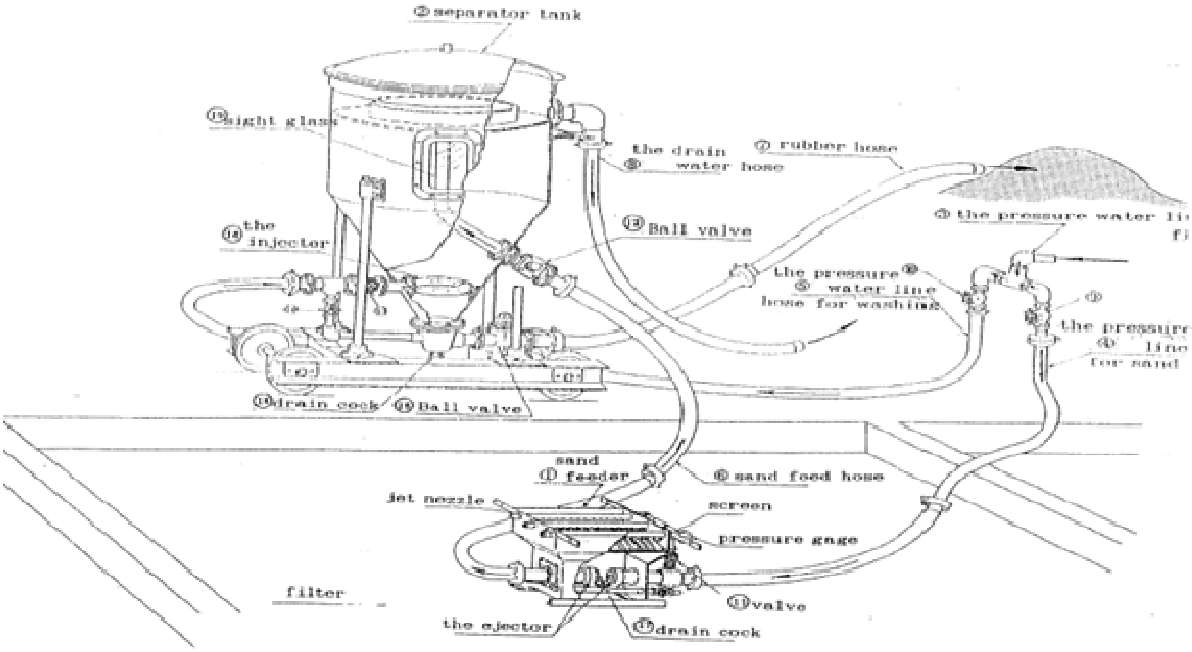



**Figure -9: Sand Washer Facility (Dhulabari WUSC)**

### A-2 Maintenance of the equipment/facilities

Main equipment/facilities are the following. Inspections and operation should be implemented followed by Mechanical and Electrical Record Formats. The key points of daily operation and inspections are the followings.

(1) Lifting pump

- Pressure
- Abnormal sounds by listening to the sound
- Different vibration by touching
- Motor temperature by touching
- Oil by observing oil gauge
- Abnormal smell/odor

(2) Compressor

- Abnormal sounds by listening to the sound
- Different vibration by touching
- Motor temperature by touching
- Abnormal smell/odor
- Safety valve operation by pulling it (Don’t approach your eyes just above the safety valve)
- Operation of compressor: stop and start pressure
- Water drain by opening drain valve until moisture can’t be seen
- Belt conditions by pushing and touching when stopping

(3) Generator

- Lubricant level (Mobil)

- Oil level by observing oil gauge (Diesel)
- Leakage of oil
- Abnormal smell/odor
- Sound and vibration
- Oil filter
- Battery indicator
- Water temperature indicator
- Water level

**A-3** **Flow management:** Raw, treated water and backwash flow, distribution, etc., : Refer to Appendix -1 : Record Formats (Appendix 1-1)

**A-4** **Record Formats for Water Quality Management:**
Record formats were prepared for evaluation of the process operation and for the bases of management, referring to the formats in O/M manual and the ones having prepared in 3 WUSCs. (Mangadh, Gauradaha and Dhulabari WUSC).

Refer to (Appendix-1: Record formats

**A-5** **Trouble shooting: Refer to manual of each equipment**
In the case where you are forced to distribute the water beyond the regulation, notice the users with the reasons.

## B. SOP for Water Quality Analysis

### B-1 Purpose of water quality analysis

- The purpose of water quality analysis is to confirm whether the supplied water quality is within the Nepali regulations and safe to the people or not.
- Therefore, water quality analysis is the most important thing in daily works.
- Water quality analysis is the fundamental thing, not only to confirm above, but also to design and evaluation of the purification plant.

**B-2 Water quality criteria:** Refer to Appendix-3: Meanings of Drinking Water Quality Standard.

**B-3 Sampling:** Raw water, final treated water, the tap and in and outlet of each plant facility, when necessary: Refer to Appendix -1: Water Quality Analysis Record in Record Formats (Appendix 1-12)

**(Remark) How to take sample**

1) Take sample into a appropriate bottle. Before using it, confirm if there is abnormal smell. If you feel abnormal smell, don't use the bottle.
2) Take sample by replacement the sample five times. Continue to open the sampling cock.

### B-4 Frequency of water quality analysis: Daily or defined in SOP at each WUSC

**Table-2: Example of sampling point and water quality parameters to be analyzed at site**

| WUSC | Sampling point | | |
|---|---|---|---|
| | Raw water | Final treated water | The tap |
| **Gauradaha, Mangadh** | pH, Turbidity, Color, Total iron, (Coliforms) | pH, Turbidity, Color, Total iron, Free residual chlorine, (Coliforms) | Color, Free residual chlorine, (Coliforms) |
| **Dhulabari** | pH, Turbidity, Color, (Coliforms) | pH, Turbidity, Color, Free residual chlorine, (Coliforms) | Color, Free residual chlorine, (Coliforms) |

- Coliforms shall be checked timely by simple detection kit.
- At least FRC (Free Residual Chlorine at the tap should be checked every day.

**(Reference-3) : How to estimate FRC without chlorine test kit.**

1) Take tap water, following the procedure Remarks of B-3
2) Take 10 mL of sample in a 50 mL PE cup, scale every 5ml, (Ask DWSS Central Laboratory)
3) Add 1 pack of DPD-F-1(Reagent to react FRC) and stir
4) Within 1 minute, if you can recognize clear pink color, it shows that FRC concentration is more than 0.2 mg/L.

At least, purchase DPD-F-1 because FRC is the most concern to the health. When FRC concentration is more than 0.2 mg/L, you don't need to worry about the existence of total coliforms.

.

### B-5 Water quality analysis methods: Simple analysis kits

- How to use of simple analysis kits: Refer to Appendix 4
- All or necessary parameters shall be checked regularly by accredited laboratories.
- Appendix-5 is a list of supplied simple analysis kits, glassware, regents, standard solutions, etc. When necessary, contact the person, below.

  Mr, Rajan Bista, Managing Director of Everest Trading Center
  Tel: 4783416, Fax: 4787734.

**B-6 Data management:** Refer to Appendix-1; Record Formats

**B-7 Disclosure of information:** Compile and analyze and in yearly report with satisfactory in comparison with water quality criteria

**B-8 Closing**

In general, simple water quality analysis kits are not reliable enough because they are simple but not official methods. Therefore, the correlation with official method is necessary for traceability.
The water quality analysis kits JICA provided are confirmed the accuracy at DWSS Central Laboratory for two years.

When you want to use another test kits, use them after accuracy confirmation with official analysis method. Ask the accuracy confirmation to DWSS Central Laboratory.
Without confirmation, don't use and believe the results.

Remind that the analysis accuracy is the most fundamental thing in water quality management.
It is strongly required that DWSS Central Laboratory always seeks for analysis accuracy.

JICA Expert trained the staff from the Central Laboratory and from Regional Laboratories for three years, focusing on how to keep analysis accuracy and gave the certificates of trainers.
We believe that they can keep seeking for analysis accuracy with the team of the trainers.

**（WTP O/M）Appendix-7　Meanings of Drinking Water Quality Standard,** August 2010,

by JICA Expert on O&M on Water Treatment Plant/Water Quality Management

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Physical | Turbidity | - | NTU | 5 (10) | - | - | • Consideration of rust in water pipe clogging<br>• Unpleasant |
| | pH | - | - | 6.5 – 8.5* | | - | • Strong acid and alkali: effect on mucous membrane<br>• Weak acid and alkali: deterioration of taste |
| | Color | - | TCU | 5 (15) | - | - | • Almost colorless by naked eye<br>• Unpleasant |
| | Total Dissolved Solids | TDS | Mg/L | 1,000 | - | - | • Pipe corrosion or scale |
| | Electricity Conductivity | EC | µcm/S | 1,500 | - | - | • Pipe corrosion or scale<br>• Assumption of TDS, in natural water TDS = 0.6 – 0.7 x EC |
| Chemical | Iron | Fe | mg/L | 0.3 (3) | • Ground water: ～1.5 mg/L<br>• Air: 0.9 - 16 µg/m$^3$<br>• River water: 0.67 mg/L<br>• Rain water: 0.23 mg/L<br>• Sea water: 0.01 mg/L<br>• Edible brown algae: 0.55 mg/g<br>• Corbicula: 0.1 mg/g<br>• Eel: 0.09 mg/g<br>• York of an egg: 0.046 mg/g<br>• Spinach: 0.037 mg/g | • Although iron is an essential element, necessary for sustaining life.<br>• Lack of iron causes anemia.<br>• Too much intake causes high blood concentrations of iron damage cells in the heart, liver and elsewhere, which can cause serious problems, including long-term organ damage and even death. | • The limit of color trouble to laundry and abnormal taste.<br>• Over 0.3 mg-Fe/L: shows yellow to brown -red. 0.5 to 1.0 mg-Fe/L produces metally taste. |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | Manganese | Mn | mg/L | 0.2 | • Soil: 200 - 3,000 mg/kg<br>• Sea water: 1.7 - 5.0 µg/L<br>• River water: 8 - 180 µg/L<br>• Air (Rural): 0.01 - 0.05 µg/$m^3$<br>• Air (polluted city): 0.2 - 1.0 µg/$m^3$<br>• Meat and fish: 0.01 -0.03 mg/100g<br>• Vegetable, fruit, serial: 0.1 - 0.6 mg/100g<br>• Beans: 2.8 mg/100g | • Essential element for the metabolism of carbohydrate and fat, synthesis of protein.<br>• Daily required is 5.5 - 10.4 mg for an adult.<br>• Acute: weariness, poor appetite, headache, arthritis, encephalitis<br>• Chronic: Central nervous damage, similar to Parkinson's Disease, unconsciousness | • To prevent black water |
| | **Arsenic** | As | mg/L | 0.05 | • Earth crust: 1.8 mg/kg<br>• Ambient: 0. O 2 -0.11 mg/$m^3$<br>• Soil: 0.1 - 40 mg/kg<br>• Rain water: 0.55 - 2.0 µg/L<br>• Sea water: 0.15 - 5.0 µg/L<br>• River water: 0.9 - 1.3 µg/L<br>• Vegetable: 0.01 - 0.13 mg/kg<br>• Beef: 0.01 - 0.10 mg/kg<br>• Fish and shell: 1.5 - 17.5 mg/kg<br>• Seaweed: 25 - 40 mg/kg<br>• Hair : 0.02 - 0.7 mg/kg<br>• Nail: 0.04 - 1.4 mg/kg<br>• Urine: 0.03 - 0.1 µg/L | • Thickening and discoloration of the skin; stomach pain, nausea, vomiting; diarrhea, numbness in hands and feet, partial paralysis, blindness<br>• Inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. | • Total intake amount, lethal death amount with safety factors. Referred to WHO's tentative guideline. |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | **Cadmium** | Cd | mg/L | 0.003 | • Ambient: 0. 0 03 - 0.053 μ g/m³<br>• Soil: 0.15 - 2 mg/kg<br>• Rain water: 0.05 μg/L<br>• Sea water: 0.05 - 0.11 μg/L<br>• River water: 0.02 - 0.1 μg/L<br>• Hot spring water: 0.01 - 2.5 μg/kg<br>• Rice: 0.09 mg/kg<br>• Wheat: 0.05 mg/kg<br>• Fruit: 0.01 mg/kg | • Breathing high levels of cadmium severely damages the lungs and can cause death. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea.<br>• Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. | • Absorption rate of cadmium from drinking water is 2 - 5 %.<br>• There is no proof that drinking two litters of water with the concentration of less than 0.01 mg-Cd/L affects on discharge of urine. |
| | **Cyanide** | CN | mg/L | 0.07 | • Not exist in natural water and environment. | • Short-term: Rapid breathing, tremors and other neurological effects at levels above 0.2 mg-CN/L<br>• Long-term: weight loss, thyroid effects, nerve damage at level of 0.2 mg-CN/L | • A quantitative limit of an old test procedure<br>• WHO limit: 0.1 mg/L |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | **Fluoride** | F | mg/L | 0.5 – 1.5* | • Rain water: ~0.6 mg/L,<br>• Sea water: 1.3 - 1.4 mg/L,<br>• River water: 0.1 - 0.2 mg/L,<br>• Well: less than 1mg/L<br>• Food: less than 1mg/kg,<br>• Fish and shell: 10 to 300 mg/kg,<br>• Tea leaves: 50 - 1,000 mg/kg<br>• Ground water: 1.4 mg/L in granite area, 1.9 mg/L in hot spring<br>• Tooth paste: less than 1mg/kg<br>• Earth crust: 300 mg/kg<br>• Ambient: 0.5 - 3 ng/m$^3$ | • Spots on tooth and Skelton disorder that causes difficulty of walking by long-term intake | • 95 % of persons who drink water of over 3 mg/L-F suffer from tooth spot.<br>• 15 % of persons who drink water of 1 mg/L-F suffer from tooth spot.<br>• And none the case is seen for the persons who drink water of less than 0.8 mg-F/L. |
| | **Lead** | Pb | mg/L | 0.01 | • Ambient: 0. 0 001 -0.001 μ g/m$^3$<br>• Soil: 2 - 200 mg/kg<br>• Rain water: 40 μg/L<br>• Sea water: 0.03 μg/L<br>• River and lake water: 0.001 - 0.01 mg/L<br>• Brown rice: 78 - 85 μg/kg<br>• Polished rice: 14 - 29 μg/kg<br>• Beef: 96 - 118 μg/kg<br>• Tuna: 167 -286 μ/kg<br>• Sardine : 8 -12 μ/kg<br>• Strawberry: 151 - 182 μg/kg<br>• Burdock: 190 - 197μg/kg<br>• Pumpkin: 291-328 μg/kg | • Loss of appetite,<br>• Nausea, vomiting, stomach cramps, constipation,<br>• Difficulty in sleeping, fatigue, moodiness,<br>• Headache,<br>• Joint or muscle aches,<br>• Anemia, and decreased sexual drive.<br>• Severe damage to the blood-forming, nervous, urinary, and reproductive systems. | • In the case where the level of Pb in drinking water is less than 0.05 mg/L, Pb level in blood does not exceed 0.1 mg/L that does not affect the health of children and infants. |
| | Ammonia | $NH_3$ | mg/L | 1.5 | - | - | • To reduce chlorination |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | Chloride | Cl | mg/L | 250 | • Surface water: - several dozens mg/L<br>• Earth crust: 130 mg/kg<br>• Seawater: 28,000 mg/L as NaCl<br>• Food: 0.36 mg/g | • Necessary for metabolism.<br>• Average daily intake for adult: 6 - 12 g/day<br>• Over 4,000 mg-Cl/L of water is harmful to the patient having heart and kidney disease.<br>• Continuous intake water of over 2,500 mg-NaCl/l is said to cause high blood pressure. | • Drinking water with over 200 mg-Cl/l has an abnormal taste. |
| | Sulphate | $SO_4$ | mg/L | 250 | - | • Lots of intake will cause dehydration | • Drinking water with over 600 mg-$SO_4$/L cause diarrhea. |
| | **Nitrate** | $NO_3$*** | mg/L | 50 | • Surface water: 0.5 - 2 mg-$NO_3$-N/L, 0.001 - 0.01 mg-$NO_2$-N/L<br>• Shallow well: $NO_3$-N level is higher than those in surface water or deep well due to permeation of domestic wastewater and industrial wastewater<br>• Vegetables and fruit: 200 - 2,500 mg-N/kg | • $NO_3$-N is transformed to $NO_2$-N in the digestive system.<br>• The nitrite forms methemoglobin, which lacks the oxygen-carrying ability of hemoglobin for the infants less than six months of age, in particular, which causes death by choke or an aftereffect of the central nervous system (Blue baby).<br>• A possibility exists that nitrate can react with amines or amides in the body to form nitrosamine which is known to cause "cancer." | • There is no case of infant children suffering from blue baby under less than 10 mg-$NO_3$-N/L. |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | Copper | Cu | mg/L | 1 | • Earth crust: 2 - 100 mg/kg<br>• Soil: 2 - 100 mg/kg<br>• Natural water: 0.2 - 30 μg/L<br>• Vegetable, wheat, dairy products, meat: less than 0.01 mg/kg | • Copper is an essential mineral to the health.<br>• About 2 mg/day for an adult is necessary.<br>• Fatal cases are generally terminated by convulsions, palsy, and insensibility<br>• Acute intake of 1 to 2 g-Cu/day causes stomach trouble.<br>• An inherited condition called Wilson's disease causes the body to retain copper, since it is not excreted by the liver into the bile. This disease, if untreated, can lead to brain and liver damage. | • The limit is determined from viewpoints of color trouble to laundry and water supply system.<br>• 2 mg-Cu/L causes unpleasant taste. |
| | Total hardness (Calcium hardness + Magnesium hardness) | $CaCO_3$ | mg/L | 500 | • Earth crust: 36,300 mg-Ca/kg,<br>• Seawater: 412 mg-Ca/L<br>• Air: 0.5 - 7,000 ng-Ca/$m^3$<br>• Water: 15 mg-Ca/L<br>• Earth crust: 20,900 mg-Mg/kg<br>• Seawater: 1,290 mg-Mg/L<br>• Air: 1 - 11,000 ng-Mg/$m^3$<br>• Water: 4 mg-Mg /L | • Ca and Mg are essential elements for the health.<br>• Water intake of high concentration of Mg causes diarrhea.<br>• Continuous intake water of 300 to 500 mg-$CaCO_3$/L is said to cause urinary calculus | • High concentration of hardness produces scale in boiler, which prevents heat transfer and causes explosion.<br>• Appropriate hardness is useful for erosion prevention in pipe. |
| | Calcium | $CaCO_3$ | mg/L | 200 | - | • Calcium is essential to body as main element of bones and teeth.<br>• High intake of calcium causes the diseases of internal secretion. | • Same as above<br>• Calcium amount maintained by adults is 1,000 to 1,200 g. |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[1)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | Zinc | Zn | mg/L | 3 | • Rock: 10 - 170 mg/kg<br>• Soil: 10 - 300 mg/kg<br>• River water: 10 μg/l<br>• Sea water: 1 μg/l<br>• Daily food intake: 5 - 20 mg/day | • Although Zinc is an essential element, necessary for sustaining all life and is contained in food,<br>• Acute intake of 50 mg-Zn/L causes diarrhea, stomachache, convulsions, stomach trouble. | • 5 to 8 mg-Zn/l water gives unpleasant taste and white precipitation. |
| | **Mercury** | Hg | mg/L | 0.001 | • Ambient: 0. 0 03 -0.009 $\mu$ g/m$^3$<br>• Soil: 0.1 mg/kg<br>• Ground water: 0.01 - 0.10 μg/L<br>• Sea water: 0.005 - 5.0 μg/L<br>• River and lake water: 0.03 - 0.1 μg/L<br>• Hot spring water: 0.01 - 2.5 μg/kg<br>• Rice: 0.01 mg/kg<br>• Vegetable: 0.01 - 0.04 mg/kg<br>• Beef: 0.015 mg/kg<br>• Fish and shell: 0.02 - 0.6 mg/kg<br>• Lever: 0.47 mg/kg<br>• Kidney: 1.11 mg/kg | • Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages.<br>• High levels of methyl mercury in the bloodstream of unborn babies and young children may harm the developing nervous system, making the child less able to think and learn<br>• Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.<br>• Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation. | • Mercury is extremely toxic and even a trace of mercury accumulates in the body race level, which causes serious diseases.<br>• Accordingly, the limit is decided as the minimum limit of determinations by atomic absorption spectrophotometer. |

| Class | Parameter | Symbol | Unit | Maximum concentration limit in Nepal | Level in environment[A)] | Health Risk | Typical background of the regulation |
|---|---|---|---|---|---|---|---|
| Chemical | Aluminum | Al | mg/L | 0.2 | • Earth crust: 81.3 g/kg<br>• Seawater: 0.001 mg/l<br>• Groundwater: 0.014 - 0.29 mg/L<br>• River water: 0.016 - 1.17 mg/L<br>• Reservoir in the area of planting trees | • Suggested that aluminum is a cause of Alzheimer's disease<br>• Toxicity for central nervous system | • Color (white turbidity) and unusual taste |
| | Residual Chlorine | $Cl_2$ | mg/L | 0.1 – 0.2** | - | • Lack of residual chlorine level causes water-borne diseases such as dysentery, typhoid, cholera, etc. | • For disinfection |
| Microbiological[B)] | **E-coil** | - | MPN/100 mL | ND | - | • Water-borne disease | • An indicator not to show pollution by water born disease-causing bacteria |
| | **Total coliform** | - | MPN/100 mL | ND in 95 % sample | - | • Water-borne disease | |

Note:

1) A): In Japan
2) *: These values show lower and upper limits
3) **: In systems using chlorination
4) ***: It is indicated as $NO_3$-N in Japan; $NO_3$-N: Nitrate nitrogen, $NO_2$-N: Nitrite nitrogen
5) ( ): Values in parenthesis refers the acceptable values only when alternatives is not available

6) B: Regarding disinfection (Microbiological)

- Effect of chlorination (Free chlorine level and time to extinction)

| Bacteria | Free chlorine level | |
|---|---|---|
| | 0.1 mg/L | 0.2 mg/L |
| Total coliforms | 5 minutes | Instantly |
| Typhoid bacillus, Cholera bacillus, dysentery bacillus | 15 – 30 seconds | - |

- In case of disinfection by boiling: 10 minutes at over 80 ℃
- Chlorination is not almighty. Some of the virus and protozoan have chlorine-resistance.

# Seminar on Water Quality Control

**O&M on Water Treatment Plant/Water Quality Management Expert**

## Topics of this Seminar

- Seminar on Meanings of Drinking Water Quality Standard in Nepal (Appendix-7)
- Seminar on process control with understanding of equipment functions
- Simple experiment of water treatment process
- Seminar on key-points of process

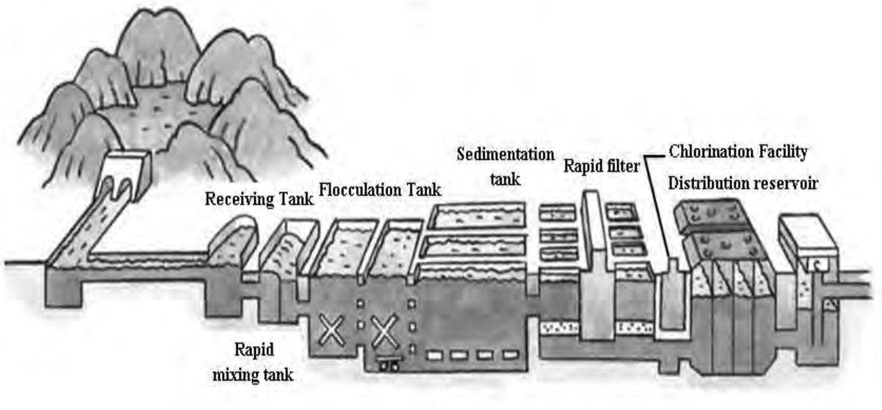
## Drinking Water Quality Standard in Nepal

- There are more parameters in advanced countries and regulated parameters has been increasing with the time
- Maximum concentration limits change from country to country; have been stricter and stricter
- Parameters in black are the ones related to human health and classified as toxic parameters.

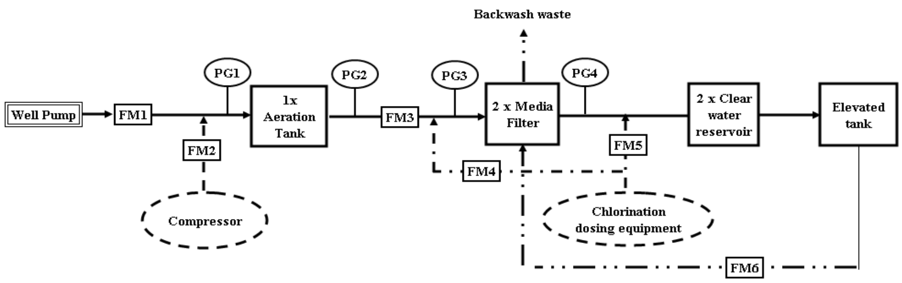
## How to determine maximum concentration limit

- Risk assessment conducted by many countries,
- Taste,
- Obstacles in use of water like scaling in the pipe or erosion of pipe,
- Purification technology and cost,
- Analysis technology

# Conceptual figure of drinking water purification plant




# Conceptual Flow Sheet of Iron Removal



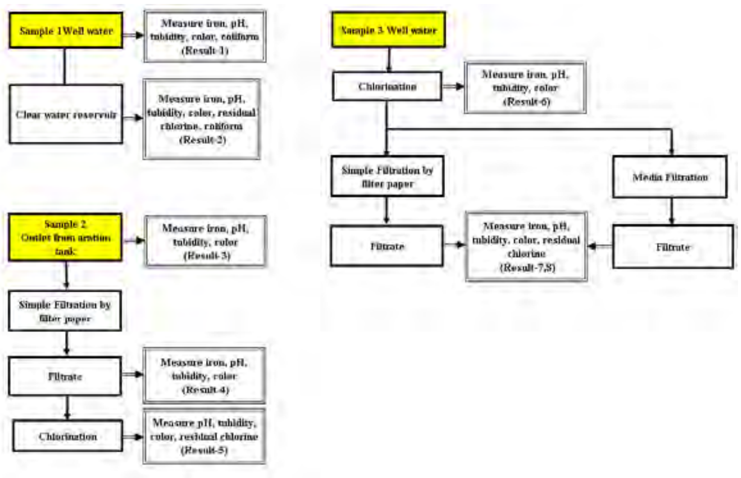

Legend

| | |
|---|---|
| FM1 | Inflow volume to aeration tank |
| FM2 | Air flow volume for oxidation of ferrous |
| FM3 | Inflow volume to media filter |
| FM4 | Chlorine dosing flow for chlorination |
| FM5 | Chlorine dosing flow for disinfection |
| FM6 | Backwash flow volume |
| PG1 | Inlet pressure of aeration tank |
| PG2 | Outlet pressure of aeration tank |
| PG3 | Inlet pressure of media filter |
| PG4 | Outlet pressure of media filter |

## Process explanation of Iron Removal

1. Iron in deep ground water exists in the form of the ferrous ($Fe^{2+}$) -soluble. It can’t be removed by conventional water purification process which basically consists of liquid-solid separation.
2. Soluble ferrous changes solid ferric hydrate ($Fe(OH)_3$) by oxidation. Compressor or chlorine is used for oxidation that’s why there are two lines in the flow-sheet.
3. After the oxidation, solid ferric hydrate ($Fe(OH)_3$) is removed by filter dual media filter; anthracite ad manganese sand. (Media filter- Iron removal tank) Almost oxidized iron is removed by anthracite layer.

## Simple experiments to understand the purification process



## Least Key Points of O/M

**1** Consider the meanings of equipment and facilities shown in Figure-1 such as pump, compressor, and chlorine dosing facility, pressure gauges and flow meters. After understanding the functions and meanings of pressure gauges, you will understand how the pressure gauges are important, for an example.

**2** Check the electric and current and wiring and level switches

**3** Check and maintain these equipment and facilities followed by O/M manual.

## Least Key Points of O/M

### 4 Confirmation of flow rates

1) Air inflow to aeration tank

- Air / water volume ratio 350 – 450 L/min at 0.2 MPa
- Water level in the aeration tank below from Max water level 400 mm
- Compressor air reducer valve (adjust by needle valve) 0.2 Mpa

2) Inflow to media filter

# Least Key Points of O/M

4 **Confirmation of flow rates**

3) Chlorine dosing rate

- Make mixed solution for its concentration that is 1% of powder solution assumed 0.3% of chlorine solution
- **Feed chlorine solution to make the concentration of the free chlorine should over 0.2 mg/L at the pipe end.**
- How to calculate dosing rate

# Least Key Points of O/M

- *In generally, when an Iron removal process gives poor results, the cause will usually be poor oxidation of the ferric hydrate due to the presence of certain protective colloids, to too acidic pH or to an excessive of ammonia, chlorine is used for oxidizing iron, the dosing rate shall bee calculated as the followings.*
- *Chlorine dosing rate (mg/L) = 0.56 x [$Fe^{2+}$] (Ferrous iron) + 1.3 x [Mn] (Manganese) + 7. 7 x [$NH_4$-N] (Ammonium nitrogen) + 0. 5*

## Least Key Points of O/M

**4 Confirmation of flow rates**

4) Backwashing flow

**Back wash time** shall be considered as follows.

Allowable differential pressure (App. Maximum 1.5m)

- Total filtration time (maximum 24 hrs.)
- Water treated quality (more than 0.3 mg/Lit as total Fe, more than 5 NTU as Turbidity, others)

## Least Key Points of O/M

4) Backwashing flow

- Reducing valve is adjusted 0.2 MPa
- Back wash flow 150 $m^3$/Hour = 2.5 $m^3$/min(Mangadh)
- x 10 minutes
- Confirm backwash water becomes clear and the anthracite flow out of the iron removal (media) tank

**5 Cleaning of flow meter to iron removal tank**

- When flow meter to iron removal tank becomes dirty, remove and clean it by soaking it into weak acid solution such as lemon water or vinegar.

## Least Key Points of O/M

**6 Check water quality**

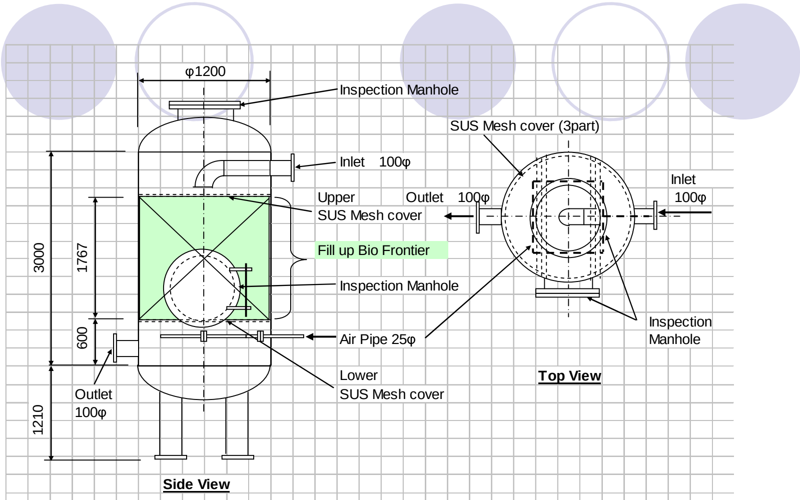
The main roll of water purification plant is to supply safety water to the people. Check water quality regularly such as pH, iron, turbidity, color, residual free chlorine and coliform.

- Residual free chlorine should be checked at tap water.
- Get correlation with official analysis method
- Simple analysis kits sometimes give you wrong information. Accordingly correlations with official analysis methods should be gotten for iron, arsenic, coliforms, $NO_2$-N and $NO_3$-N; the parameters which are directly risky for human health. If there is no correlation, don't use the simple analysis kit.

## Least Key Points of O/M

7 **Record all data and information to analysis and evaluate for process control**

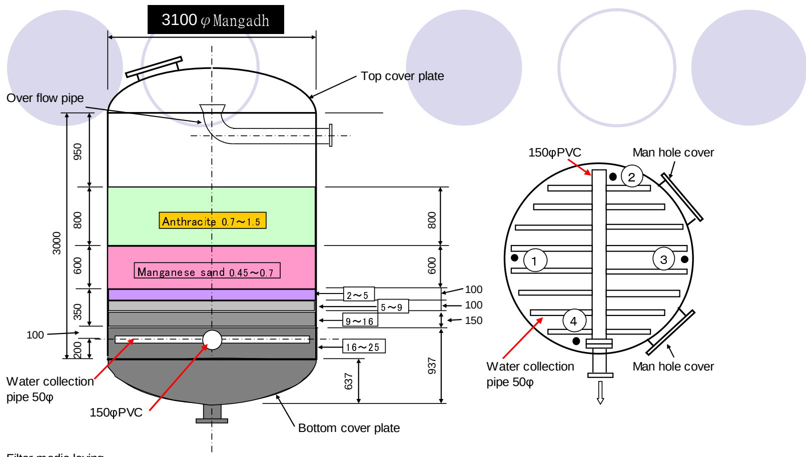
- Prepare record formats by referring to the ones in O/M to analysis and evaluate the process control




Bio frontier laying

| No. | Description | Design | Result | Evaluation |
|---|---|---|---|---|
| 1 | Fill up Bio frontier Polypropylene | 4500 liter | | |

**Structure of Aeration Tank**




Filter media laying

| S.No. | Name of Filter media & Size | Filling Height (mm) | Top level from bottom of top cover | Total Volume ($m^3$) |
|---|---|---|---|---|
| 1 | Gravel 16～25 | *1 937 | 2700 | 5.30 |
| 2 | Gravel 9～16 | 150 | 2550 | 1.14 |
| 3 | Gravel 5～9 | 100 | 2450 | 0.76 |
| 4 | Gravel 2～5 | 100 | 2350 | 0.76 |
| 5 | Manganese sand | 600 | 1750 | 4.53 |
| 6 | Anthracite | 800 | 950 | 6.04 |

*1 Filling level is 300mm from top of bottom cover

**Structure of Iron Removal Filter**

# Features of Slow Sand Filter

- Slow filtration rate: need large area
- Biological treatment processes rather than physical filtration
- Possible to remove soluble substances such as manganese, iron, ammonium nitrogen, etc.
- Very low disinfectant levels thereby reducing chlorine dosing rate
- Slow sand filter is not backwashed; it is maintained by having the top layer of sand scraped off when flow is eventually obstructed by biological growth.

# Cleaning of slow sand filter


1. Before cleaning
The state of lack of filtration due to mad or algae


2. Clearing of walls
Removing dirt on the walls

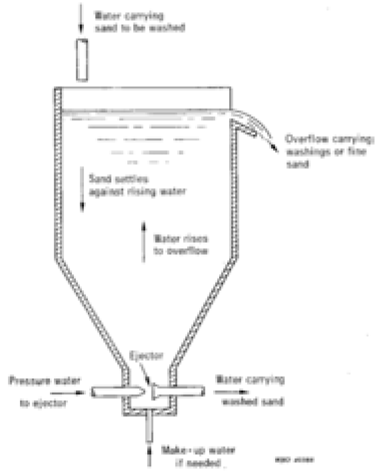

3. Scrapping dirted sand
Scrapping dirty parts on the surface of the sand layer


4. Cleaning with sand washer
Cleaning the scrapped sand by sand washer with high pressure water


5. Preparing the surface evenly


6. Completion of the works

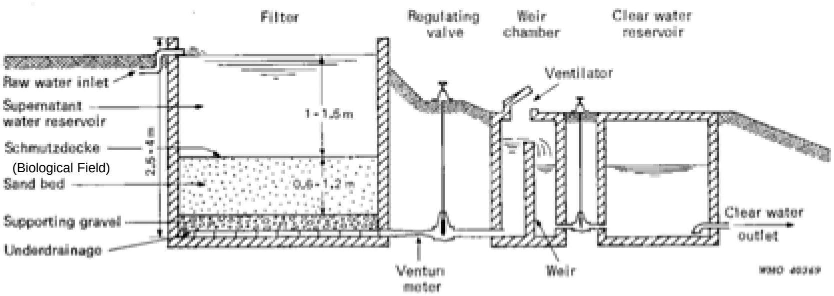
# Sand cleaning facility for slow sand filter



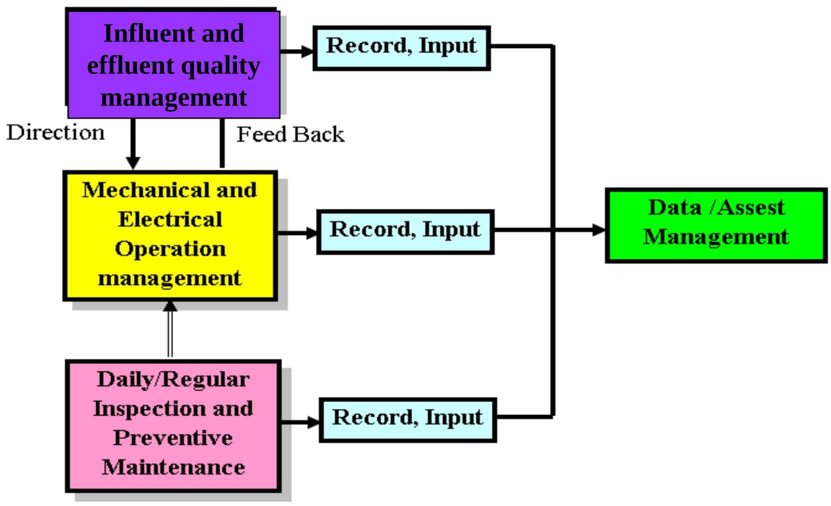

| Item | Slow Sand Filter | Rapid Sand Filter |
|---|---|---|
| Pre treatment | Not required except plain sedimentation | Coagulation, Flocculation and Sedimentation |
| Base materials | Gravel base of 30 to 75 cm depth with 3 to 65mm size graded gravel. | Gravel base of 45 to 50 cm depth with gravel size varies from 3 to 50 mm in 4 or 5 layers |
| Filter sand<br>▪ Effective size<br>▪ Uniformity coefficient<br>▪ Thickness of sand bed | <br>▪ 0.25 to 0.35 mm<br>▪ 3 to 5.0<br>▪ 80 to 100 cm | <br>▪ 0.45 to 0.70 mm<br>▪ 1.2 to 1.7<br>▪ 60 to 75 cm |
| Under drainage system | Open jointed pipes or drains covered with perforated blocks | Perforated pipe laterals discharging into main header |
| Size of each unit | 50 to 200 sq.m | 10 to 100 sq.m |
| Rate of filtration | 100 to 200 Lph/sq.m | 4800 to 7200 Lph/sq.m |
| Cost<br>▪ Installation<br>▪ O&M | <br>▪ High<br>▪ Low | <br>▪ Low<br>▪ High |
| Efficiency<br>▪ Turbidity of feed water<br>▪ Removal of bacteria | <br>Low; < 30 NTU<br>98 to 99% | <br>Any level of turbidity of feed water; (with pre-treatment)<br>80 to 90% |
| Suitability | For water supply to rural areas and small town | For public water supply to towns and cities |
| Post treatment | Slight disinfection | Complete disinfection is a must |
| Ease of construction | Simple | Complicated; |
| Skilled supervision | Not essential | Essential |
| Loss of head<br>▪ Initial<br>▪ Final | <br>▪ 10c m<br>▪ 80 to 120 cm | <br>▪ 30 cm<br>▪ 250 to 350 cm |
| Method of cleaning | ▪ Scrapping and removing *Schmutzedecke* and 1.5 to 3 cm thick sand layer<br>▪ Laborious | ▪ Back washing with or without compressed air agitation<br>▪ Simple and easy |
| Quantity of wash water required | 0.2 to 0.5% of total water filtered | 1 to 5% of the total water filtered |
| Cleaning Interval | Three to four months | One to two days |

Comparison of Slow and Rapid Sand Filter

# Structure of Slow Sand Filter




# Concept of Quantitative Operation



# Record Sheet

1. Daily Water Production and Distribution Report
2. Daily Chlorine  Consumption Report
3. Compressor Operation
4. Filtration rate of Iron Removal Filter (Gauradaha WUSC)
5. Backwash velocity (Gauradaha)
6. Filtration rate of Iron Removal Filter (Mangadh WUSC)
7. Backwash velocity (Mangadh)
8. Daily Electricity Consumption Report
9. Filtration rate of Rough Filter (Dhulabari  WUSC)
10. Backwash velocity of Rough Filter (Dhulabari WUSC)
11. Filtration rate of Slow Sand Filter (Dhulabari  WUSC)
12. Water Quality Analysis Record
13. Daily Alum Consumption Report

# 1. Daily Water Production and Distribution Report

**Month, Year**

| Day | Day of the Week | Production ($m^3$/Day) | | | | | | | | Distribution ($m^3$/day) | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) Yesterday reading Time | (2) Today Reading Time | (3) Net Operation Hour | (4) Non-Operation Time | (5) Actual Operation | (6) Yesterday Meter Reading | (7) Today Meter Reading | (8) Difference ($m^3$/day) | (9) Net Operation Hour | (10) Non-Operation Time | (11) Actual Operation | (12) Initial Meter Reading | (13) Final Meter Reading | (14)Difference ($m^3$/day) | |
| 1 | | **8.0** | **8.0** | **19.1** | **0.33** | **18.8** | **51992** | **52176** | **1,840** | **17.0** | **0.5** | **16.5** | **35534** | **35694** | **1,600** | |
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| **(15) Total** | | | | 19.1 | | | | | 1840.0 | 17.0 | | | | | 1600.0 | |
| **(16) Average** | | | | | | | | | | | | | | | | |

**Remarks**

(1):Fixed time, for an example 8:00
(2) Fixed time, for an example, 8:00
(3): Sum of another operation record, run and stop being used at each WUSC, in case of total operation hours 8;40 = 8 + 40/60
(4) : Sum of another operation record for backwash etc. being used in each at WUSC, in case of 20 minutes= 20/60
(5) = (3) - (4)
(6) : Raw water meter reading at (1)
(7) : Raw water meter reading at (2)
(8) = {(7) - (6)} x 10
(9) : From another operation record, run and stop being used at each WUSC, in case of 17:35 = 17 + 35/60
(10): Sum of another operation record like time, if any, in case of 30 minutes = 30/60
(11) = 9) -10)
(12): Distribution wetter meter reading at (1)
(13): Distribution wetter meter reading at (2)
(14) = {(13) - (12)} x 10 Pay attention of unit
(16) : (15)/total days of the month

# 2. Daily Chlorine Consumption Report

**Month, Year**

| Day | Day of the Week | Chlorine Solution Consumption (L/Day) (1) Yesterday's Reading | (2) Today's reading | (3) Actual Operation Hour | (4) Difference Liter | Chlorine solution (w/v %) (5) Chlorine (kg) | (6) Solution ($m^3$) | (7) w/v % | (8) Effective chlorine concentration (%) | (9) Consumed chlorine (g/day) | (10) Treated water ($m^3$/day) | (11) Chlorine feeding rate ($g/m^3$) | (12) FRC at tap,($g/m^3$) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 500.0 | 100.0 | 18.8 | 400.0 | **9.0** | **1.0** | 0.9 | 35 | 1260 | 1840 | 0.7 | 0.3 | |
| 2 | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| **(13) Total** | | | | 18.8 | 400.0 | | | | | 1,260 | 1,840 | | | |
| **(14) Average** | | | | | | | | | | | | | | |

**Remarks**

(1) Gauge reading of chlorine solution tank at the time of (1) in the sheet of Daily Water Production and Distribution Report
(2) Gauge reading of chlorine solution tank at the time of (2) in the sheet of Daily Water Production and Distribution Report
(3) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
(4) = (1)- (2)
(5) : Bleach (kg) to make chlorine solution
(6) : Water to make chlorine solution, incase of 500 L = 0.5 $m^3$
(7) = (5)/(6)/10
(8) : % by manufacture
(9) = (4) x (7)/100 x (8)/100 x 1,000
(10) : (8) in the sheet of Daily Water Production and Distribution Report
(11) = (9)/(10)
(12) Actual FRC concentration at tap
(14) : (13)/total days of the month

# 3. Compressor Operation

**Month. Year**

| Day | Day of the week | (1) Actual Operation hours | (2) Flow rate (L/min) | (3) No. of compressor |
|---|---|---|---|---|
| 1 | | 18.8 | 250 | 1 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
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| | | | | |
| **Total** | | 18.8 | | |

**Remarks**

(1): (5) in the sheet of Daily Water Production and Distribution Report

(2) Air flow meter reading

(3) : Number of operating compressor

## 4. Filtration rate of Iron Removal Filter (Gauradaha WUSC)

**Month, Year**

| Day | Day of the week | (1) Actual Operation hours (Hr) | (2) Treated water volume ($m^3$/day) | (3) Filter area ($m^2$) | (4) Filtration Rate (m/hour) | (5) Design filtration rate (m/hour) |
|---|---|---|---|---|---|---|
| 1 | | 12.0 | 650 | 9.1 | 6.0 | 5.5 |
| 2 | | | | | | 5.5 |
| 3 | | | | | | 5.5 |
| 4 | | | | | | 5.5 |
| 5 | | | | | | 5.5 |
| 6 | | | | | | 5.5 |
| 7 | | | | | | 5.5 |
| 8 | | | | | | 5.5 |
| 9 | | | | | | 5.5 |
| 10 | | | | | | 5.5 |
| 11 | | | | | | 5.5 |
| 12 | | | | | | 5.5 |
| 13 | | | | | | 5.5 |
| 14 | | | | | | 5.5 |
| 15 | | | | | | 5.5 |
| 16 | | | | | | 5.5 |
| 17 | | | | | | 5.5 |
| 18 | | | | | | 5.5 |
| 19 | | | | | | 5.5 |
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| 23 | | | | | | 5.5 |
| 24 | | | | | | 5.5 |
| 25 | | | | | | 5.5 |
| 26 | | | | | | 5.5 |
| 27 | | | | | | 5.5 |
| 28 | | | | | | 5.5 |
| 29 | | | | | | 5.5 |
| 30 | | | | | | 5.5 |
| 31 | | | | | | 5.5 |
| | | | | | | |
| **(6) Total** | | 12 | 650 | 9 | 6.0 | 5.5 |
| **(7) Average** | | | | | | |

Remarks
(1) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
2) : (8) in the sheet of Daily Water Production and Distribution Report
(4) = (2)/(1)/(3)
(7): (6)/Total days of the month

# 5. Backwash velocity (Gauradaha)

**Month.Year**

| Day | Day of the week | (1) Starting time | (2) Finish time | (3) Duration of backwash time (time) | (4) Backwash flow ($m^3$/hour) | (5) Area of filter ($m^2$)/filter | (6)Back Wash Velocity (m/hr) | (7) No. of filter | (8) Design backwash velocity (m/hour) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 15.5 | 15.9 | 0.4 | 87 | 4.2 | 21 | | 21 |
| 2 | | | | | | | | | 21 |
| 3 | | | | | | | | | 21 |
| 4 | | | | | | | | | 21 |
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| 31 | | | | | | | | | 21 |
| | | | | | | | | | |
| **(9) Total** | | | | 0.4 | | | | | |
| **(10) Average** | | | | | | | | | |

**Remarks**

(1) Backwash starting time, in case of 12:40 = 12 + 30.60
(2) Backwash finish time, in case of 13:10 = 13 + 10/60
(3) = (2) - (1)
(4) Backwash flow meter reading
(5) Unit filter area
(6) = (4)/(5)
(7) : Number of backwashing filter
(10) : (9)/Total days of the month

# 6. Filtration rate of Iron Removal Filter (Mangadh WUSC)

**Month, Year**

| Day | Day of the week | (1) Actual Operation hours (Hr) | (2) Treated water volume ($m^3$/day) | (3) Filter area ($m^2$) | (4) Filtration Rate (m/hour) | (5) Design filtration rate (m/hour) |
|---|---|---|---|---|---|---|
| 1 | | 18.8 | 1840 | 15.1 | 6.5 | 6.1 |
| 2 | | | | | | 6.1 |
| 3 | | | | | | 6.1 |
| 4 | | | | | | 6.1 |
| 5 | | | | | | 6.1 |
| 6 | | | | | | 6.1 |
| 7 | | | | | | 6.1 |
| 8 | | | | | | 6.1 |
| 9 | | | | | | 6.1 |
| 10 | | | | | | 6.1 |
| 11 | | | | | | 6.1 |
| 12 | | | | | | 6.1 |
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| 16 | | | | | | 6.1 |
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| 29 | | | | | | 6.1 |
| 30 | | | | | | 6.1 |
| 31 | | | | | | 6.1 |
| | | | | | | 6.1 |
| **(6) Total** | | 19 | 1,840 | 15 | 6.5 | 6.1 |
| **(7) Average** | | | | | | |

Remarks
(1) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
2) : (8) in the sheet of Daily Water Production and Distribution Report
(4) = (2)/(1)/(3)
(5): (4)/Total fays of the month

# 7. Backwash velocity (Mangadh)

**Month.Year**

| Day | Day of the week | (1) Starting time | (2) Finish time | (3) Duration of backwash time (time) | (4) Backwash flow ($m^3$/hour) | (5) Area of filter ($m^2$)/filter | (6)Back Wash Velocity (m/hr) | (7) No. of filter | (8) Design backwash velocity (m/hour) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 15.5 | 15.9 | 0.4 | 150 | 7.5 | 20 | | 20 |
| 2 | | | | | | | | | 20 |
| 3 | | | | | | | | | 20 |
| 4 | | | | | | | | | 20 |
| 5 | | | | | | | | | 20 |
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| 31 | | | | | | | | | 20 |
| | | | | | | | | | |
| **(9) Total** | | | | 0.4 | | | | | |
| **(10) Average** | | | | | | | | | |

**Remarks**

(1) Backwash starting time, in case of 12:40 = 12 + 30.60

(2) Backwash finish time, in case of 13:10 = 13 + 10/60

(3) = (2) - (1)

(4) Backwash flow meter reading

(5) Unit filter area

(6) = (4)/(5)

(7) : Number of backwashing filter

(10)  : (9)/Total days of the month

# 8. Daily Electricity Consumption Report

**Month. Year**

| Day | Day of the Week | (1)Treated Water Volume ( $m^3$/Day) | NEA Line | | | | | Generator | | (9) Total Electricity Consumption (Kwh/day) | (10) $kWh/m^3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (2) Yesterday's reading (kWh) | (3) Today's Reading (kWh) | (4) Difference By NEA Line (kWh) | (5) Total net operation hours (hour) | (6) Total operation hours by NEA | (7) Actual Operation hours by generator(Hr) | (8) kWh | | |
| 1 | | 1,840 | 123 | 340 | 217 | 18.8 | 12.8 | 6.0 | 102.0 | 319.0 | 0.17 |
| 2 | | | | | | | | | | | |
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| | | | | | | | | | | | |
| (11) Total | | 1840.0 | 123.0 | 340.0 | 217.0 | | | 6.0 | 102.0 | 319.0 | 0.17 |
| (12) Average | | | | | | | | | | | |

**Remarks**

(1) : (8) in the sheet of Daily Water Production and Distribution Report
(2): Meter reading at the time of (1) in the sheet of Daily Water Production and Distribution Report
(3): Meter reading at the time of (2) in the sheet of Daily Water Production and Distribution Report
(4) = (3) - (2)
(5) : Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
(6) : Actual operation hours by NEA from another record being used at each WUSC
(7) = (5) - (6)
(8) = (7)/(6) x (4)
(9) = (6) + (8)
(10) = (9)/(3)
(12) = (11)/Total days of the month

# 9. Filtration rate of Rough Filter (Dhulabari  WUSC)

**Month, Year**

| Day | Day of the week | (1) Actual Operation hours (Hr) | (2) Treated water volume ($m^3$/day) | (3) Unit Filter area ($m^2$) | (4) Nos. of Filter | (5) Filter area ($m^2$) | (6) Filtration Rate (m/day) | (7) Design filtration rate (m/hour) |
|---|---|---|---|---|---|---|---|---|
| 1 | | **18.8** | **2,200** | **30** | **2** | **60** | **28.7** | **38** |
| 2 | | | | | | | | **38** |
| 3 | | | | | | | | **38** |
| 4 | | | | | | | | **38** |
| 5 | | | | | | | | **38** |
| 6 | | | | | | | | **38** |
| 7 | | | | | | | | **38** |
| 8 | | | | | | | | **38** |
| 9 | | | | | | | | **38** |
| 10 | | | | | | | | **38** |
| 11 | | | | | | | | **38** |
| 12 | | | | | | | | **38** |
| 13 | | | | | | | | **38** |
| 14 | | | | | | | | **38** |
| 15 | | | | | | | | **38** |
| 16 | | | | | | | | **38** |
| 17 | | | | | | | | **38** |
| 18 | | | | | | | | **38** |
| 19 | | | | | | | | **38** |
| 20 | | | | | | | | **38** |
| 21 | | | | | | | | **38** |
| 22 | | | | | | | | **38** |
| 23 | | | | | | | | **38** |
| 24 | | | | | | | | **38** |
| 25 | | | | | | | | **38** |
| 26 | | | | | | | | **38** |
| 27 | | | | | | | | **38** |
| 28 | | | | | | | | **38** |
| 29 | | | | | | | | **38** |
| 30 | | | | | | | | **38** |
| 31 | | | | | | | | **38** |
| | | | | | | | | |
| **(8) Total** | | 19 | 2,200 | | | | | |
| **(9) Average** | | | | | | | | **38** |

Remarks
(1) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
2) : (8) in the sheet of Daily Water Production and Distribution Report
(4) : Numbers of slow sand filter being used
(5)=  (4) x (3)
(6) = (2) x (1)/24/(5)

If this rough filter is used in slower rate, then water bloom (green algae) will grow and it will choke the surface of sand layer and it is difficult to remove this type of algae. So the filter rate of this rough filter should maintain the design filter rate.

(9) = (8)/ total days of the month

# 10. Backwash velocity of Rough Filter (Dhulabari WUSC)

**Month.Year**

| **Day** | **Day of the week** | **(1) Starting time** | **(2) Finish time** | **(3) Duration of backwash time (time)** | **(4) Backwash flow ($m^3$/min)** | **(5) Area of filter ($m^2$)/filter** | **(6)Back Wash Velocity (m/hr)** | **(7) No. of filter** | **(8) Design backwash velocity ($m^3$/min)** |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 15.5 | 15.7 | 0.2 | 18 | 30.0 | 36.0 | | 17-25 |
| 2 | | | | | | | | | 17-25 |
| 3 | | | | | | | | | 17-25 |
| 4 | | | | | | | | | 17-25 |
| 5 | | | | | | | | | 17-25 |
| 6 | | | | | | | | | 17-25 |
| 7 | | | | | | | | | 17-25 |
| 8 | | | | | | | | | 17-25 |
| 9 | | | | | | | | | 17-25 |
| 10 | | | | | | | | | 17-25 |
| 11 | | | | | | | | | 17-25 |
| 12 | | | | | | | | | 17-25 |
| 13 | | | | | | | | | 17-25 |
| 14 | | | | | | | | | 17-25 |
| 15 | | | | | | | | | 17-25 |
| 16 | | | | | | | | | 17-25 |
| 17 | | | | | | | | | 17-25 |
| 18 | | | | | | | | | 17-25 |
| 19 | | | | | | | | | 17-25 |
| 20 | | | | | | | | | 17-25 |
| 21 | | | | | | | | | 17-25 |
| 22 | | | | | | | | | 17-25 |
| 23 | | | | | | | | | 17-25 |
| 24 | | | | | | | | | 17-25 |
| 25 | | | | | | | | | 17-25 |
| 26 | | | | | | | | | 17-25 |
| 27 | | | | | | | | | 17-25 |
| 28 | | | | | | | | | 17-25 |
| 29 | | | | | | | | | 17-25 |
| 30 | | | | | | | | | 17-25 |
| 31 | | | | | | | | | 17-25 |
| | | | | | | | | | |
| **(9) Total** | | | | 0.2 | | | | | |
| **(10) Average** | | | | | | | | | |

**Remarks**

(1) Backwash starting time, in case of 12:40 = 12 + 30.60
(2) Backwash finish time, in case of 13:10 = 13 + 10/60
(3) = (2) - (1)
(4) Backwash flow meter reading
(5) Unit filter area
(6) = (4)/(5)
(7) : Number of backwashing filter
(10) : (9)/Total days of the month

# 11. Filtration rate of Slow Sand Filter (Dhulabari  WUSC)

**Month, Year**

| Day | Day of the week | (1) Actual Operation hours (Hr) | (2) Treated water volume ($m^3$/day) | (3) Unit Filter area ($m^2$) | (4) Nos. of Filter | (5) Filter area ($m^2$) | (6) Filtration Rate (m/day) | (7) Design filtration rate (m/day) |
|---|---|---|---|---|---|---|---|---|
| 1 | | **24.0** | **2,200** | 231 | **2** | **462** | **4.8** | **5** |
| 2 | | | | 231 | | | | 5 |
| 3 | | | | 231 | | | | 5 |
| 4 | | | | 231 | | | | 5 |
| 5 | | | | 231 | | | | 5 |
| 6 | | | | 231 | | | | 5 |
| 7 | | | | 231 | | | | 5 |
| 8 | | | | 231 | | | | 5 |
| 9 | | | | 231 | | | | 5 |
| 10 | | | | 231 | | | | 5 |
| 11 | | | | 231 | | | | 5 |
| 12 | | | | 231 | | | | 5 |
| 13 | | | | 231 | | | | 5 |
| 14 | | | | 231 | | | | 5 |
| 15 | | | | 231 | | | | 5 |
| 16 | | | | 231 | | | | 5 |
| 17 | | | | 231 | | | | 5 |
| 18 | | | | 231 | | | | 5 |
| 19 | | | | 231 | | | | 5 |
| 20 | | | | 231 | | | | 5 |
| 21 | | | | 231 | | | | 5 |
| 22 | | | | 231 | | | | 5 |
| 23 | | | | 231 | | | | 5 |
| 24 | | | | 231 | | | | 5 |
| 25 | | | | 231 | | | | 5 |
| 26 | | | | 231 | | | | 5 |
| 27 | | | | 231 | | | | 5 |
| 28 | | | | 231 | | | | 5 |
| 29 | | | | 231 | | | | 5 |
| 30 | | | | 231 | | | | 5 |
| 31 | | | | 231 | | | | 5 |
| | | | | | | | | |
| **(8) Total** | | 24 | 2,200 | | | | | 5 |
| **(9) Average** | | | | | | | | |

Remarks
(1) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
2) : (8) in the sheet of Daily Water Production and Distribution Report
(4) : Numbers of slow sand filter being used
(5)=  (4) x (3)
(6) = (2) x (1)/24/(5)
(9) : (8)/total days of the month

# 12. Water Quality Analysis Record

**Month, Year**

| Day | Day of the week | Sampling point | Parameters | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pH | | Color | | Turbidity | | M-Alkalinity | | Iron | | FRC | | |
| | | | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | |
| 1 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 2 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 3 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 4 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 5 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 6 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 7 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 8 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 9 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |

# 12. Water Quality Analysis Record

**Month, Year**

| Day | Day of the week | Sampling point | Parameters | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pH | | Color | | Turbidity | | M-Alkalinity | | Iron | | FRC | | |
| | | | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | |
| 10 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 11 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 12 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 13 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 14 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 15 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 16 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 17 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 18 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |

# 12. Water Quality Analysis Record

**Month, Year**

| Day | Day of the week | Parameters | | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sampling point | pH | | Color | | Turbidity | | M-Alkalinity | | Iron | | FRC | | |
| | | | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | |
| 19 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 20 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 21 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 22 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 23 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 24 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 25 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 26 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 27 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 28 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |

## 12. Water Quality Analysis Record

**Month, Year**

| Day | Day of the week | Sampling point | pH | | Color | | Turbidity | | M-Alkalinity | | Iron | | FRC | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | Result | Regulation | |
| 29 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 30 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |
| 31 | | Inlet to the plant | | | | | | | | | | | | | |
| | | Outlet of the plant | | | | | | | | | | | | | |
| | | Tap water | | 6.5 – 8.5* | | 5 (15)≤ | | 5 (10)≤ | | | | 0.3 (3)≤ | | 0.2-0.4 (Note) | |
| | | Outlet of rough filter | | | | | | 30≤ (Note) | | 20≥ | | | | | |
| | | Outlet of sedimentation tank | | | | | | | | | | | | | |

Note: Recommendation, Guideline

# 13. Daily Alum Consumption Report

**Month, Year**

| Day | Day of the Week | Alum Solution Consumption (L/Day) | | | | Alum solution (w/v %) | | | (8) Consumed Alum (g/day) | (9) Treated water ($m^3$/day) | (10) Alum feeding rate (g/$m^3$) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) Start Time | (2) Final Stop time | (3) Actual Operation Hour | (4) Difference Liter | (5) Alum (kg) | (6) Solution ($m^3$) | (7) w/v % | | | | |
| 1 | | **750** | **250** | 18.8 | 500.0 | **50** | **1.0** | 5 | 25,000 | 1840 | 13.6 | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **(11) Total** | | | | 18.8 | 500.0 | | | | 25,000 | 1,840 | | |
| **(12) Average** | | | | | | | | | | | | |

**Remarks**

(1) Gauge reading of chlorine solution tank at the time of (1) in the sheet of Daily Water Production and Distribution Report
(2) Gauge reading of chlorine solution tank at the time of (2) in the sheet of Daily Water Production and Distribution Report
(3) Actual operation hour in the sheet of Daily Water Production and Distribution Report (5)
(4) = (1)- (2)
(5) : Alum (kg) to make alum solution
(6) : Water to make alum solution, incase of 500 L = 0.5 $m^3$
(7) = (5)/(6)/10
(8) = (4)/1000 x (7)*10*1000
(9) : (8) in the sheet of Daily Water Production and Distribution Report
(10) = (9)/(10)
(12) : (11)/total days of the month

# Standard Operation Procedure (SOP)
# on
# O&M of Water Distribution Facilities

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1. Draft Standard Operation Procedure (SOP) on O&M of Water Distribution Facilities

**1.1 Water Distribution Facilities**

Water facilities consist principally of intake facility, raw water transmission pipe, water treatment plant, transmission pipe, elevated tank for water storage and distribution pipe.
Since regular check of water distribution facilities is accomplished, targets for O&M and New Planning Formulation of Water Distribution Facilities are shown below.

As for the first target, WUSC confirms the current status of distribution facilities included in the existing facilities, and makes inspection, flow and repair records of facilities such as raw water transmission pipe, transmission pipe, valves and elevated tank. Main purpose of these activities is to inspect them regularly.

As for the second target, water distribution maps that consist of pipe routes and locations of valves and washout drain and fire hydrant, pipe diameter and pipe material is to be created. This information map is necessary for maintenance and repair of facilities.

Object facilities of inspection and check sheet are shown below.

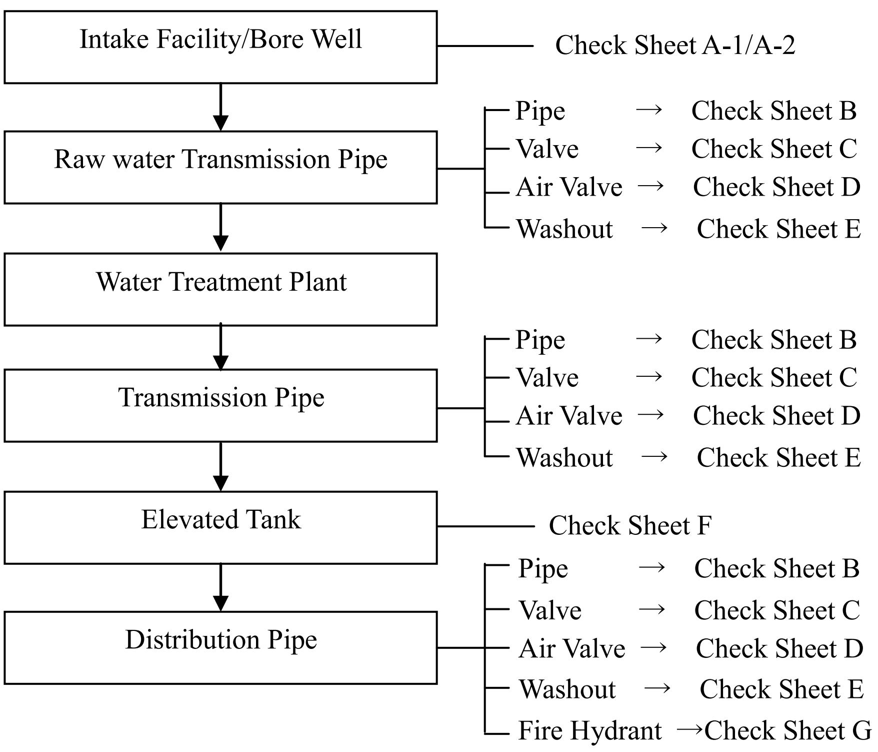



**Figure 1.1.1 Target water supply facilities and check sheet of inspection**

### 1.2 Provision of Survey

Required items in facilities inspection are shown below

- ✓ Inspection Sheets
- ✓ (Digital) Camera
- ✓ Cover Opener (T key)
- ✓ Wrench, spanner, Screw driver, cotton work gloves and so on
- ✓ Maps

### 1.3 Consideration of Facility Survey

Items that WUSC staffs must always be aware of O&M for water supply facilities are shown below.

#### 1.3.1 Intake Facility

- ✓ Observational items are mainly Fence, Concrete degradation, Facility condition (Appearance), Water quality (turbidity, unusual odor), Screen (Rust, trash-filled), Sedimentation in canal, and so on.

- ✓ WUSC staffs conduct the intake facility survey periodically. The inspectors contact the WUSC when discovering malfunction of the facility.
- ✓ The Guard always supervises the fence to prevent trespassing.
- ✓ WUSC displays Keep Off of general people in the bulletin board and signs at the intake site.

#### 1.3.2 Pipelines and Valves

1) Raw Water Transmission and Transmission Pipes:

- ✓ There is little information of pipe from residents since raw water transmission pipes are located far from the management office (WTP) such as the rice fields and mountainous region. It is thought of behind in the discovery when the pipe has a malfunction. Therefore, WUSC staffs make periodical inspection.

2) Distribution Pipes:

- ✓ WUSC staffs prevent leakage of water in pipes, especially leakage from joints.
- ✓ WUSC replaces a old pipes when there is too much water leakage from pipe and not from the joints.
- ✓ WUSC staffs monitor and maintain pipes where it is possible to generate rust-colored water by stagnation of water at dead ends.

3) Valve:

- ✓ Gate Valve: Gate valve is mainly used by on-off control. In case of opening only some position of valve disc, use of the gate valve is not advised. Valve disc in valve box moves up and down, and opens and shuts.
- ✓ Butterfly Valve: Valve disc in the valve box makes a valve rod in an axis, turns and opens and shuts.

4) Air Valve:

- ✓ Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water.

5) Washout:

- ✓ Washout: Washout drains are provided to keep the pipelines free from blockade. It shall be washed out at least once in 3 month in dry season and once a month in rainy season with enough water to flush the deposited dirt until clear water at washout is observed

#### 1.3.3 Elevated Tank

- ✓ WUSC staffs clean the inside of the tank once a year.

✓ In case of cleaning inside the tank, staffs confirm leakage of water from the concrete crack and joint inside the tank.

**Table 1.3.1 Check Items of Water Facilities**

| Facilities | Check Items | Remarks |
|---|---|---|
| Intake | Date, Fence, Concrete degradation, Condition (appearance), Water quality, Screen, Sedimentation, etc. | Repair record, Sketch, Photograph |
| Pipe | Location, Diameter, pipe material, Condition (appearance), Water quality, Leakage, Sound, Customer complaints, etc. | Repair record, Sketch, Photograph |
| Valve, Air valve, Washout, Fire Hydrant | Type, Location, Main pipe dia., Condition (appearance), Working, Leakage, Sound, Valve status, etc. | Repair record, Sketch, Photograph |
| Elevated Tank | Location, Crack of concrete, Condition (appearance), Water quality, Leakage, Sound, Cleaning, etc. | Repair record, Sketch, Photograph |

### 1.4 Out of Order and Measures of Valve

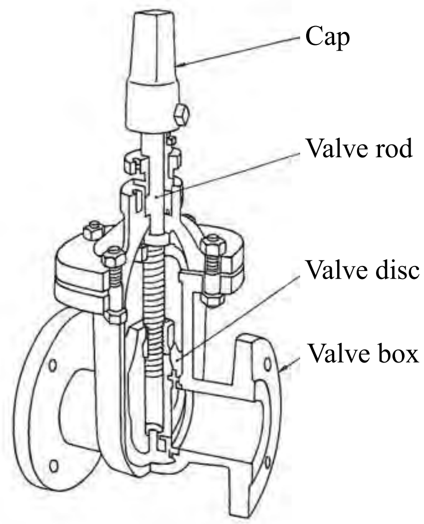



**Figure 1.4.1 Gate Valve**

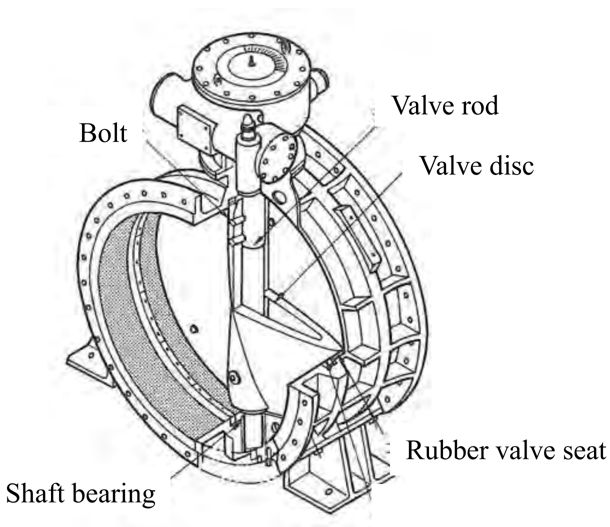



**Figure 1.4.2 Butterfly Valve**

**Table 1.4.1 Out of Order and Measures of Valve**

| | Malfunction | Causes | Measures |
|---|---|---|---|
| Gate Valve | It is impossible to open and shut a valve. | The valve seat is filled with alien substance such as garbage and sand. | Removes alien substance. |
| | | Abnormal abrasion of valve rod joint | Adjustment and repair of valve joint |
| | | Twist and distortion of valve rod | Replacement of valve rod |

| | Malfunction | Causes | Measures |
|---|---|---|---|
| | | | |
| | | Abnormal abrasion of valve rod and valve box guide | Repair of valve box edge. |
| | | Malfunction of reduction gears | Decomposition and parts cleaning. Replacement of parts of reduction gears |
| | Torque generates strongly in case of operation of the valve.<br>Leakage of water from ground of valve | The valve seat and valve rod are filled with alien substance | Remove alien substance. |
| | | Packing gland tighten up too much. | Adjustment of packing gland nut. |
| | | Valve disc digs deep into valve seat. | Adjustment of valve opening. |
| | | Abnormal abrasion of packing, bad fastening of packing | Adjustment or replacement of packing |
| | | Dirt and so on adhere to a outcrop of valve rod, and surface of rod is a flaw. | Grinding or replacement of valve rod |
| | Leakage of water in spite of indicating close on opening gauge | Abnormal abrasion or damage of valve seat | Repair or replacement of valve seat |
| | | Bad opening gauge | Inspection, replacement of valve and gauge |
| | | Bad adjustment with valve | Readjustment with valve |
| | Vibration and/or noise from valve | Generation of cavitation in valve box | Set the valve opening with no generation of cavitation. |
| Butterfly Valve | It is impossible to open and shut a valve. | The valve seat is filled with alien substance such as garbage and sand. | Remove alien substance.<br>Repair rubber valve seat<br>Repair a edge of valve disc. |
| | | Malfunction of reduction gears | Decomposition and parts cleaning. Replacement of parts of reduction gears. |
| | Torque generates strongly in case of operation of the | Bad shaft bearing of valve disc | Replacement of shaft bearing |

| | Malfunction | Causes | Measures |
|---|---|---|---|
| | valve. | Valve disc moved down | Adjustment of valve disc position with adjusting-bolt |
| | | Valve disc digs deep into valve seat. | Adjustment of valve opening. |
| | Leakage of water from valve seat with abnormal torque when closing valve. | Separation of rubber valve seat | Replacement of rubber valve seat |
| | | The valve seat and valve rod are filled with alien substance | Remove alien substance. |
| | Leakage of water in spite of indicating close on opening gauge | Damage of rubber valve seat | Replacement of rubber valve seat |
| | | Bad opening gauge | Conducting inspection of valve and gauge |
| | | Bad adjustment with valve | Readjustment with valve |
| | Vibration and/or noise from valve | Backlash of gear in second reduction gears | Adjustment and/or replacement of gear |
| | | Generation of cavitation in valve box | Inspect a cause of cavitation, and remove it. |

### 1.5 Procedures of investigation and report to WUSC

At the time of the regular investigation of the water supply facilities, WUSC staffs make inspection record, and report to WUSC. When the abnormality and problem in the water facilities are discovered, staffs repair it and inform WUSC of its result. WUSC reports and/or requests WSSDO to support when necessary.

#### 1.5.1 Routine Work Procedures

Procedures of investigation and report under the normal situation are shown below.

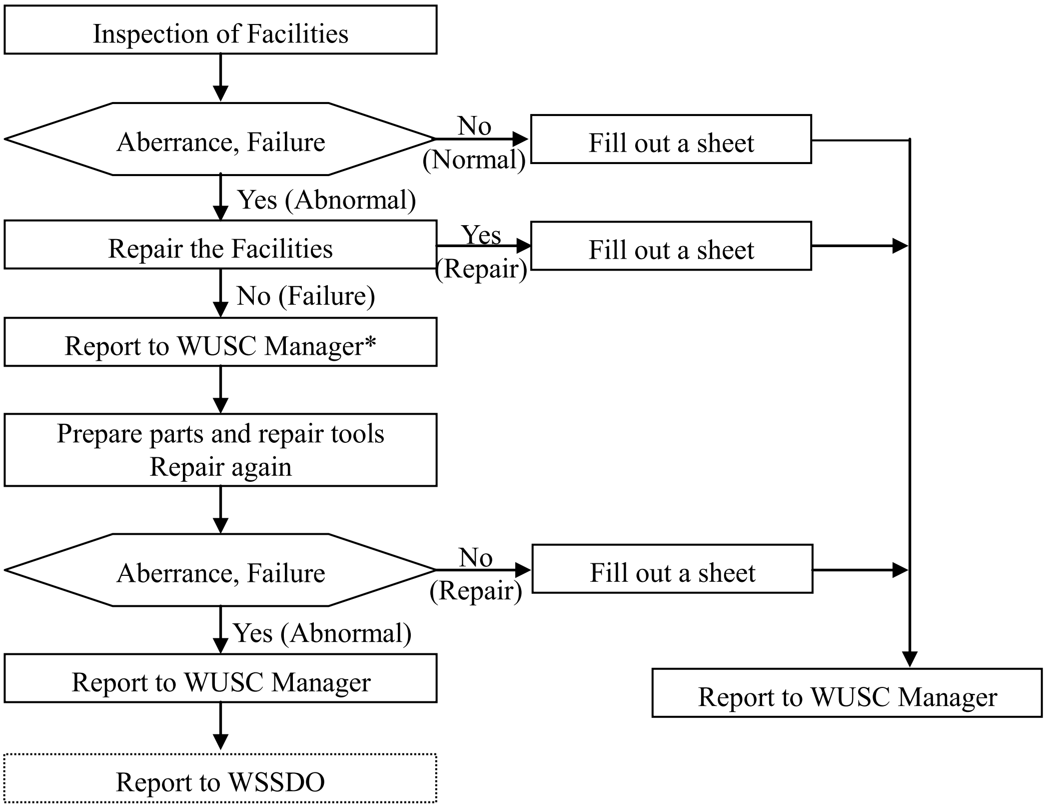



**Figure 1.5.1 Procedure of the Inspection and Report to WUSC**

### 1.5.2 Emergency Situation Procedures

In emergency, as the priority is given to protect life of residents and to secure safety, establishment of liaison system is described in the SOP. In order to inform rapidly, WUSC staff need to identify emergent incidence properly and inform it to the manager/board members as fast as possible. The manager/board members must decide to inform to residents, collection proper information and grasping the proper situation of the incident. Liaison system in WUSC needs to establish, since residents may provide information to WUSC.

Emergency situations will be classified into;

1. Stop of water supply function (large scale power failure, damage of facilities, water contamination)
2. Natural disaster (earthquake, damages caused by floods, landslide, fire disaster, abnormal climate, infectious disease)
3. Terrorism (threat, destructive activities)

The emergency in this context is defined as 1) stop of water supply function.

The SOP describes that when emergency situation takes place, response will be made to protect life of residents and to secure safety, to protect water supply facilities, to secure continuance and safety of facility operation.

Procedures under the emergency situation are shown below.

1) Contact from WUSC

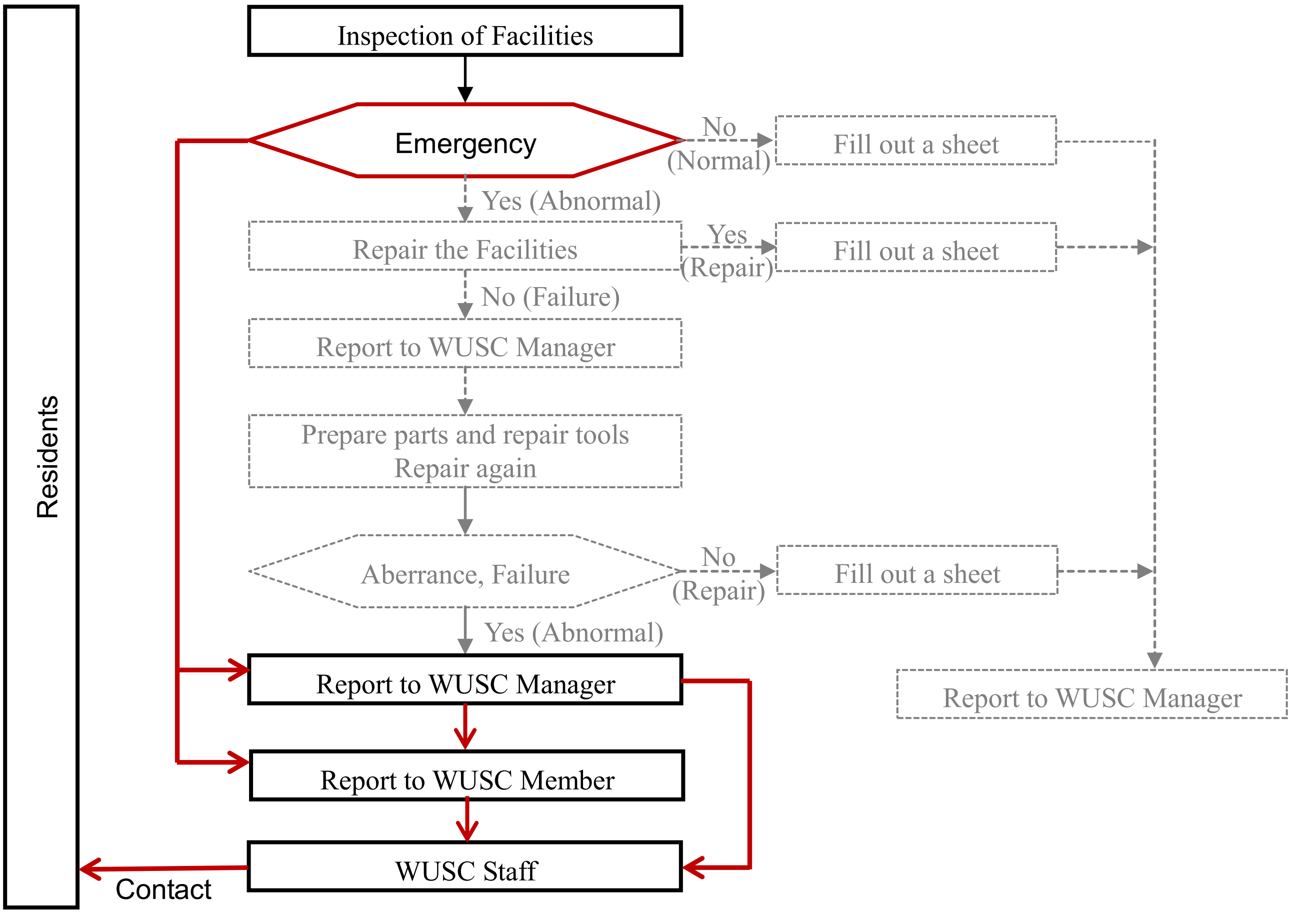



**Figure 1.5.2 Emergency Flow Chart (Contact from WUSC)**

2) Contact from Residents

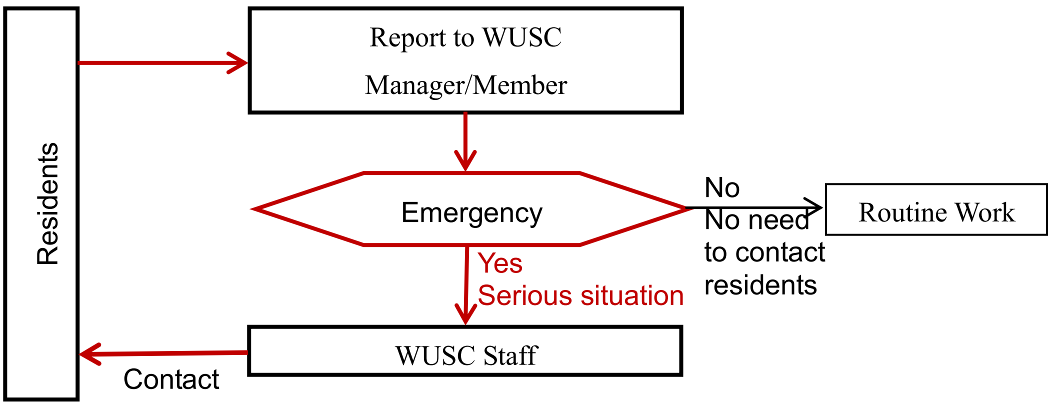



**Figure 1.5.3 Emergency Flow Chart (Contact from Residents)**

CHECK SHEET A-1

## Intake Facility **Inspector:**

| No. | Inspection Date (dd/mm/yy) | Fence | Concrete degradation | Condition (Appearance) | Water Quality (Turbidity, unusual odor) | Screen (Rust, trash-filled) | Sedimentation in canal | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| | [Sample of fill-in] | | | | | | | |
| 1 | 12/09/2010 | Destroyed 5m | Crack on Canal | Dirty in valve pit Need to clean | Thick, sallow | Trash-filled Need to clean | Sedimentation 4cm | Fence 20/9/2010<br>Concrete 20/9/2010<br>Clean for pit and Screen 20/9/2010<br>Removed sand from canal 22/9/2010 |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| | | | | | | | | |

Sketch

or

Photograph

CHECK SHEET A-2

**Bore Well** **Inspector:**

| No. | Inspection Date(dd/mm/yy) | Wall (Fence) | Bore Hole Plate Form | Condition (Appearance) | Water Quality (Turbidity, unusual odor) | Submersible Pumps | Submersible Cable | Non-return Valve | Wash out Valve | Flow Meter | Pressure Gauge | Repair Record Date(dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

CHECK SHEET B

**Pipe** **Inspector:** **Inspection Date:**

| No. | Location | Main pipe Dia., Material | Condition (Appearance) | Water Quality | Leakage | Sound, etc | Customer Complaints | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

CHECK SHEET C

**Valve** **Inspector:** **Inspection Date:**

| No. | Type | Location | Main pipe Dia. | Condition (Appearance) | working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| | [Sample of fill-in] | | | | | | | | |
| 3 | Gate | VR5-4 (route No.+Nos) | OD 160 HDPE | Rusty Need to clean | Ok | Water leakage | No | Open | clean 20/9/2010 Leakage 20/9/2010 |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

Sketch

or

Photograph

CHECK SHEET D

**Air Valve** **Inspector:** **Inspection Date:**

| No. | Location | Main pipe Dia. | Condition (Appearance) | working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

CHECK SHEET E

**Washout** **Inspector:** **Inspection Date:**

| No. | Location | Main pipe Dia. | Condition (Appearance) | working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

CHECK SHEET F

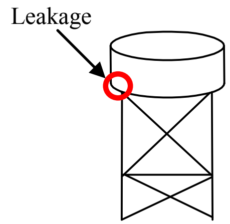
**Elevated Tank Check List Inspector:** **Inspection Date:**

| No. | Location | Crack of Concrete | Condition (Appearance) | Water Quality | Leakage | Sound, etc | Cleaning inside tank | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

Sketch

or

Photograph



CHECK SHEET G

**Fire Hydrant Check List** **Inspector:** **Inspection Date:**

| No. | Location | Main pipe Dia. | Condition (Appearance) | working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

## 1.6 Water Distribution Network Map

### 1.6.1 Purpose

Distribution pipelines and appurtenances have enormous length, and embedded pipes have various environments and conditions. Conditions of embedded pipes and structures should be grasped in order to maintain the pipelines by engineers

Therefore, distribution network map and its ledger should be made and kept systematically. This map can help engineers to understand and to conduct a new project such as improvement of facility and/or renewal in formulation stage of planning.

### 1.6.2 Revision of Map

Pipes change frequently with extension, improvement and moving of pipes. Therefore, engineers have to grasp facility information promptly and revise the map accurately.

Main information of water facilities on distribution network map is shown below.

| Item | Information | Remarks |
|---|---|---|
| Pipe | location, material, diameter, length | Included in abandoned pipes |
| Valve, Washout, Fire Hydrant | Location, Valve type | |
| Topographical factor | Road, House, River (Cannel) | |

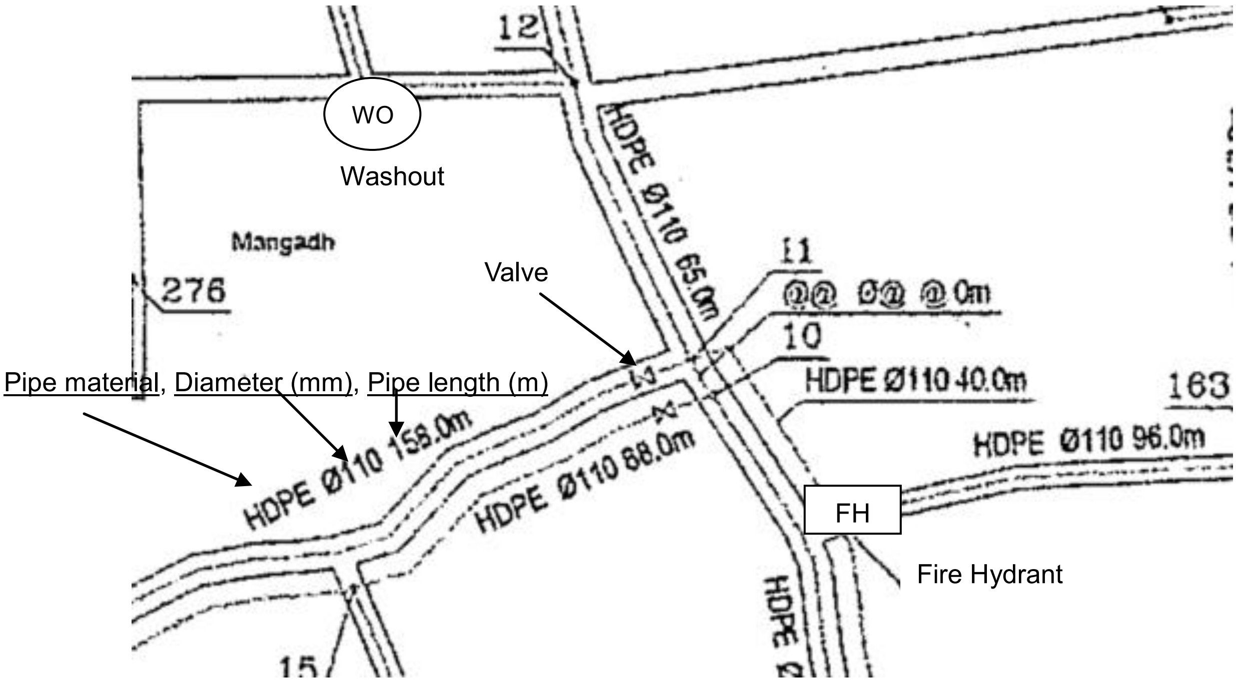



**Figure 1.6.1 Sample of Water Distribution Network Map**

### 1.6.3 Problems and Countermeasures

Since the water distribution maps are linked together with the facility information/ledgers, the information can be shared and be centralized for other staffs. Therefore, the facility information which technicians and plumbers have relied on their experience and memories till now can be visualized and be also shared to a third person. Furthermore, places where consumer complaints such as low water pressure and water quality deterioration occur can be confirmed with the information map, and the causes can be supposed. WUSCs are able to study countermeasures such as elimination of dead ends, pipe looping and valve control, and they take measures.

## 2. New Planning Formulation of Water Distribution Facilities

A water distribution facility consists of pipes, service reservoirs, elevated tanks, pumps, valves, washouts and other accessory equipment.
The water distribution facility is required to be arranged under a rational plan, be able to supply water required by customers with a proper water pressure, and be easy in maintenance. Furthermore, keeping the quality of treated water flowing in the distribution pipelines is also required to be adequately taken into account.

**2.1 Water Distribution Facilities Plan**

The facilities to store and distribute treated water to users can be planned and designed according to water resources, location, nature of area and demand. Consideration has to be taken during the planning, design, and operation of distribution and storage tanks to prevent or mitigate any effect. The purpose of water distribution facilities plan is to introduce the basic concepts included in planning of distribution systems.

Important issues and factors are,

(1) Planning and implementation issues,
(2) Planning and conceptual design of water distribution network
(3) Design of pipelines
(4) Operation and maintenance of distribution pipelines

**2.2 Issues in the Planning Process**

Planning and implementation issues of water distribution facilities include,

- Type, size and location of distribution facilities
- Involvement of the public during the planning and implementation process. The public may be affected directly by location and construction of facilities.

**2.3 Type, Size and Location of Facilities**

The primary factors of distribution facilities include the location and required demand of the water users. The principal facilities needed for the delivery of treated water are an elevated tank for storage, transmission and distribution pipes.
It is basically required that a service reservoir be arranged at a place as close to the center of the service area as possible and at a high place if such a high advantageous for water distribution is available, or at any other proper place if such a high place is not available for any geographical reason, etc.
Elements of typical treated water storage and distribution system are shown in **Figure 2.3.1**.

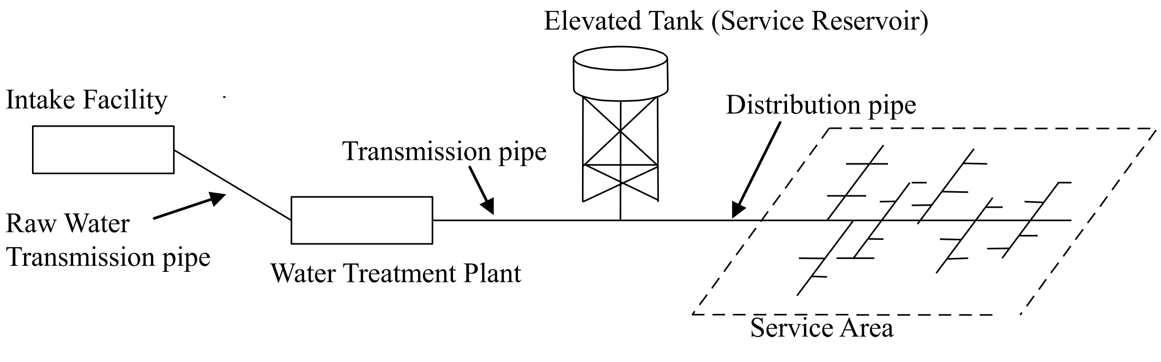



**Figure 2.3.1 Element of typical Water Supply Facilities**

In terms of facility structure, durability, earthquake resistance, water-tightness, etc. must be taken into full account. Therefore, for arranging a service reservoir, a place with ground as firm and strong as possible must be selected.

### 2.4 Planning and Conceptual Design of Distribution Facilities

The planning process consists of the following tasks.

- Identification of water user's demand
- Determination of water quantities and pressure required for water demand.
- Distribution system layout as optimization system including pipeline routes and pipe diameters
- Distribution system analysis

One of the initial planning tasks is to determine how the location and required quantities of water supply match the location and demands of users. Important characteristics of the main demand include,

1) the quantity of water demand,
2) the physical location and elevation of points of use within the service area
3) the required operation pressure at providing water points

### 2.5 Required Quantities

Major demand, average daily flow, maximum daily flow and peak hourly flow have to be determined. Peak hourly demand is the most important flow rate criterion for sizing distribution facilities.

### 2.6 Maximum daily design water flow, Hourly maximum design water flow

There are three kinds of design water flow, average daily design water flow, maximum daily design water flow and maximum hourly design water flow

Annual water flow divided by 365 days makes average daily design water flow in the target years. This is used for estimation of service charge and operation and maintenance costs.
Maximum daily design water flow means water flow on the day of maximum water generation in a year. This maximum daily design water flow is used in design of water treatment plant which needs to cope with seasonal variation, and is used in design of transmission pipelines and transmission pumps.

Hourly maximum design water flow is 24 hours conversion of numerical value ($m^3$/day) of a peak water flow per hour on the day of maximum water generation, is used for design of distribution pipes and distribution pump.

1) Water Demand

Water demand rate to be adopted in the design are as follows;
Domestic water demand for service connection (Daily average): 100 L/capita/day (DWSS Design Criteria)

2) Variation Coefficient

Variation coefficient means magnitude of variation of water demand.

(Daily maximum value) / (Daily average value) = 1.2

3) Leakage Rate

Leakage rate was estimated to be 10 % of average daily water flow

4) Hourly peak factor

Hourly maximum water demand is estimated by multiplying daily maximum water demand by the peak factor. The peak factor 3.0 is taken as standard in Nepal.

The peak factor indicates the ratio of hourly maximum to hourly average in the day of the maximum demand and generally used to grasp hydraulic characteristic of principal pipes in pipe network such as distribution main pipes. In fact, the peak factor means that a ratio of water users open faucets at the same time to average use, but not increase of water flow of service pipes such as house connection pipes and tertiary pipes.

$$\boxed{\text{Daily Max / Daily Ave.} = 1.20}$$

$$\boxed{\text{Hourly Max / Daily Max} = 3.0}$$

Unit design average daily water flow, design maximum daily water flow and design maximum hourly water flow are calculated as below.

Unit average daily water = 100 L/capita/day x 1.1 (included in leakage)
Unit maximum daily water = Unit of average daily water×1.2
Unit maximum hourly water = Unit of maximum daily water ×3.0

**2.7 Distribution Network System**

The distribution network system consists of all pipeline routes, the locations, sizes and elevated tanks. Two types of distribution systems may be mainly used tree type distribution system or grid type one as shown in **Figure 2.7.1** and **Figure2.7.2.**

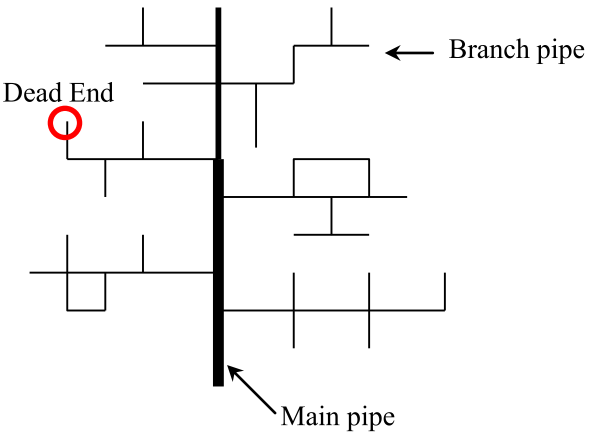



**Figure 2.7.1 Tree Type Distribution System**

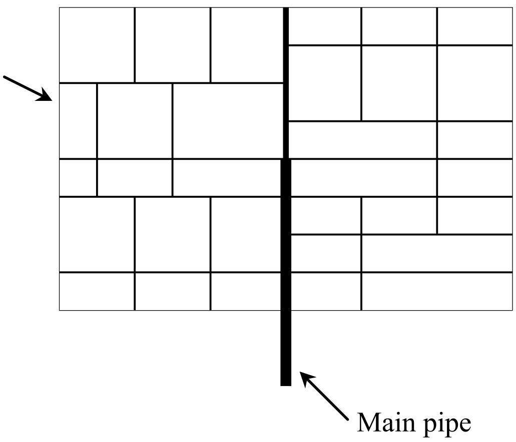


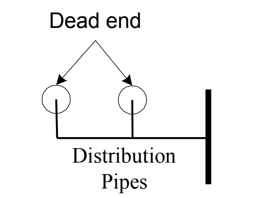
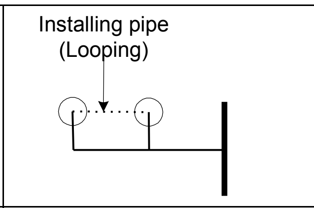
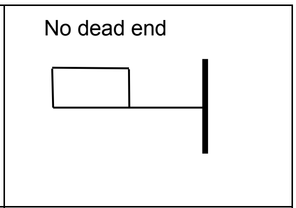

**Figure 2.7.2 Grid Type Distribution System**

1) Tree Type System: In Dhulabari and Gauradaha WUSC

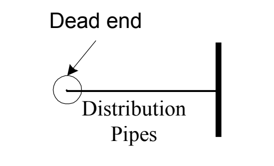
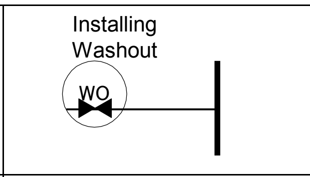
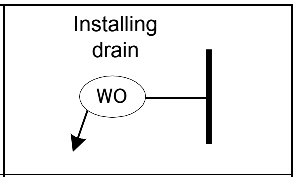
A single main is used that reduces in size with increasing distance from the source. Branch lines emanate from main pipe. <u>Tree type system has dead ends which are the potential for stagnation and deterioration of water quality</u>, and periodic flushing is required to remove deposits in dead points.
A dead end pipe where water threatens to be retained should be avoided as much as possible.

The dead points are shown in **Figure 2.7.3 and 2.7.4** in Dhulabari and Gauradaha pipeline networks.

How to eliminate a dead end or to avoid generating rust-colored water at a dead end
a) To loop a pipe network

| | | |
|---|---|---|
|  |  |  |
| 1) Current situation | 2) Connecting between the dead ends | 3) Loop Network |

b) To install a washout drain at a dead end

| | | |
|---|---|---|
|  |  |  |
| 1) Current situation | 2) Installing a washout at a dead end | 3) Washed out through a drain periodically |

2) Grid Type System: In Mangadh WUSC

This pipeline system is laid out in a lattice-shaped, with the piping usually deceasing in size as the distance increasing from source. In grid type system, headloss will generally be less compared with a tree type system. Looping network eliminates dead ends in the distribution system. Therefore, the potential for stagnation and deterioration of water quality can be reduced.

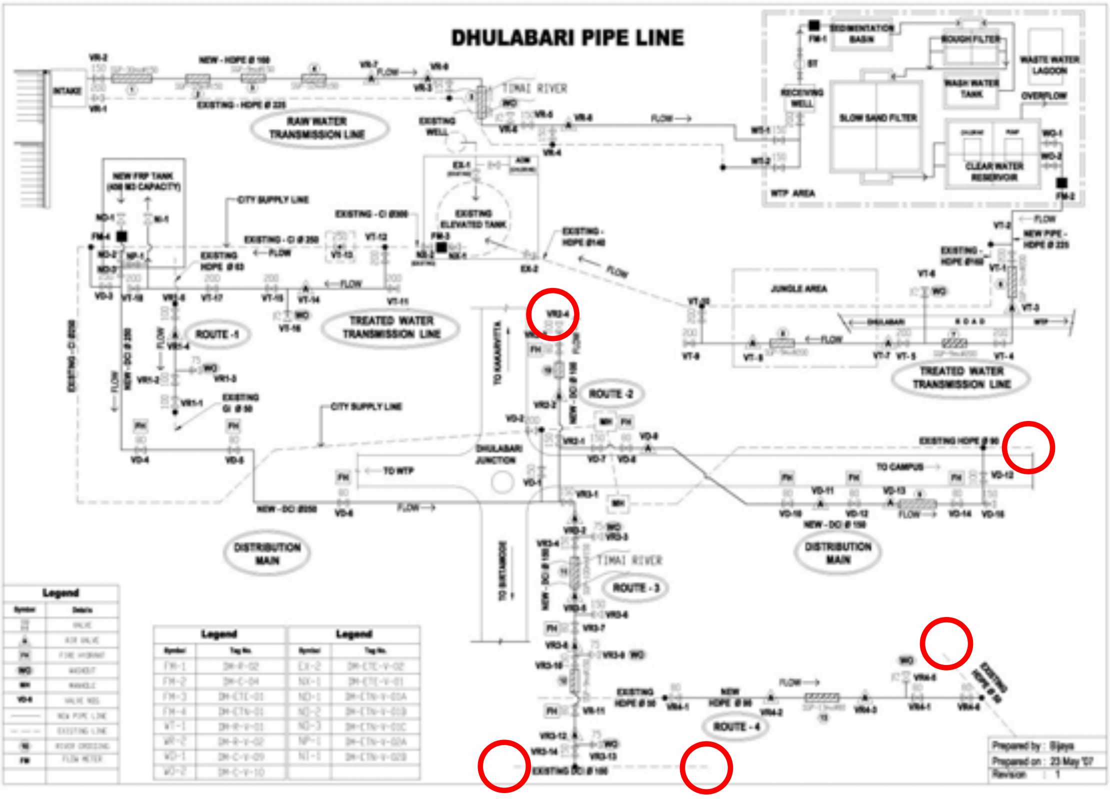



**Figure 2.7.3 Flow Diagram of Pipelines in Dhulabari**

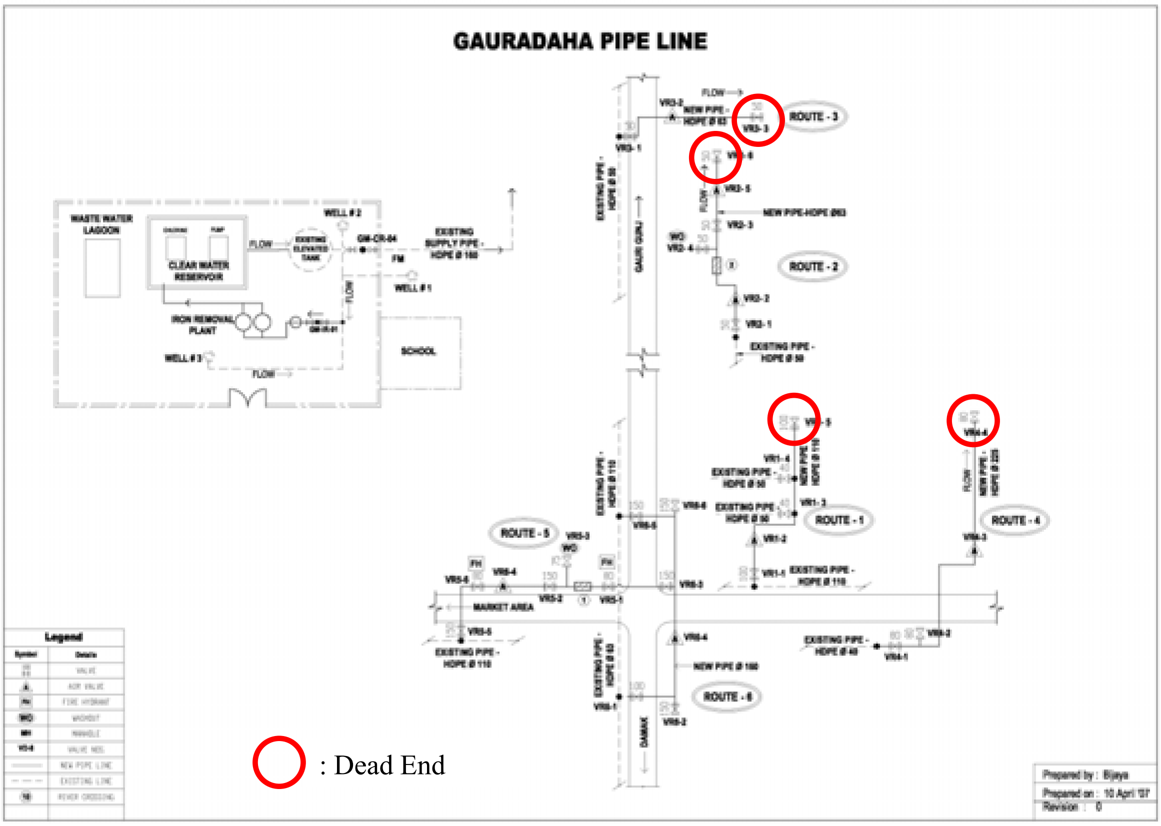



**Figure 2.7.4 Flow Diagram of Pipelines in Gauradaha**

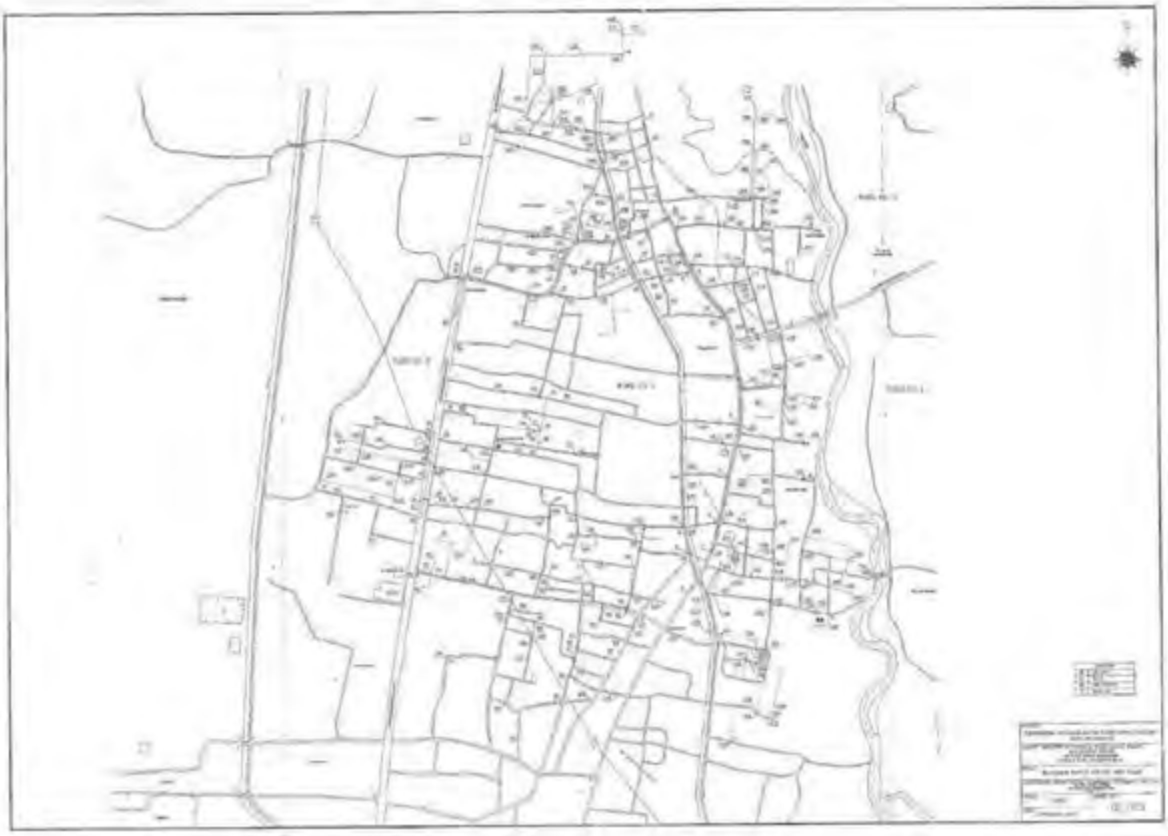


**Figure 2.7.5 Pipelines in Mangadh**

A major problem of water quality caused by a distribution pipeline is red water caused by rust generated on the inner surfaces of the distribution pipes.
The cast-iron pipes and steel pipes deteriorated in painting and lining with the lapse of years cause red water. Therefore, such proper measures must be taken as replacing pipes by any other kind of pipes or rehabilitating pipes.

**2.8 Distribution System**

The distribution system can be classified into gravity flow type and pump boosting type, depending on the height relation between the service reservoir and the distribution area. If any proper high place is available in or near the distribution area, the service reservoir is located there to adopt gravity flow type, and if not available, pump boosting type is adopted.
Gravity flow type is more excellent than pump boosting type since it is not affected by electric service interruption and allows safe water supply to be secured. Therefore, if any proper high place is available in or near the distribution area, gravity flow type is adopted in principle, considering the economic advantages of construction cost and maintenance cost.
Furthermore, it is necessary to make use of topographical and geographical conditions as much as possible, for securing the energy of positions, thereby saving the electric power used, and also to arrange, considering the expansion of the range of the water service system.

**2.9 Piping System Sizing**

In design of water distribution systems, the size of the pipelines must be balanced against the maximum velocity in the pipelines and total headloss across the distribution network. If the pipe sizes are too small, headloss will be greater, and pressures will be reduced. Appropriate sizes of pipe have to be determined.

The principal design criteria for water pipelines are maximum velocity and required pressures. In general, appropriate velocities are between 0.5 and 1.5 m/s in a pipeline, it will result in the most economical construction costs.

**2.10 Design Criteria in Hydraulic Analysis**

The information below is the hydraulic design criteria.

Pipe materials: HDPE
Pressure rating: PN 2.5, 4, 6, 10 type pipes

Minimum service pressure: 0.5 – 0.7 bars throughout the distribution network except that service pressure will be relaxed in case of fire flow (using a fire hydrant).
H-W Coefficient: C= 110 - 150 (HDPE)
Minimum flow velocity: 0.3 m/sec.
Maximum flow velocity: 3 m/sec.
Typical range of hydraulic gradient: 0.1 - 0.5 %

Hazen-Williams Equation;

$$V = 0.35464\, C\, D^{0.63}\, I^{0.54}$$

$$Q = 0.27853\, C\, D^{2.63}\, I^{0.54}$$

$$I = 10.666\, C^{-1.85}\, D^{-4.87}\, Q^{1.85}$$

V: velocity (m/sec), Q: flow rate ($m^3$/sec), D: pipe diameter(m), I: hydraulic gradient (‰)

1) Maximum Pressure Head

In design and construction of distribution networks, it is necessary to ensure minimal leakage will be addressed. Leakage increases proportionally as pressure increases. A maximum residual pressure of approximately 50 m head will be adopted to minimize excessive water usage and excessive leakage.

2) Pipe Roughness

Pipe roughness factor is 120 as Hazen-Williams coefficient.
In case of new pipeline design included in pipe bends and fittings, H-W coefficient (C) is 120 generically.
In case of new straight pipeline design, H-W coefficient (C) is 130 generically.

3) Selection of Pipe Specification

The pipe manufacturer's allowable pressure is taken at 20 degrees. However, for instance, the water temperature may reach 40 degrees in summer. To account for the higher temperature, a reduction factor of 0.74 will be applied to the pipe maximum allowable pressure. For PN16, allowable operating pressure, the hydrostatic pressure, will be 1.18 MPa (= 1.6 MPa x 0.74 at 40 degrees).

**Table 2.10.1 Pressure Reduction Factor for Each Water Temperature**

| Water Temperature ℃ | 20 | 25 | 30 | 35 | 40 |
|---|---|---|---|---|---|
| Pressure Reduction Factor | 1.00 | 0.93 | 0.87 | 0.80 | 0.74 |
| Maximum Allowable Pressure MPa ($kgf/cm^2$) | 1.00 (10.2) | 0.93 (9.5) | 0.87 (8.9) | 0.80 (8.2) | 0.74 (7.5) |
| Working Pressure MPa ($kgf/cm^2$) | 0.75 (7.6) | 0.68 (6.9) | 0.62 (6.3) | 0.55 (5.6) | 0.49 (5.0) |

Note 1: Maximum allowable pressure = working pressure + water-hammer pressure 0.25 MPa (2.6 $kgf/cm^2$)
Note 2: Derivation of pressure reduction factor is based on the International Standard.

**Pressure Head;**
Pressure head is a term that represents the internal energy of a fluid as a column of water.

Pressure Head (m) = Hydrostatic Head (m) – Head Loss (m)

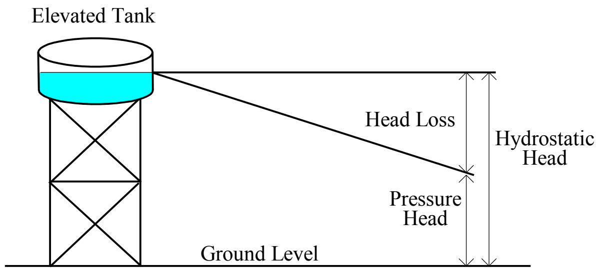



**Figure 2.10.1 Pressure Head**

**Head Loss**;
In any real moving fluid, energy is dissipated due to friction. Head loss is divided into two main categories, major losses associated with energy loss per length of pipe, and minor losses associated with bends, fittings and valves. The common equation used to calculate major head losses is the Hazen-Williams equation.

Head Loss (m) = Hydraulic gradient (‰) x Pipe Length (m)
= I x L
= $10.666C^{-1.85}D^{-4.87}Q^{1.85}$ x L

**Hydrostatic Head;**
Hydrostatic head is the pressure rise caused by gravity acting on a column of water or fluid that is not in motion.

Hazen-Williams equation (C = 110) is shown in **Figure 2.10.2**.
Friction loss for each pipe diameter, i.e. C=130 and 100 m pipe length is shown in **Figure 2.10.3** and **Table 2.10.3**.

## Table 2.10.2 High Density Polyethylene Pipe (HDPE)

**HDPE Pipes Dimension ( IS 4984-1987 / NS 40-2042 )**

| | Pressure Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PN 2.5 | | PN 4 | | PN 6 | | PN 10 | |
| de mm | e mm | di mm | e mm | di mm | e mm | di mm | e mm | di mm |
| 16 | | | | | | | 2.2 | 11.9 |
| 20 | | | | | | | 2.6 | 15.2 |
| 25 | | | | | | | 3.1 | 19.2 |
| 32 | | | | | 2.6 | 26.9 | 4.0 | 24.4 |
| 40 | | | 2.2 | 35.6 | 3.2 | 33.7 | 4.9 | 30.7 |
| 50 | | | 2.7 | 44.7 | 3.9 | 42.2 | 6.0 | 38.5 |
| 63 | 2.2 | 58.6 | 3.3 | 56.5 | 4.9 | 53.3 | 7.6 | 48.4 |
| 75 | 2.6 | 69.9 | 4.0 | 67.1 | 5.7 | 63.6 | 9.0 | 57.8 |
| 90 | 3.1 | 83.9 | 4.8 | 80.5 | 6.9 | 76.3 | 10.8 | 69.3 |
| 110 | 3.7 | 102.6 | 5.7 | 98.7 | 8.3 | 93.4 | 13.4 | 84.3 |
| 125 | 4.2 | 116.6 | 6.4 | 112.2 | 9.5 | 106.1 | 15.0 | 96.3 |
| 140 | 4.7 | 130.7 | 7.3 | 125.5 | 10.5 | 119.0 | 16.7 | 107.9 |
| 160 | 5.3 | 149.5 | 8.3 | 143.4 | 12.0 | 136.0 | 19.0 | 123.5 |
| 180 | 6.0 | 168.0 | 9.3 | 161.5 | 13.6 | 152.9 | 21.5 | 138.8 |
| 200 | 6.7 | 186.7 | 10.3 | 179.4 | 15.1 | 169.9 | 23.8 | 154.3 |
| 225 | 7.4 | 210.3 | 11.6 | 201.9 | 16.8 | 191.4 | 26.8 | 173.4 |
| 250 | 8.3 | 233.5 | 12.9 | 224.3 | 18.7 | 212.6 | 29.8 | 192.8 |
| 280 | 9.2 | 261.7 | 14.3 | 251.4 | 20.9 | 238.2 | 33.2 | 216.2 |
| 315 | 10.3 | 294.5 | 16.1 | 282.8 | 23.6 | 267.9 | 37.3 | 243.3 |
| 355 | 11.6 | 331.9 | 18.1 | 318.8 | 26.5 | 302.0 | 42.0 | 274.2 |
| 400 | 13.1 | 373.9 | 20.4 | 359.2 | 29.9 | 340.3 | 47.4 | 308.9 |
| 450 | 14.6 | 420.8 | 22.9 | 404.2 | 33.5 | 383.0 | 53.2 | 347.8 |
| 500 | 16.4 | 467.3 | 25.5 | 449.1 | 37.2 | 425.6 | 59.3 | 386.0 |

de = outside diameter of the pipe
di = inside diameter of the pipe
e = wall thickness
PN = nominal pressure rating (bar)

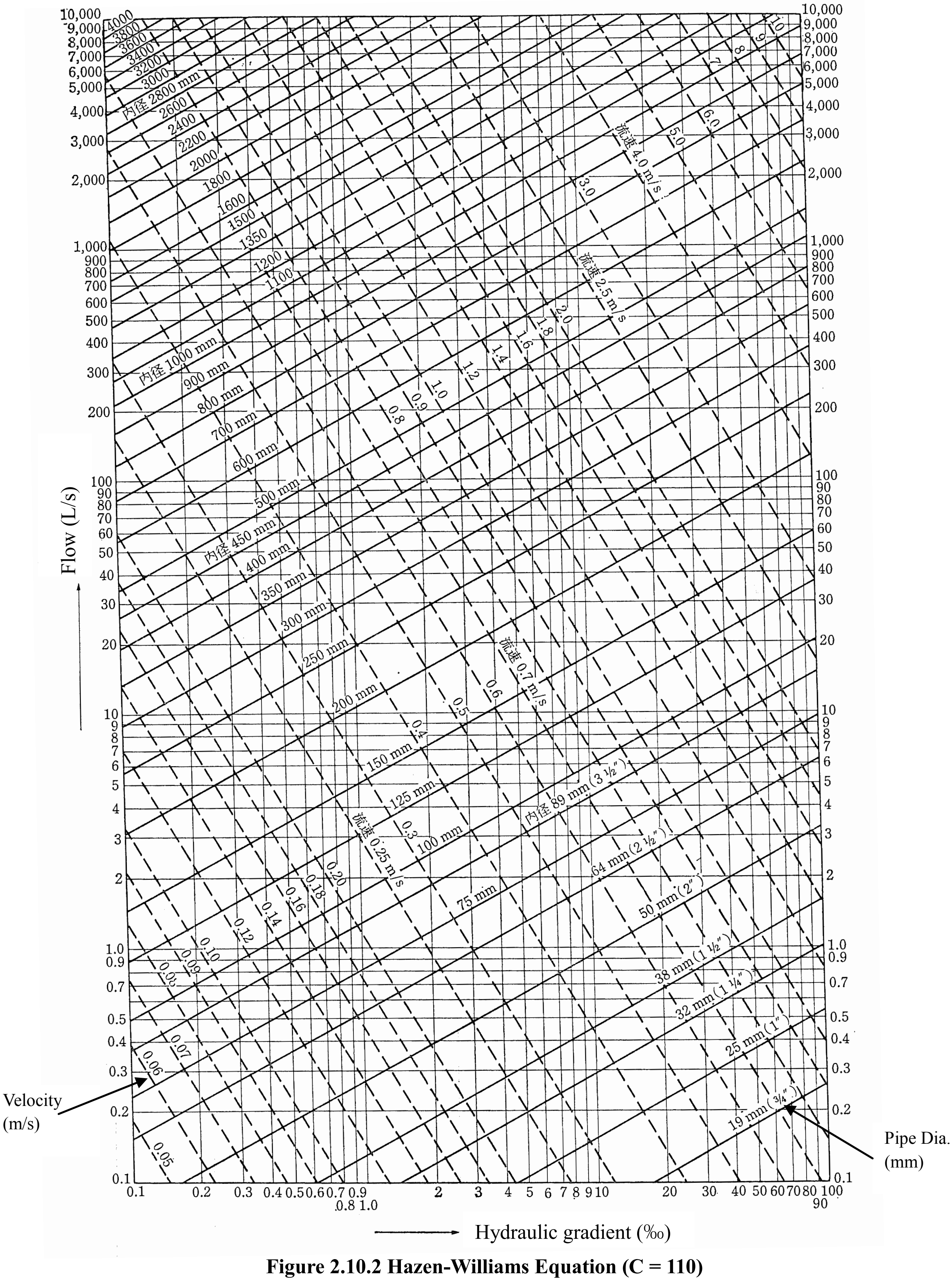



**Figure 2.10.2 Hazen-Williams Equation (C = 110)**

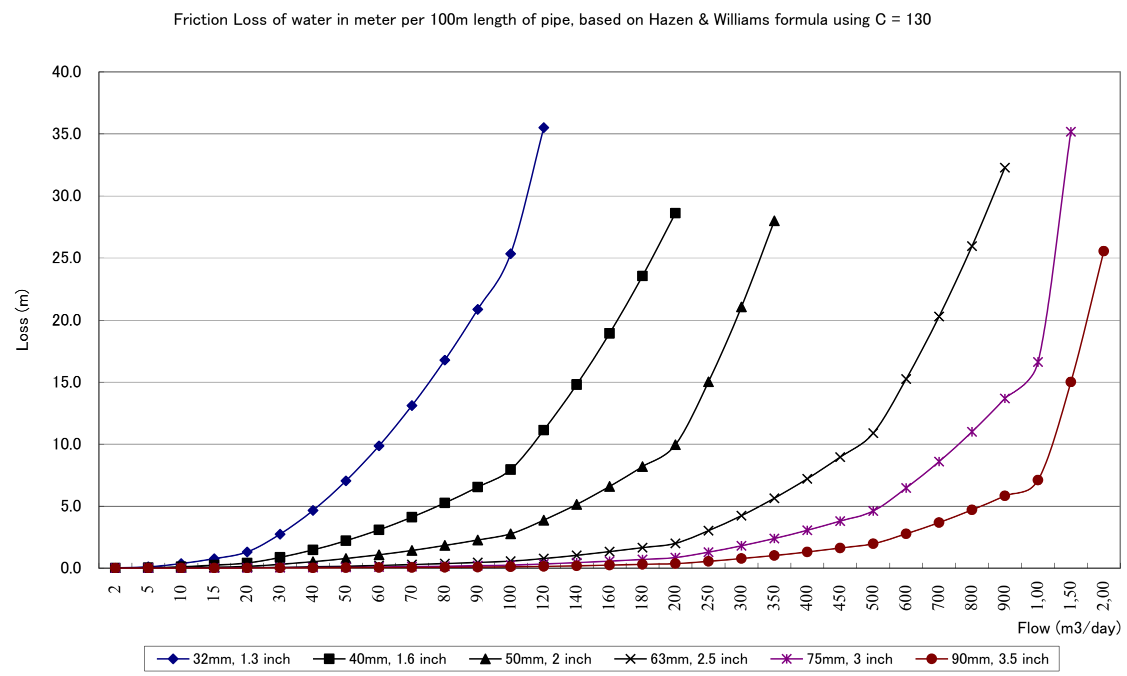



**Figure 2.10.3 Friction Loss of Water in Meter per 100 m (C=130)**

## Table 2.10.3 Friction Loss of Water in Meter per 100 m (C=130)

**Friction Loss of water in meter per 100 m length of pipe, Based on Hazen & Williams Formula Using C = 130**

| | | | | Diameter in mm | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outside Diameter | 32 | | 40 | | 50 | | 63 | | 75 | | 90 | | 110 | | 125 | | 140 | | 160 | |
| | | | Inside Diameter | 26 | | 33 | | 41 | | 57 | | 68 | | 81 | | 100 | | 113 | | 127 | | 145 | |
| | | | | 1.3-in. | | 1.6-in. | | 2-in. | | 2.5-in. | | 3-in. | | 3.5-in. | | 4.3-in. | | 5-in. | | 5.5-in. | | 6.3-in. | |
| Flow | | | | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss | Velocity | Loss |
| L/s | $m^3$/min | $m^3$/hr | $m^3$/day | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m | m/sec | m |
| 0.02 | 0.00 | 0.1 | 2 | 0.04 | 0.0 | 0.03 | 0.0 | 0.02 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 |
| 0.06 | 0.00 | 0.2 | 5 | 0.11 | 0.1 | 0.07 | 0.0 | 0.04 | 0.0 | 0.02 | 0.0 | 0.02 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 |
| 0.12 | 0.01 | 0.4 | 10 | 0.22 | 0.4 | 0.14 | 0.1 | 0.09 | 0.0 | 0.05 | 0.0 | 0.03 | 0.0 | 0.02 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 |
| 0.17 | 0.01 | 0.6 | 15 | 0.33 | 0.8 | 0.20 | 0.2 | 0.13 | 0.1 | 0.07 | 0.0 | 0.05 | 0.0 | 0.03 | 0.0 | 0.02 | 0.0 | 0.02 | 0.0 | 0.01 | 0.0 | 0.01 | 0.0 |
| 0.23 | 0.01 | 0.8 | 20 | 0.44 | 1.3 | 0.27 | 0.4 | 0.18 | 0.1 | 0.09 | 0.0 | 0.06 | 0.0 | 0.04 | 0.0 | 0.03 | 0.0 | 0.02 | 0.0 | 0.02 | 0.0 | 0.01 | 0.0 |
| 0.35 | 0.02 | 1.3 | 30 | 0.65 | 2.7 | 0.41 | 0.9 | 0.26 | 0.3 | 0.14 | 0.1 | 0.10 | 0.0 | 0.07 | 0.0 | 0.04 | 0.0 | 0.03 | 0.0 | 0.03 | 0.0 | 0.02 | 0.0 |
| 0.46 | 0.03 | 1.7 | 40 | 0.87 | 4.7 | 0.54 | 1.5 | 0.35 | 0.5 | 0.18 | 0.1 | 0.13 | 0.0 | 0.09 | 0.0 | 0.06 | 0.0 | 0.05 | 0.0 | 0.04 | 0.0 | 0.03 | 0.0 |
| 0.58 | 0.03 | 2.1 | 50 | 1.09 | 7.0 | 0.68 | 2.2 | 0.44 | 0.8 | 0.23 | 0.2 | 0.16 | 0.1 | 0.11 | 0.0 | 0.07 | 0.0 | 0.06 | 0.0 | 0.05 | 0.0 | 0.04 | 0.0 |
| 0.69 | 0.04 | 2.5 | 60 | 1.31 | 9.8 | 0.81 | 3.1 | 0.53 | 1.1 | 0.27 | 0.2 | 0.19 | 0.1 | 0.13 | 0.0 | 0.09 | 0.0 | 0.07 | 0.0 | 0.05 | 0.0 | 0.04 | 0.0 |
| 0.81 | 0.05 | 2.9 | 70 | 1.53 | 13.1 | 0.95 | 4.1 | 0.61 | 1.4 | 0.32 | 0.3 | 0.22 | 0.1 | 0.16 | 0.1 | 0.10 | 0.0 | 0.08 | 0.0 | 0.06 | 0.0 | 0.05 | 0.0 |
| 0.93 | 0.06 | 3.3 | 80 | 1.74 | 16.8 | 1.08 | 5.3 | 0.70 | 1.8 | 0.36 | 0.4 | 0.26 | 0.2 | 0.18 | 0.1 | 0.12 | 0.0 | 0.09 | 0.0 | 0.07 | 0.0 | 0.06 | 0.0 |
| 1.04 | 0.06 | 3.8 | 90 | 1.96 | 20.8 | 1.22 | 6.5 | 0.79 | 2.3 | 0.41 | 0.5 | 0.29 | 0.2 | 0.20 | 0.1 | 0.13 | 0.0 | 0.10 | 0.0 | 0.08 | 0.0 | 0.06 | 0.0 |
| 1.16 | 0.07 | 4.2 | 100 | 2.18 | 25.3 | 1.35 | 7.9 | 0.88 | 2.8 | 0.45 | 0.6 | 0.32 | 0.2 | 0.22 | 0.1 | 0.15 | 0.0 | 0.12 | 0.0 | 0.09 | 0.0 | 0.07 | 0.0 |
| 1.39 | 0.08 | 5.0 | 120 | 2.62 | 35.5 | 1.62 | 11.1 | 1.05 | 3.9 | 0.54 | 0.8 | 0.38 | 0.3 | 0.27 | 0.1 | 0.18 | 0.1 | 0.14 | 0.0 | 0.11 | 0.0 | 0.08 | 0.0 |
| 1.62 | 0.10 | 5.8 | 140 | 3.05 | 47.2 | 1.90 | 14.8 | 1.23 | 5.1 | 0.64 | 1.0 | 0.45 | 0.4 | 0.31 | 0.2 | 0.21 | 0.1 | 0.16 | 0.0 | 0.13 | 0.0 | 0.10 | 0.0 |
| 1.85 | 0.11 | 6.7 | 160 | 3.49 | 60.4 | 2.17 | 18.9 | 1.40 | 6.6 | 0.73 | 1.3 | 0.51 | 0.6 | 0.36 | 0.2 | 0.24 | 0.1 | 0.18 | 0.0 | 0.15 | 0.0 | 0.11 | 0.0 |
| 2.08 | 0.13 | 7.5 | 180 | 3.93 | 75.2 | 2.44 | 23.5 | 1.58 | 8.2 | 0.82 | 1.6 | 0.57 | 0.7 | 0.40 | 0.3 | 0.27 | 0.1 | 0.21 | 0.1 | 0.16 | 0.0 | 0.13 | 0.0 |
| 2.31 | 0.14 | 8.3 | 200 | 4.36 | 91.3 | 2.71 | 28.6 | 1.75 | 9.9 | 0.91 | 2.0 | 0.64 | 0.8 | 0.45 | 0.4 | 0.29 | 0.1 | 0.23 | 0.1 | 0.18 | 0.0 | 0.14 | 0.0 |
| 2.89 | 0.17 | 10.4 | 250 | 5.45 | 138.0 | 3.38 | 43.2 | 2.19 | 15.0 | 1.13 | 3.0 | 0.80 | 1.3 | 0.56 | 0.5 | 0.37 | 0.2 | 0.29 | 0.1 | 0.23 | 0.1 | 0.18 | 0.0 |
| 3.47 | 0.21 | 12.5 | 300 | 6.54 | 193.4 | 4.06 | 60.6 | 2.63 | 21.0 | 1.36 | 4.2 | 0.96 | 1.8 | 0.67 | 0.8 | 0.44 | 0.3 | 0.35 | 0.2 | 0.27 | 0.1 | 0.21 | 0.0 |
| 4.05 | 0.24 | 14.6 | 350 | 7.63 | 257.2 | 4.74 | 80.5 | 3.07 | 28.0 | 1.59 | 5.6 | 1.12 | 2.4 | 0.79 | 1.0 | 0.52 | 0.4 | 0.40 | 0.2 | 0.32 | 0.1 | 0.25 | 0.1 |
| 4.63 | 0.28 | 16.7 | 400 | 8.72 | 329 | 5.42 | 103.1 | 3.51 | 35.8 | 1.82 | 7.2 | 1.28 | 3.0 | 0.90 | 1.3 | 0.59 | 0.5 | 0.46 | 0.3 | 0.37 | 0.1 | 0.28 | 0.1 |
| 5.21 | 0.31 | 18.8 | 450 | 9.81 | 409 | 6.09 | 128.2 | 3.95 | 44.5 | 2.04 | 9.0 | 1.43 | 3.8 | 1.01 | 1.6 | 0.66 | 0.6 | 0.52 | 0.3 | 0.41 | 0.2 | 0.32 | 0.1 |
| 5.79 | 0.35 | 20.8 | 500 | 10.91 | 498 | 6.77 | 155.8 | 4.39 | 54.1 | 2.27 | 10.9 | 1.59 | 4.6 | 1.12 | 2.0 | 0.74 | 0.7 | 0.58 | 0.4 | 0.46 | 0.2 | 0.35 | 0.1 |
| 6.94 | 0.42 | 25.0 | 600 | 13.09 | 697 | 8.12 | 218.3 | 5.26 | 75.9 | 2.72 | 15.2 | 1.91 | 6.5 | 1.35 | 2.8 | 0.88 | 1.0 | 0.69 | 0.5 | 0.55 | 0.3 | 0.42 | 0.2 |
| 8.10 | 0.49 | 29.2 | 700 | 15.27 | 927 | 9.48 | 290 | 6.14 | 100.9 | 3.18 | 20.3 | 2.23 | 8.6 | 1.57 | 3.7 | 1.03 | 1.3 | 0.81 | 0.7 | 0.64 | 0.4 | 0.49 | 0.2 |
| 9.26 | 0.56 | 33.3 | 800 | 17.45 | 1,187 | 10.83 | 372 | 7.02 | 129.2 | 3.63 | 26.0 | 2.55 | 11.0 | 1.80 | 4.7 | 1.18 | 1.7 | 0.92 | 0.9 | 0.73 | 0.5 | 0.56 | 0.3 |
| 10.42 | 0.63 | 37.5 | 900 | 19.63 | 1,476 | 12.19 | 462 | 7.89 | 160.6 | 4.08 | 32.3 | 2.87 | 13.7 | 2.02 | 5.8 | 1.33 | 2.1 | 1.04 | 1.2 | 0.82 | 0.7 | 0.63 | 0.3 |
| 11.57 | 0.69 | 41.7 | 1,000 | 21.81 | 1,794 | 13.54 | 562 | 8.77 | 195.2 | 4.54 | 39.2 | 3.19 | 16.6 | 2.25 | 7.1 | 1.47 | 2.5 | 1.15 | 1.4 | 0.91 | 0.8 | 0.70 | 0.4 |
| 17.36 | 1.04 | 62.5 | 1,500 | 32.72 | 3,798 | 20.31 | 1,189 | 13.16 | 413 | 6.81 | 83.0 | 4.78 | 35.2 | 3.37 | 15.0 | 2.21 | 5.4 | 1.73 | 3.0 | 1.37 | 1.7 | 1.05 | 0.9 |
| 23.15 | 1.39 | 83.3 | 2,000 | 43.62 | 6,466 | 27.08 | 2,025 | 17.54 | 704 | 9.08 | 141.4 | 6.38 | 59.9 | 4.49 | 25.5 | 2.95 | 9.2 | 2.31 | 5.0 | 1.83 | 2.9 | 1.40 | 1.5 |
| 28.94 | 1.74 | 104.2 | 2,500 | 54.53 | 9,771 | 33.85 | 3,060 | 21.93 | 1,063 | 11.35 | 214 | 7.97 | 90.5 | 5.62 | 38.6 | 3.69 | 13.8 | 2.89 | 7.6 | 2.29 | 4.3 | 1.75 | 2.3 |
| 34.72 | 2.08 | 125.0 | 3,000 | 65.43 | 13,690 | 40.62 | 4,287 | 26.31 | 1,490 | 13.61 | 299 | 9.57 | 126.8 | 6.74 | 54.1 | 4.42 | 19.4 | 3.46 | 10.7 | 2.74 | 6.1 | 2.10 | 3.2 |
| 40.51 | 2.43 | 145.8 | 3,500 | 76.34 | 18,208 | 47.39 | 5,702 | 30.70 | 1,981 | 15.88 | 398 | 11.16 | 169 | 7.87 | 71.9 | 5.16 | 25.8 | 4.04 | 14.2 | 3.20 | 8.0 | 2.45 | 4.2 |
| 46.30 | 2.78 | 166.7 | 4,000 | 87.24 | 23,310 | 54.16 | 7,300 | 35.08 | 2,536 | 18.15 | 510 | 12.75 | 216 | 8.99 | 92.1 | 5.90 | 33.0 | 4.62 | 18.2 | 3.66 | 10.3 | 2.81 | 5.4 |
| 52.08 | 3.13 | 187.5 | 4,500 | 98.15 | 28,985 | 60.93 | 9,077 | 39.47 | 3,154 | 20.42 | 634 | 14.35 | 268 | 10.11 | 114.5 | 6.63 | 41.0 | 5.20 | 22.6 | 4.11 | 12.8 | 3.16 | 6.7 |
| 57.87 | 3.47 | 208.3 | 5,000 | 109.05 | 35,223 | 67.70 | 11,030 | 43.85 | 3,833 | 22.69 | 770 | 15.94 | 326 | 11.24 | 139.1 | 7.37 | 49.9 | 5.77 | 27.5 | 4.57 | 15.6 | 3.51 | 8.2 |
| 69.44 | 4.17 | 250.0 | 6,000 | 130.86 | 49,353 | 81.23 | 15,455 | 52.63 | 5,370 | 27.23 | 1,079 | 19.13 | 457 | 13.48 | 195 | 8.85 | 69.9 | 6.93 | 38.5 | 5.48 | 21.8 | 4.21 | 11.4 |
| 81.02 | 4.86 | 291.7 | 7,000 | 152.68 | 65,640 | 94.77 | 20,555 | 61.40 | 7,142 | 31.77 | 1,435 | 22.32 | 608 | 15.73 | 259 | 10.32 | 92.9 | 8.08 | 51.2 | 6.40 | 29.0 | 4.91 | 15.2 |
| 92.59 | 5.56 | 333.3 | 8,000 | 174.49 | 84,033 | 108.31 | 26,315 | 70.17 | 9,144 | 36.30 | 1,838 | 25.51 | 778 | 17.98 | 332 | 11.80 | 119.0 | 9.24 | 65.6 | 7.31 | 37.1 | 5.61 | 19.5 |
| 104.17 | 6.25 | 375.0 | 9,000 | 196.30 | 104,492 | 121.85 | 32,722 | 78.94 | 11,370 | 40.84 | 2,285 | 28.70 | 968 | 20.23 | 413 | 13.27 | 147.9 | 10.39 | 81.6 | 8.23 | 46.2 | 6.31 | 24.2 |
| 115.74 | 6.94 | 416.7 | 10,000 | 218.11 | 126,980 | 135.39 | 39,764 | 87.71 | 13,817 | 45.38 | 2,777 | 31.89 | 1,176 | 22.47 | 502 | 14.74 | 180 | 11.55 | 99.1 | 9.14 | 56.1 | 7.01 | 29.4 |

### 2.11 Consideration of Planning of Distribution Network

Confirmation of the following pipe conditions in pipe planning.

1. Pipe Diameter: Investigation of main pipe and branch pipe diameters.
2. Pipe Routes: Confirmation of pipe route and pipe position with map of the existing pipe network.
3. The distribution network layout for new areas to be served will be formed by loops of pipelines to the extent practicable, thereby minimizing dead ends and providing flexibility in operation.
4. Pipe Connecting Node: Confirmation of position of pipe connecting node with map of the existing pipe network.
5. Determination of diversion culvert location: method of installation of pipe at diversion points is decided after confirming other existing buried objects. Clearance between pipe and buried object should be more than 0.3 m.

#### 2.11.1 Pipe Materials

Many pipe materials are available for the water distribution. The most commonly used pipe materials are ductile iron, steel, polyvinylchloride (PVC) and high density polyethylene (HDPE). HDPE pipes are adopted mainly in 3 WUSCs. The features and limitation of HDPE are described below.

- Light weight for ease of installation
- Flexible, but required special bedding conditions to limit deflection
- Special corrosion protection is not required
- Available in welding joints only
- Special joint restrains may not be required at changes in direction
- HDPE pipe is not affected by hydrogen sulphide. (for Sewer)

HDPE pipe has been in use for a number of years on clean water and dirty water (sewage) applications. It is a flexible pipe type with respect to the pipe itself and can tolerate some ground movement. Early problems with the pipe associated with jointing (couplings were used) have been overcome with the advent of fusion welding either by sleeve or butt welding. When butt welding is used, care has to be taken to remove any ‘melted’ material from inside of pipe in order to help prevent the potential for blockages.

Where fusion welded HDPE pipe is used there is no need to install thrust blocks at fittings, bends and other ancillary items. The thrust block, however, may be required at valve installation points.

#### 2.11.2 Welding Joints of HDPE

Welding joints are used for HDPE pipe. HDPE pipe joints are welded by using simple tools as shown in **Figure 2.11.1** and **Figure 2.11.2.** Welded joints are restrained and can not be pulled apart under pressure and is appropriate for manual jointing. However, in case of incorrect joint such as insufficient and gappy at joint point, joints may pull apart and/or leakage of water may occur.

Butt welding applications:
Joints are non-removable and tension-resistant

For correct butt welding:

- Parts to be welded must be cut square
- The welding plate and the parts to be welded must be clean.
- The welding plate must be at the correct temperature.

Butt welding for using a welding plate:

- Press clean and cut-square ends against the weld plate.
- Do not accelerate the cooling process. For instance, usage of water for cooling.

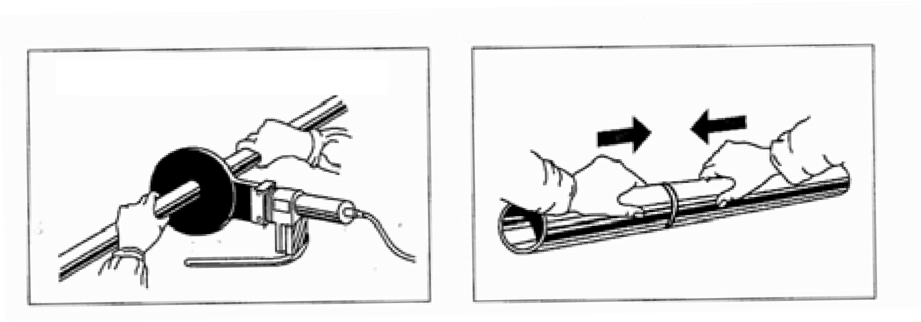


**Figure 2.11.1 Manual Butt Welding**

| | | | |
|---|---|---|---|
|  |  |  |  |
| a) Soldering iron | b) Heating soldering iron over a gas burner | c) Manual welding joint. | d) Handmade socket type conjugation tube |

Note; While method of manual welding joint a)-c) is used in Dhulabari and Gauradaha WUSCs, handmade sockets are used in Mangadh WUSC.

**Figure 2.11.2 Method of Welding Joints in 3 WUSCs**

### 2.11.3 Foundation of Pipeline

1. The foundation of an underground pipeline shall be designed, sufficiently considering the conditions of the ground, loading conditions and the properties of the pipes used.
2. The backfilling earth shall be selected to allow proper compaction when the pipes are buried.
3. When a pipeline is laid in poor subsoil, the ground conditions and pipeline settlement shall be sufficiently examined, to use an execution method, pipes and joints suitable

The quality of the nature of backfill soil affects the execution convenience of backfill and compaction, and also greatly affects the safety of the pipeline. Especially for steel pipes and PVC pipes, cobble stones and rock debris which threaten to damage the pipe should not be contained, and if excavated soil is not good enough to satisfy the design conditions, soil dressing is necessary.

## 2.12 Accessory Equipment

The accessory equipment of distribution pipelines can be classified into air valves, valves, fire hydrants, washout, flow meter and manholes. As the accessory equipment, the most appropriate devices must be arranged at proper places, considering the arrangement of distribution pipelines, the topographical and geographical conditions of the distribution area and water demand.

The accessory equipment which have been used for long periods of time may be functionally degraded due to the wear at sliding portions and the deterioration of paint at wetted portions, to cause trouble in stable water supply. The accessory equipment must be rehabilitated and improved at opportune timing, to restore or improve the functions.

### 2.12.1 Air Valves

Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water. Trapped air, if allowed to accumulate at a high point, carries out restrictions and reduces the capacity of the pipeline due to increasing headloss.
When a pipeline is filled with water, the air in the pipeline must be properly eliminated, and when water in a pipeline must be eliminated for the necessity of construction or other work, proper air suction is necessary.

Schematic illustrating placement of air valves on distribution system is shown in **Figure 2.12.1**.

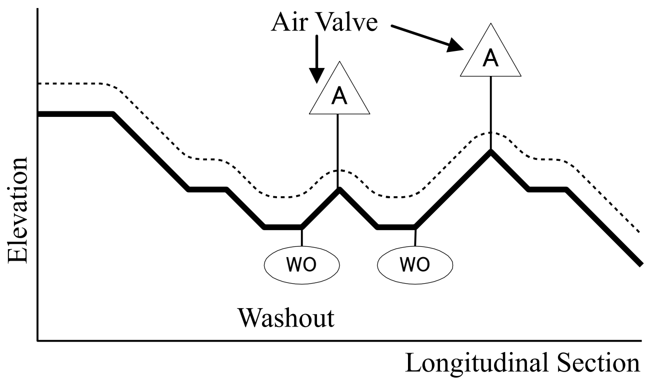



**Figure 2.12.1 Locations of Air Valves and Washouts**

### 2.12.2 Gate Valve and Butterfly valve

Valves are provided throughout water distribution network to control flows and maintain pipelines. Valves will allow sections of the distribution network to be isolated for leakage, repair and replacement. Shutoff of flow on the distribution pipeline is usually achieved by using gate valves or butterfly valves. Isolation valves shall be of the gate valve for 300 mm diameters below, and butterfly valves for 300 mm above. Valve will be installed at intervals of about 500m, but not exceeding 1000 m in the distribution network.

For the distribution network, sufficient isolation valves will be provided so as to provide adequate isolation for purpose of maintenance and repairs. Where gate valves are provided at branches, more than 3 valves will not be provided at crosses and more than 2 valves will not be provided at tees.

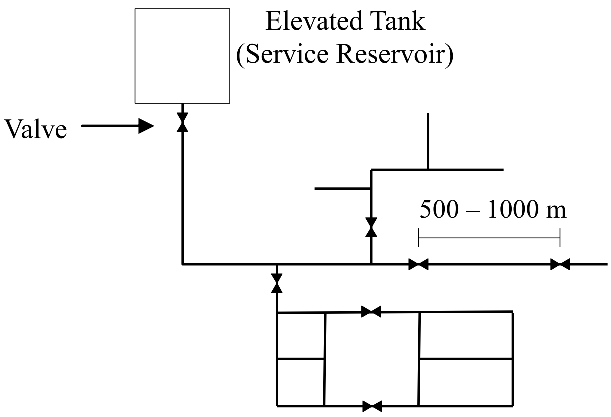
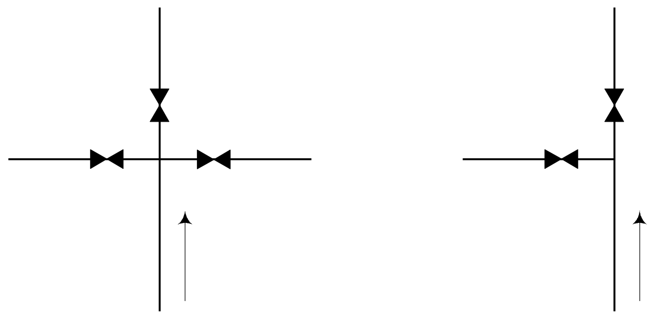



**Figure 2.12.2 General Valve Locations**



**(a) At Cross** **(b) At Tee**

**Figure 2.12.3 Valve Location**

**2.12.3 Washout:**

Washouts are small pipe connections with valve located at dead ends and low spots in the distribution pipelines to allow accumulated sediment to be cleaned by flushing and the pipeline drained.

1. Location of washout drain: washout drain should be installed nearby drainage canal or river
2. Drain pipe diameter is normally 1/2 – 1/4 size of main pipe diameter
3. Washout drain should be built strongly at the spillway so as not to erode or to be destroyed by draining. If the place near an washout drain is likely to be eroded or damaged by discharge, protective work especially by concrete, rubble mound, etc. must be provided.
4. Washout drain is set at a position higher than the high water level of the water channel to prevent the backflow of sanitary wastewater from the water channel.

**2.12.4 Fire Hydrant**

These fire hydrants can be used in case of fire. Fire hydrant will be located in the distribution network on all pipelines of at least 150 mm nominal diameter, otherwise, negative pressure may occur in small diameter such as less than 100 mm. Spacing will be at about 200 m and at street corners if practicable and at locations to avoid obstruction to property owners.

**2.13 Service Reservoirs and Elevated Tanks**

Service reservoir and elevated tank are a reservoir for receiving water from a water treatment plant and distributing in response to the demand of the distribution area, and must have function to respond to the hourly change of distributed amount and also a function to be able to maintain a predetermined amount and water pressure even when an accident occurs upstream of the service reservoir and/or the elevated tank.

The service reservoir and the elevated tank must be water-tight, sanitary, and sufficiently durable in structure to avoid contamination from outside.

When in great depth in a service reservoir and elevated tank, water is likely to leak from expansion joints, construction joints due to water pressure. It is necessary to adopt a highly water-tight and durable concrete structure. For this purpose, it is necessary to apply a water shut plate of PVC or rubber to the expansion joints and construction joints as required, or coat the concrete on the inside surface of the service reservoir and the elevated tank with waterproof mortar or epoxy resin paint, for securing water tightness and preventing the deterioration of concrete by chlorine.

**2.14 Operation and Maintenance (O&M) of Distribution Facilities**

Distribution facilities require proper operation and maintenance to maintain reliable service to the water users. O&M of pipeline include periodic flushing of the pipes to maintain water quality, regular checking of

disinfection residuals throughout the system to prevent deterioration water quality. m
Important method of maintaining water quality is to institute a program of periodic flushing of water distribution mains. Flushing can be accomplished by using fire hydrant and washout drain at low points and dead ends in distribution system. Flushing water can be discharged to cannels or local waterways with permission of administrator.

Further important O&M function for distribution systems is a program of regular exercising of the valves and fire hydrants. Valves and fire hydrants should be operated at least once annually to ensure their proper operation.

Washout drains are provided to keep the pipelines free from blockade. It shall be washed out at least once in 3 month in dry season and once a month in rainy season with enough water to flush the deposited dirt until clear water at washout is observed

# Standard Operation Procedure (SOP)
# on
# Water Meter Reading
# And
# Meter Calibration Control

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**Procedure of Water Meter Maintenance**

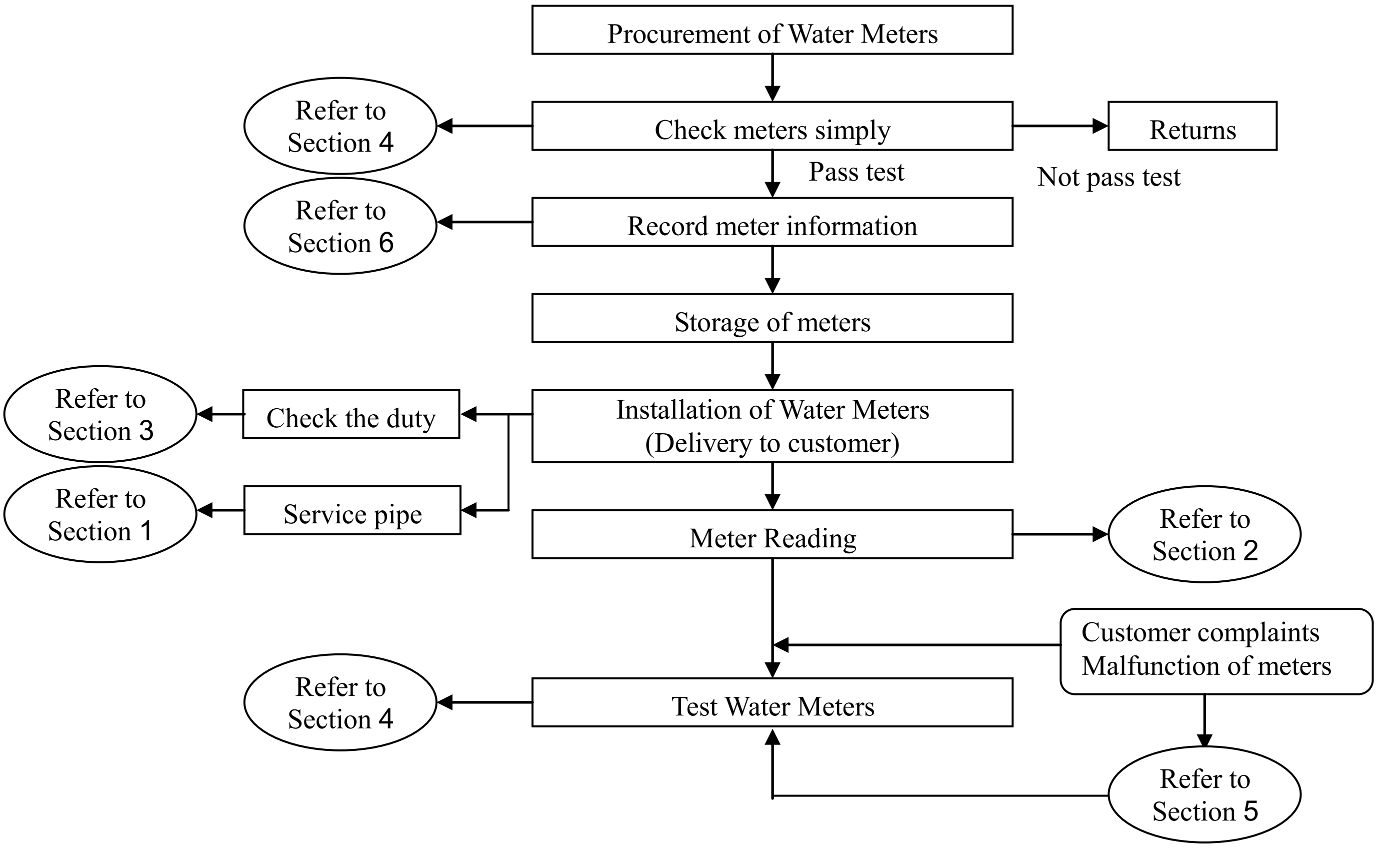



**Figure 1 Procedure of Water Meter Maintenance**

## 1. Installation of Service pipe and Water Meter

Water service installation should be given such that service pipes with adequate size and devices are reasonably combined so as to stably supply the water volume needed by users and supply a safe water.
For the exact measurement of water consumption, proper selection, installation and control of water meters are essential.
Even when service pipes are properly designed and executed, it is not possible to secure stable water supply and water quality if the method of use is not proper, improper devices are installed, or rebuilding is made upon users' discretion. Therefore, instruction and guidance should be given to users on the proper use and maintenance of water service pipe installation.

### 1.1 Service Pipe

a) Connection point from distribution pipe should be surveyed sufficiently to avoid cross connections.
b) Service pipe diameter should be smaller in principle than distribution (main) pipe diameter.
c) Not to connect from joint and/or fitting point on main pipe.
d) Clean the surface of main pipe when service pipe is connected. During the installation of service saddle, fasten equally with bolts on the main pipe.

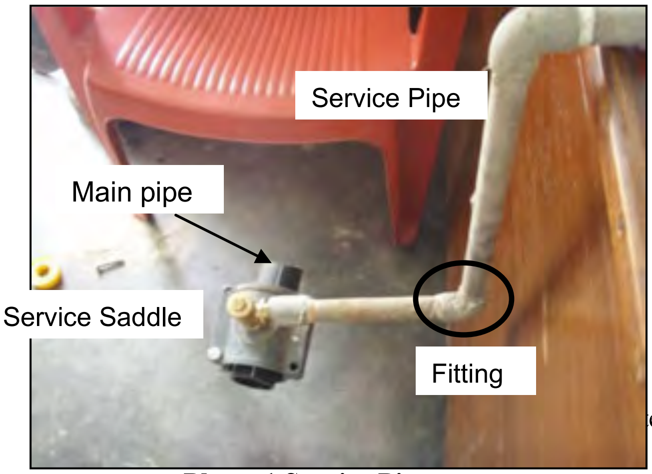



**Photo-1 Service Pipe**

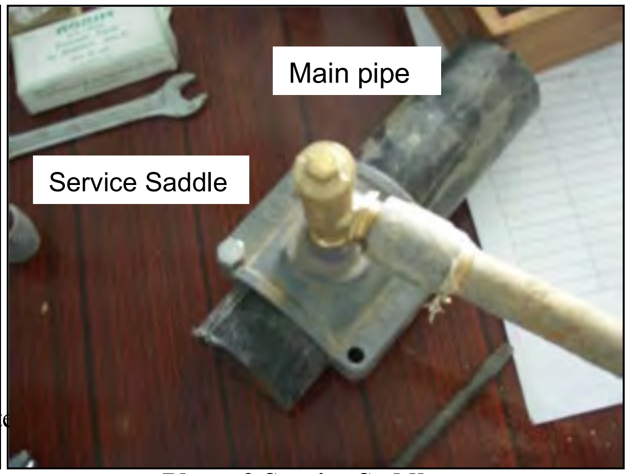



**Photo-2 Service Saddle**

### 1.2 Location of Water Meter

a) Water meter is principally located inside the ground for easy inspection and/or replacement and where the probability of meter damage meter is low.
b) In case of installing a water meter under ground, use a meter box.
c) In case of installing water meter, inflow direction sign on a meter should be confirmed and set in the horizontal position.
d) There are two types of a meter position. One is the order of a stop valve and a meter (Type-1), the other is a meter and a stop valve (Type-2).

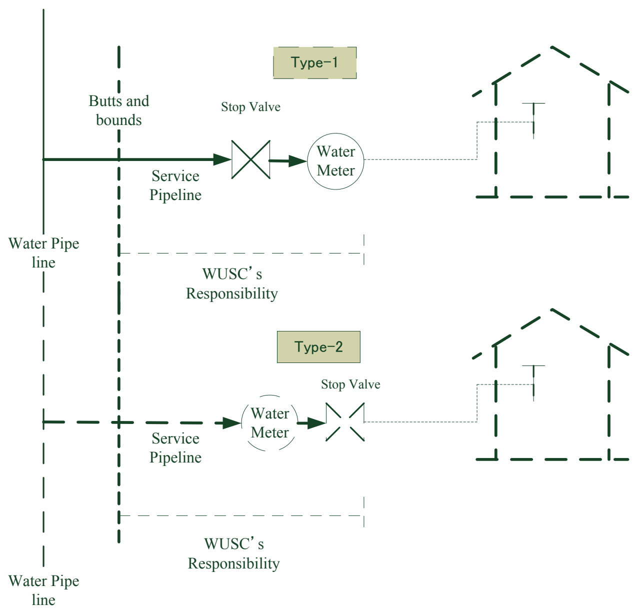



**Figure 1.1 Service Pipe**

### 1.3 Pipe Working

a) Distance of service pipe and other embedded pipes should be kept at least 30 cm to avoid accidents such as cross connection and pipe damage.
b) Underground pipe works should be kept in a straight line as much as possible as it is easier to understand and locate the pipes later and such pipe laying is much economical.
c) Put a stopper at pipe end with plug to avoid filthy water from flowing into pipe when pipe stops working temporary or daily.
d) In drilling the distribution pipe, it shall not adversely affect the strength and inner coat.
e) When the service pipe is branched from the distribution pipe, corporation stop, saddled corporations stop and T-pipes shall be used.
f) A stop valve and a water meter should be provided at position facilitating future maintenance, and service pipe should be laid as straight as possible.
g) Pipes are exposed along building/house columns and walls, where pipes are susceptible to damage due to deflection and vibrations by external forces, the pipes' own weight and water pressure, pipes should be fixed to the building/house using brackets at 1 – 2 m intervals.
h) When piping is completed, it is desirable that pipes are flushed and undergo flow before attaching meters.

### 1.4 Water Meter

Water meters are attached to water service equipment and used to integrate water volume consumed by users, and the measured water volume forms a basis of water to control water charges and revenue earning water rates.
Additionally, conditions required for water meters are followings;

a) Good measuring accuracy
b) Durability
c) Sufficient capacity
d) Good sensitivity
e) Wide measuring range
f) Ease in reading

g) Ease in handling
h) Relatively failure-free

**Photo-3 Installed water meter**

**Photo-4 Water meter**


**Photo-5 Meter indicator**

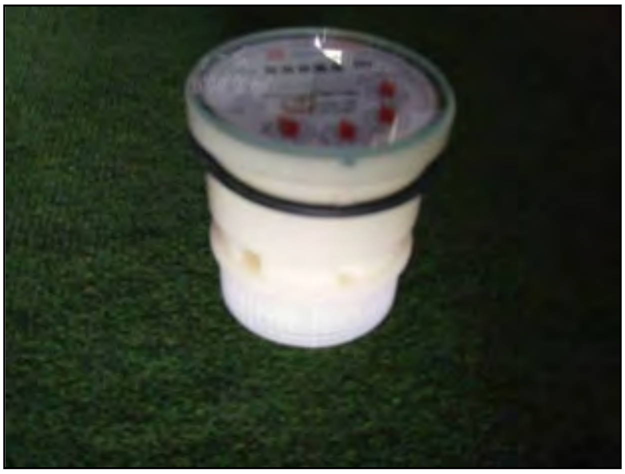


**Photo-6 Impeller and Gear wheel**

**1.5 Water Meter Type**

Water meters measure the water consumption of which the working condition is diverse. For the domestic water meter type, there is estimation type in view of the proportionality of the vane wheel revolution and the volume of passing water.
Water meters are generally vane wheel jet type. Meter mounts are threaded for diameters 15 – 40 mm and flanged for diameters 50 – 350 mm, in general.

**1.5.1 Vane wheel jet type water meter**

This water meter type is designed so that the vane wheel built in the meter chamber is rotated by water flow to integrate the volume of passing water.
Single jet type water meter refers to a structure by which the water flown to the meter case is directly given to the vane wheel.
Multi jet type water meter refers to a structure in which another meter case (inner case) is provided in the meter case, and water is supplied as a jet flow from one nozzle to the vane wheel.

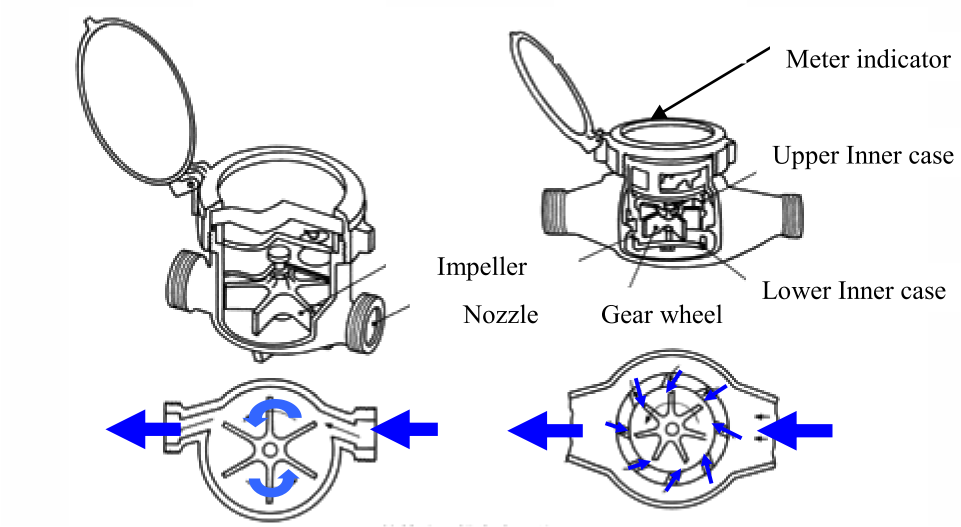



**Figure 1.2 Single jet type water meter** **Figure 1.3 Multi jet type water meter**

### 1.5.2 Wet Type and Dry Type

The wet type refers to meters of which the indicating mechanism, including the scale plate, is entirely submerged in the water.
The dry type refers to meters of which the scale plate and indicating mechanism are isolated from the flow unit by board. The vane wheel rotation is transmitted to the indicating mechanism.

### 1.5.3 Rotary Index

Rotary index is used to find out the flow rate at which rotary index of water meter starts sensitivity, and flow rates of trace flows such as water leakage.

## 1.6 Proper treatment of a water meter and suggestion of water meter installation

### (1) Precaution for safety's sake

- To pay attention while carrying heavy equipment and installing water meters since there are possibilities of injury.
- Not to touch directly a screw joint part on a meter case because there is a possibility of injury. To put on cotton work gloves to help prevent injury.

- To use appropriate tools such as wrenches for plumbing. Hindrance and accident may be caused by using inappropriate tools for plumbing.

- Not to pour hot or boiling water into the water meter. When hot water of more than 40 degrees flows in a water meter, there is a possibility to damage the inside plastic parts of the water meter.


**(2) Precaution for water meter management during meter storage**

- Not to give water meter a strong shock. When a water meter falls, there is a possibility of meter damage and might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.
- Not to give water meter vibration. When a water meter receives vibration for many hours, it might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.


- To cover gateway of water meter to prevent the wind blowing through the meter during water meter storage. When air blows through the water meter, it is possible that measured value can progress or revert because impeller rotates due to the wind. To put caps on the gateway of water meter to prevent this from happening.
- To cover gateway of water meter to prevent unwanted substances entering water meter during meter storage. When unwanted substances entered meter, it might be difficult to measure since the unwanted substance obstructs the rotation of the impeller.


**(3) Precaution for water meter and installation**

**a) Precaution for location of water meter installation.**

Water meters should be installed in places which meet the following factors.

- A water meter for domestic (15 mm diameter, i.e. vane wheel jet type water meter) shall be installed horizontally in accordance with ISO 4064 in each house.

- To install water meter in horizontal position. To set the meter horizontally with indicator upward according to the arrow shown on the meter.
- To select the place where installation and removal of a water meter are easy. Since it is necessary to replace water meter periodically (recommended in every 8 years), appropriate place for installing and removing a water meter is required.

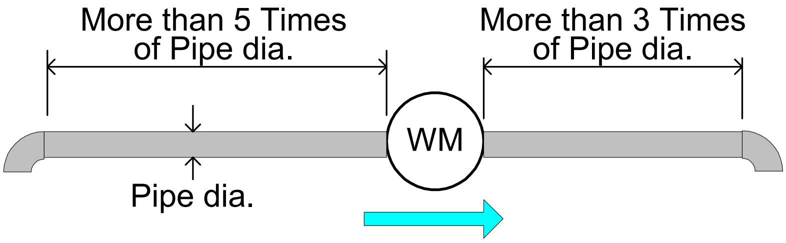
- To select the place where meter reading is easy. Since it is necessary to conduct meter reading periodically, appropriate place, which is dry condition and not submerged, is required.
- To select the place where momentary pressure variation is low. It might be difficult to measure accurately because the rotation of the impeller will be increased by momentary pressure variation. The maximum working pressure, however, is 1 MPa.
- To select a place where there is no influence on vibration. It might be difficult to measure accurately because the rotation of the impeller is increased by vibration.
- Not to install water meter at a submerged location.

**b) Precaution for water meter installation**

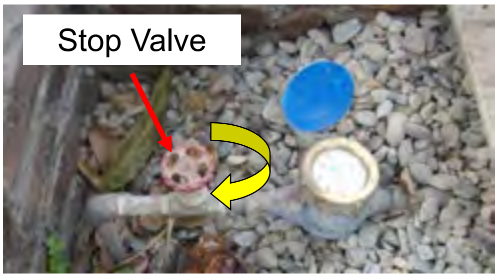
Water meter installation conditions sometimes have an influence on the performance of the meter. Observe the following factors in order to keep accurate performance of water meter.

- Water meter installation fitting should be the total length of the meter and packing. In case of bad measurement, such as short or long, the meter can not be installed to pipes.
- When a welding junction is conducted at a pipe joint part, detach the water meter from the pipes. The plastic parts inside the water meter may be damaged by the high temperature of the welding.


- Pipe length of more than 5 times of a pipe diameter in the upper stream of a water meter and the pipe length of more than 3 times in the downstream are required on a pipe arrangement. When the pipe length is shorter than above mentioned length, it might be difficult to measure accurately due to the influence of a valve or a bent pipe.




- To use proper packing to fit a pipe diameter during meter installation. Water leakage at joint parts and/or water measuring error may occur due to different dimensions of packing.
- The inside of the pipe should always be cleaned by flowing water before installing water meter. It might be difficult to measure accuracy because unwanted substances inside the pipe might obstruct the rotation of the impeller or even destroy the meter.
- To open a stop valve slowly when feeding water. When opening a stop valve hastily, the water meter might be damage due to water hammer.




## 2. Outline of Meter Reading

Meter reading is the foundation of water tariff. It is necessary to keep conditions for easy reading and replacement, and effort should be made to improve accuracy of meter reading.

The direct reading type integrates and digitally displays measured values.

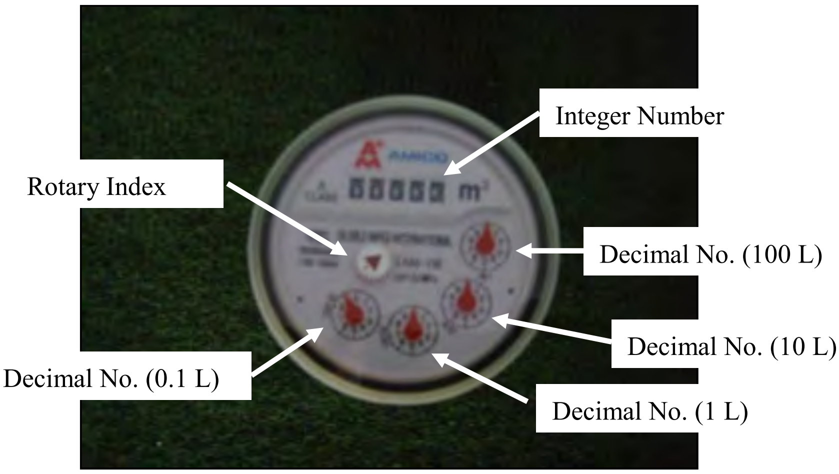


**Photo-7 Meter Reading**

Meter Reading: Integer number only, not to calculate the decimal places.

### 3. Responsibility of installation fee and maintenance of water meter

When water meters and house connections (water service pipes) are installed in houses, WUSCs and/or customers have responsibilities of installation and maintenance for a water meter and house connection. The division of roles for installation and maintenance are shown in **Table 3.1**.

**Table 3.1 Responsibilities of WUSCs and Customers**

| | | WUSCs | Customers | Remarks |
|---|---|---|---|---|
| House Connection (Water service pipe) | Install | Work | Customer should prepare material. | |
| | Pay | - | Payment includes pipes and fittings | |
| Water meter | Install | Supply and Work | - | |
| | Pay | - | Pay | |
| Charge of repair | | - | Customer payment | |
| Maintenance | | WUSCs | - | |

## 4. Water Meter Calibration Control

The performance of water meters shall be such that they can accurately measure as wide a flow range as possible and are durable.

Two methods of a water meter calibration are introduced herein. One is using the water meter calibration equipment at Technical Support Center (TSC) in Itahari (refer to section 4.1), the other is examination of instrumental error to an existing water meter (refer to section 4.2 (1)).

### 4.1 Water Meter Accuracy Management Equipment

A master meter can be set at Technical Support Center (TSC) in Itahari in order to calibrate customer's existing water meter.

- Purpose of establishment
  Improvement in performance of repair meter of WUSC
- Principle of equipment
  a) Typical size of the water meter to authorize is 15 mm (1/2 inch)
  b) Measurement of theoretical amount of water is calculated from a water gauge.
  c) Accuracy management is evaluated from the difference of the measurement value of water amount and water meter (Refer to Figure 4.2)
  d) The range of an allowable error of measurement may be from ±5% to ±2%.
  e) The resisting pressure examination of a water meter is carried out by 20 kgf/cm$^2$.

Verification tolerance is used in this method (refer to section 4.2 (2)).

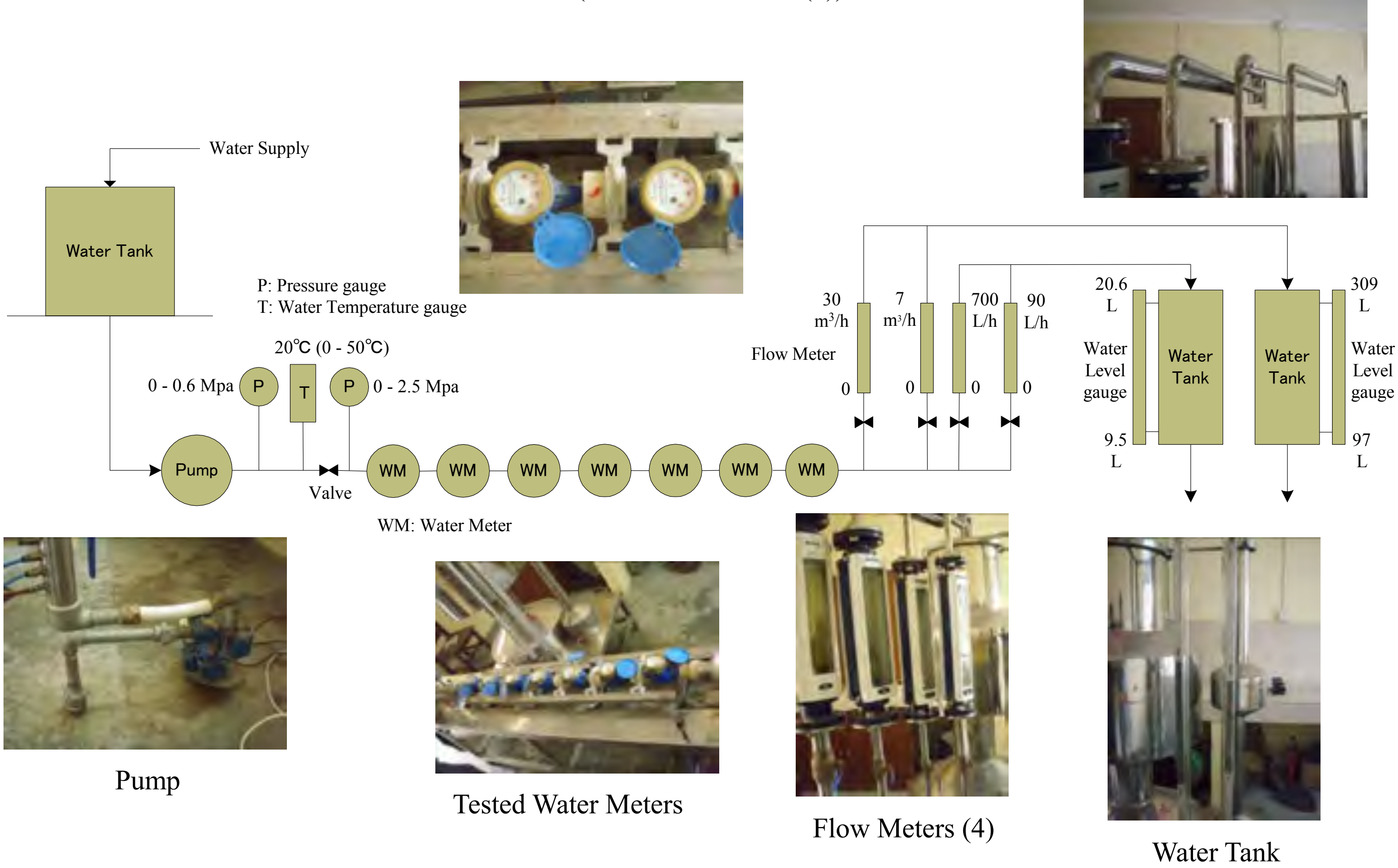



**Figure 4.1 Flow sheet of Water Meter Accuracy Management Equipment at TSC**

**(1) Verification Tolerance**

Verification tolerance is a permitted limit to judge acceptance or rejection of the water meter test. The range is shown in **Figure 4.2**.

**(2) Simple check of water meter**

・As for the operation of the water meter, it confirms that the impeller operates with breath.

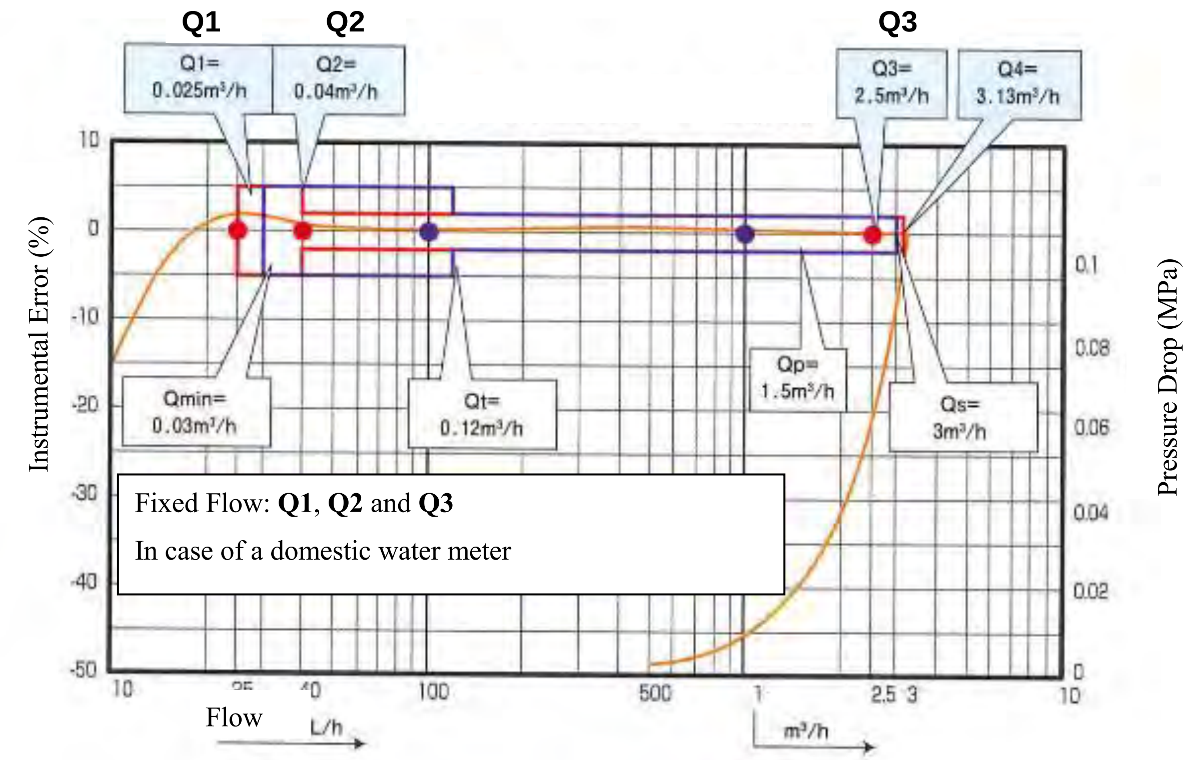



**Figure 4.2 Range of Verification Tolerance for Domestic Water Meter (15 mm)**

In delivery inspection, there are 3 points to check the flow rate.

Q1: Rating minimum flow. The flow is a required minimum flow under meter movement conditions.

Q2: Moving flow (Q2 = Q1 x 1.6). The flow is a border value between small flow rang and big flow rang.

Q3: Rating maximum flow. The flow is a required maximum flow under meter movement conditions.

Q4: Critical discharge (Q4 = Q3 x 1.25). This is maximum flow to maintain a meter performance.

### 4.2 Examination of Instrumental Error with Master (Standard) Water Meter

Tolerance is the range of allowable instrumental error. There are 2 kinds of tolerance, users' tolerance and verification tolerance.

#### (1) Users' Tolerance

Engineer confirms whether indiscrete value of a tested water meter is within users' tolerance (±10 %) or not. (Note: verification tolerance is ±2 - ±5 %.)
Users' tolerance is an allowable error of active water meter during the period of examination validity (8 years).
Examination of Instrumental error (%) with Master (standard) water meter is conducted by using equipment shown in **Figure 4.3**. Process of examination is shown below.

1. Engineer excludes air by running water through the meter and service pipe.
2. Fully open the stop valve of Master (standard) water meter
3. Open the faucet slowly.
4. Fully close off the stop valve of Master (standard) water meter, and read indiscrete values of 2 meters.
5. Fully open the stop valve of Master (standard) water meter.
   Again fully close off the stop valve of Master (standard) water meter after running water up to fixed test flow.
   Read indiscrete values of 2 meters.
   (i.e. flow is 50 L in case of 40 mm diameter.)

Calculation method of instrumental error is shown below.

$$E (\%) = (I-Q)/Q \times 100$$

E: Instrumental error (%)
I: Indiscrete value of tested water meter (L)
Q: Indiscrete value of Master (standard) water meter (L)

The range of an allowable instrumental error of measurement may be ±10 % (i.e. in case of 100 L, the range of an allowable is ±10 L.)

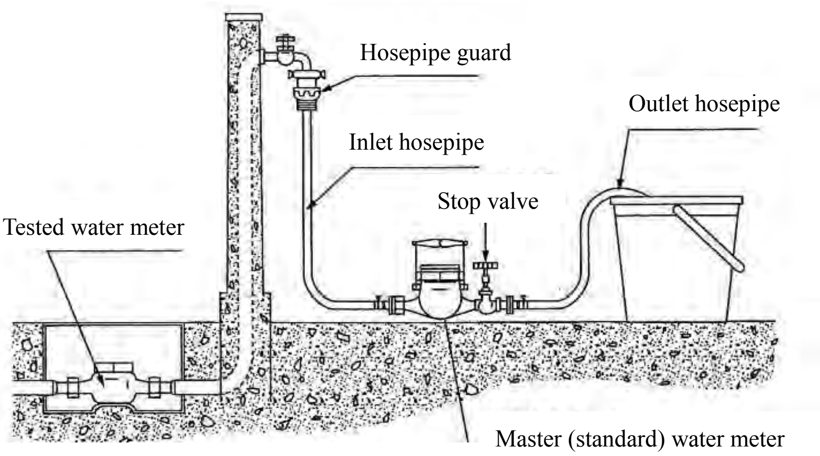



**Figure 4.3 Example of Examination of Instrumental Error with Master (standard) water meter**

**[Example of Calculation]**

**Case 1**

| Type of water meter | Initial indicator | Final Indicator | Difference |
|---|---|---|---|
| Tested Meter (User's) | 109.1067 $m^3$ | 109.1477 $m^3$ | +0.0410 $m^3$ (I) |
| Master Meter | 20.3782 $m^3$ | 20.4182 $m^3$ | +0.0400 $m^3$ (Q) |

E (%) = (I-Q)/Q x 100

= (0.0410-0.0400) / 0.0400 x 100

**= 2.5 % <± 10%** It is OK!

**Case 2**

| Type of water meter | Initial indicator | Final Indicator | Difference |
|---|---|---|---|
| Tested Meter (User's) | 109.1067 $m^3$ | 109.1417 $m^3$ | +0.0350 $m^3$ (I) |
| Master Meter | 20.3782 $m^3$ | 20.4182 $m^3$ | +0.0400 $m^3$ (Q) |

E (%) = (I-Q)/Q x 100

= (0.0350-0.0400) / 0.0400 x 100

**= -12.5 % >± 10% It is above tolerance error!**

The Tested (User's) Meter should be replaced.

## 5. Out of Order and Measures of Water Meter

Water meter failures are categorized such as no proceeding indicator, delay of indicator, inverse rotation of indicator, derangement, leakage from meter, unclearness of meter and meter damage.

1) No proceeding indicator: Indicators stop after installing or during use.
2) Delay of indicator: Phenomenon that indiscrete value decreases temporary or continuously during use.
   a. In case of indiscrete value decrease since no proceeding indicator occurred temporarily.
   b. In case of inaccurate of meter: since water meter is damaged.
3) Inverse rotation of indicator: Phenomenon of indiscrete value subtraction due to inverse rotation of indicator.
4) Derangement of indicator: Phenomenon that indicator sometimes moves inversely, unstable due to damaged meter parts.
5) Leakage from meter: Phenomenon of leakage from meter or surroundings of meter.
6) Unclearness of meter: It is not easy to read a meter due to unclearness of meter indicator and plate glass.
7) Meter damage: Phenomenon that water meter is partially damaged due to external factors such as collision.

| 1. No indicator proceeding | | |
|---|---|---|
| Cause | Instance | Measure |
| Alien substance such as sands, rust and pipe material get into gear portion and stops meter | ✓ Indicator stops immediately after opening the valve.<br>✓ Meter indicator d stops suddenly.<br>✓ No indicator proceeding after water is cutoff. | Pipe cleaning is always conducted after pipe works. |
| Over flow causes abnormal abrasion of meter parts and damage them. | Abrasion is caused by heavy water flow | Change meter to big rating one. |
| Damage by water hammer | When opening a valve forcefully after meter installation, there is a dash in the plumbing and the meter indicator will not work. | Open the stop valve slowly. |
| The transformation of the meter parts by hydrothermal, hot water | Plastic meter plastic parts are transformed and become immovable due to hydrothermal. | Replacement of meter parts |
| No proceeding indicator by circumgyration by rapid inflow of air | In case of beginning the flow of water after meter installation and/or upstream side plumbing, a lot of air makes the impeller rotate at a high-speed and the plastic parts are transformed due to generation of heat. | ✓ Air should be released gradually.<br>✓ Stop valve in a meter should be opened slowly. |
| Meter parts are damaged by dropping and impact | Indicator plate and gear wheel are damage and its turn becomes impossible to operate. | ✓ Meters should be handled carefully especially during transportation.<br>✓ Damaged meters should be checked to confirm the meter functions. |

| 2. Delay of indicator | | |
|---|---|---|
| Case | Instance | Measure |
| Alien substance such as sands, rust and pipe material get into impeller portion and stop meter temporally. | Alien substances are crowded at impeller makes it temporarily immovable, but due to pressure fluctuation the clog is recovered. | Pipe cleaning is always conducted after pipe working. |
| Over flow causes abnormal abrasion of meter parts and damage them. | Abnormal abrasion of rotation axes and gear wheel causes unstable condition. | Change meter to big rating one. |
| Delay of indicator by too little flow | In case the flow rate is below the minimum flow rate. | Change meter to suitable rating one. |

| | | |
|---|---|---|
| Bad meter installation posture | The installed meter is leaning extremely. | Install meter on horizontal pipes |
| Accumulation of scale inside the meter | Smooth turn of impeller is obstructed due to the accumulation of alien substances such as sand. | Cleaning regularly |

| 3. Inverse rotation of indicator | | |
|---|---|---|
| Cause | Instance | Measure |
| Reverse installation | - | Meter should be installed in the direction as indicated in the case. |
| Backflow in service pipe | Water flows backward by siphon when pump is stopped. | Check valve should be installed to prevent backflow |
| Influence of ventilation | Ventilation from exit side of meter backlashes and indicated value decreases. | Entrance and exit of meter should be covered by caps or a vinyl bag. |

| 4. Derangement of indicator | | |
|---|---|---|
| Cause | Instance | Measure |
| Cause of water hummer | Indicator plate is damaged, and gear wheels are dislocated and make irregular turn. | Stop valve in a meter should be opened slowly. |
| Cause of over flow | Gear wheels were dislocated and make irregular turn due to abnormal abrasion of meter parts. | Change meter to big rating one. |

| 5. Leakage from meter | | |
|---|---|---|
| Cause | Instance | Measure |
| Destruction by water hummer | When opening a valve forcefully, there is a dash in plumbing and the windowpane destroyed. | Stop valve in a meter should be opened slowly |
| Transformation and deterioration of gasket in meter | Fastening is too strong and causes crack. | Appropriate fastening. |

| 6. Unclearness of meter | | |
|---|---|---|
| Cause | Instance | Measure |
| Accumulation of alien substance such as sands, rust inside the meter | Iron rust and other substances get accumulate inside the meter and meter reading becomes difficult. | Clean regularly |
| Adhesion of water inside the meter | The register box of the dry-meter is cracked by water hammer, and moisture was trapped inside it. | The Stop valve in a the meter should be opened slowly to prevent impact of water hammer |

| 7. Meter damage | | |
|---|---|---|
| Cause | Instance | Measure |
| Falling meter | Indicator plate and gear wheel are damaged. | ✓ The meter should be handled carefully during the transportation and installment.<br>✓ Damaged meters should not be used. |

## 6. Management of Water Meter

A suitable record of meters is one that provides full and complete information on the installation, repair and testing of each meter with a minimum of expense. The time and effort devoted to maintaining meter records are considerable because of the number of units involved and because meters do not remain at one location during their useful life bur frequently moved.

Information of water meter is managed and recorded properly. The contents of the record sheet are as follows:

**[Management Items]**

Installation date, meter size, registration number, make, type, date of purchase, manufacturer's serial number or utility's number, user name, installation location (Word No., address), etc.

## Meter Record

No.

| Registration No. | Installation Record | | | | | | | | | Test and Repair Record | | | | Date of disposal (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Installation date (dd/mm/yy) | Meter Type | Meter Size | Make | Date of purchase (dd/mm/yy) | Manufacturer's serial No. | User's name | Word No. | Address | Date of Repair (dd/mm/yy) | Result | Date of Test (dd/mm/yy) | Result | |
| | | | | | | | | | | | | | | |
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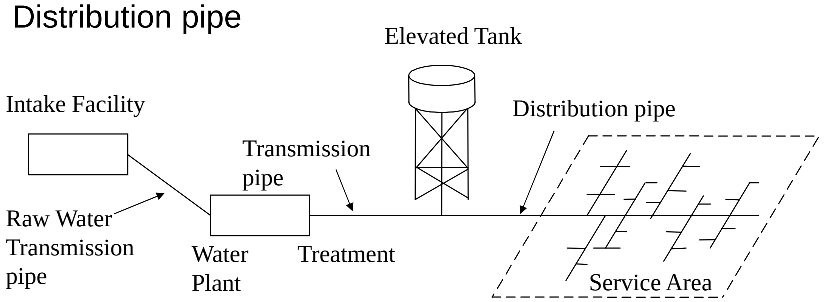
# Draft Standard Operation Procedure (SOP) on O&M of Water Distribution Facilities

## 1.1 Water Distribution Facilities

<u>Regular check of water distribution facilities</u>

- Intake facility
- Raw water transmission pipe
- Transmission pipe
- Elevated tank
- Distribution pipe



# 1.2 Purpose of Activities

1st Target

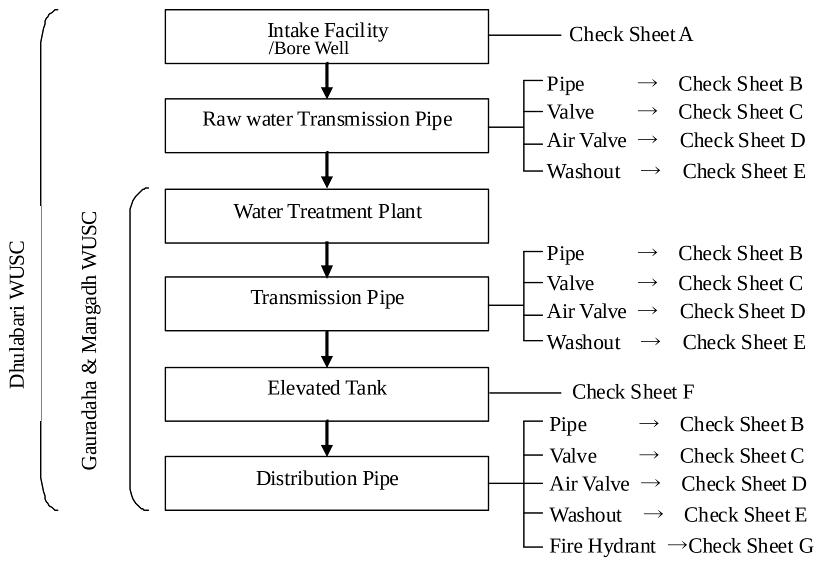
- To confirm the current status of distribution facilities included in the existing facilities.
- To make inspection record, flow record and repair record of facilities

2nd Target

- To create water distribution map
- Pipe routes, locations of valves, washout drains, fire hydrant, pipe dia. and material

→Information map is necessary for maintenance and repair

# 1.3 Object Facilities of Inspection and Check Sheet



# 2. Provision of Survey

Required items in facilities inspection

- ✓ Inspection Sheets
- ✓ (Digital) Camera
- ✓ Cover Opener (T key)
- ✓ Wrench, Spanner, Screw driver, Cotton work gloves
- ✓ Maps
- ✓ others

# 3. Facility Survey

3.1 Intake Facility

- Observational items are mainly Fence, Concrete degradation, Facility condition (Appearance), Water quality (turbidity, unusual odor), Screen (rust, trash-filled), Sedimentation in canal.
- To conduct the intake facility survey periodically. The inspectors contact the WUSC when discovering malfunction of the facility.
- The guard always supervises the fence to prevent trespassing.
- To displays "Keep Off" of general people in the bulletin board and signs at the intake site.

## 3.2 Raw Water Transmission and Transmission Pipes

- There is little information of pipe from residents since raw water transmission pipes are located far from the WTP office such as the rice fields and mountainous region.
- It is thought of behind in the discovery when the pipe has a malfunction.

→WUSC staffs make periodical inspection.

## 3.3 Distribution Pipes

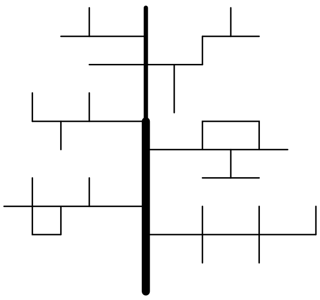
- To prevent leakage of water in pipes, especially leakage from joint parts.
- To replace a old pipe when there is too much water leakage from pipe and not from the joint.
- To monitor and maintain pipes where it is possible to generate rust-colored water by stagnation of water at dead ends.

# Welding Joints of HDPE

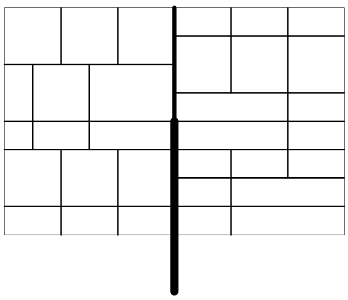
- Welded joints are restrained and can not be pulled apart under pressure and is appropriate for manual jointing. However, in case of incorrect joint such as insufficient and gappy at joint point, joints may pull apart and/or leakage of water may occur.

| | | | |
|---|---|---|---|
| a) Soldering iron | b) Heating soldering iron over a gas burner | c) Manual welding joint. | d) Handmade socket type conjugation tube |

# Distribution Network System

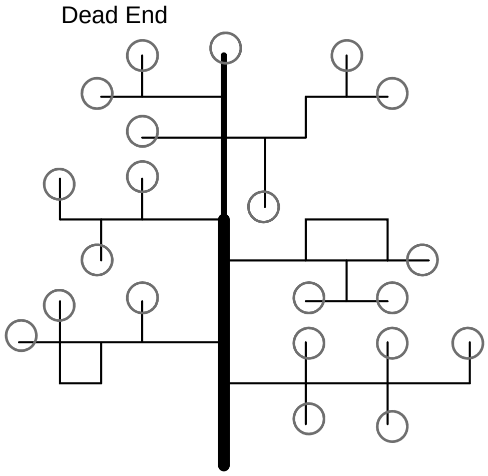


Tree Type Distribution System

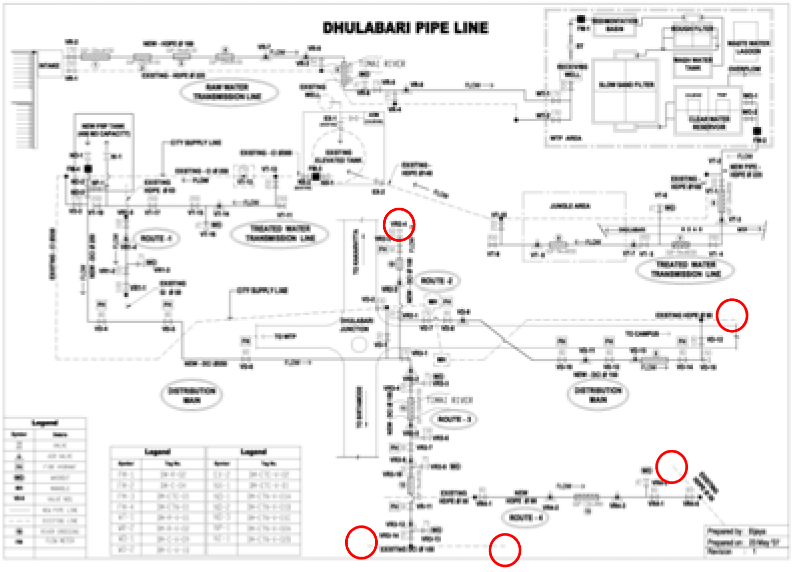


Grid Type Distribution System

## Tree Type Distribution System




## Flow Diagram of Pipelines in Dhulabari



# 3.4 Valve

Gate Valve:

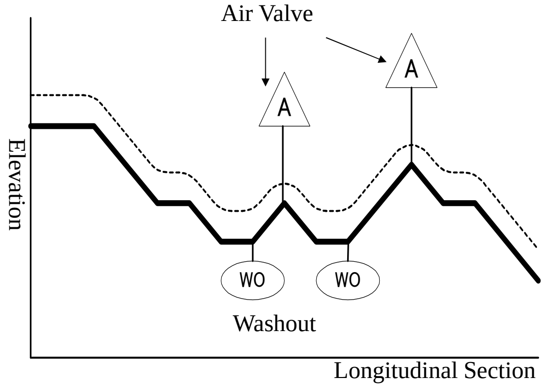
- ✓ Gate valve is mainly used by on-off control.
- ✓ In case of opening only some position of valve disc, use of the gate valve is not advised.
- ✓ Valve disc in valve box moves up and down, and opens and shuts.

Butterfly Valve:

- ✓ Valve disc in the valve box moves a valve rod in an axis, turns and opens and shuts.

# 3.5 Air Valve

- Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water.



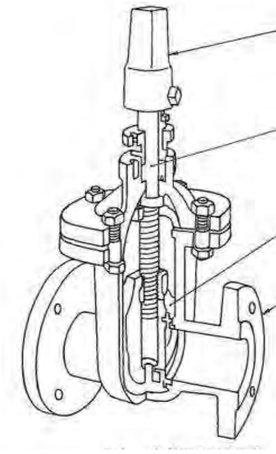
# 3.6 Washout Drain

- Washout drains are provided to keep the pipelines free from blockade.
- It shall be washed out at least once in 3 months in dry season and once a month in rainy season with enough water to flush the deposited dirt until clear water at washout is observed.

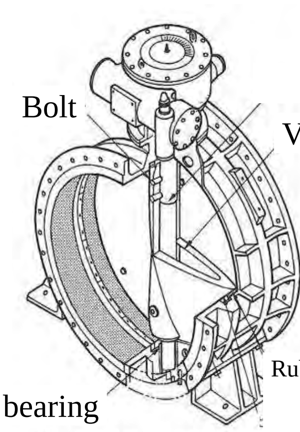
# 3.7 Check Items of Water Facilities

| Facilities | Check Items | Remarks |
|---|---|---|
| Intake | Date, Fence, Concrete degradation, Condition (Appearance), Water quality, Screen, Sedimentation, etc. | Inspection and Repair record, Sketch, Photograph |
| Pipe | Location, Diameter, Material, Condition, Water quality, Leakage, Sound, Customer complaints, etc. | Inspection and Repair record, Sketch, Photograph |
| Valves, Washout, FH | Type, Location, Main pipe dia., Condition, Working, Leakage, Sound, Valve status, etc. | Inspection and Repair record, Sketch, Photograph |
| Elevated Tank | Location, Crack of concrete, Condition, Water Quality, Leakage, Sound, Cleaning, etc. | Inspection and Repair record, Sketch, Photograph |

# 3.8 Gate and Butterfly Valve




Gate Valve




Butterfly Valve

# 3.9 Out of Order and Measures of Valve

## <u>Gate Valve - 1</u>

<u>Malfunction: It is Impossible to open and shut a valve</u>

| Causes | Measures |
|---|---|
| The valve seat is filled with alien substance such as garbage and sand | Removes alien substance |
| Abnormal abrasion of valve rod joint | Adjustment and repair of valve joint |
| Twist and distortion of valve rod | Replacement of valve rod |
| Abnormal abrasion of valve rod and valve box guide | Repair of valve box edge. |
| Malfunction of reduction gear | Decomposition and parts cleaning.<br>Replacement of parts of reduction gears |

## 3.9 Out of Order and Measures of Valve

### Gate Valve - 2

Malfunction: Torque generates strongly in case of operation of the valve. Leakage of water from ground of valve

| Causes | Measures |
|---|---|
| The valve seat and valve rod are filled with alien substance | Remove alien substance |
| Packing gland tighten up too much | Adjustment of packing gland nut. |
| Valve disc digs deep into valve seat | Adjustment of valve opening |
| Abnormal abrasion of packing, bad fastening of packing | Adjustment or replacement of packing |
| Dirt and so on adhere to a outcrop of valve rod, and surface of rod is a flaw. | Grinding or replacement of valve rod |

## 3.9 Out of Order and Measures of Valve

### Gate Valve - 3

Malfunction: Leakage of water in spite of indicating close on opening gauge

| Causes | Measures |
|---|---|
| Abnormal abrasion or damage of valve seat | Repair or replacement of valve seat |
| Bad opening gauge | Inspection, replacement of valve and gauge |
| Bad adjustment with valve | Readjustment with valve |

Malfunction: Vibration and/or noise from a valve

| Causes | Measures |
|---|---|
| Generation of cavitation in valve box | Set the valve opening with no generation of cavitation |

# 3.10 Out of Order and Measures of Valve
## Butterfly Valve - 1

Malfunction: It is impossible to open and shut a valve

| Causes | Measures |
|---|---|
| The valve seat is filled with alien substance such as garbage and sand | Remove alien substance<br>Repair rubber valve seat<br>Repair a edge of valve disc |
| Malfunction of reduction gears | Decomposition and parts cleaning<br>Replacement of parts of reduction gears. |

# 3.10 Out of Order and Measures of Valve
## Butterfly Valve - 2

Malfunction: Torque generates strongly in case of operation of the valve

| Causes | Measures |
|---|---|
| Bad shaft bearing of valve disc | Replacement of shaft bearing |
| Valve disc moved down | Adjustment of valve disc position with adjusting-bolt |
| Valve disc digs deep into valve seat | Adjustment of valve opening |

# 3.10 Out of Order and Measures of Valve
## Butterfly Valve - 3

Malfunction: Leakage of water from valve seat with abnormal torque when closing valve

| Causes | Measures |
|---|---|
| Separation of rubber valve seat | Replacement of rubber valve seat |
| The valve seat and valve rod are filled with alien substance | Remove alien substance |

# 3.10 Out of Order and Measures of Valve
## Butterfly Valve - 4

Malfunction: Leakage of water in spite of indicating close on opening gauge

| Causes | Measures |
|---|---|
| Damage of rubber valve seat | Replacement of rubber valve seat |
| Bad opening gauge | Conducting inspection of valve and gauge |
| Bad adjustment with valve | Readjustment with valve |

## 3.10 Out of Order and Measures of Valve
## Butterfly Valve - 5

Malfunction: Vibration and/or noise from a valve

| Causes | Measures |
|---|---|
| Backlash of gear in second reduction gears | Adjustment and/or replacement of gear |
| Generation of cavitation in a valve box | Inspect a cause of cavitation, and remove it. |

## 3.11 Elevated Tank

- To clean the inside of the tank once a year.
- In case of cleaning inside the tank, staffs confirm leakage of water from the concrete crack and joint inside the tank.

## 4. Check Sheet

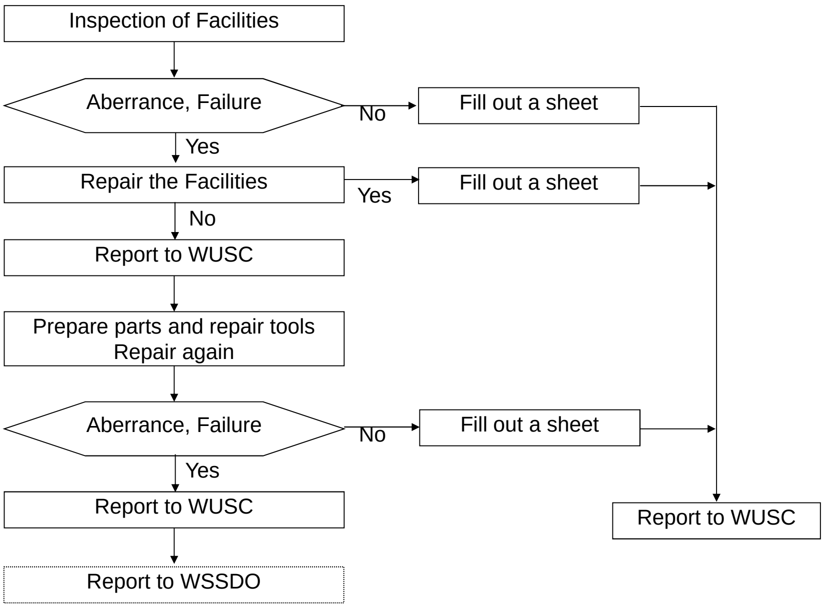
| No. | Inspection Date (dd/mm/yy) | Fence | Concrete degradation | Condition (Appearance) | Water Quality (Turbidity, unusual odor) | Screen (Rust, trash-filled) | Sedimentation in canal | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| | [Sample of fill-in] | | | | | | | |
| 1 | 12/09/2010 | 5m damage | Crack on Canal | Dirty in valve pit Need to clean | Thick, sallow | Trash-filled Need to clean | Sedimentation 4cm | Fence 20/9/2010 Concrete 20/9/2010 Clean for pit and Screen 20/9/2010 Removed sand from canal 22/9/2010 |
| 4 | | | | | | | | |
| 5 | | | | | | | | |

Sketch
or
Photograph

## 5. Procedures of Investigation and Report to WUSC

- At the time of the regular investigation of the water supply facilities, WUSC staffs make a inspection record, and report to WUSC (Manager).
- When the abnormality and problem in the water facilities are discovered, staffs repair it and inform WUSC (Manager) of its result.
- WUSC reports and/or requests WSSDO to support when necessary.

# 5.1 Procedures of investigation and Report




# 6. Water Distribution Network Map

6.1 Purpose

- Distribution pipelines and appurtenances have enormous length, and embedded pipes have various environments and conditions.
- Conditions of embedded pipes and structures should be grasped in order to maintain the pipelines by engineer.

→Distribution Network Map and its ledger should be made and kept systematically.

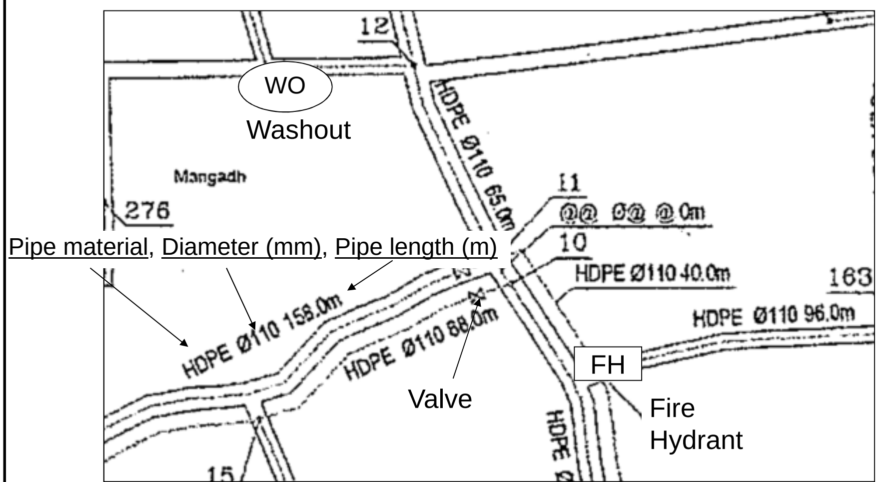
→This map can help engineers to understand and to conduct a new project such as improvement of facility and/or renewal in formulation stage of a planning.

## 6.2 Revision of Map

- Pipe change frequently with extension, improvement and moving of pipes.
- Engineers have to grasp a facility information promptly and revise the map accurately.

| Item | Information | Remarks |
|---|---|---|
| Pipe | Location, Material, Diameter, length | Including abandoned pipe |
| Valve, Washout, FH | Location,<br>Valve Type | |
| Topographical Factor | Road, House,<br>River (Cannel) | |

## Sample of Water Distribution Network Map



# Annex : Check Sheet

Check Sheet A : Intake Facility
Check Sheet B : Pipe
Check Sheet C : Valve
Check Sheet D : Air Valve
Check Sheet E : Washout
Check Sheet F : Elevated Tank
Check Sheet G : Fire Hydrant

## Check Sheet A : Intake Facility/Bore Well

### Intake Facility

Inspector: Inspection Date:

| No. | Inspection Date (dd/mm/yy) | Fence | Concrete degradation | Condition (Appearance) | Water Quality (Turbidity, unusual odor) | Screen (Rust, trash-filled) | Sedimentation in canal | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |

Sketch
or
Photograph

# Check Sheet A : Intake Facility/Bore Well

## Bore Well

Inspector: Inspection Date:

| No. | Inspection Date (dd/mm/yy) | Wall (Fence) | Bore Hole Plat Form | Condition (Appearance) | Water Quality (Turbidity, unusual odor) | Submersible Pumps | Submersible Cable | Non-return Valve | Wash out Valve | Flow Meter | Pressure Gauge | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |

Sketch
or
Photograph

# Check Sheet B: Pipe

Inspector: Inspection Date:

| No. | Location | Main pipe Dia., Material | Condition (Appearance) | Water Quality | Leakage | Sound, etc | Customer Complaints | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |

## Check Sheet C : Valve

Inspector: Inspection Date:

| No. | Type | Location | Main pipe Dia. | Condition (Appearance) | Working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| | [Sample of fill-in] | | | | | | | | |
| 3 | Ga te | VR5-4 (route No.+N os) | OD 160 HDP E | Rusty Need to clean | Ok | Water leakag e | No | Open | clean 20/9/2010 Leakage 20/9/2010 |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |

Sketch
or
Photograph

## Check Sheet D : Air Valve

Inspector: Inspection Date:

| No. | Location | Main pipe Dia. | Condition (Appearance) | Working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

## Check Sheet E : Washout

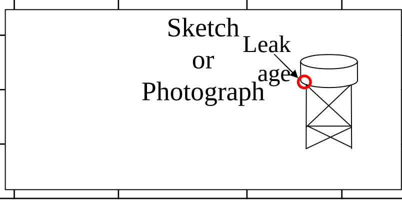
Inspector: Inspection Date:

| No. | Location | Main pipe Dia. | Condition (Appearance) | Working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

## Check Sheet F : Elevated Tank

Inspector: Inspection Date:

| No. | Location | Crack of Concrete | Condition (Appearance) | Water Quality | Leakage | Sound, etc | Cleaning inside tank | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |



# Check Sheet G : Fire Hydrant

Inspector: Inspection Date:

| No. | Location | Main pipe Dia. | Condition (Appearance) | Working | Leakage | Sound, etc | Valve Status | Repair Record Date (dd/mm/yy) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |

# Draft Standard Operation Procedure (SOP) on New Planning Formulation of Water Distribution Facilities

## Planning of water distribution facilities

1. Service area
2. Target Year
3. Location of facilities
   3.1 Location of facilities
4. Estimation of Water Demand
5. Planning of Distribution Networks
   5.1 Pipe Size
   5.2 Pressure Head
   5.3 Pipe Materials
   5.4 Welding Joints of HDPE
   5.5 Gate and Butterfly valves
   5.6 Roles and Location of Valves
   5.7 Locating valves at Branches
   5.8 Air Valves and Washouts
   5.9 Washout Drains
   5.10 Fire Hydrants

## 1.Service area

- Identification of Service Area
- Municipality border/Regional border
- Any existing water facility
- Whether for expansion of facilities or new planning
- Population

  high density- cost will be minimize and effect will be higher

  Scatter- cost will be higher and effect will be less.
- Facilities available.(Industries, schools, hospitals and government offices)

## 2.Target Year

- Generally for 15 years.
- Considering developments activities, available funds and population growth, it can be changed.

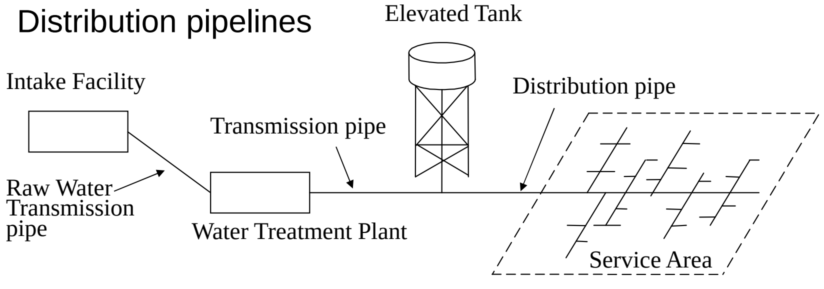
# 3.Location of Facilities

- Facilities are provided near the service areas.
  If not appropriate location, then suitable location at higher elevation are chosen to provide effective supply.
- Geographic features are taken into account on choosing location of Facilities.

# 3.1 Water Distribution Facilities

Regular check of water distribution facilities

- Intake facility
- Raw water transmission pipelines
- Water Treatment Plant
- Transmission pipelines
- Elevated tank or Service reservoir
- Distribution pipelines



## A) Intake

- Generally intake lies at outside of city area, only in case of deep boring where other alternative are not available, they are constructed in appropriate locations.
- Availability of water throughout the year.
- Accessibility to site.
- Selection of water source (Surface water or Groundwater)

## B) Water treatment plant

- Meets WHO or Nepal standards of quality water.
- To remove contamination of constituent agents.
- To provide quality water to consumer.

## C) Service Reservoir

- Purpose to collect water from intake.
- Capable to collect design capacity.
- Accessibility.
- Future expansion provision.
- Away to avoid trespassing.

## D) Elevated Tank

- Provided for provision of gravity flow type.
  Reduction on electricity consumption.
- Provided near service area using advantage of geographical condition.

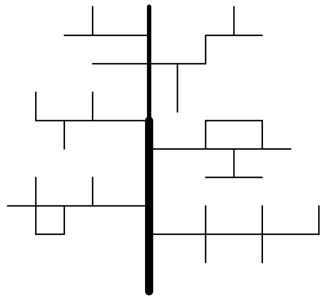
## E) Pipe Route

- Identification of shortest pipe route with more number of service connection points.
- Identifying pipeline network.(Grid or tree type etc.)

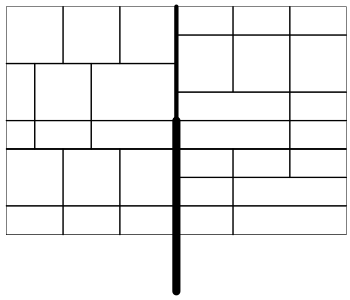
## F) Distribution Pipelines

- Pipe size arrangements.
- Location of various apparatus.(Air valves, Valves, Fire hydrants, and washouts)
- Pipe materials.(HDPE, Cast iron, Galvanized iron)

## G) Distribution Network Systems

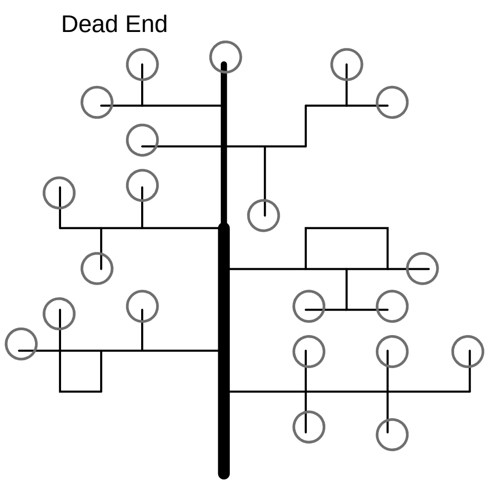


Tree Type Distribution System



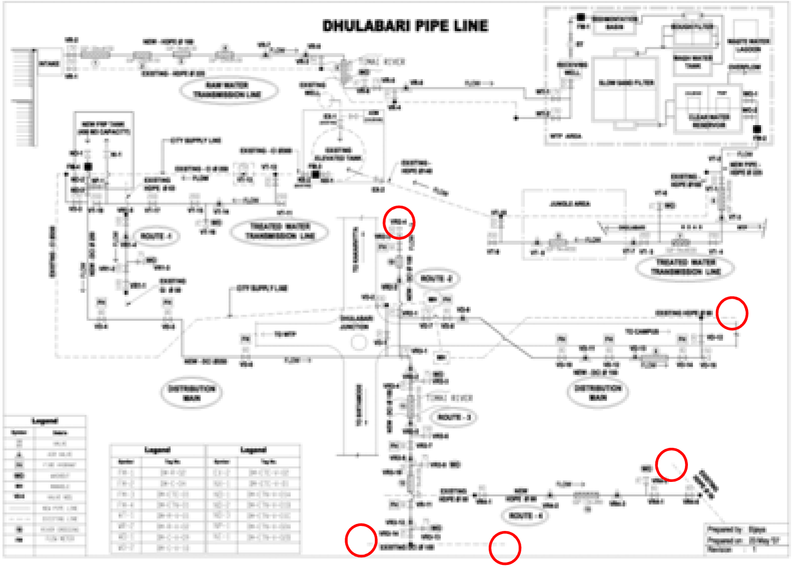
Grid Type Distribution System

## H) Tree Type Distribution System



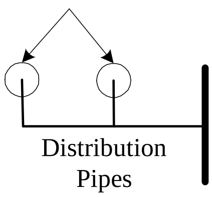
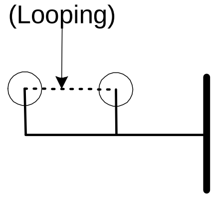
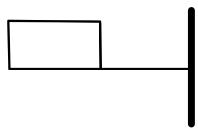

Tree type system has dead ends which are the potential for stagnation and deterioration of water quality

## I) Flow Diagram of Pipelines in Dhulabari



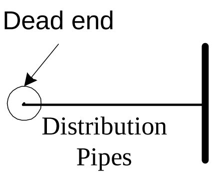

## J) Elimination of dead end

To loop a pipe network

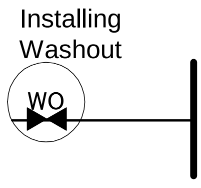
| | | |
|---|---|---|
|   |   |   |
| 1) Current situation | 2) Connecting between the dead ends | 3) Loop Network |

## K) Avoiding of generation of rust-colored water at a dead end

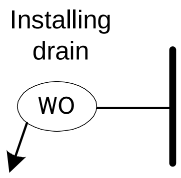
To install a washout drain at a dead end




1) Current situation




2) Installing a washout at a dead end




3) Washed out through a drain periodically

## 4. Estimation of Water Demand

1. Estimate the Design Population
2. Estimation of Water volume required in service area
3. Maximum daily design water flow, Hourly maximum design water flow
4. Pipe Size
5. Pressure Head

## 4.1 Estimate the Design Population

- To calculate Design population, survey is carried out.
- Increase rate is determined.
- Arithmetic, Geometric and Incremental Increase Rate, mostly Geometric is used.

## 4.2 Estimation of Water volume required in service area

A) Average daily design water flow:

Annual water flow divided by 365 days

→ Estimation of service charge and O&M costs

2) Maximum daily design water flow:

Water flow on the day of maximum water generation in a year

→ Design of WTP, Transmission Pipe and Transmission Pump

3) Hourly maximum design water flow:

24 hours conversion of numerical value ($m^3$/day) of a peak water flow per hour on the day of maximum water generation

→ Design of distribution pipe and distribution pump

## 4.3 Maximum daily design water flow, Hourly maximum design water flow

1)Water demand

Domestic water demand (daily average):

100 L/capita/day

2) Leakage Rate

10 % of average daily water flow → 10 L/capita/d

3) Variation Coefficient

Daily maximum/Daily average = 1.2

→ (100 + 10 L/capita/d) x 1.2 = 132 L/capita/d

4) Hourly peak factor

Hourly maximum/ Daily maximum = 3.0

→ 132 x 3.0 = 396 L/capita/d

## 5. Planning of Distribution Network

1. Pipe Diameter:

   Investigation of main pipe and branch pipe diameters.

2. Pipe Routes:

   Confirmation of pipe route and pipe position with map of the existing pipe network.

3. The distribution network layout:

   Network will be formed by loops of pipelines to the extent practicable, thereby minimizing dead ends and providing flexibility in operation.

4. Pipe Connecting Node:

   Confirmation of position of pipe connecting node with map of the existing pipe network.

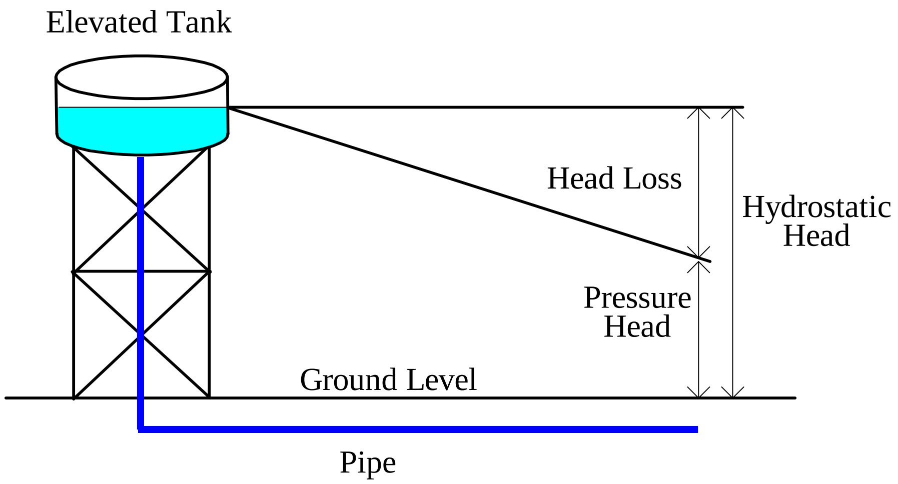
5. Determination of siphon culvert location:

   Method of installation of pipe at diversion points is decided after confirming other existing buried objects. Clearance between pipe and buried object should be more than 0.3 m.

## 5.1 Pipe Size

- In design of water distribution system, pipe size must be balanced against the maximum velocity and total head loss across the distribution network.
- Pipe size too small → Head loss will be greater.
  → Pressures will be reduced.
- Pipe size too big → Head loss will be reduced.
- Appropriate velocities are 0.5 – 1.5 m/sec in a pipeline.
  → Economical construction.
  Q ($m^3$/sec) = A ($m^2$) x V (m/sec)
  Q: Flow, A: Sectional area of a pipe, V: Velocity

## 5.2 Pressure Head (1)



## 5.2 Pressure Head (2)

- **Pressure head**: Internal energy of a fluid as a column of water.
  Pressure Head (m) = Hydrostatic Head (m) – Head Loss (m)
- **Head loss**: Loss of energy due to friction.
- Major losses- length of pipe,
- and minor losses- bends, fittings and valves.
  **Head Loss** (m) = Hydraulic gradient (‰) x Pipe Length (m)
  $= I \times L$
  $= 10.666\, C^{-1.85} D^{-4.87} Q^{1.85} \times L$
- **Hydrostatic head** : the pressure rise caused by gravity acting on a column of rest water or fluid.

## 5.2.1 Hydraulic Design Criteria

- Pipe materials: HDPE
- Pressure rating: PN 2.5, 4, 6, 10 type pipes
  Maximum residual pressure: approx. 50 m
- Minimum service pressure: 0.5 - 0.7 bars throughout the distribution network except that service pressure will be relaxed in case of fire flow (using a fire hydrant).
- Hazen-Williams Coefficient: C= 110 - 150 (HDPE)
  Included in pipe bends: C = 120
  Straight pipeline : C = 130
- Minimum flow velocity: 0.3 m/sec.
- Maximum flow velocity: 3 m/sec.
- Typical range of hydraulic gradient: 0.1 - 0.5 %

## 5.2.2 Selection of Pipe Specification

| Water Temperature ℃ | 20 | 25 | 30 | 35 | 40 |
|---|---|---|---|---|---|
| Pressure Reduction Factor | 1.00 | 0.93 | 0.87 | 0.80 | 0.74 |
| Maximum Allowable Pressure MPa ($kgf/cm^2$) | 1.00 (10.2) | 0.93 (9.5) | 0.87 (8.9) | 0.80 (8.2) | 0.74 (7.5) |
| Working Pressure MPa ($kgf/cm^2$) | 0.75 (7.6) | 0.68 (6.9) | 0.62 (6.3) | 0.55 (5.6) | 0.49 (5.0) |

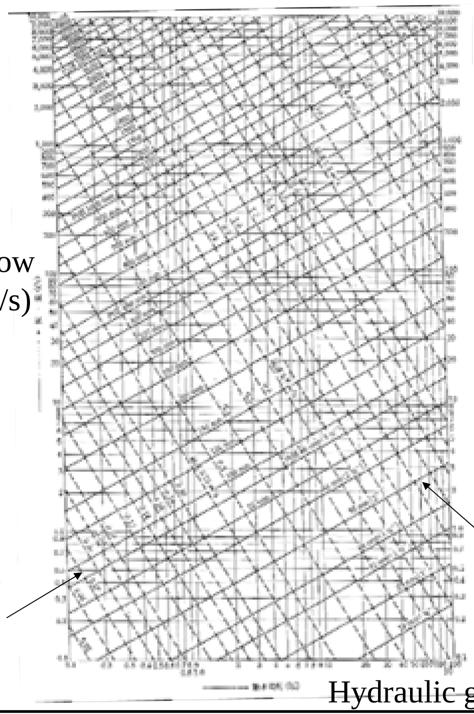
## 5.2.3 HDPE Diameter

**HDPE Pipes Dimension ( IS 4984-1987 / NS 40-2042 )**

| | Pressure Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PN 2.5 | | PN 4 | | PN 6 | | PN 10 | |
| de mm | e mm | di mm | e mm | di mm | e mm | di mm | e mm | di mm |
| 16 | | | | | | | 2.2 | 11.9 |
| 20 | | | | | | | 2.6 | 15.2 |
| 25 | | | | | | | 3.1 | 19.2 |
| 32 | | | | | 2.6 | 26.9 | 4.0 | 24.4 |
| 40 | | | 2.2 | 35.6 | 3.2 | 33.7 | 4.9 | 30.7 |
| 50 | | | 2.7 | 44.7 | 3.9 | 42.2 | 6.0 | 38.5 |
| 63 | 2.2 | 58.6 | 3.3 | 56.5 | 4.9 | 53.3 | 7.6 | 48.4 |
| 75 | 2.6 | 69.9 | 4.0 | 67.1 | 5.7 | 63.6 | 9.0 | 57.8 |
| 90 | 3.1 | 83.9 | 4.8 | 80.5 | 6.9 | 76.3 | 10.8 | 69.3 |
| 110 | 3.7 | 102.6 | 5.7 | 98.7 | 8.3 | 93.4 | 13.4 | 84.3 |
| 125 | 4.2 | 116.6 | 6.4 | 112.2 | 9.5 | 106.1 | 15.0 | 96.3 |
| 140 | 4.7 | 130.7 | 7.3 | 125.5 | 10.5 | 119.0 | 16.7 | 107.9 |
| 160 | 5.3 | 149.5 | 8.3 | 143.4 | 12.0 | 136.0 | 19.0 | 123.5 |
| 180 | 6.0 | 168.0 | 9.3 | 161.5 | 13.6 | 152.9 | 21.5 | 138.8 |
| 200 | 6.7 | 186.7 | 10.3 | 179.4 | 15.1 | 169.9 | 23.8 | 154.3 |
| 225 | 7.4 | 210.3 | 11.6 | 201.9 | 16.8 | 191.4 | 26.8 | 173.4 |
| 250 | 8.3 | 233.5 | 12.9 | 224.3 | 18.7 | 212.6 | 29.8 | 192.8 |
| 280 | 9.2 | 261.7 | 14.3 | 251.4 | 20.9 | 238.2 | 33.2 | 216.2 |
| 315 | 10.3 | 294.5 | 16.1 | 282.8 | 23.6 | 267.9 | 37.3 | 243.3 |
| 355 | 11.6 | 331.9 | 18.1 | 318.8 | 26.5 | 302.0 | 42.0 | 274.2 |
| 400 | 13.1 | 373.9 | 20.4 | 359.2 | 29.9 | 340.3 | 47.4 | 308.9 |
| 450 | 14.6 | 420.8 | 22.9 | 404.2 | 33.5 | 383.0 | 53.2 | 347.8 |
| 500 | 16.4 | 467.3 | 25.5 | 449.1 | 37.2 | 425.6 | 59.3 | 386.0 |

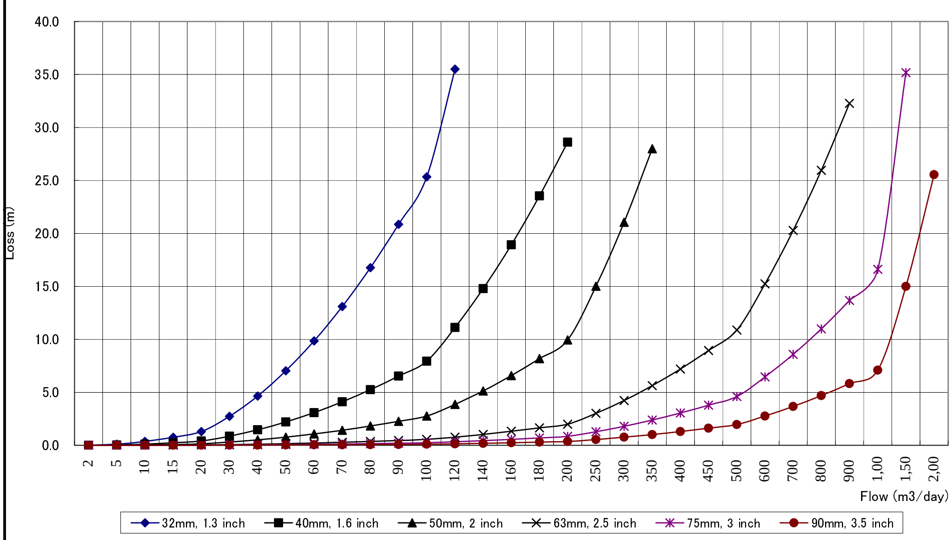
de = outside diameter of the pipe
di = inside diameter of the pipe
e = wall thickness
PN = nominal pressure rating (bar)

## 5.2.4 Hazen-Williams Equation




## 5.2.5 Friction Loss of Water

Friction Loss of water in meter per 100m length of pipe, based on Hazen & Williams formula using C = 130



## 5.3 Pipe Materials

High Density Polyethylene (HDPE) pipe is adopted in most projects.

- Light weight for ease of installation
- Flexible pipe
- Special corrosion protection is not required
- Available in welding joints
- Special joint restrains may not be required at changes in direction
- (HDPE pipe for a sewer is not affected by hydrogen sulphide.)

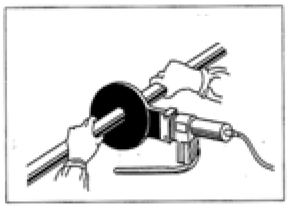
## 5.4 Welding Joints of HDPE (1)

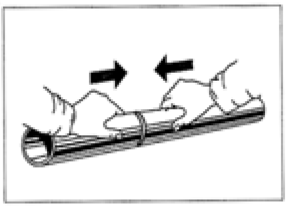
- Welded joints are restrained and can not be pulled apart under pressure and is appropriate for manual jointing. However, in case of incorrect joint such as insufficient and gappy at joint point, joints may pull apart and/or leakage of water may occur.

| | | | |
|---|---|---|---|
| a) Soldering iron | b) Heating soldering iron over a gas burner | c) Manual welding joint. | d) Handmade socket type conjugation tube |

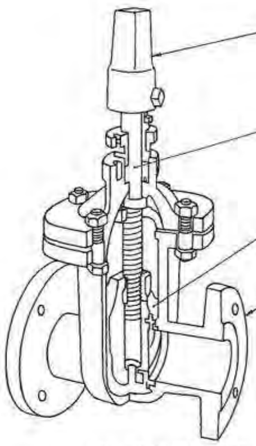
## 5.4 Welding Joints of HDPE (2)

- For correct butt welding:
  - Parts to be welded must be cut square
  - The welding plate and the parts to be welded must be clean.
  - The welding plate must be at the correct temperature.
- Butt welding for using a welding plate:
  - Press clean and cut-square ends against the weld plate.
  - Do not accelerate the cooling process. For instance, usage of water for cooling.

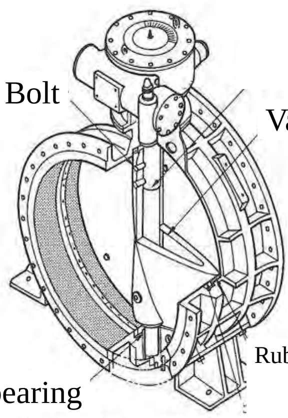




## 5.5 Gate and Butterfly Valve (1)




Gate Valve




Butterfly Valve

## 5.5 Valve (2)

Gate Valve:

✓ Gate valve is mainly used by on-off control.

✓ In case of opening only some position of valve disc, use of the gate valve is not advised.

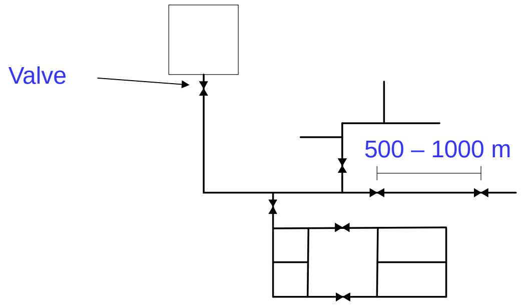
✓ Valve disc in valve box moves up and down, and opens and shuts.

Butterfly Valve:

✓ Valve disc in the valve box moves a valve rod in an axis, turns and opens and shuts.

## 5.6 Roles of Valves and Locations

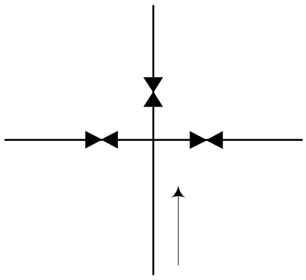
- To control flows and maintain pipelines
  → Leakage Repair and Pipe Replacement
- Gate Valve for 300 mm diameters below
- Butterfly Valve for 300 mm above
- To be installed at intervals of approx. 500 m – 1000 m



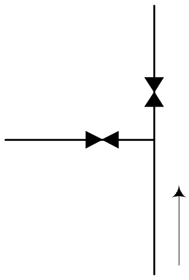
## 5.7 Location of Valves at Branches

(a) Maximum 3 valves will be provided at crosses

(b) Maximum 2 valves will be provided at tees



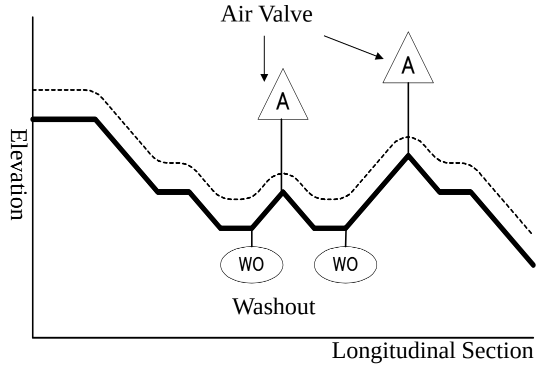
(a) Cross



(b) Tee

## 5.8 Air Valve and Washout

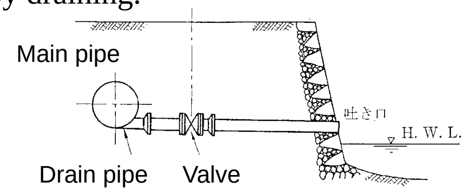
- Air valves are located on all high points in the transmission and distribution pipelines to allow trapped air to be release from pipelines without loss of water.



## 5.9 Washout Drain

- Washouts are located at dead ends and low spots in the distribution pipelines to allow accumulated sediment to be cleaned by flushing.

1. Location of washout drain: washout drain should be installed nearby drainage canal or river.
2. Drain pipe diameter is normally 1/2 – 1/4 size of main pipe diameter.
3. Washout drain should be built strongly at the spillway so as not to erode or to be destroyed by draining.




## 5.10 Fire Hydrant

- Fire hydrant will be located in the distribution network on all pipelines of at least 150 mm nominal diameter.
- Otherwise, negative pressure may occur in small diameter such as less than 100 mm.
- Spacing will be at about 200 m.

# Procedure for Hand Made Sockets and its Installation

## 1. Fire and Marking on Pipes

Put on the fire first.

Either on the stove or other means of heating.

Mark the required Length on the Pipe with desired Diameter pipe for Socket .

## 2. Cutting and Heating of pipes

Put over the fire to get the pipe Expand in Diameter.

Cut the marked Length of pipe for Socket .

## 3. Heating and Expanding of Pipes

Roll a pipe of smaller diameter to get the heated part to expand up to outer diameter of connecting pipe.

Check the pipe if it is loosen or not.

# 4. Filing and inserting the pipes

Insert Standard size filed pipe of same size to minimum 150 mm length.

File the end surface of same size pipe with sand paper or with round or flat file.

# 5. Pressing and heating again

Put the surface over the fire and rotate the pipe for penetration for length more than 150 mm .

Hit it on the firm ground or wooden plank for more penetration inside.

## 6. Heating and Pressing another end

Put the standard size pipe of same diameter and let for some time to cool down

Now put the another side of pipe over the fire for expansion.

## 7. Completion of Socket

Put the socket at leakage point to prevent leakage or on expansion purposes.

Hand made socket is ready to use

## 8. Installing inspection

Mark the length on the pipe approximately to cut.

Check the socket to fit the length to be cut.

## 9. Cutting of pipes

Pull the pipe above the ground to insert inside the socket.

Check if length cut is ok or not.

The penetration must be at least 150 mm inside.

# 10. Installing Pipes

For proper fixing, hit the socket with another pipe.

Insert the pipe in the socket.

# 11. Inserting and placing of pipes

Slowly press it down on the ground for proper installation.

Pull another pipe at required height to let it insert inside the socket.

# 12. Completion of Connections

Installation of socket completed.

Thanks for your Presence and attaining this workshop.

NJS Consultant
And
Morang, WSSDO

The Problem of Water Supply
on Distribution Pipe

## Problem on Pipeline

It is possible to supply water normally from the elevated tank in service area.

Water supply sometimes stops due to temporal water supply.

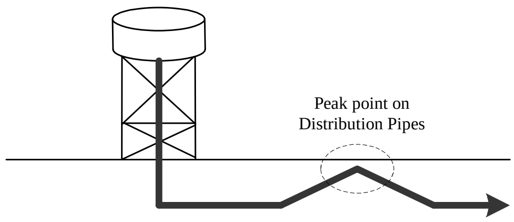
However, water can not be provided at a certain place in spite of resuming water supply.

# 1. Possible Cause

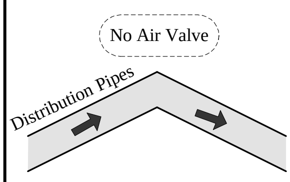
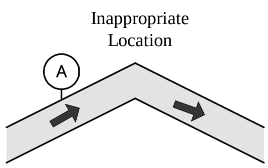
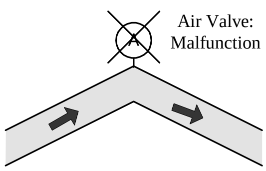
1) Since there may be entrapped air at a higher elevation on the pipeline, the entrapped air can hinder from conveying water through pipe.

2) Location of an air valve may be inappropriate.

3) An air valve may be malfunction but an air valve is installed at peak point.




# 2. Entrapped Air Occurrence Point

|   |   |   |
|---|---|---|
| Nonexistence air valve at peak point on pipeline | In appropriate location of an air valve | An air valve is malfunction. |

# 3. Measure

- To confirm the geographical higher elevations on the pipe route at first, then confirm an air valve existence or nonexistence.
- When necessity of an air valve is ascertained at some higher elevations, the air valve should be installed at the point.

# 4. Occurrence Procedure and Measure

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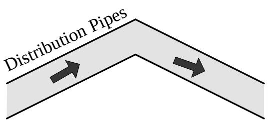
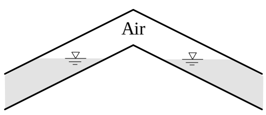
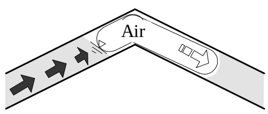
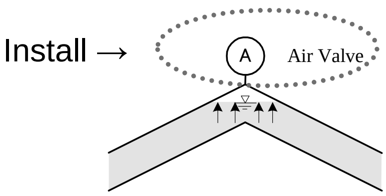
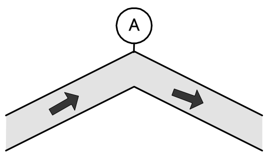
<td>

1) Normal Operation for conveying water in pipeline</td>
<td>

2) When water supply was suspended, entrapped air may occur at peak point on pipeline.</td>
<td>

3) The entrapped air can hinder from conveying water when water supply resumed.</td>
</tr>
<tr>
<td colspan="2">

4) When an air valve is installed at the peak point, the air valve releases entrapped air from inside pipe.</td>
<td>

5) Normal Operation after installing an air valve</td>
</tr>
</table>

# Service pipe Installation, Water Meter Reading and Meter Calibration Control

## Table of Contents

1. Installation of Service pipe and Water Meter
2. Outline of Meter Reading
3. Responsibility of installation fee and maintenance of water meter
4. Water Meter Calibration Control
5. Out of Order and Measures of Water Meter
6. Management of Water Meter

## 1. Installation of Service pipe and Water Meter

### 1.1 Service Pipe

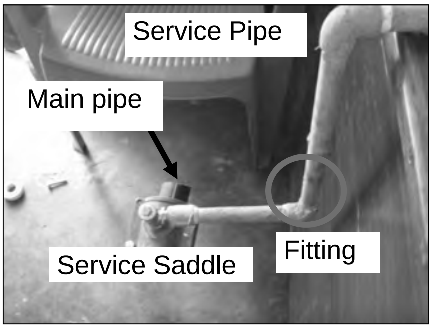
a. Connection point from distribution pipe should be surveyed sufficiently to avoid cross connections.

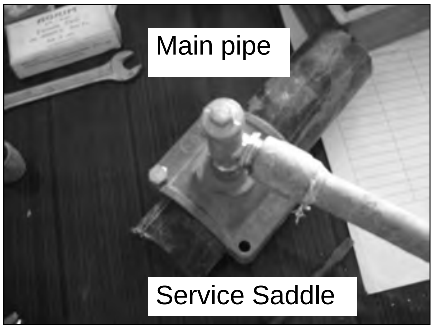
b. Service pipe diameter should be smaller in principle than distribution (main) pipe diameter.

c. Not to connect from joint and/or fitting point on main pipe.

d. Clean the surface of main pipe when service pipe is connected. During the installation of service saddle, fasten equally with bolts on the main pipe.

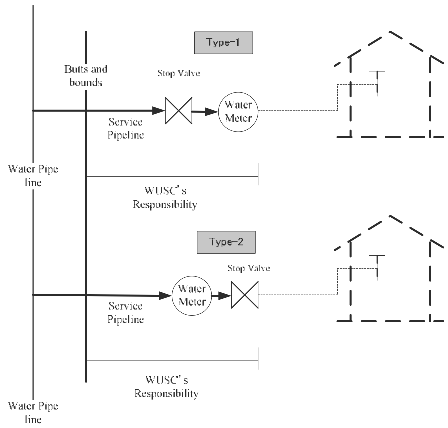
## Main pipe and Service pipe



# 1.2 Location of Stop valve

- Stop valve will be installed in front and behind meter and/or meter box without hindering meter maintenance.




# 1.3 Location of Water Meter

a. Water meter is principally located inside the ground for easy inspection and/or replacement and where the probability of meter damage is low.

b. In case of installing a water meter under ground, use a meter box.

c. In case of installing water meter, inflow direction sign on meter should be confirmed and set in the horizontal position.

# 1.4 Pipe Working

a. Distance of service pipe and other embedded pipes should be kept at least 30 cm to avoid accidents such as cross connection and pipe damage.

b. Underground pipe works should be kept in a straight line as much as possible as it is easier to understand and locate the pipes later and such pipe laying is much economical.

c. Put a stopper at pipe end with plug to avoid filthy water from flowing into pipe when pipe stops working temporary or daily.

# Water Meter

Installed water meter

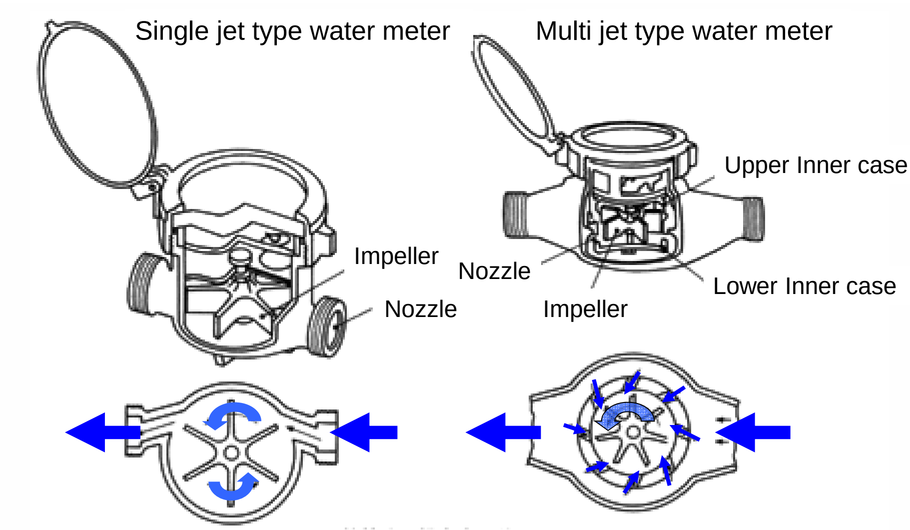
Water meter

# Water Meter Inner Case

Meter indicator

Impeller and Gear wheel

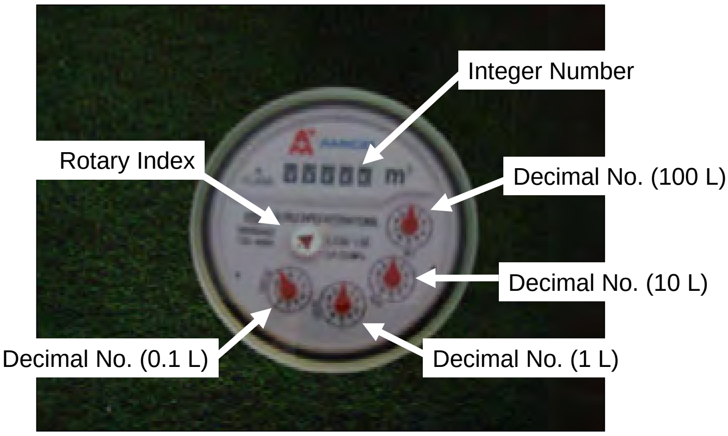
# Vane wheel jet type water meter



# 2. Outline of Meter Reading

- Meter reading is the foundation of water tariff. It is necessary to keep conditions for easy reading and replacement, and effort should be made to improve accuracy of meter reading.

# Meter Reading



## 3. Responsibilities of installation fee and maintenance of water meter

| | | WUSCs | Customer |
|---|---|---|---|
| House Connection | Install | Work | Prepare material |
| | Pay | - | Pipes and Fittings |
| Water Meter | Install | Supply and Work | - |
| | Pay | - | Pay |
| Charge of Repair | | - | Pay |
| Maintenance | | WUSCs | - |

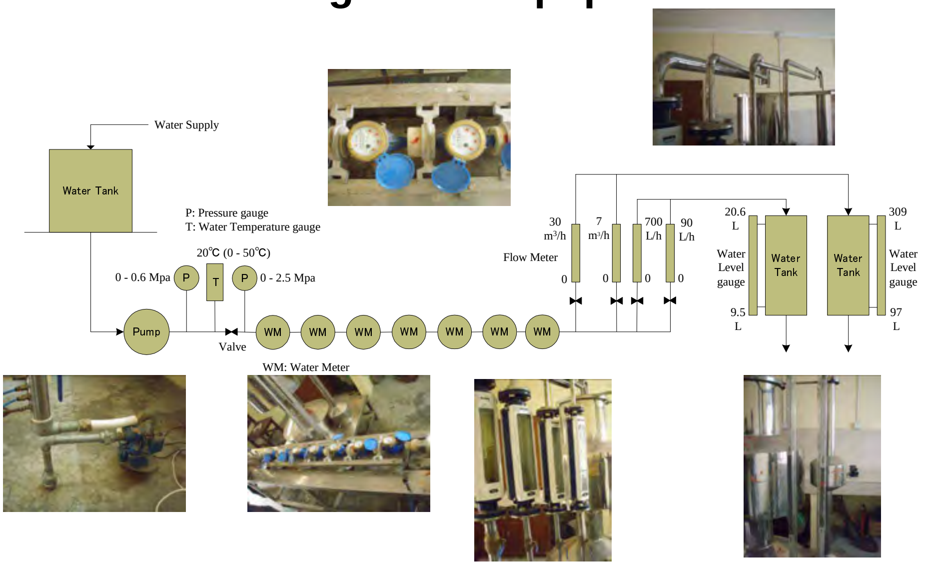
## 4. Water Meter Calibration Control

ERMSO Water Meter Accuracy Management Equipment
(at Technical Support Center (TSC) in Itahari, in Sunsari district)

[Purpose of Establishment]
- Improvement in performance of the repair meter of WUSC (based on the charge)

[Principle of Equipment]
- Measurement of theoretical amount of water is calculated from a water gauge.
- Accuracy management is evaluated from the different of the measurement value of water amount and a water meter
- The range of an allowable error of measurement may be ±2 - 5% (for TCS laboratory)
- (Allowable error ±10% is for an existing water meter)

## Flow sheet of Water Meter Accuracy Management Equipment




## 5. Out of Order and Measures of Water Meter (1)

- No proceeding indicator:
  Indicators stop after installing or during use.
- Delay of indicator:
  Phenomenon that indiscrete value decreases temporary or continuously during use.
- Inverse rotation of indicator:
  Phenomenon of indiscrete value subtraction due to inverse rotation of indicator.
- Derangement of indicator:
  Phenomenon that indicator sometimes moves inversely, unstable due to damaged meter parts.

# 5. Out of Order and Measures of Water Meter (2)

- Leakage from meter: Phenomenon of leakage from meter or surroundings of meter.
- Unclearness of meter: It is not easy to read a meter due to unclearness of meter indicator and plate glass.
- Meter damage: Phenomenon that water meter is partially damaged due to external factors such as collision.

## 5.1 No indicator proceeding

| Cause | Instance | Measure |
|---|---|---|
| Alien substance such as sands, rust and pipe material get into gear portion and stops meter | Indicator stops immediately after opening the valve. | Pipe cleaning is always conducted after pipe works. |

## 5.2 Delay of indicator

| Cause | Instance | Measure |
|---|---|---|
| Bad meter installation posture | The installed meter is leaning extremely. | Install meter on horizontal pipes |

## 5.3 Inverse rotation of indicator

| Cause | Instance | Measure |
|---|---|---|
| Reverse installation | - | Meter should be installed in the direction as indicated in the case. |

## 5.4 Derangement of indicator

| Cause | Instance | Measure |
|---|---|---|
| Cause of over flow | Gear wheels were dislocated and make irregular turn due to abnormal abrasion of meter parts. | Change meter to big rating one. |

## 5.5 Leakage from meter

| Cause | Instance | Measure |
|---|---|---|
| Destruction by water hummer | When opening a valve forcefully, there is a dash in plumbing and the windowpane destroyed. | Stop valve in a meter should be opened slowly |

## 5.6 Unclearness of meter

| Cause | Instance | Measure |
|---|---|---|
| Accumulation of alien substance such as sands, rust inside the meter | Iron rust and other substances get accumulate inside the meter and meter reading becomes difficult. | Clean pipe regularly |

## 5.7 Meter damage

| Cause | Instance | Measure |
|---|---|---|
| Falling meter | Indicator plate and gear wheel are damaged. | Damaged meters should not be used. |

# 6. Management of Water Meter

Purpose:

A suitable record of meter is one that provides full and complete information on the installation, repair and testing of each meter with a minimum of expense.

- Time and effort
- Number of Meters
- Meters do not remain at one location
- Meters can be relocated/moved

**Meter Record** No.

| | Installation Record | | | | | | | | | Test and Repair Record | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Registration No. | Installation date (dd/mm/yy) | Meter Type | Meter Size | Make | Date of purchase (dd/mm/yy) | Manufacturer's serial No. | User's name | Word No. | Address | Date of Repair (dd/mm/yy) | Result | Date of Test (dd/mm/yy) | Result | Date of disposal (dd/mm/yy) |

[Management Items]

Installation date, meter size, registration number, make, type, date of purchase, manufacturer’s serial number or utility’s number, user name, installation location (Word No., address), etc.

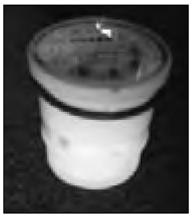
# Proper Treatment of a Water Meter

## 1. Precaution for Safety (1)

- To pay attention while carrying heavy equipment and installing water meters since there are possibilities of injury.
- Not to touch directly a screw joint part on a meter case because there is a possibility of injury.  To put on cotton work gloves to help prevent injury.

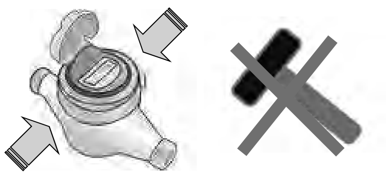
## 1. Precaution for Safety (2)

- To use appropriate tools such as wrenches for plumbing. Hindrance and accident may be caused by using inappropriate tools for plumbing.
- Not to pour hot or boiling water into the water meter. When hot water of more than 40 degrees flows in a water meter, there is a possibility to damage the inside plastic parts of the water meter.

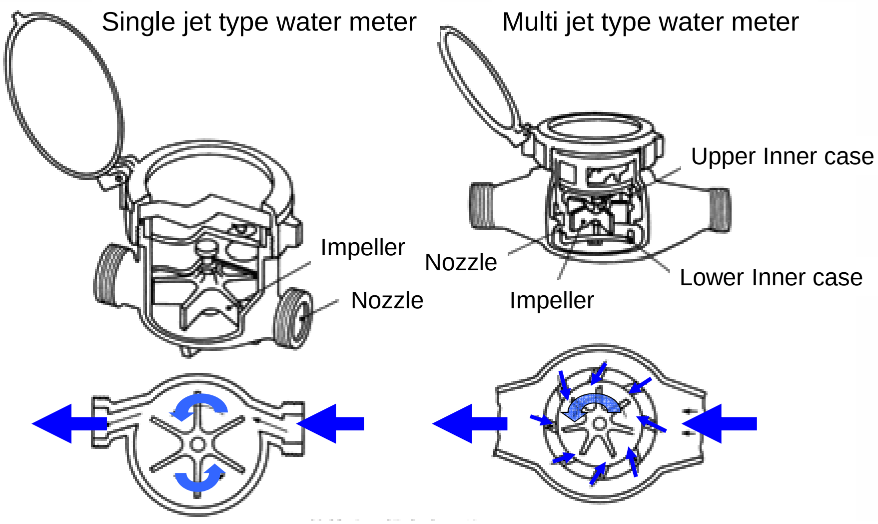


## 1. Precaution for Water Meter Management during Meter Storage (1)

- Not to give water meter a strong shock.
  When a water meter falls, there is a possibility of meter damage and might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.
- Not to give water meter vibration.
  When a water meter receives vibration for many hours, it might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.



## Vane wheel jet type water meter



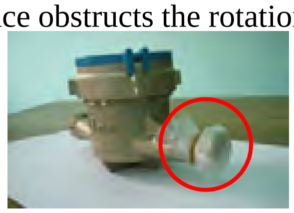

## 1. Precaution for Water Meter Management during Meter Storage (2)

- To cover gateway of water meter to prevent the wind blowing through the meter during water meter storage.

  When air blows through the water meter, it is possible that measured value can progress or revert because impeller rotates due to the wind. To put caps on the gateway of water meter to prevent this from happening.

- To cover gateway of water meter to prevent unwanted substances entering water meter during meter storage.

  When unwanted substances entered meter, it might be difficult to measure since the unwanted substance obstructs the rotation of the impeller.



## 2. Precaution for location of water meter installation (1)

- To install water meter in horizontal position.

To set the meter horizontally with indicator upward according to the arrow shown on the meter.

- To select the place where installation and removal of a water meter are easy.

Since it is necessary to replace water meter periodically (recommended in every 8 years), appropriate place for installing and removing a water meter is required.

## 2. Precaution for location of water meter installation (2)

- To select the place where meter reading is easy. Since it is necessary to conduct meter reading periodically, appropriate place, which is dry condition and not submerged, is required.
- To select the place where momentary pressure variation is low.

It might be difficult to measure accurately because the rotation of the impeller will be increased by momentary pressure variation. The maximum working pressure, however, is 1 MPa.

## 2. Precaution for location of water meter installation (3)

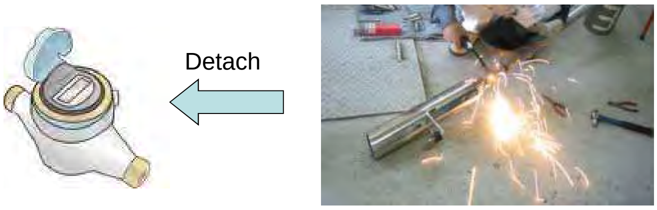
- To select a place where there is no influence on vibration. It might be difficult to measure accurately because the rotation of the impeller is increased by vibration.
- Not to install water meter at a submerged location.

## 3. Precaution for water meter installation (1)

- Water meter installation fitting should be the total length of the meter.

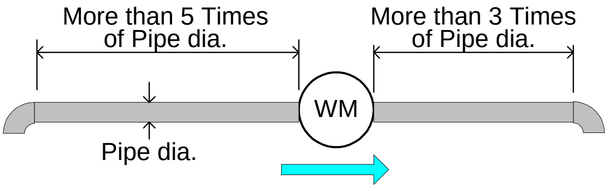
  In case of bad measurement, such as short or long, the meter can not be installed to pipes.
- When a welding junction is conducted at a pipe joint part, detach the water meter from the pipes.

  The plastic parts inside the water meter may be damaged by the high temperature of the welding.



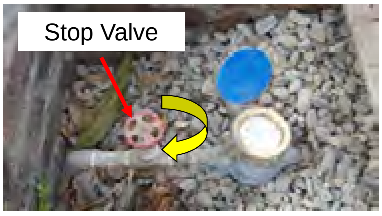
## 3. Precaution for water meter installation (2)

- Pipe length of more than 5 times of a pipe diameter in the upper stream of a water meter and the pipe length of more than 3 times in the downstream are required on a pipe arrangement. When the pipe length is shorter than above mentioned length, it might be difficult to measure accurately due to the influence of a valve or a bent pipe.
- To use proper packing to fit a pipe diameter during meter installation. Water leakage at joint parts and/or water measuring error may occur due to different dimensions of packing.




## 3. Precaution for water meter installation (3)

- The inside of the pipe should always be cleaned by flowing water before installing water meter. It might be difficult to measure accuracy because unwanted substances inside the pipe might obstruct the rotation of the impeller or even destroy the meter.
- To open a stop valve slowly when feeding water. When opening a stop valve hastily, the water meter might be damage due to water hammer.

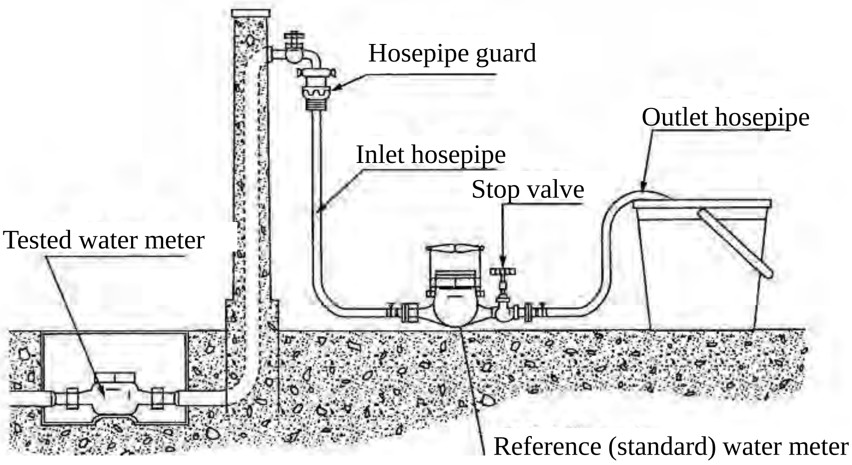


## 4. Examination of Instrumental error with reference (standard) water meter

Examination of Instrumental error (%) with reference (standard) water meter is conducted by using equipment.

1. Engineer excludes air by running water through the meter and service pipe.
2. Fully open the stop valve of reference (standard) water meter
3. Open the faucet slowly.
4. Fully close off the stop valve of reference (standard) water meter, and read indiscrete values of 2 meters.
5. Fully open the stop valve of reference (standard) water meter.
   Again fully close off the stop valve of reference (standard) water meter after running water up to fixed test flow.
   Read indiscrete values of 2 meters.
6. The range of an allowable instrumental error of measurement may be ±10 % (i.e. in case of 100 L, the range of an allowable is ±10 L.)

## 5. Examination of Instrumental error with reference (standard) water meter



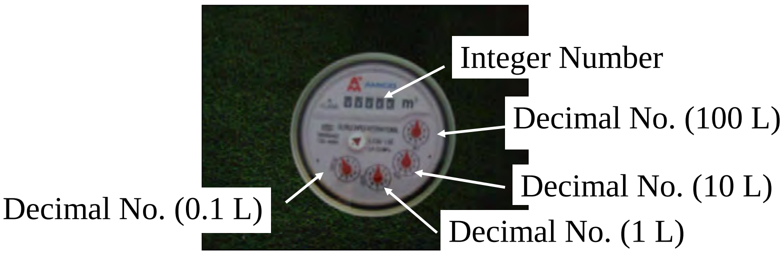
## 5.1 Calculation of Instrumental Error

$$E = \frac{I - Q}{Q} \times 100$$

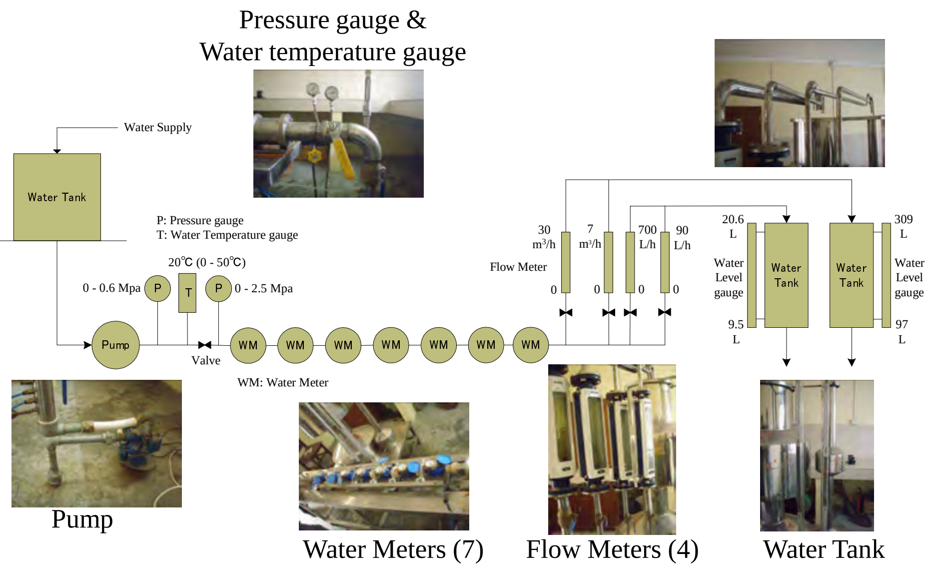
E: Instrumental error (%)

I: Indiscrete value of tested water meter (L)

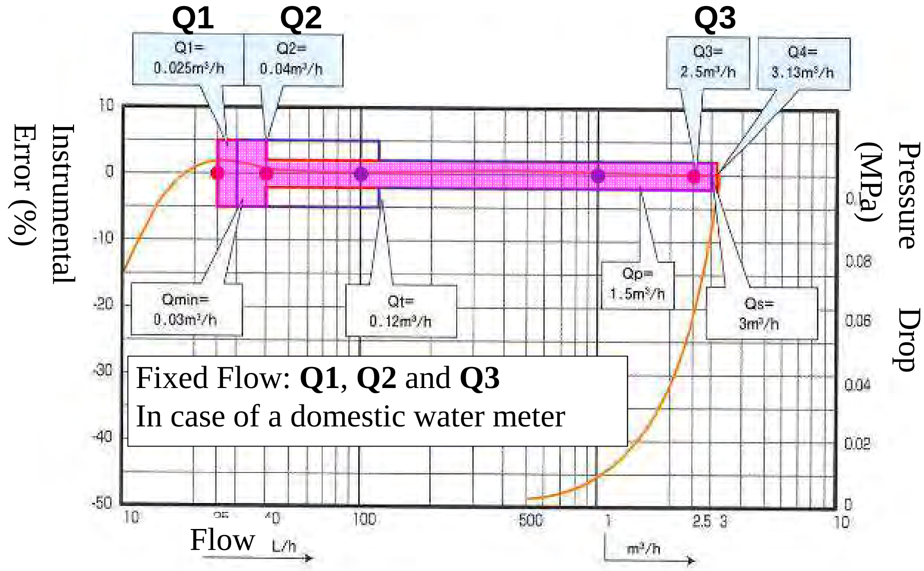
Q: Indiscrete value of reference (standard) water meter (L)



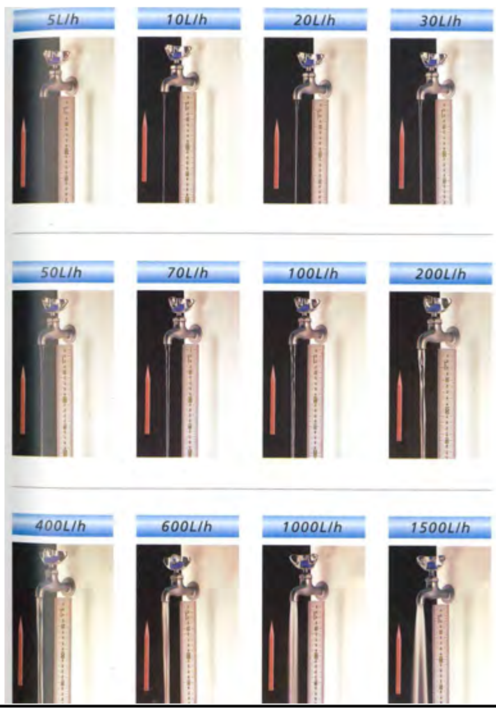

## 6 Meter Calibration Equipment (TSC in Itahari)



## 6. Range of Verification Tolerance for Domestic Water Meter (15 mm)




## 7. Comparison of Flow

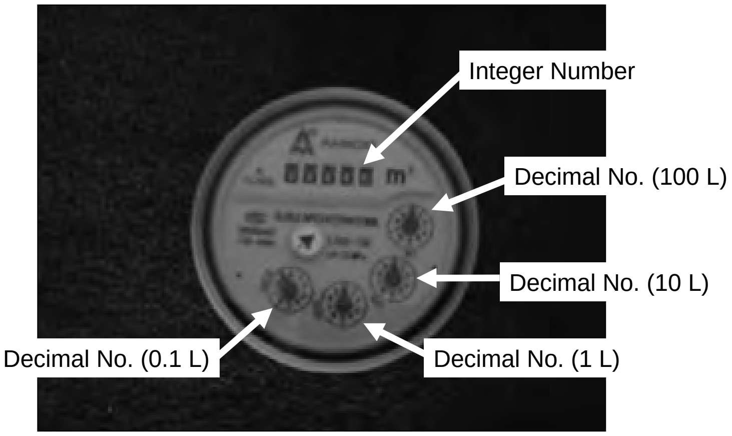


Water Meter Calibration
& Water Distribution Facilities
On the Job Training

Jhapa WSSDO

# 1. OJT of Water Meter Calibration

1.1 Meter Reading up to 0.1L Decimal

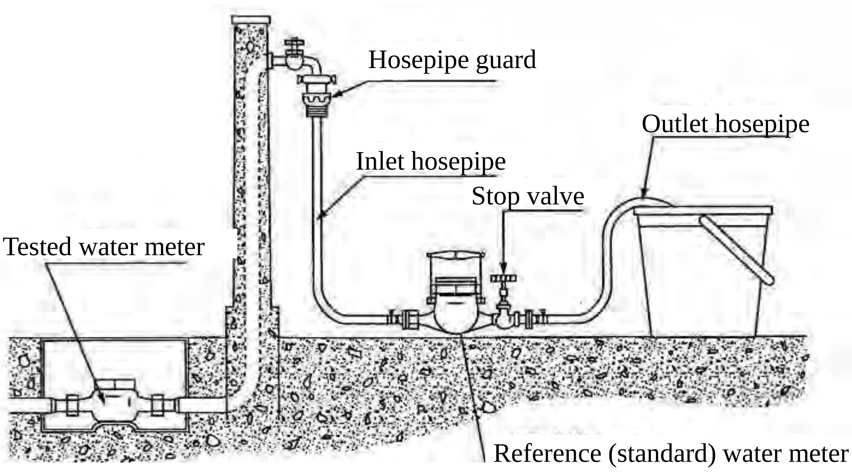


# 1.2 Instruction on Meter Reading

WUSC meter readers don’t usually read decimal number to count consumption water

WSSDO staff instructing meter reading.

# 1.3 Setting for Calibrating the Meter



# 1.4 Setting for Calibrating the Meter

Checking if any leakage at the connection points

Checking flow indicator and moving

# 1.5 Reading the Actual Number

After calibration

Before calibration

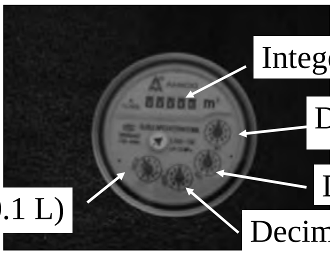
# 1.6 Calculation of instrumental Error

$$E = \frac{I - Q}{Q} \times 100$$

E: Instrumental error (%)

I: Indiscrete value of tested water meter (L)

Q: Indiscrete value of reference (standard) water meter (L)




# 1.7 Calculating the Error

Checking the error if within ±10%

WSSDO presenting the way to calculate the error

# 1.8 Assuring User’s Meter

User has complaints that the meter shows higher amount than the actual use.

# 1.9 Calibration of User’s Meter

Master Meter

User’s Meter

## 1.10 Calculation of the Error

User’ s meter was ideal one. It means it does not have any defect in the meter.

Instrumental error was 0% (it is within ±10%)

## 1.11 Wrong Installation

Horizontal Type Meter (Wrong Installation)

Vertical Type Meter (Correct Installation)

# 2. Water Distribution Facility Inspection

Main Purpose: To keep the facilities in good condition

- To confirm the current status of distribution facilities included in the existing facilities.
- To make inspection record, flow record and repair record of facilities

# 2.1 Instruction of Inspection

Gate valve chamber

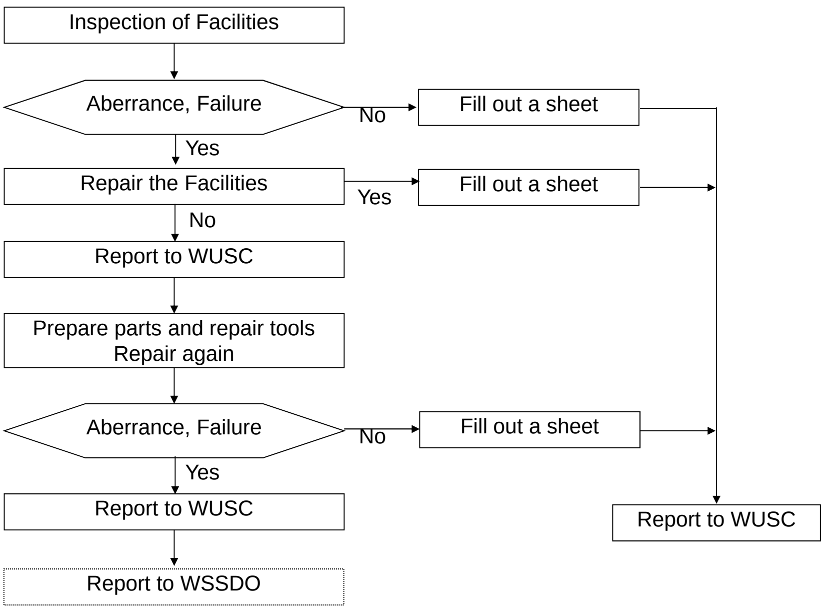
Recording actual condition on the inspection sheet

# 2.2 Conducting Inspection

Instructing how to record the condition in the sheet and report it to their manager

Air valve chamber without cover

# 2.3 Procedures of investigation and Report



Thank you very much for your attention and sharing your invaluable information!

# 6.Manual/guide of management area

6-1 Business Planning
6-2 Monitoring and Evaluation of Business Plan (English)
6-3 Annual Reporting
6-4 Monthly Report
6-5 User Complaints Management
6-6 Problem Solving using PCM methodology
6-7 Awareness program samples

This chapter covers non-technical area SOP, but we do not call SOP in this field, rather calls manual, guideline or introduction.

First explain business plan with introductory, sample business plan of Dhullabari WUSC with summary presentation (English), and workshop material prepared by Eng. Jyoti Tamang.

Second is introductory of monitoring and evaluation (English) of business plan.

Third is guideline of annual reporting and fourth is our recommendable monthly report. Fifth is user our recommendation of establishing complaints management system and sixth is our introducing of problem solving techniques using PCM methodology. Last part is sample output of awareness program workshop for Salakpur WUSC and Pathari WUSC. We recommend to doing such public hygiene education to school kids and women’s group for get their understanding and support to activities of WUSC.

# Draft Introductory of Business Planning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February 2013

## 1. Objective

Objectives of business planning are many, but be sure as this introductory aims to explain how to prepare business plan, and business plan mentioned here is business planning for realize WUSC management model. There are several types of business plan and each has their own objectives. Business plan in this introductory is aims to realize objectives WUSC management model intended for.

### (1) WUSC management model

WUSC management model aims for realize ideal status of WUSC management. It determined WUSC is "provide safe and clean water affordably and stable manner with reasonable cost to maximum people lives in jurisdiction". And WUSC requested to determine measureable target for realize this ideal status step by step, while utilizing component of WUSC management model. WUSC management model has SOP as component and WUSC can utilize SOP as tool for realize the objectives.

Determined measureable targets are called milestone and WUSC has been improving and realizing to ideal status step by step. Each step confirmed with realizing target of milestone. Every time when WUSC realize mile stone, WUSC close to realize ideal status where WUSC management model determined.

For realizing the ideal status, it may necessary to consider two aspects, concept to strengthening 1) capabilities and 2) communication with stakeholders.

#### 1) Capabilities

There needs to strengthening 3 capabilities, A) capacity of facility, B) financial capability and C) operational capability. Briefly, A) capacity of facility should be maintained more than water demand, and B) financial capability should be maintained more than financial demand, and C) operational capability should be meet operational requirement in term of skill and capability of staff and institutional system. This business plan mainly aims to obtain A) capacity of facility meet and exceed water demand, and B) maintaining financial soundness. For strengthening C) operational capability, WUSC need to implementing SOP and standardizing business operational process as well as enhancing capability of staff by training based on SOP.

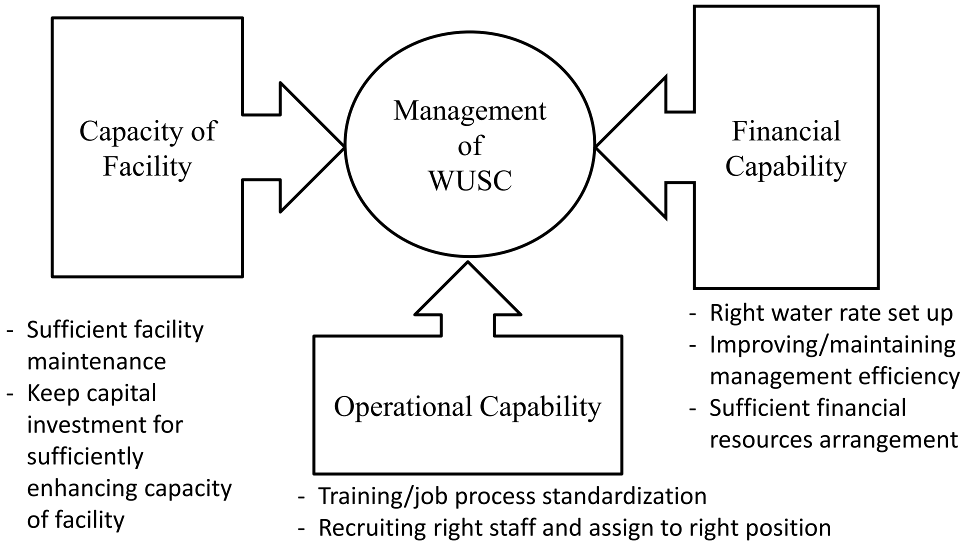


Figure 1-1: Concept for strengthening capability of WUSC

2) Communication with stakeholders

This means, WUSC should maintaining sufficient corporate communication specially with users, and get their understanding as well as their support. This could be realized with conducting awareness program. Through awareness program, user can understand importance of good hygiene practice and roles of water supply, including how important to use safe and clean water for sustain healthy life, and also healthy is resources for earn necessary income or activity for sustain family.


Figure 1-2: Concept of Corporate Communication of WUSC and layer training

More detail on WUSC model, please read “Draft Guideline of WUSC Management Model” and review training and workshop material relate with the WUSC Management Model.

## 2. Structure of business plan

(1) Structure

Normally business plan starts review of performance during last period when former business plan covers, and then establishing strategy based on issues and problems, and lastly prepares series of plans accordingly:

- Technical planning
- User service planning
- Administrative planning
- Financial planning
- Financial feasibility study
- Monitoring and Evaluation planning

Table of contents for draft business plan for Tankisinuwari WUSC is as follows, for example:

Table 2-1: sample of table of contents

Tankisinuwari Water Users and Sanitation Committee

Draft Business Plan for 2013 to 2027

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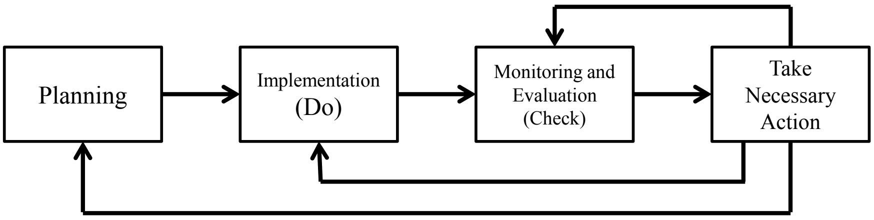
This table of contents shows “Executive Summary”, on top to show summary of the plan. Then “Background” presenting necessary information on business plan including location, mission, vision and objectives of WUSC, issues and problems. After that, follows, engineering plan, customer service plan, administrative plan, financial plan and lastly monitoring and evaluation plan.

(2) Planning process

1) PDCA cycle

Planning means prepare plan, implementing, monitoring and evaluating and take necessary action based on monitoring and evaluation for keep implementation on right truck. This is so called PDCA cycles. Therefore, planning is not finish to prepare business plan. If finish this stage, plan is just paper but nothing else. Without implementing, plan has no meaning. Also without monitoring and evaluating, implementation has no meaning. Therefore, manage with planning cycle with concept of PDCA cycle is very important.




PDCA cycle management for achieve ideal status
P: Planning
D: Do, implementing
C: Check, monitoring and evaluation
A: Act, take necessary action for keep implementation on right truck

Figure 2-2: Concept of manage improvement with PDCA cycle (PDCA management cycle)

2) Planning process

In planning, business plan normally starts A) technical plan, then follows B) commercial plan, C) administrative plan D), financial plan and considering E) financial feasibility. Then if financially feasible, prepare G) monitoring and evaluation plan for F) implementation.

A) Technical Plan

Project population and decide coverage ratio (or population served) and consumption volume (consumption per day per capita) and project water demand. Compare water demand and capacity of facility, decide facility improvement plan, if it may emerged water shortage. On this process, prepared capital cost for facility improvement and operation and maintenance cost of facility, and hand over these information to customer service plan, administrative plan and financial plan. Main objective of technical plan is maintaining capacity of facility more than water demand.

B) Customer service plan (commercial plan)

Customer service plan mainly focus for design increasing number of connection and water rate. Based on that two data, planner projects “revenue from sales of water”. This is important information for financial plan. Design of water rate is link with financial plan.

C) Administrative plan

Administrative plan mainly focus for design of number of staff considering labor efficiency and maintaining quality of services. If staff is shortage, quality of service is drop, but if over-staffs, that affects management efficiency.

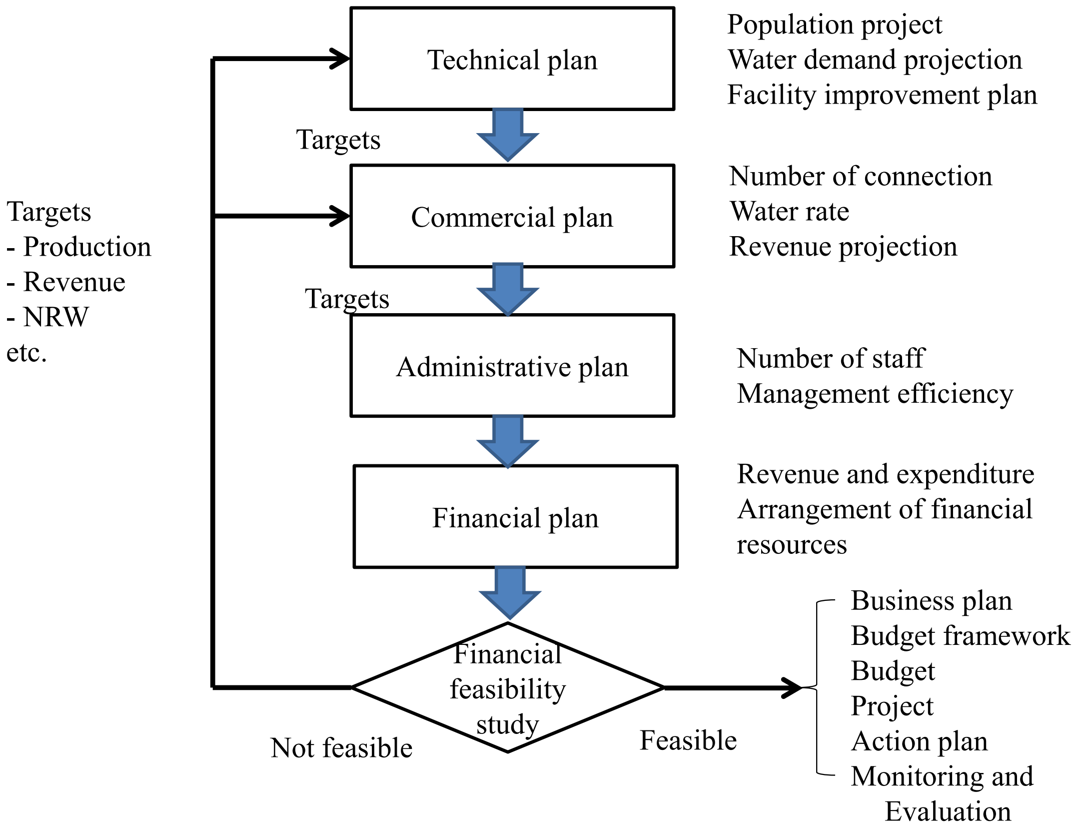



Figure 2-3: business planning procedure

D) Financial plan

Financial plan mainly focus for project revenue and expenditure, for combine costs data from each plans. Based on necessary expenditure, then design and project revenue, mainly revenue from sales of water and services (operational revenue), and if shortage consider to arrange grant, subsidiary or loan for cover necessary cost. When arrange necessary financial resource with loan, financial cost (loan repayment) is emerged. Normally, operational cost would be covered by revenue from sales of water and services, but sometimes difficult to cover capital cost for facility investment, and financial resources arrangement with grant, subsidiary and/or loan may necessary for cover capital cost. Regarding cost recovery, water rate is designed.

E) Financial feasibility

After prepare financial plan, confirm financially all plan can be feasible. Sometimes for limitation of financial resources, planner request to change other plan. For example, if difficult to get pledge of grant to facility improvement, and increasing water rate is also limited, it may unavoidable to be negative cash balance, or shortage of cash. In that case, consider to change scope of facility improvement plan and reduce cost, until avoid to be negative cash balance.

F) Implementation of business plan

After completion of planning, results are hand over to budget and budget control, construction project, or activity. Implementation of business plan means disbursement for business activity should be controlled in the budget framework financial plan decide, and construction project should be conducted with schedule technical plan decides, or improving of water rate should be conducted as customer service plan decides.

G) Monitoring and evaluation plan

Business plan request to review actual performance and confirm implementation of business plan is on right truck. For this purpose, monitoring and evaluation schedule and check items are also determined on monitoring and evaluation plan. Normally this monitoring and evaluation should be conducted during April to May using last 9 months' actual performance and if necessary, change budget and activity already approved for next fiscal year starts from June by the assembly on last December. No necessary to mentions monitoring should be done monthly, quarterly and semi-annually and take necessary action if necessary. But main objective of this monthly and quarterly review is manage expenditure within budget and maintaining positive cash balance. On the other hand, annual monitoring and evaluation determined in the business plan aims to review and update annual budget and/or business plan, if necessary.

Note: implementation of business plan means conducting activities mentioned in the business plan, or achieving target in the business plan. Therefore implementation means, construct facility mentioned in the technical plan, for example, but normally construction of new facility may carry on by the construction project. So, executing the project means implementing the technical plan and equal implementing the business plan. Or increasing number of connection and achieve the target, or achieves target sales of water, these are means implementing the commercial plan. Increasing water rate as commercial plan decided, that is implementing commercial plan. Increasing number of staff as mentioned in the administrative plan, means implementing administrative plan. Control disbursement within the budget framework mentioned in the financial plan means implementing the business plan. Negotiate grant with DWSS and achieve revenue for capital investment means implementing the business plan. Results of these should be confirmed with monitoring and evaluation plan. Figure-2 shows arrow after financial feasibility study, and these key words pointed by arrow means implementing the business plan on Figure-1. “Business plan” means completing report type business plan or developing presentation material for explain business plan. “Budget framework” means “expense” in the financial plan hand over to budget framework for budget control. Budget should be respects this budget framework in the business plan and break to more detail. With this manner, business plan is implemented by budgeting.

## 3. Technical plan

Technical plan aims to achieve and maintaining capacity of facility meet water demand. For this purpose, first analyze population and water demand. Projects population and decides coverage ratio (or population served) and consumption volume (consumption per day per capita). Based on these data of coverage ratio (equal population served) and consumption per day per capita, then planer calculates water demand. Compares water demand and capacity of facility, decides facility improvement plan, if it may emerged water shortage. On this process, prepared capital cost for facility improvement as well as operation and maintenance cost of facility, and hand over these information to customer service plan, administrative plan and financial plan. Main objective of technical plan is maintaining capacity of facility more than water demand.

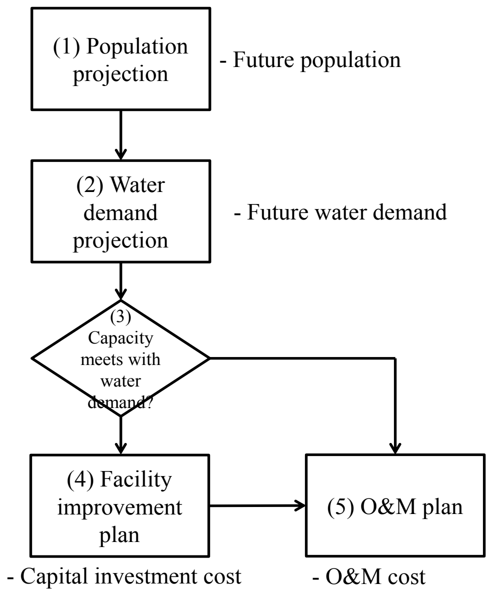



Figure 3-1: technical planning process

(1) Projection of Population

- Project population in jurisdiction

Based on census, and population growth rate, projects population by zone, and then summarize to jurisdiction. Census data of population, household and population growth would be available from VDC: Village Development Committee. Also, that data is available from statistic data book annually published. Projection is very simple:

Population = Population of previous year * (1+ growth rate)

Normally projects for 15 years.

Table 3-1: sample of project population

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |

Then decide coverage ratio. Normally VDC has also data on average number of house members. With this data, WUSC can calculate present population served and present service coverage ratio.

Present population served = Number of active connection * ANHM

ANHM: Average Number of House Member

This data on present population served becomes base line for project future population served.

(3) Service Coverage rate

Then decide future service coverage ratio. Decision of this future service coverage ratio highly depends on policy and strategy of WUSC. Therefore, it may better to decide every 5 years first, as medium term (after 5 years), long term (after 10 years) and far long term (after 15 years), and then adjust to annual base.

Table 3-1: sample of project population served (stage approach)

| | unit | Base line | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|
| (1) Population | | 14,000 | 17,868 | 22,805 | 29,105 |
| (2) Population growth | % | 5.00% | 5.00% | 5.00% | 5.00% |
| (3) Coverage ratio | % | 60% | 64% | 69% | 74% |
| (4) Population served | | 8,400 | 11,435 | 15,735 | 21,538 |

In this sample, planner first decides to improving service coverage ratio of medium term target to

65%, 70% for long term and 75% for far long term, and later adjust to 64%, 79%, and 74%, because increasing 1% annually has more sense than increasing 1.2% annually.

(4) Population served

Based on service coverage improvement policy, calculate population served.

PS = PoP*SC

PS: population served

PpP: population

SC: Service coverage rate, decide based on policy

Table 3-2: sample of project population served (annually approach)

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |

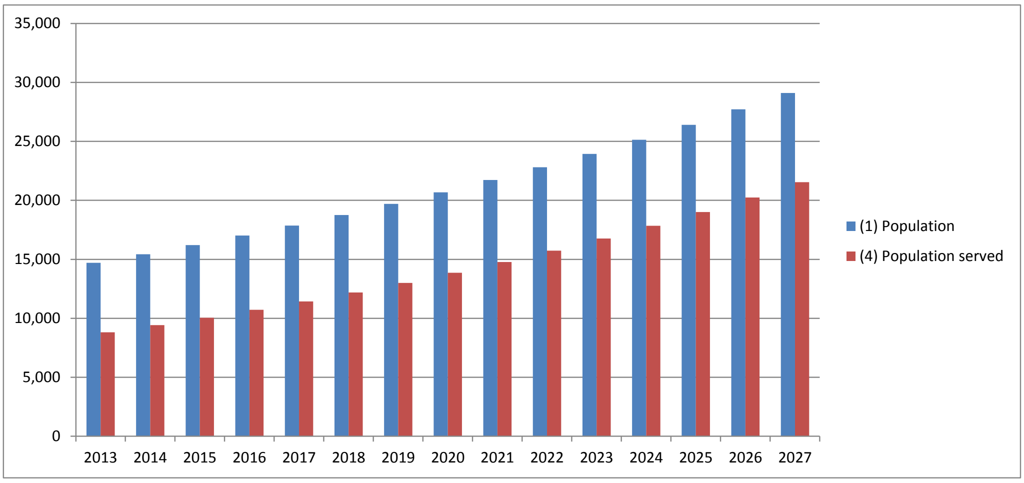



Figure 3-2: population and population served

Using population and population served, you may drawing graph and show how coverage would be improving by year. With this graph, WUSC can explain their plan to achieving “provide water to maximum people”, toward coverage ratio of 100%.

(5) Water consumption per day per capita

Generally said, 60 litter/day/capita is minimum for human being sustain life in standard level, and standard is 105 litter/day/capita is sort of target for many developing country. If WUSC provide water less than standard, WUSC also should consider to increasing water supply. Sample of technical plan designs to increasing water consumption per day per capita to 69 litter after 5 years, from presently 65 litter with increasing 1 liter yearly to domestic customer.

Also consider consumption of other category of customer. Normally two different type of customer in this category, A) hotel and restaurant, so called big volume user, and B) school children, or government institutions, so called institutional user. Their water usage patterns are different. For example, school kids may use only 30 litter per day per capita and only in day time. But if number of school kids is, say 4,000 for 8 schools, it may better count. However, if number of such users is few and consumption is not significant to total, WUSC can ignore.

Decide water consumption per day per capita is also influenced policy. Therefore, better adapt same approach when decide service coverage ratio, decide every 5 years, medium term, long term and far long term target.

Table 3-3: sample of project consumption (stage approach)

| | unit | Base line | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|
| (5) Consumption/capita/day | litter | 65 | 70 | 75 | 79 |

This sample shows WUSC decide 70 l/d/c for medium term target, 75 l/d/c for long term target and 80 l/d/c for far long term target, but change to 79 l/d/c later for reason of capacity of facility.

(6) Water demand

First project water demands of domestic customer, because normally domestic customer consumes more than 95% of total water consumption. Of course consumption sharing domestic customer and other customer may different for geopolitical situation in management environment. In industrial area, and area there are so many factory need clean water, may be consumption volume of industry user may bigger than domestic user. In tourism spots, like resort where so many hotels exist, may be consumption of these commercial users may significant. But in normal case, number of these customers is limited and total consumption of these customers may not so significant to total consumption. However, if consumption of these users is significant, then, project water demand for these users.

1) Projection of water demand for domestic user

Based on the consumption per capita per day, projects water demand.

Water demand= PS*C

PS: population served

C: Consumption, normally consumption per capita per day, decide by policy

If WUSC does not have data on C (consumption per day per capita), first calculate average consumption per connection per month for domestic customer in sample base. Pick up several months, and get total of billed water volume, and then divided billed number of connection. Then divide this average monthly consumption volume per connection with average number of household, and 30 days.

2) Projection of water demand (other big users)

Based on the consumption trend, projects water demand of other users. Normally by category and then calculate sum. Projection for commercial users and industrial users, normally also calculate based on trend.

Lastly add two demands and make total water demand projection

Table 3-3: sample of project water demand (annually approach)

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 65 | 66 | 67 | 68 | 69 |
| - domestic customer | | 65 | 66 | 67 | 68 | 69 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |

In Salakpur, for shortage of water resources for animal, user gives water from water supply system (WUSC water) to their animal. So, planner first try to calculate water demand for animals, say 30 litter per day per cow, and 15 litter per day per goat and sheep, 5 litter per day per chicken. But later, adjust this issue with count one person additional to average number of household and continues calculation of water demand.

In Chandragadhi, there are significant numbers of school and government offices, for this place is their District Capital. So, assumes 50 litter per day per capita for these users including school pupil, state police, prisoner and government staff.

(7) –(12) Distribution water volume

First considers water production capacity. Then calculate how much WUSC can distribute water, for this volume is ceiling of billed water, or maximum water volume for revenue. This distribution volume (maximum water volume for revenue) is reduced from production volume by leakage, not accounted, or many other reasons. In this "introduction", it called "Capacity of Facility".

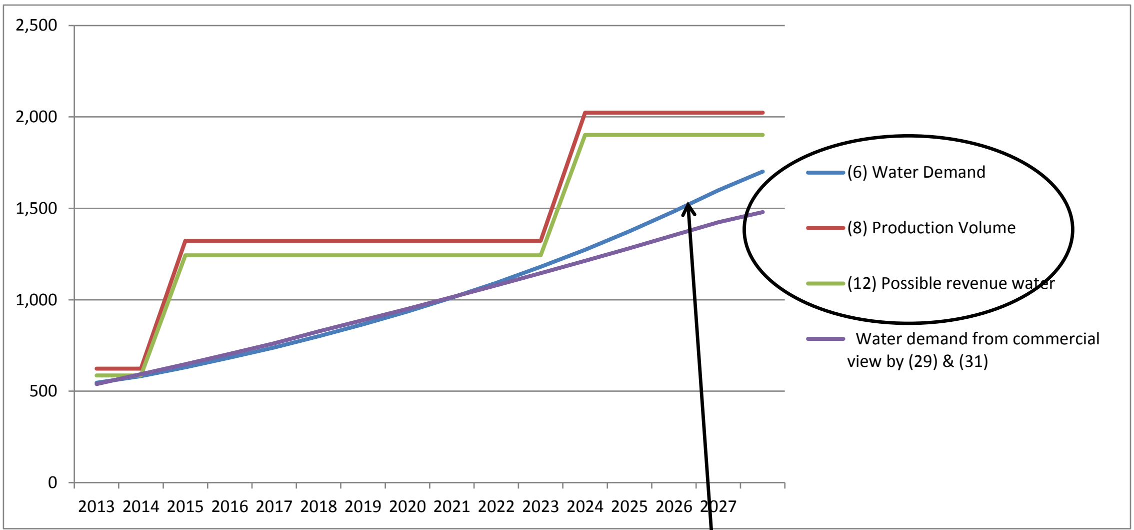
FC = Prd*(1-NRW)

FC: Capacity of facility for provide water
Prd: Production volume
NRW: Non Revenue Water

Check FC is more than water demand or not? Normally, with increasing of population, and increasing coverage ratio and increasing water consumption per day per capita, some day in future, FC may not exceed water demand. So, before it was happen, consider enhancement of capacity of facility.

Table 3-4: sample of project water demand and capacity of facility comparison

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 65 | 66 | 67 | 68 | 69 |
| - domestic customer | | 65 | 66 | 67 | 68 | 69 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| (7) Intake Water Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 592 | 1,257 | 1,257 | 1,257 |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 586 | 1,244 | 1,244 | 1,244 |
| | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | 3,700 | 725 | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | 2,000 | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 0 | 3,700 | 2,725 | 0 |




Water demand based on population served

Figure 3-3: sample of project water demand and capacity of facility comparison

In this case (table 3-4), production capacity of existing facility is 623 cubic meter per day, and 5% NRW. It means ceiling of distribution water is 592 cubic meter per day. Present water demand is only 546 cubic meter per day, and FC is exceeding with this figure. However, water demand increasing to 582 in 2013, and 631 in 2014. So, FC is less than water demand (631 cubic meter per day) in 2014. This situation also could confirm with line graph of Figure 3-3. Blue line is water demand, and green line is distribution capacity. If green line is going under blue line, it means water shortage would emerge. Before this was happen, WUSC need facility enhancement.

Note: More precisely, engineer considers peak consumption and considers capacity of facility can maintaining more than maximum water demand. This technical plan is not consider for simplified, but no reason to refuse this engineering idea.

Engineer rather wants to use UFW: Un-account for Water, but business planner rather wants to use NRW: Non-revenue Water.

(13) Water supply facility improvement plan

When FC becomes less than water demand, consider enhancing capacity of facility. DWSS's concept of facility improvement is, enhance capacity and meet for future 10 years water demand.

Regarding Table 3-4 an Figure 3-3, water shortage would be emerged in 2014. For avoiding this situation, WUSC need construction project for enhance capacity of facility. Table 3-5 shows necessary construction for enhancing capacity of facility. With this construction, WUSC can enhance intake capacity 700 cubic meters per day, and intake capacity is now be 1,323 cubic meter per day. Enhancing intake capacity to 1,323, but consider NRW, FC become 1,244 cubic meters per day. 1,244 cubic meter per day is enough and exceeding more than water demand until 2023. But in 2023, this capacity would not meet with water demand anymore. Again in 2023, WUSC need another additional facility improvement. On the other hand, if WUSC keep enhancing like this way, WUSC can maintain capacity of facility more than water demand.

For realize the capacity enhancement in 2014, WUSC develop new water resources (drilling borehole), and install submersible pump. Total amount of this facility enhancement costs is estimated 3.7 million Nepal Rupees (with price of year 2012), shown on table 3-5 and column (13) of Table 3-4.

Also facility improvement considers existing of issues and problems. If there are issues and problems, solution should also count and incorporate into facility improvement plan. This WUSC has problem of water consumption instability. When water demand is increasing, it is very high. In that time, elevated tank is empty but pumping up is unable to catch up. For avoid this situation, they also construct ground reservoir. Added more, their pipeline is deteriorated and considers replacement of old pipe. These elements also counting and incorporate with facility improvement project in 2014.

Table 3-5: cost estimation for enhance capacity of facility

| (1) Facility improvement of 2014 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Graund reservor | 1 | 1,000 | 1,000 |
| 5) transmission line | 4,000 | 0.28 | 1,120 |
| 6) pipe fitting (20%) | | | 224 |
| 7) Contingency (25%) | | | 1,261 |
| total | | | 3,700 |
| 8) 50% cost share | | | 1,850 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

Planner also considers pipeline network expansion. If people lives in some area are not yet access with safe water for non-service coverage area, planer may consider to providing water to people lives in these area.

Table 3-6: cost estimation for enhance capacity of facility

| (2) Extension project in 2015 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Pipleline | 1,000 | 0.40 | 400 |
| 2) Pipeline fiting (20%) | | | 80 |
| 3) Civil works | | | 100 |
| 4) Cntiengency (25%) | | | 145 |
| Total | | | 725 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

Table 3-6 shows sample of cost estimate for construction of network expansion. WUSC plan to extend 1km and cost is estimated 725 thousands Nepal Rupee.

Facility improvement should be also consider geographic information and understand where is major user located, and where new facility would built with year of improvement. For this purpose, planer also prepare schemer map, and confirm technical plan with planner of customer service. Pipeline expansion plan should also meet with marketing plan of customer services and identify number of additional connection. Figure 3-4 shows sample of such schemer map and allocate location of new facility constructing, and beneficially expected. In this map, brown line is extension pipeline that totals 1km, and provide two areas, University Area and Indra Pur Area.

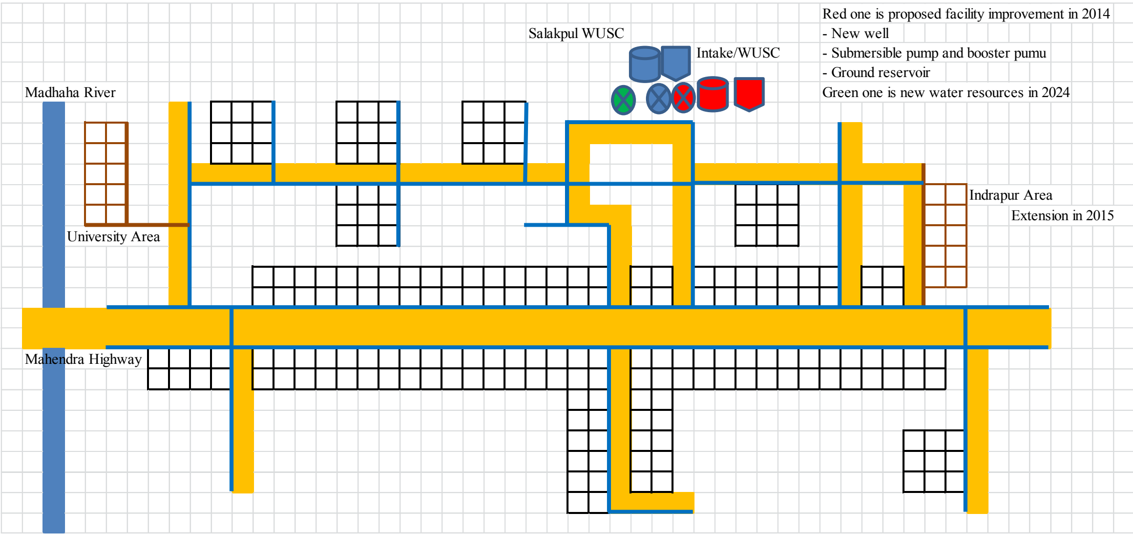



Figure 3-4: schemer map

(14) Rehabilitation

Also, for keep maintaining water production capability, engineer must prepare plan for maintaining, rehabilitation and renewing facility.

Normally, it may better consider large scale rehabilitation and maintenance for every 10 years. Life span of submersible pump and generator are normally 10 years. Concrete construction is around 30 years. Of course it may no necessary to mentions maintenance is done in daily facility operation work, and if broken or something not good, repair immediately. However, large scale rehabilitation, renovation and maintenance costs huge amount and not cover with normal operational budget. Working volume may also huge and could not do in daily activity. Thus better consider schedule and budget in the business plan. Table 3-7 shows sample of such large scale rehabilitation in 2015, and also count on column (14) of Table 3-4.

Table 3-7: cost estimation for rehabilitation

| (4) Rehabilitation of 2015 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Rehabilitation of elevated tank | 1 | 1,000 | 1,000 |
| 2) Rehabilitation of generator | 1 | 200 | 200 |
| 3) Rehabilitation of submersible pum | 1 | 400 | 400 |
| 4) Contingency (25%) | | | 400 |
| total | | | 2,000 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

Cost for construction and large scale rehabilitation count as capital cost, and column (15) of Table 3-4 shows necessary capital cost. This information hand over to financial plan.

Also information of capacity of facility hand over to commercial plan. In commercial plan, planner cannot increase additional connection and/or average consumption per connection more than FC, calculated in the technical plan. This is confirmed as purple line is not exceeds more than green line in Figure 3-3. Purple line shows water demand from commercial view and calculated by number of connection and average consumption per connection.

(19) - (27): Projection of O&M cost

Last step is project O&M (facility operation and maintenance) cost. Concept of projection is, simply inflating to previous cost until large scale facility improvement. And when in large scale facility improvement, add increasing cost accordingly on what improving facility. For example, if facility improvement including installation of pump, power cost (electricity) would be increasing. So add electricity cost. If install generator, it may increasing fuel cost and so add increasing of fuel cost. Also these may necessary to increasing number of pump operator. In that case, also increasing salary would be necessary.

Project O&M cost for facility operation and maintenance regarding:

1) power and fuel for pumping,
2) chemical and filtration for water production,
3) spare parts, maintenance, and
4) other O&M cost for production and distribution of water

   For simplify, you can escalate actual cost of based year with average inflation rate, but when big capital investment is conducted, you need to adjust O&M cost.

Note: If planner could have data on production volume and consumption of electricity and fuel, and chemical, planner can adjust O&M cost according with production volume. This allocation may use column (19) for electricity and fuel, (22) for chemical and (25) for spare parts and repair cost. However, normally it is difficult until planner know separately production and electricity consumption, and fuel and production, for column (19). WUSC in Jhapa and Morang subsidized chemical from WSSDO, and also lack the data on how much they spend and how much the cost. For such difficulty, in this business plan adapt simplified method mentioned above.

Salary of engineer whom supervise operation and maintenance of facility would be counted in

O&M cost. However, if WUSC is small or medium size, for simplification, salaries may count in administrative plan as well as administrative cost including office management. This introduction follows this idea.

Column (19) to (26) of table 3-8 shows sample of projection on O&M cost. Power and fuel cost in 2012 estimates actual power and fuel cost of July 2011 to June 2012 and put amount to baseline. Same as other cost includes spare part. However, WUSC does not count chemical cost presently subsidized from WSSDO. To baseline, inflates those with 6% and project year after, until 2027. But in 2014, WUSC plan to do construction project and install pump that increasing power and fuel cost. That shows column (19). Also spare parts may necessary and increasing maintenance cost that show column (25). Inflated costs of these are shown in column (20) and (26). These costs for O&M are called operational cost and hand over to financial plan.

Table 3-8: Comprehensive technical plan

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 65 | 66 | 67 | 68 | 69 |
| - domestic customer | | 65 | 66 | 67 | 68 | 69 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| (7) Intake Water Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 592 | 1,257 | 1,257 | 1,257 |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 586 | 1,244 | 1,244 | 1,244 |
| | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | 3,700 | 725 | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | 2,000 | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 0 | 3,700 | 2,725 | 0 |
| (16) Inflated capital investment | ,000 RP | | 0 | 4,079 | 3,155 | 0 |
| (17) Inflation rate | % | 5% | 5% | 5% | 5% | 5% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 |
| | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | | 400 | | |
| (20) Inflated (19) | ,000 NR/ | dummy | | 441 | 0 | |
| (21) Power and fuels for pumping | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 0 | | 0 | |
| (23) Inflated (22) | ,000 NR/ | dummy | 0 | | 0 | |
| (24) Chemical for production | ,000 NR/ | 0 | 0 | 0 | 0 | 0 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | | 30 | | |
| (26) Inflated (25) | ,000 NR/ | dummy | | 32 | 0 | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 68 | 71 | 106 | 112 | 117 |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 800 | 840 | 1,355 | 1,422 | 1,493 |

Note 3-1: projection of population and water demand had better do by zone, as development is different by zone.

## Table 3-9: zone based technical planning

(1) Population

| Area | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Increases |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kapsabet Town | 13,600 | 14,600 | 14,936 | 15,279 | 15,700 | 16,061 | 16,400 | 16,777 | 17,163 | 17,558 | 17,962 | 18,375 | |
| High class | 1,360 | 1,460 | 1,494 | 1,528 | 1,570 | 1,606 | 1,640 | 1,678 | 1,716 | 1,756 | 1,796 | 1,837 | 2.3% |
| Medium class | 4,760 | 5,110 | 5,228 | 5,348 | 5,495 | 5,621 | 5,740 | 5,872 | 6,007 | 6,145 | 6,287 | 6,431 | 2.3% |
| Low class | 7,480 | 8,030 | 8,215 | 8,404 | 8,635 | 8,834 | 9,020 | 9,227 | 9,440 | 9,657 | 9,879 | 10,106 | 2.3% |
| Kapngetuny | 6,000 | 6,400 | 6,554 | 6,711 | 6,900 | 7,066 | 7,200 | 7,373 | 7,550 | 7,731 | 7,916 | 8,106 | |
| High class | 600 | 640 | 655 | 671 | 690 | 707 | 720 | 737 | 755 | 773 | 792 | 811 | 2.4% |
| Medium class | 2,100 | 2,240 | 2,294 | 2,349 | 2,415 | 2,473 | 2,520 | 2,580 | 2,642 | 2,706 | 2,771 | 2,837 | 2.4% |
| Low class | 3,300 | 3,520 | 3,604 | 3,691 | 3,795 | 3,886 | 3,960 | 4,055 | 4,152 | 4,252 | 4,354 | 4,459 | 2.4% |
| Kamobo | 3,550 | 3,850 | 3,927 | 4,006 | 4,100 | 4,182 | 4,300 | 4,386 | 4,474 | 4,563 | 4,654 | 4,748 | 2.0% |
| Kamurguiywa | 1,850 | 2,000 | 2,032 | 2,065 | 2,100 | 2,134 | 2,250 | 2,286 | 2,323 | 2,360 | 2,397 | 2,436 | 1.6% |
| Kimaam | 650 | 650 | 665 | 680 | 700 | 716 | 750 | 767 | 785 | 803 | 821 | 840 | 2.4% |
| Kipture | 1,350 | 1,450 | 1,480 | 1,512 | 1,550 | 1,583 | 1,600 | 1,634 | 1,668 | 1,703 | 1,739 | 1,775 | 2.2% |
| total | 27,000 | 28,950 | 29,594 | 30,252 | 31,050 | 31,741 | 32,500 | 33,223 | 33,962 | 34,718 | 35,490 | 36,280 | |

(2) Water Demand (L/Capita/day)

| Area | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kapsabet Town | | | | | | | | | | | | |
| High class | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Medium class | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Low class | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
| Kapngetuny | | | | | | | | | | | | |
| High class | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Medium class | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Low class | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
| Kamobo | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| Kamurguiywa | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| Kimaam | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| Kipture | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |

(3) Water Demand (c.m./day)

| Area | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kapsabet Town | 1,091 | 1,172 | 1,199 | 1,226 | 1,260 | 1,289 | 1,316 | 1,346 | 1,377 | 1,409 | 1,441 | 1,475 |
| High class | 204 | 219 | 224 | 229 | 236 | 241 | 246 | 252 | 257 | 263 | 269 | 276 |
| Medium class | 476 | 511 | 523 | 535 | 550 | 562 | 574 | 587 | 601 | 615 | 629 | 643 |
| Low class | 411 | 442 | 452 | 462 | 475 | 486 | 496 | 508 | 519 | 531 | 543 | 556 |
| Kapngetuny | 482 | 514 | 526 | 539 | 554 | 567 | 578 | 592 | 606 | 620 | 635 | 651 |
| High class | 90 | 96 | 98 | 101 | 104 | 106 | 108 | 111 | 113 | 116 | 119 | 122 |
| Medium class | 210 | 224 | 229 | 235 | 242 | 247 | 252 | 258 | 264 | 271 | 277 | 284 |
| Low class | 182 | 194 | 198 | 203 | 209 | 214 | 218 | 223 | 228 | 234 | 239 | 245 |
| Kamobo | 170 | 185 | 188 | 192 | 197 | 201 | 206 | 211 | 215 | 219 | 223 | 228 |
| Kamurguiywa | 89 | 96 | 98 | 99 | 101 | 102 | 108 | 110 | 111 | 113 | 115 | 117 |
| Kimaam | 31 | 31 | 32 | 33 | 34 | 34 | 36 | 37 | 38 | 39 | 39 | 40 |
| Kipture | 65 | 70 | 71 | 73 | 74 | 76 | 77 | 78 | 80 | 82 | 83 | 85 |
| total | 1,928 | 2,067 | 2,114 | 2,161 | 2,219 | 2,269 | 2,321 | 2,374 | 2,427 | 2,482 | 2,538 | 2,595 |

(4) Water demand forecst on other pupose (c.m./day)

| Area | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Increases |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kapsabet Town | 275 | 291 | 297 | 302 | 309 | 315 | 321 | 327 | 334 | 340 | 347 | 354 | 1.9% |
| Kapngetuny | 91 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 | 112 | 115 | 117 | 2.0% |
| Kamobo | 112 | 116 | 117 | 118 | 119 | 120 | 122 | 123 | 124 | 125 | 126 | 127 | 0.8% |
| Kamurguiywa | 14 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 18 | 2.1% |
| Kimaam | 0 | 0 | | | 0 | | 0 | | | | | | |
| Kipture | 0 | 0 | | | 0 | | 0 | | | | | | |
| total | 492 | 518 | 527 | 536 | 546 | 555 | 565 | 575 | 585 | 595 | 605 | 615 | |

(5) Water demand total (c.m./day)

| Area | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kapsabet Town | 1,366 | 1,463 | 1,495 | 1,529 | 1,569 | 1,604 | 1,637 | 1,674 | 1,711 | 1,749 | 1,788 | 1,828 |
| Kapngetuny | 573 | 610 | 624 | 638 | 656 | 671 | 684 | 700 | 716 | 733 | 750 | 767 |
| Kamobo | 282 | 301 | 305 | 310 | 316 | 321 | 328 | 334 | 339 | 344 | 350 | 355 |
| Kamurguiywa | 103 | 111 | 113 | 115 | 117 | 119 | 124 | 126 | 128 | 130 | 132 | 135 |
| Kimaam | 31 | 31 | 32 | 33 | 34 | 34 | 36 | 37 | 38 | 39 | 39 | 40 |
| Kipture | 65 | 70 | 71 | 73 | 74 | 76 | 77 | 78 | 80 | 82 | 83 | 85 |
| total | 2,420 | 2,585 | 2,640 | 2,697 | 2,765 | 2,825 | 2,886 | 2,948 | 3,012 | 3,077 | 3,143 | 3,211 |

(6) Water production capacity

| | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| capacity | 550 | 550 | 2,700 | 3,000 | 3,300 | 3,600 | 3,600 | 3,600 | 3,600 | 3,600 | 3,600 | 3,600 |

(7) NRW

| | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NRW | | | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |

(8) Revenue water ceiling

| | 2007 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2,160 | 2,400 | 2,640 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |

Note 3-2: It is recommendable to prepare list of major project and activity

1) Major issues from Engineering plan

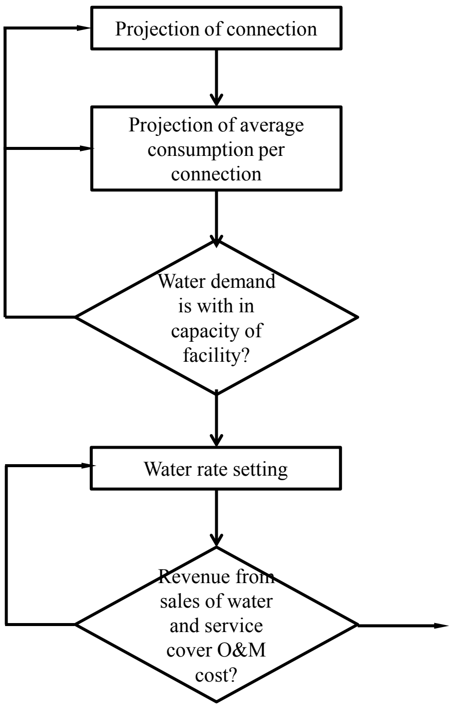
Table 3-10: list of project and major activity

| (1) Major activties and targets of facility o&M and engineering | | | | |
|---|---|---|---|---|
| | Item | target year | cost | other resources |
| 1 | Preventing facility maintenance in 2018 | 2018 | 500,000 | |
| 2 | Preventing facility maintenance in 2021 | 2021 | 500,000 | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

Note: One of question from reader is "why decide target service coverage ratio before simply thinking number of additional connection?" This business plan looks duplicated work for first decide target service coverage ratio in the technical planning, and then decide number of additional connection in the commercial planning. How you answer to this question? My answer is, if this business plan is not stand on "WUSC management model and support model", yes it may, however, unfortunately, this business plan stand on WUSC management model. WUSC management model aims to obtain "provide safe and clear water affordably stably with reasonable cost to maximum people of the jurisdiction". This business plan design and judges achievement of "provide (safe) water to maximum people", with service coverage ratio. Therefore, thinking with service coverage ratio is mandatory for this business plan. This business plan is tool for implementing WUSC management model. For that purpose, design how to achieve target coverage ratio in the business plan. This is extreme opinion, but thinking number of connection is role of commercial plan and no necessary consider number of connection in technical planning. Of course, in reality, technical planning must consider or adjust with commercial plan and/or financial plan. If achieving target service coverage ratio requires huge capital cost, it should be adjust within financial capability.

## 4. Customer service plan

Customer service plan mainly focus for design increasing number of connection and water rate. Based on that two data, planner projects “revenue from sales of water”. This is important information for financial plan. Design of water rate is link with financial plan.




(28) - (29) projection of connection

First analyze the trend and then consider market, wiliness of user and capacity of facility, and decide additional number of connection.

Table 4-1: Historical number of connection

| B: Customer service | unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Base line |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 0 | 350 | 240 | 240 | 240 | 119 | |
| (29) Number of active connection | | | 350 | 590 | 830 | 1,070 | 1,189 | 1,189 |

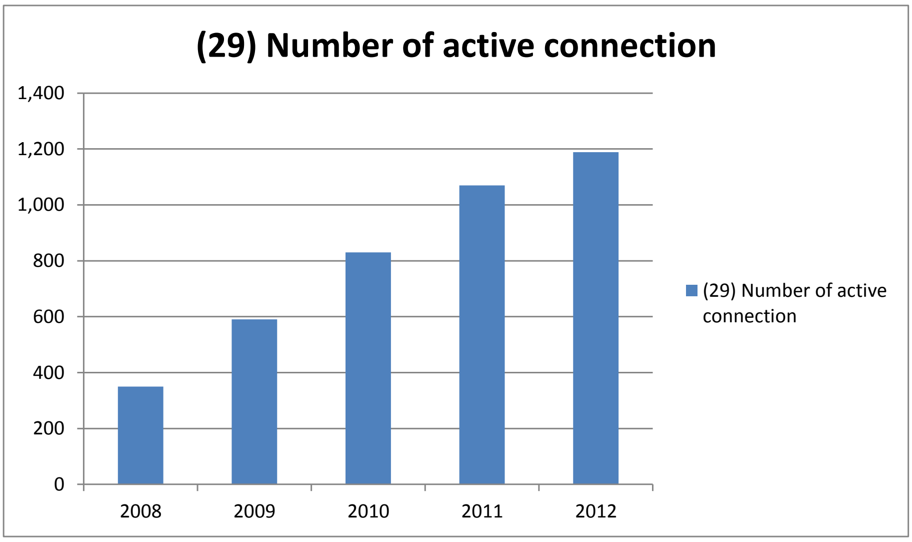



Figure 4-1: Historical number of connection

Table 4-1 and Figure 4-1 show historical trend of number of connection. Around 240 of connection is increased except 2012, for capacity of water close with limit. Schemer map Figure 3-4 shows increasing focuses in market area and highway side, where population rapidly increasing. Added more, two areas, University area and Indrapuri area are areas where strongly service is requested.

However, for increasing coverage ratio, WUSC rather wishes slow but steady increment. Thus WUSC decide to increasing 100 new connections annually. Result shows table 4-2 and figure 4-2.

Table 4-2: Number of connection

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 |

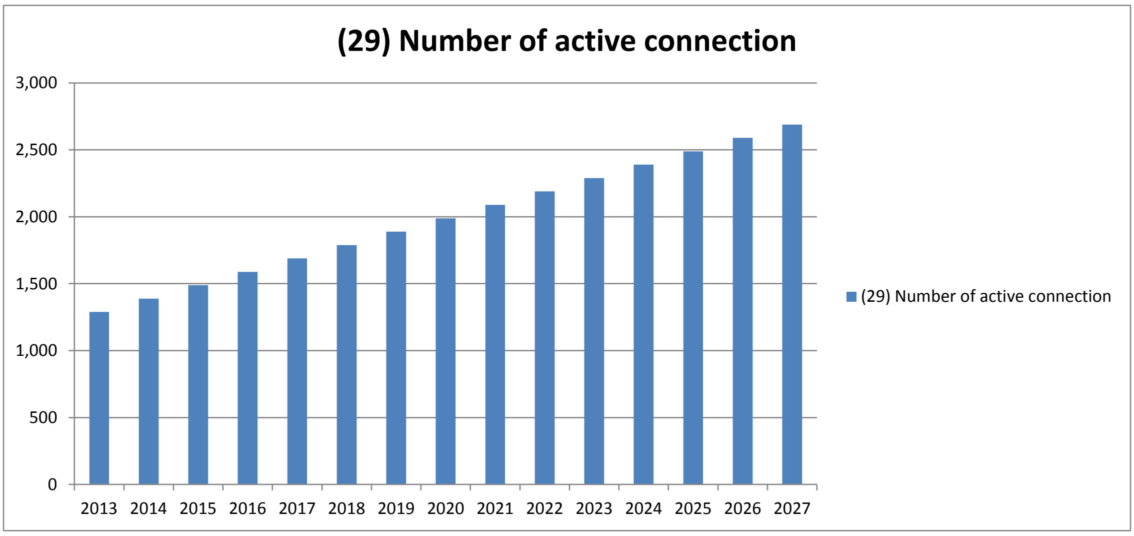



Figure 4-2: Number of connection

For decide additional connection, also consider service coverage ratio in technical plan and number of connection. It should meet with improvement of the coverage ratio. Added more, it is recommendable to decide by zone and summarized.

Table 4-3 and Figure 4-3 show case of Dhulabari WUSC, and they project number of connection by zone.

Table 4-3: Number of connection by zone

| Numberof connectrion by zone | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | average |
| Zone 1 | 795 | 845 | 895 | 945 | 995 | 1,045 | 1,095 | 1,145 | 1,195 | 1,245 | 50 |
| Zone 2 | 220 | 250 | 280 | 310 | 340 | 370 | 400 | 430 | 460 | 490 | 30 |
| Zone 3 | 405 | 445 | 485 | 525 | 565 | 605 | 645 | 685 | 725 | 765 | 40 |
| Zone 4 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 30 |
| Zone 5 | 430 | 465 | 500 | 535 | 570 | 605 | 640 | 675 | 710 | 745 | 35 |
| Zone 6 | 300 | 335 | 370 | 405 | 440 | 475 | 510 | 545 | 580 | 615 | 35 |
| Total | 2,300 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 220 |

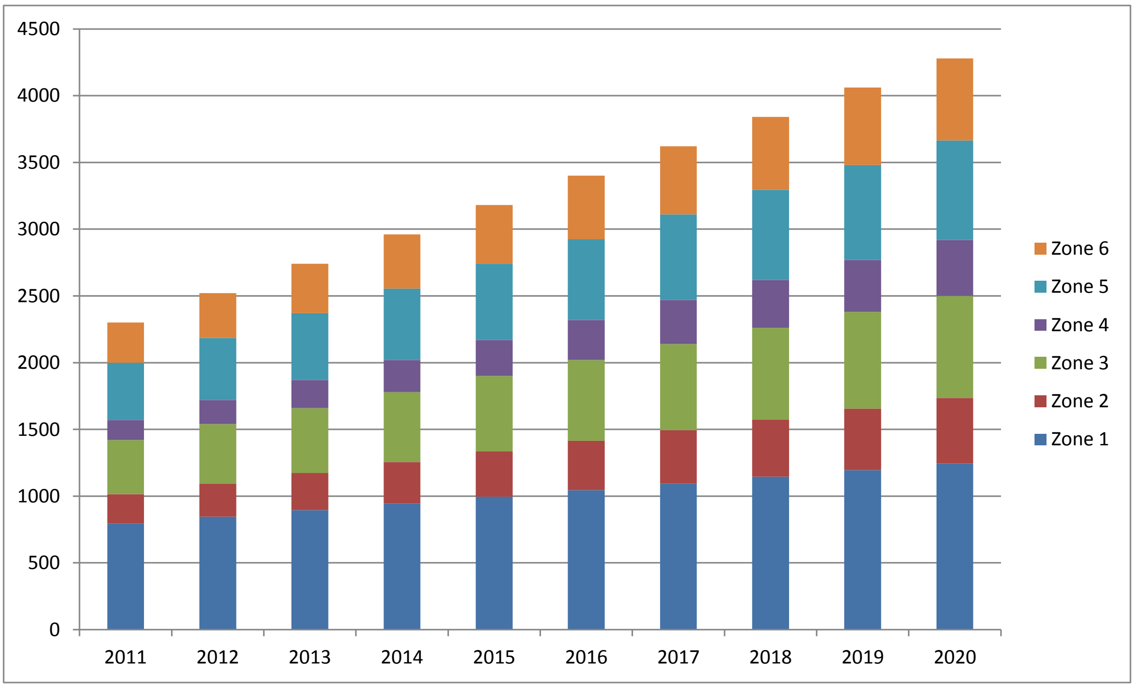



Figure 4-3: Number of connection by zone

Also it may better consider stage approach and decide additional number by terms. In case of Tankishinuwari WUSC, they decide 100 new connections during medium target (204-2017) and 200 in long term target (2018-2022), and 250 for far long term (2023-2027).

(31) Average monthly consumption volume per connection

Based on present average consumption volume per connection, decide future volume. For decide average consumption per connection, also consider water demand per capita per day decide in technical plan.

Average monthly consumption per connection = (C*ANHM*30 days)/1000

where:

C: Consumption, normally consumption per capita per day, decide by policy

ANHM: Average Number of Household Member

Note: ANHM: Average Number of Household Member would be changing, and fewer, by changing of life style, normally reducing gradually.

Please aware normally C use "litter per day per capita" as measure unit, but "Average monthly consumption per connection" use "cubic meter per month" as measure unit. Therefore, need to multiply 30 days and divided by 1,000. Table 4-4 column (31) shows sample.

Table 4-4: Average monthly consumption per connection

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 |
| (30) Average family size | person/fa | 7 | 7 | 7 | 7 | 7 |
| **(31) Avr. consumption per connection** | **cm/mont** | **13.6** | **13.8** | **14** | **14.2** | **14.4** |
| (32) Confirmation of (31) with (5) | cm/montl | 13.65 | 13.86 | 14.07 | 14.28 | 14.49 |

(32) Confirmation

Please care water consumption could not exceed capacity of facility. Figure 4-4 is basically same line graph show as Figure 3-3. Purple line shows water consumption calculated based on number of connection and average monthly consumption per connection. This line could not exceed green line that represents distribution capacity. Also, blue line that represents water demand had better meet with purple line. If there is big differ (gap), it is necessary to adjust number of connection and consumption. But it is only period during medium term (within 5 years), and no necessary to meet in far long term period (from 10 to 15 years after). Column (32) on Table 4-4 shows calculation of water demand based on member of household (30) and (5) on Table 3-3, water consumption per day per capita. These two figures should be met.

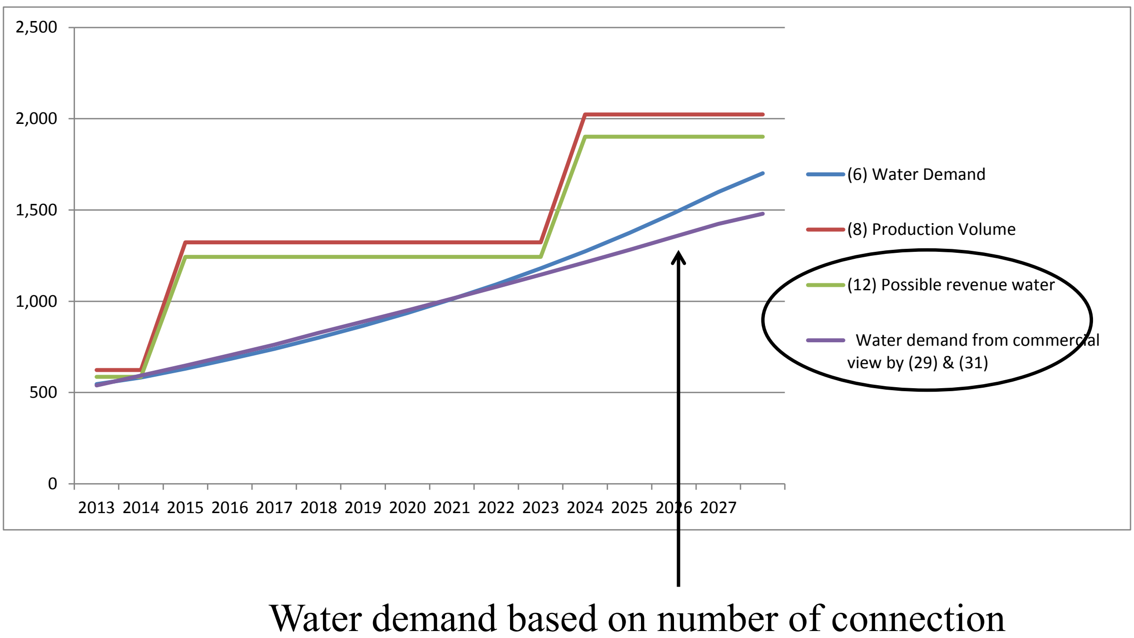



Figure 4-4: sample of water consumption and capacity of facility comparison

(33) minimum charge volume

Decide water rate, normally minimum charge and commodity charge. WUSC in Jhapa adapts minimum charge to first 8 cubic meter, instead WUSC in Morang adapts first 10 cubic meter. In most case, average monthly consumption volume never exceed more than 20 cubic meter and normally no necessary to consider commodity charge for more than 20 cubic meter. (In case of WUSC in Jhapa, more than 16 cubic meter).

Table 4-5: water rate setting

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 | 1,689 |
| (30) Average family size | person/fa | 7 | 7 | 7 | 7 | 7 | 7 |
| **(31) Avr. consumption per connection** | **cm/mont** | **13.6** | **13.8** | **14** | **14.2** | **14.4** | **14.7** |
| (32) Confirmation of (31) with (5) | cm/montl | 13.65 | 13.86 | 14.07 | 14.28 | 14.49 | 14.7 |
| (33) Minimum charge volume | cm/montl | 10 | 10 | 10 | 10 | **10** | **10** |
| **(34) Water rate (minimum charge)** | **NR** | **65** | **90** | **90** | **110** | **110** | **120** |
| **(35) Water rate (commodity charge 10** | **NR** | **15** | **15** | **15** | **18** | **18** | **20** |
| **(35) Water rate (commodity charge 25** | **NR** | **20** | | | | | |
| **(36) Collection efficiency** | **%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 139 | 186 | 204 | 271 | 295 | 354 |
| (38) Expected annual revenue from sales | ,000 NR/ | 1,664 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 |

(34) – (35) water rate setting

Basically, water rate design for cover full cost of operation and maintenance, plus depreciation. However, when WUSC plans capital investment, even could expected grant aid, however, request 10% equity contribution minimum. (90% of the cost would be provided as grant from DWSS and/or other government agencies and VDC). Normally, WUSC may contribute this cost with labor, but still recommends to counting this cost in business plan. It means this 10% of project cost should be target of cost recover by water sales. On the other hand, in normal situation, DWSS and/or other government agency and VDC may support 10% of project cost as grant. Therefore, cost that must be shoulder by WUSC is only 90%, in maximum. It may no necessary to say, this cost (90%) is target for cover by sales of water and services, and should be consider water rate setting.

So:

1) In full cost recovery policy: target to cover all cost, 90% of capital cost and 100% of operation cost, and 100% of financial cost. Be aware, 90% of capital cost means cost for facility improvement and not means furniture and other fix asset. These are cost for cover by sales of water. Financial cost means repayment to bank, if WUSC consider borrowing money. In case of Small Town Project by Asian Development Bank, 50% of project cost is arranged by loan, and

WUSC must return 50% of project cost to the bank. Water rate is designed for cost recovery of all these cost.

2) In cost recovery of operational cost policy: normally WUSC adapts this concept and exclude cost for facility improvement (capital investment) from target of cost recovery by sales of water and services. Water rate is designed for cost recovery of only operational cost.

3) In between policy: However, for secure of government budget and increasing of WUSC, policy 2) is sometimes difficult. In that case, it is necessary to negotiate how much government provides grant or subsidiary. Anyway, remained would be target for cost recovery by sales of water and services, and water rate should design for that.

Other policy is, fixed cost should be covered by minimum charge and flexible cost should be covered by commodity charge. This introduction explains for policy of 2) show concept as Figure 4-5.

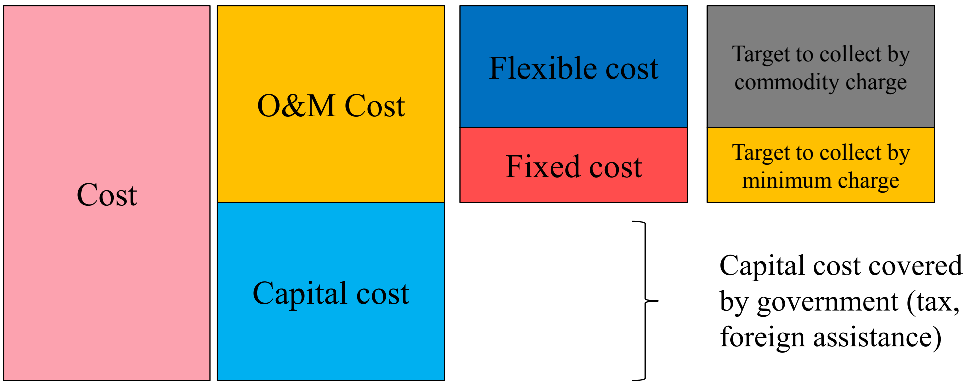



Figure 4-5: concept of water rate setting (1/4)

So, in case first 10 cubic meter is for minimum charge, minimum charge (U1) could calculated with:

U1=[[(FI + AI + AS)) / N]*R]*A

And commodity charge (U2) could be calculated with:

U2=[[(FL) / N ]/ (V – 10) ]*A

where:

A: Adjustment indicator

AI: adjustment for inflation and increases of cost in future

AS: adjustment for avoid rapid fraction of water rate

FI: Monthly fixed cost of O&M

FL: Monthly flexible cost of O&M

N: Number of active connection in the middle of year

R: Reverse indicator of on time collection efficiency

U1: required minimum charge

U2: required commodity charge 10-20 cubic meters

V: Average consumption per connection per month in case less than 20 cubic meters

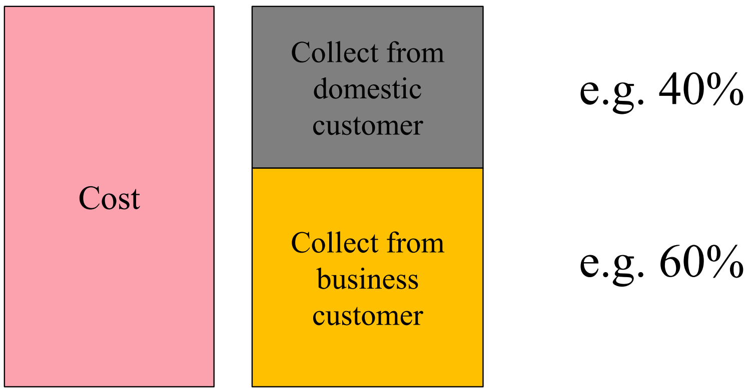



Figure 4-6: concept of water rate setting (2/4)

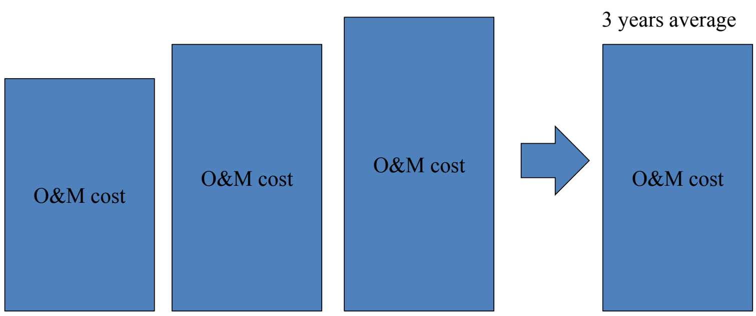



Figure 4-7: concept of water rate setting (3/4)

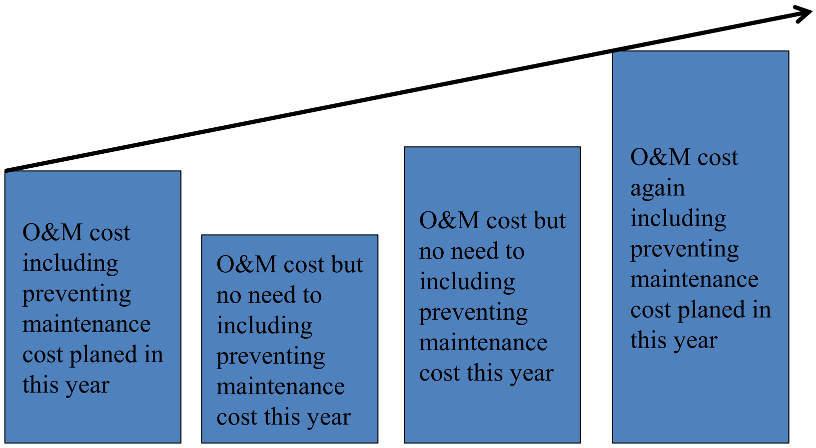



Figure 4-8: concept of water rate setting (4/4)

Fixed cost normally includes salaries and wages excluding allowance for over time, power and fuel for pumping cost in normal operation, and other office management in normal business activity. Flexible cost includes overtime wages, extra fuel cost when load shading frequently emerged, or expenses for special events. However, roughly could be assumed 60% is fixed cost and 40% is flexible cost, though depend on financial structure of WUSC. If system of WUSC is basically based on gravity system and water source is spring, and less use power for pumping, may be 80% would be fixed cost and other 20% would be flexible cost. So, you may adjust based on cost structure of WUSC.

Also, when setting water rate, consider avoiding fluctuation. If incase of cost is constantly increasing like Figure 4-7, however, for avoiding increasing water rate every year, set water rate for average of future 3 years and increasing, for example every two years. So, theoretically, water rate of first year is 1.5 times higher than necessary water rate, but makes ensure to avoid deficit.
Normally cost would be fluctuating like Figure 4-8, and water rate set for cover cost like arrow.

Since water rate setting is highly link with financial plan, in practically, calculation of necessary water rate is conducted by financial planner.

Note: operation cost including depreciation. So, when capital investment happen, count project cost to fixed asset amount and depreciating. For simplified, count around 80% of project cost as fixes asset value (assumes 20% is labor cost and administration cost and would not count as asset, though you need adjustment by nature and contents of construction). Again, for simplification, you can discount 5% every year to total asset value of previous year. But of course it is better for adjust by nature of fixed asset. For generator and pump, these may 10 years for 10%, but concrete building may be 2.5 % for 40 years.

But for simplification, just put water rate on column (34) and (35) and see that water rate setting cause negative cash balance or positive cash balance. If positive cash balance, lets proceeding forward. In reality, suppose calculation say minimum charge is 93.765 Nepal Rupee, but it is not set this 93.765 Rupee as minimum charge. It is senseless as well as WUSC cannot back the change of 0.765 Nepal Rupee to user for his payment of 94 Rupee. Therefore, designer may decide 95 Rupees or most case 100 Rupee. Water rate increasing also may not increase 5.340 Rupee, but instead 10 Rupee. So, case of Table 4-5, WUSC increasing 20 Rupee in 2015 and 10 Rupee more in 2017.

Table 4-6: water rate setting

| | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 65 | 90 | 90 | 110 | 110 | 120 | 120 | 130 |
| (35) Water rate (commodity charge) | NR | 15 | 15 | 15 | 18 | 18 | 20 | 20 | 22 |

Figure 4-9 shows graph of water rate improvement plan and may understand this WUSC increasing water rate according with inflation rate 6%, but not every year. They increasing every two years, for avoid user's complain and impression of "water rate is always increasing". If every two years, bad impression may not much significant.

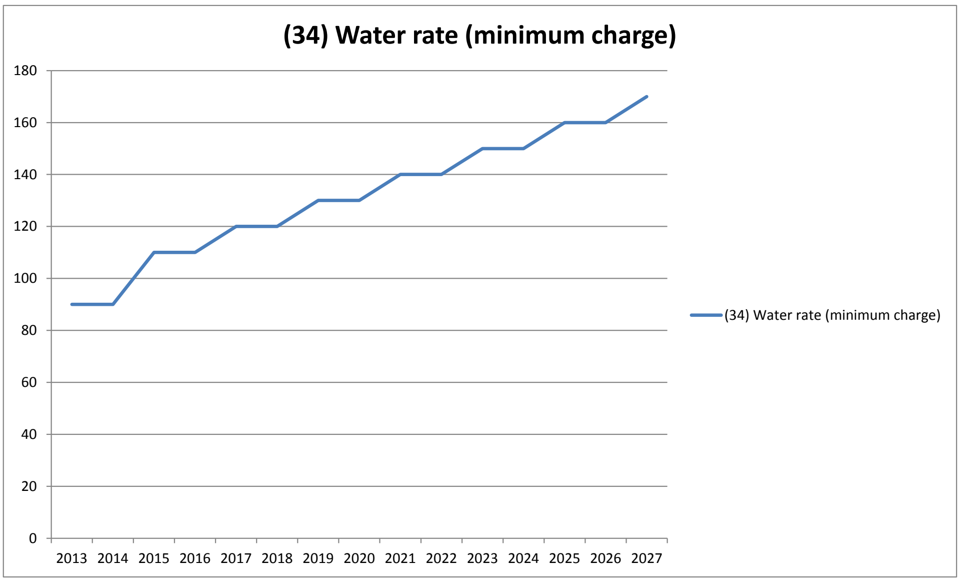


Figure 4-9: water rate improvement

(38) Revenue from sales of water

Lastly of customer service plan, project revenue from sales of water.

RevS = ((Min + Com*(Con-10))*NoC)*ColE*12 months

RevS: Revenue from sales of water

Min: Minimum charge

Com: Commodity charge

Con: average monthly consumption volume per connection

NoC: Number of connection

ColE: Collection efficiency

In case of minimum charge adapts consumption of first 10 cubic meters. If it is 8 cubic meter, please replace 10 with 8, in the equation.

Anyway, revenue from sales of water may like shown graph on Figure 4-10.

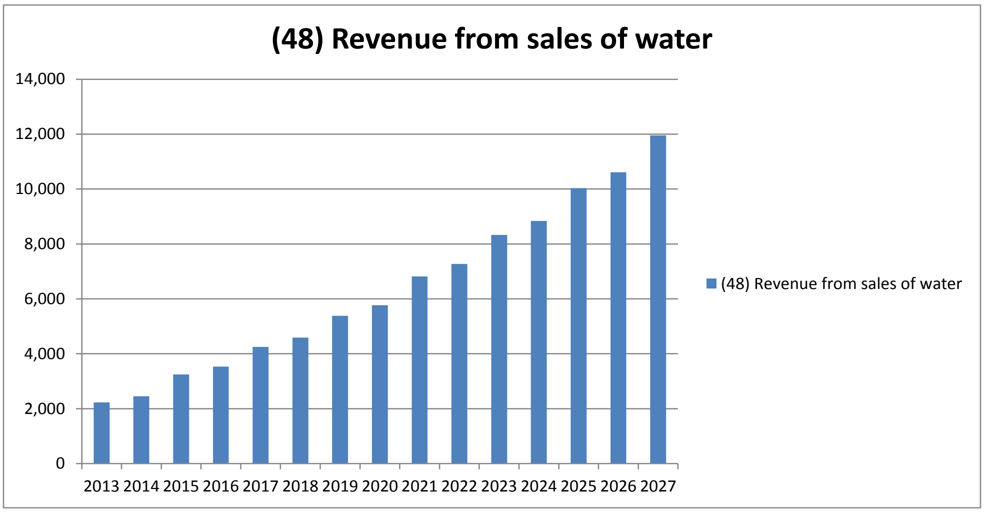



Figure 4-10: Revenue from sales of water

Note-4-1: It is recommendable to prepare list of major activity in customer service area like Table 4-7.

Table 4-7: List of activity in Customer Service Area

(2) Major activties and targets of customer services

| | Item | target year | cost | other resources |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

## 5. Administrative plan

Administrative plan mainly focus for design of number of staff considering labor efficiency and maintaining quality of services. If staff is shortage, quality of service is drop, but if over staff, that affects management efficiency.

(39) – (40) staffing

Staffing or decide number of staff based on following policies:

- Based on requirement for facility operation
- Based on job flow standardization (including computerization)
- Based on organizational standardization
- Based on labor efficiency
  - not makes over loading to staff, for maintaining quality of work
  - not too much staff
  - 120 to 200 connections per staff

First count how much number of technical staff (pump operator and plumber, mechanical engineer, electric engineer and chemist) is necessary based on facility operation. Then count how much number of customer service staff (including meter reader, plumber for service connection, customer service clerks and cashier). Lastly count staff for administrative work (bookkeeper, accountant, stock keeper, miscellaneous like janitor, messenger, security and gardener). Several jobs could be covered by one staff (multi task). In such adjustment, and decide total number of staff.

Computerization may not require rapid increasing of staff.

Also consider organizational structure. Organizational structure should follow standard organizational structure, sample shown Figure 5-1 and Figure 5-2.

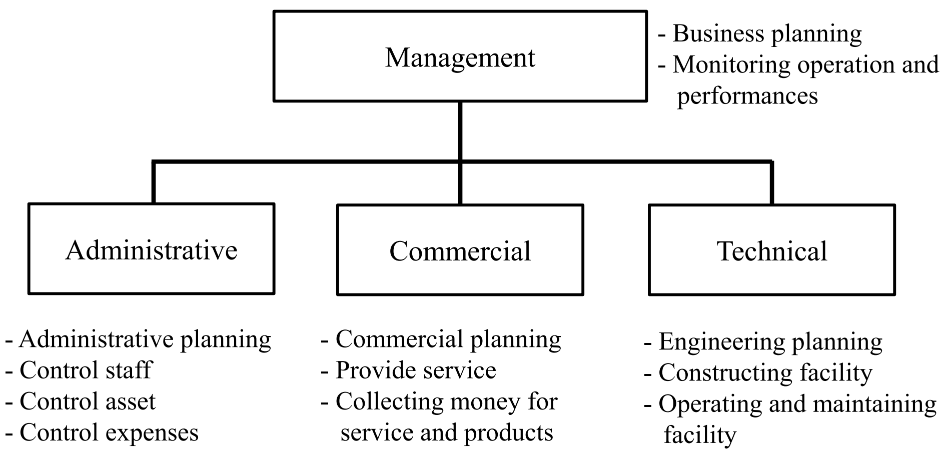


Figure 5-1: standard functional structure

Lastly, consider labor efficiency. It may recommendable to control total number of staff for achieve labor efficiency of connection per staff is between 120 and 200. If number of connection per staff is less than 120, it may suspects over staff, and exceeds 200, may be labor shortage. If labor shortage is happen, quality of work would be dropped and staff may tire for work, or mistake would be increasing. Or salary payment for overtime may increase.

Table 5-1 shows sample of staffing plan and design for maintaining labor efficiency for number of connection does not exceed more than 200.

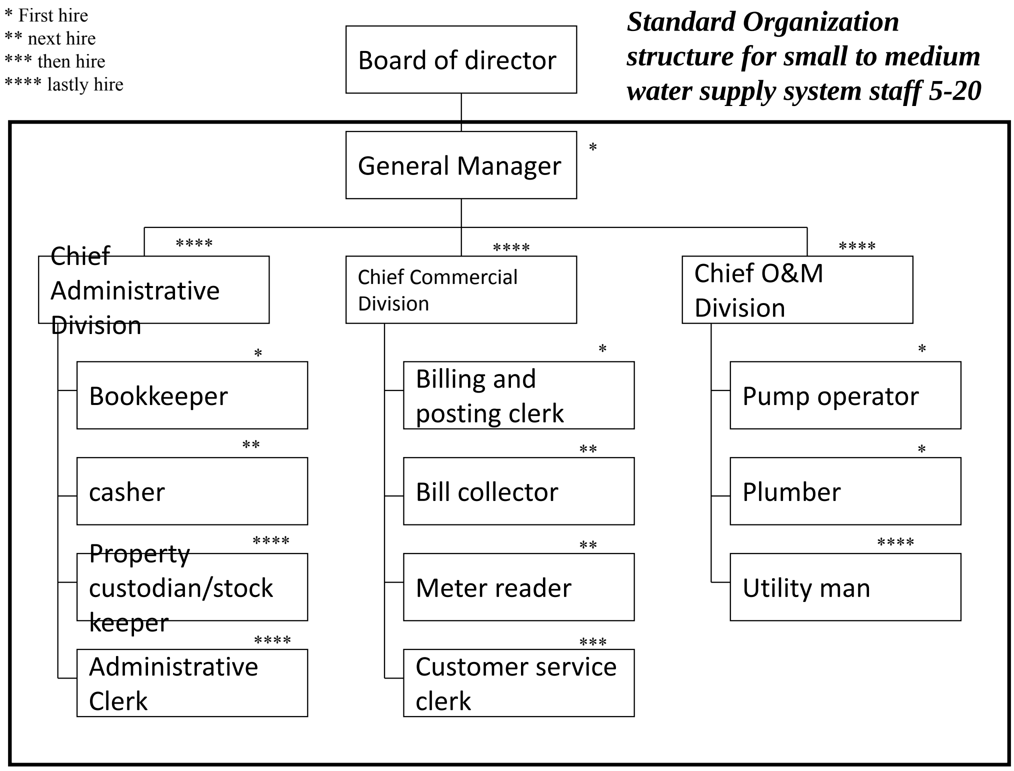



Figure 5-2: sample of standard functional organization and priority of recruiting

Table 5-1: staffing plan

| C: Administrative plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | 0 | 0 | 1 | 0 | 1 | 0 |
| (40) Number of staff | | 7 | 7 | 8 | 8 | 9 | 9 |
| Number of connection per staff | 0 | 170 | 184 | 174 | 186 | 177 | 188 |

Table 5-2: administrative plan

| C: Administrative plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (39) Increases of staff | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| (40) Number of staff | 0 | 7 | 7 | 8 | 8 | 9 | 9 |
| (41) Increasing salaries | NR/staff | 0 | 0 | 281 | 0 | 310 | 0 |
| (42) Inflated (41) | ,000 NR/ye | n.a. | 0 | 295 | 0 | 325 | 0 |
| (43) Salaries and wages | ,000 NR/ye | 1,874 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 |
| (44) Increases admi cost (*1) | ,000 NR/ye | 0 | 17 | 19 | 22 | 26 | 30 |
| (45) Inflated (44) | ,000 NR/ye | n.a. | 18 | 20 | 23 | 27 | 31 |
| (46) Administrative cost | ,000 NR/ye | 167 | 193 | 223 | 257 | 297 | 343 |
| (47) subtotal of salaries and admi cost | ,000 NR/ye | 2,041 | 2,161 | 2,584 | 2,737 | 3,226 | 3,418 |

(43) Salaries

Salaries can calculate simply based on average salary and number of staff. Inflating salaries with inflation rate, until staff is increase. When number of staff is increase, add additional salary, as average salaries multiple with additional number of staff.

More rigorously, consider difference of salaries by job and post. However, if total salaries are not significantly impacts to total cost, recommend to adapting simplified method introduce in this introduction.

(46) administrative cost

Lastly calculate administrative cost. Again, simply inflating previous administrative cost until when staff is increased. When number of staff increase, adjust administrative cost according with increasing of staff. But this method is very simplified. You can adjust considering computerization, organizational structure and location of office and facility.

Note-5-1: It is recommendable to prepare list of major activity in administrative area like Table 5-3, activity list in administrative area and Table 5-4, activity list for WUSC wide.

Table 5-3: List of activity in administrative area

| (3) Major activties and targets of administrative works | | | | |
|---|---|---|---|---|
| | Item | target year | cost | other resources |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

Table 5-4: List of activity in whole WUSC

1) Major issues of company wide

| (4) Major activties and targets of management/company wide | | | | |
|---|---|---|---|---|
| | Item | target year | cost | other resources |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

## 6. Financial plan

Financial plan mainly focus for projecting revenue and expenditure, combine costs data from each plans. Based on necessary expenditure, then design and projecting revenue, mainly revenue from sales of water and services (operational revenue), and if shortage consider to arrange grant, subsidiary or loan for cover necessary cost. When arrangement is necessary on financial resource with loan, financial cost (loan repayment) is emerged. Normally, operational cost would be covered by revenue from sales of water and services, but sometimes difficult to cover capital cost for facility investment, and financial resources arrangement with grant, subsidiary and/or loan may necessary for cover capital cost. Regarding cost recovery policy, water rate is designed.

(48) – (50) Operational revenue

This financial plan adapt cash flow concept. Some financial plan adapt income statement concept or also consider balance sheet concept. Purpose of this financial plan is check WUSC can maintaining positive cash flow or not, and not concerns other issues, such as WUSC can repay loan. If financial plan required such things, also should consider projected balance sheet and projected income statement.

In concept of cash flow, there are three kinds of revenues, operational revenue, revenue for capital investment and revenue from financial activity. Operational revenue includes (48) sales of water and (49) sales of services.

Table 6-1: Financial plan (operational)

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 |
| (49) Revenue from others | ,000 NR/ye | 579 | 668 | 735 | 975 | 1,061 | 1,275 |
| (50) Revenue from operational activity | ,000 NR/ye | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 |
| (51) Salaries | ,000 NR/ye | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 |
| (52) Power | ,000 NR/ye | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 |
| (53) Chemicals | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 68 | 71 | 106 | 112 | 117 | 123 |
| (55) Other O&M and administration | ,000 NR/ye | 682 | 193 | 223 | 257 | 297 | 343 |
| (56) Expenditure for operational activity | ,000 NR/ye | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 |
| (57) Cash balance of operational activities | ,000 NR/ye | 215 | -104 | -753 | 66 | -123 | 540 |

(48) Revenue from sales of water

Revenue from sales water is already mentioned on customer service plan, and data is just carry on from column (38) on Table 4-5. Calculation is very simple:

RevS = ((Min + Com*(Con-10))*NoC)*ColE*12 months

RevS: Revenue from sales of water
Min: Minimum charge
Com: Commodity charge
Con: average monthly consumption volume per connection
NoC: Number of connection
ColE: Collection efficiency

In case of minimum charge adapts consumption of first 10 cubic meters.

(49) Revenue from others

Revenue from others, mainly services, and some are easily calculating but some are not so easy. For revenue from service to new customer, WUSC can expect application fee, meter sales and material sales for connection, and equation is:

- Revenue from new connection
  = ConNew * (app + meter + material)

ConNew: new connection
app: application fee
meter: sales of meter
material: sales of material

- Member fee
  Member fee also can calculate as:
= number of member * annual due

Same as card fee
= number of member * card fee

But revenue from penalty charge and other service including register fee may not so easy. So, simplified:

Other revenue from operational activities = revenue from sales of water * ratio

This ratio can calculate with historical financial data. Table 6-2 shows actual financial performance of the WUSC and trend shows revue from others is around 30%, so simply:

ratio=0.3

Table 6-2: Financial performance

| Financial performance 2009-2011 | unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Base line |
|---|---|---|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | | | 837 | 1,256 | 1,450 | 1,851 | 1,851 |
| (44) Revenue from others | ,000 NR/year | | | 623 | 575 | 416 | 579 | 579 |
| (45) Operational revenue | ,000 NR/ye | 0 | 0 | 1,460 | 1,831 | 1,866 | 2,430 | 2,430 |
| (46) Salaries | ,000 NR/year | | | 467 | 529 | 646 | 733 | 733 |
| (47) Power | ,000 NR/year | | | 312 | 348 | 437 | 732 | 732 |
| (48) Chemicals | ,000 NR/year | | | 0 | 0 | 0 | 0 | 0 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | | | 67 | 98 | 83 | 68 | 68 |
| (50) Other O&M and administration | ,000 NR/year | | | 320 | 475 | 227 | 682 | 682 |
| (51) Operational expenditure | ,000 NR/year | | | 1,166 | 1,450 | 1,393 | 2,215 | 2,215 |
| (52) Cash balance of operational activities | ,000 NR/year | | | 294 | 381 | 473 | 215 | 215 |
| | | | | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | | | | 0 | 57 | |
| (54) Capital expenditure | ,000 NR/year | | | | 0 | 0 | | |
| (55) Revenue from financial activity | ,000 NR/year | | | 48 | 71 | 210 | 274 | |
| (56) Financial cost | ,000 NR/year | | | | 0 | 0 | 0 | 0 |
| Revenue | ,000 NR/year | | | 1,508 | 1,902 | 2,076 | 2,761 | 2,761 |
| Expenditure | ,000 NR/year | | | 1,166 | 1,450 | 1,393 | 2,215 | 2,215 |
| (57) Cash balance | ,000 NR/year | | | 342 | 452 | 683 | 546 | 546 |
| (58) End balance | ,000 NR | 1263 | 1,263 | 1,605 | 2,057 | 2,740 | 3,286 | 0 |
| Descripancy | | | | | | | | |
| (59) Additional fixed asset | ,000 NR/year | | | | | | | |
| (60) Fixed asset *3) | ,000 NR | | | | 11,466 | 10,808 | | 0 |
| (61) Depreciation | ,000 NR/year | | | | 1,724 | 668 | | |

Operational revenue should fully cover operational expense. If not, consider increasing water rate more.

Figure 6-1 shows concept of financial planning. Revenue is basically determined number of connection, consumption volume per connection, water rate and collection efficiency, in case of not considers revenue from grant, subsidiary and loan disbursement. Therefore, for increasing revenue, change these 4 elements. But please care, number of connection and consumption volume has limitation with capacity of facility and you cannot design more than capacity of facility.

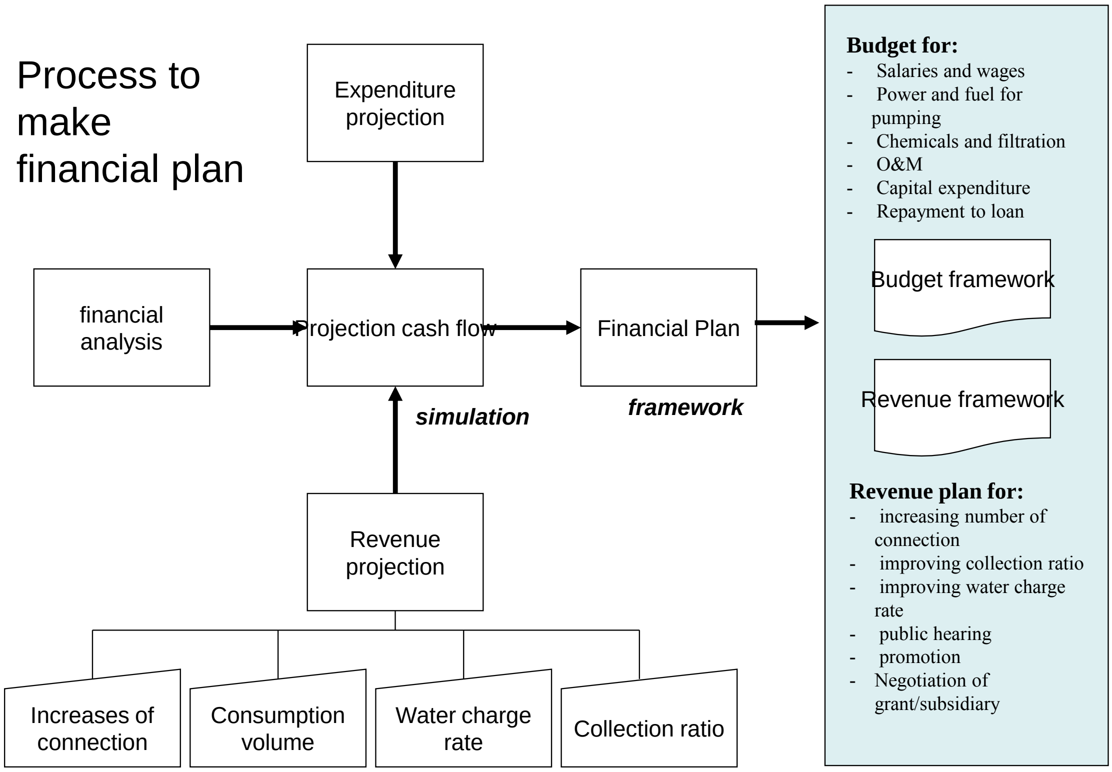



Figure 6-1:

(56) Operational expenses

Operational expenses are, salaries (51), electricity and fuel for pumping (52), chemical (53), spare parts and maintenance cost (54) and administrative cost (55). (52), (53) and (54) comes from technical plan and (51) and (55) comes from administrative plan on Table 6-1. Total of these expenses is (56) on Table 6-1. Therefore, simply check operational revenue (50) exceeds (56) on Table 6-1. If not, increasing revenue from sales of water (48) by water rate improvement or find chance to increasing number of connection, or, reduce expenditure.

(59) Capital investment

(59) is capital cost comes from technical plan. In technical cost, cost estimation is counted on column (13) and/or (14) and inflating to (16) on Table 3-8. This amount straightly comes to (59) on Table 6-3.

(58) revenue for capital investment

(58) is part of financial resources arrangement and counts on grant and/or subsidiary. In the future, situation may change. Author recommends to DWSS for establishing fund and provide many

financial assisting schemes, but not realized at this moment. Present antacid rule is:

- Request 10% equity contribution to WUSC for grant (90% is grant)
- Support 10% from grant when WUSC improving facility by themselves.

Otherwise, in most case, it is space of negotiation. In case of Salakpur, they can success to negotiate their capital investment in 2014, for 50% of cost is provided from DWSS (grant), but must share other 50% of the cost by WUSC. In case of Urlabari WUSC, portion is 60% (grant) and 40% (WUSC). Colum (58) of Table 6-3 shows in case of Salakpur and count 50% of capital investment on column (59), because this amount will provide from DWSS as grant.

Table 6-3: Financial plan

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 |
| (49) Revenue from others | ,000 NR/ye | 579 | 668 | 735 | 975 | 1,061 | 1,275 |
| (50) Revenue from operational activity | ,000 NR/ye | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 |
| (51) Salaries | ,000 NR/ye | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 |
| (52) Power | ,000 NR/ye | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 |
| (53) Chemicals | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 68 | 71 | 106 | 112 | 117 | 123 |
| (55) Other O&M and administration | ,000 NR/ye | 682 | 193 | 223 | 257 | 297 | 343 |
| (56) Expenditure for operational activity | ,000 NR/ye | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 |
| (57) Cash balance of operational activities | ,000 NR/ye | 215 | -104 | -753 | 66 | -123 | 540 |
| | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 188 | 0 | 2,040 | 2,839 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ye | 0 | 0 | 4,079 | 3,155 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ye | 140 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 9 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 |
| (63) Expenditure | ,000 NR/ye | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 |
| (64) Cash balance | ,000 NR/ye | 534 | -104 | -2,793 | -249 | -123 | 540 |
| (65) End balance | ,000 NR | 3,286 | 3,182 | 389 | 140 | 17 | 557 |

But suppose if WUSC try to cover other 50% of cost, it is impossible and causes negative cash balance. Operational revenue is not enough for cover 50% of this capital investment.

(60) Financial revenue

This is basically loan disbursement from bank or lending agencies. But can use this column for banking nature revenue. This WUSC consider share mechanism and accept deposit. WUSC collect deposit from user. After completion of construction project, share 50% of profit with user who deposit and keep other 50% of profit for WUSC.

Table 6-4: Financial plan

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 | 5,768 | 6,817 |
| - domestic customer | | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 | 5,768 | 6,817 |
| - non domestci customer | | | | | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 579 | 668 | 735 | 975 | 1,061 | 1,275 | 1,376 | 1,614 | 1,730 | 2,045 |
| (50) Revenue from operational activity | ,000 NR/ | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 |
| (51) Salaries | ,000 NR/ | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 | 3,588 | 3,767 | 3,955 | 4,568 |
| (52) Power | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 | 1,517 | 1,593 | 1,672 | 1,756 |
| (53) Chemicals | ,000 NR/ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 68 | 71 | 106 | 112 | 117 | 123 | 129 | 136 | 143 | 150 |
| (55) Other O&M and administration | ,000 NR/ | 682 | 193 | 223 | 257 | 297 | 343 | 396 | 458 | 529 | 611 |
| (56) Expenditure for operational activity | ,000 NR/ | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 | 5,630 | 5,954 | 6,299 | 7,085 |
| (57) Cash balance of operational activities | ,000 NR/ | 215 | -104 | -753 | 66 | -123 | 540 | 332 | 1,041 | 1,199 | 1,777 |
| | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 188 | 0 | 2,040 | 2,839 | 0 | 0 | 0 | 0 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 0 | 0 | 4,079 | 3,155 | 0 | 0 | 0 | 0 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 140 | | 2,040 | | | | | | | |
| (61) Financial cost | ,000 NR/ | 9 | | | | | 0 | 0 | 203 | 298 | 602 |
| (62) Revenue | ,000 NR/ | 2,758 | 2,897 | 7,265 | 7,064 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 |
| (63) Expenditure | ,000 NR/ | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 | 5,630 | 6,157 | 6,597 | 7,687 |
| **(64) Cash balance** | **,000 NR** | **534** | **-104** | **-753** | **-249** | **-123** | **540** | **332** | **838** | **901** | **1,175** |
| **(65) End balance** | **,000 NR** | **3,286** | **3,182** | **2,429** | **2,180** | **2,057** | **2,596** | **2,928** | **3,766** | **4,668** | **5,843** |

Table 6-4 shows this case. So, 50% of capital cost (that DWSS does not provide) covered from deposit. In 2017, it is positive cash balance, however, it become deficit after reduce depreciation amount from this balance, and WUSC has no duty to pay to depositor. It is same in 2018. However, in 2019, WUSC may have profit and 50% of profit (203 thousand Rupees) must pay to depositor.

(61) Financial cost

Normally this column used for counting repayment to loan. But as I mentioned above, this column also use for financial cost nature expenses.

Table 6-5: Financial plan

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 4,845 | 6,969 | 7,939 | 9,201 | 9,844 | 10,022 | 12,293 | 12,279 |
| - domestic customer | | 4,845 | 6,969 | 7,939 | 9,201 | 9,844 | 10,022 | 12,293 | 12,279 |
| - non domestci customer | | | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 3,103 | 2,091 | 2,382 | 2,760 | 2,953 | 3,006 | 3,688 | 3,684 |
| (50) Revenue from operational activity | ,000 NR/ | 7,948 | 9,060 | 10,321 | 11,962 | 12,797 | 13,028 | 15,981 | 15,963 |
| (51) Salaries | ,000 NR/ | 2,113 | 1,968 | 2,066 | 2,336 | 2,628 | 3,128 | 3,477 | 3,854 |
| (52) Power | ,000 NR/ | 1,024 | 2,125 | 2,231 | 2,343 | 2,460 | 2,583 | 2,712 | 2,848 |
| (53) Chemicals | ,000 NR/ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 755 | 793 | 832 | 874 | 918 | 964 | 1,012 | 1,062 |
| (55) Other O&M and administration | ,000 NR/ | 1,217 | 193 | 223 | 257 | 297 | 343 | 396 | 458 |
| (56) Expenditure for operational activity | ,000 NR/ | 5,109 | 5,078 | 5,353 | 5,811 | 6,303 | 7,018 | 7,598 | 8,222 |
| (57) Cash balance of operational activities | ,000 NR/ | 2,839 | 3,982 | 4,969 | 6,151 | 6,494 | 6,010 | 8,383 | 7,740 |
| | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 985 | 51,676 | 0 | 213 | 0 | 0 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 224 | 86,126 | 0 | 2,130 | 0 | 0 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 430 | 34,451 | | | | | | |
| (61) Financial cost | ,000 NR/ | 0 | | | | 784 | 666 | 1,969 | 1,759 |
| (62) Revenue | ,000 NR/ | 9,363 | 95,186 | 10,321 | 12,175 | 12,797 | 13,028 | 15,981 | 15,963 |
| (63) Expenditure | ,000 NR/ | 5,333 | 91,205 | 5,353 | 7,941 | 7,087 | 7,683 | 9,567 | 9,981 |
| **(64) Cash balance** | **,000 NR** | **4,030** | **3,982** | **4,969** | **4,234** | **5,710** | **5,345** | **6,414** | **5,982** |
| **(65) End balance** | **,000 NR** | **6,546** | **10,528** | **15,496** | **19,730** | **25,440** | **30,785** | **37,199** | **43,181** |
| | | | | | | | | | |
| (66) Additional fixed asset | ,000 NR/ | dummy | 86,126 | 0 | 2,130 | 0 | 0 | 0 | 0 |
| (67) Fixed asset *3) | ,000 NR | 27,804 | 112,540 | 106,913 | 103,697 | 98,513 | 93,587 | 88,908 | 84,462 |
| (68) Depreciation *2) | ,000 NR/ | 87 | 5,627 | 5,346 | 5,185 | 4,926 | 4,679 | 4,445 | 4,223 |

Return 50% of profit to share holders (members)
Profit = revenue-expenditure-depreciation

In case of Salakpur, water rate is still too low and sales growth is relatively low while they need more investment for facility improvement. However, other WUSC may more attractive for investor. Table 6-5 shows other WUSC that take same approach. From this WUSC, depositor (investor) can expects around 3% return and increasing of return. This is not so bad investment, although this is rough estimation and need more rigorous financial analysis.

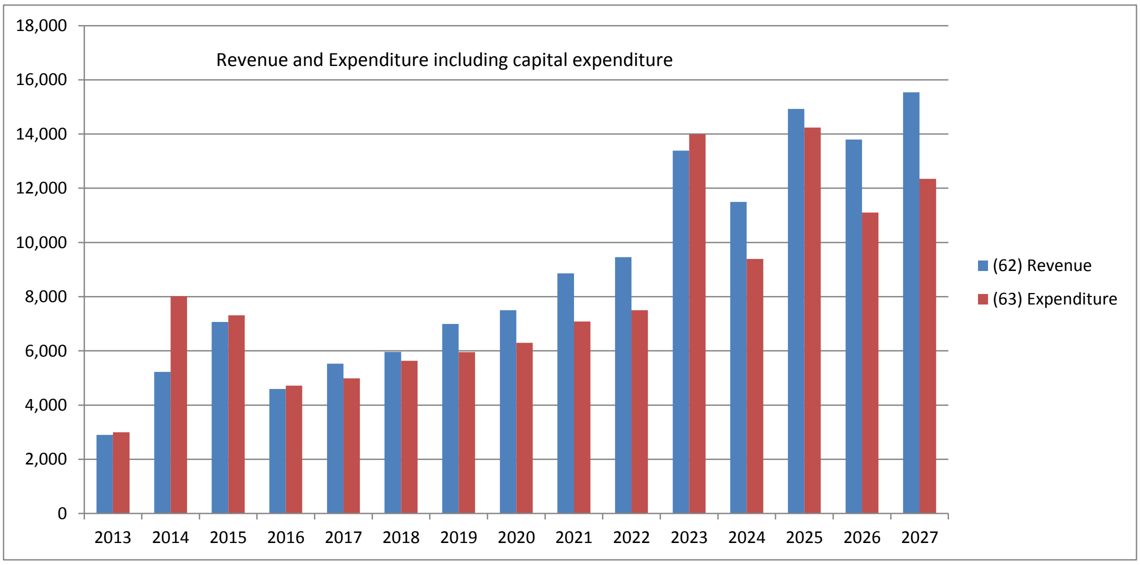


Figure 6-2: Revenue and expenditure

If WUSC arrange the necessary capital cost with loan, planner may calculate necessary annual repayment with following equation:

AR = PMT(interest, return period, amount)

while
AR: Annual repayment
interest is not percentage, but actual decimal point. If “5%”, it should be “0.05”.
amount should be minus figure, for example, “5,000 NR” should be “-5,000”.

So, case of borrow 5,000 NR for 10 years with interest rate of 5% is:
=PMT(0.05, 10, -5000)

And amount would be 648NR
This amount is not change during 10 years return period.

If planer should also consider project balance sheet, he may also need to know principles:

PR= PPMT(interest, year, return period, amount)

while
PR: principle portion of the loan
year means year in the return period, because amount is different with year in the period. Interest portion is much more than principle portion in early year and reverse in later year. So, first year of return period is 1, and second year is 2.
amount should be minus figure, for example, “5,000 NR” should be “-5,000”.

So, case of borrow 5,000 NR for 10 years with interest rate of 5% and principle portion of 3$^{rd}$ year is:
=PPMT(0.05, 3, 10, -5000)

And amount would be 438NR
Please care, principle portion is changing during return period and amount is increasing by year. This figure may necessary for count on liability on balance sheet.

Also if you need interest portion, equation is:
IP= IPMT(interest, year, return period, amount)

while
IP: interest portion of the loan

So, case of borrow 5,000 NR for 10 years with interest rate of 5% and interest portion of 3rd year is:
=PPMT(0.05, 3, 10, -5000)
And amount would be 209NR

So, 438+209=648?
(sorry missing figure less than decimal). It is 647.52, after 438.27+209.25

(62) Revenue
This column simply shows total of revenue (50), (58) and (60), respectively operational revenue, revenue for capital investment and revenue from financial activity.

(63) Expenditure
It may no necessary to explain, but same as (62), this column simply add three figures from (56), (59) and (61).

(64) Cash balance
This column shows result of (62) minus (63), and expectedly positive, though sometimes difficult when required huge capital investment.

(65) End balance
This column shows accumulation of (64) and means how much WUSC has cash. This is calculated adding previous end balance to cash balance (64). This figure should not be negative, and also would better maintaining more than 5% of amount against revenue from sales of water (48) for prepare emergency disbursement. If WUSC does not have any cash, but still survive theoretically, however, may dangerous of not have any single cash and if something emerged, like broken pipe, facility failure, out of order, etc. These may emerge in any time.

(66) – (68) Fixed asset and depreciation

This financial planning stand on cash flow and not much concerns balance sheet. However, for gives some information for water rate design, this financial planning also prepares some. Colum (66) count fixed asset value, and assumes 80% of capital investment would be fixed asset value, and other 20% is labor and supervising, but it may better adjust by nature of capital investment. For example, more than 30% of cost for pipeline extension project may labor cost. Or, cost estimate may not count such labor cost WUSC plan to provide (shoulder).

(67) is present asset value, as subtract depreciation (68) and add new asset (66). But again, please care, this is very simplified.

(68) is depreciation, and for simplified, assumes 5% of fixed asset value. Please care, depreciation period is different with fix asset. For example, pump and generator may 10 years, and depreciation may 19% for 10 years. Concrete building may 40 years and 2.5% for 40 years. You can set like that depends on nature of fix asset counting on. But if difficult, simply assumes 5% and drop the value, and count this amount for deprecation. This information may necessary for calculate necessary water rate. But gain, this calculated water rate may not use directly. It is just information for decide water rate, and water rate must consider also other factors, trend, inflation, cost recovery policy.

Note: This is not considered in this business plan, but if WUSC may plan to arrange loan for financial resources, it may necessary for considering project balance sheet, and design to maintaining certain level for debt ratio and current ratio. Financial plan in this business plan may too much simplified for that purpose.

## 7. Financial feasibility study

Financial feasibility is very simple, just check end balance would be negative or positive. If it becomes negative, simply WUSC is bankrupt. So just try to avoid on such situation. So, if WUSC can keep maintaining positive cash balance on operational part, first step is OK. If already negative cash balance in this part, it means water rate is too low.

Secondly check end balance. Most case of this situation, capital investment is the reason, and in this case:

1) Change scope of capital investment, including divide project, or postpone implementation

or

2) Increasing more water rate
3) Negotiate more grant portion

Table 7-1: First plan

| Items | Quantity | Unit Cost | Cost |
|---|---|---|---|
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Graund reservor | 1 | 1,000 | 1,000 |
| 5) transmission line | 4,000 | 0.28 | 1,120 |
| 6) pipe fitting (20%) | | | 224 |
| 7) Pipleline | 1,000 | 0.40 | 400 |
| 8) Pipeline fiting (20%) | | | 80 |
| 9) Civil works | | | 100 |
| 10) Contiengency | | | 1,406 |
| Total | | | 7,030 |
| 11) 50% of cost share | | | 3,515 |

Table 7-2: second plan

| (1) Facility improvement of 2014 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Graund reservor | 1 | 1,000 | 1,000 |
| 5) transmission line | 4,000 | 0.28 | 1,120 |
| 6) pipe fitting (20%) | | | 224 |
| 7) Contingency (25%) | | | 1,261 |
| total | | | 3,700 |
| 8) 50% cost share | | | 1,850 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

| (2) Extension project in 2015 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Pipleline | 1,000 | 0.40 | 400 |
| 2) Pipeline fiting (20%) | | | 80 |
| 3) Civil works | | | 100 |
| 4) Cntiengency (25%) | | | 145 |
| Total | | | 725 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

In case of Salakpur, first they consider facility improvement like shown Table 7-1. In this case, WUSC must share 3.5 million Rupee. But if WUSC could not success to collect money, and requested to provide this amount from cash on hand, WUSC fall negative end balance. So, WUSC divides first plan into two, and postpone pipeline expansion project to 2015.

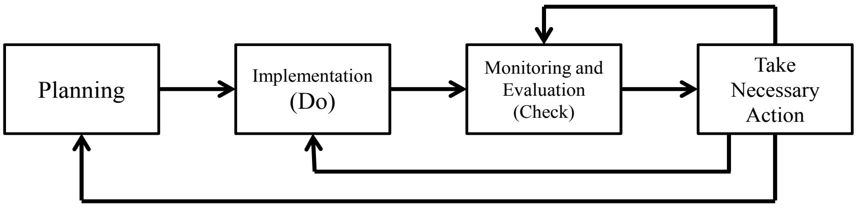
## 8. Monitoring and Evaluation planning

Business plan request to review actual performance and confirm implementation of business plan is on right truck. For this purpose, monitoring and evaluation schedule and check items are also determined on monitoring and evaluation plan. Normally this monitoring and evaluation should be conducted during April to May using last 9 months' actual performance and if necessary, change budget and activity already approved for next fiscal year starts from June by the assembly on last December. No necessary to mentions monitoring should be done monthly, quarterly and semi-annually and take necessary action if necessary. But main objective of this monthly and quarterly review is manage expenditure within budget and maintaining positive cash balance. On the other hand, annual monitoring and evaluation determined in the business plan aims to review and update annual budget and/or business plan, if necessary.

(1) Concept of M&E: Monitoring and Evaluation

1) Monitoring

Monitoring is mainly confirms implementation is on right truck. Figure 8-1 is concept of PDCA cycle and business plan is expected to manage in this PDCA cycle. Therefore, monitor checks achievement of major management performance using monthly report, quarterly report and annual report.




C: Check, monitoring an evaluation
- Monitoring progress and achievement of action plan
- Monitoring performance and results
  both with:
- Monthly (monthly report)
- Quarterly and semi-annually (quarterly report)
- Annually (annual report)

Figure 8-1: concept of M&E (1/2)

However, business plan is annual based and only request to confirm achievement of major management performance target, coverage ratio (and population served), water consumption per day per capita (with average monthly consumption per connection), production volume, management efficiency as NRW, collection efficiency and labor efficiency, and financial soundness (with maintaining positive cash balance). If WUSC can achieves target on these indicators, assumes implementation is on right truck and WUSC is achieving toward ideal status WUSC management model expects.

But if WUSC is not achieves these targets, take necessary action for achieving target. This is concept of monitoring.

2) Concept of evaluation

Concept of evaluation is a bit different, and evaluation is get conclusion on activity and performances of WUSC are meet objectives in term of:

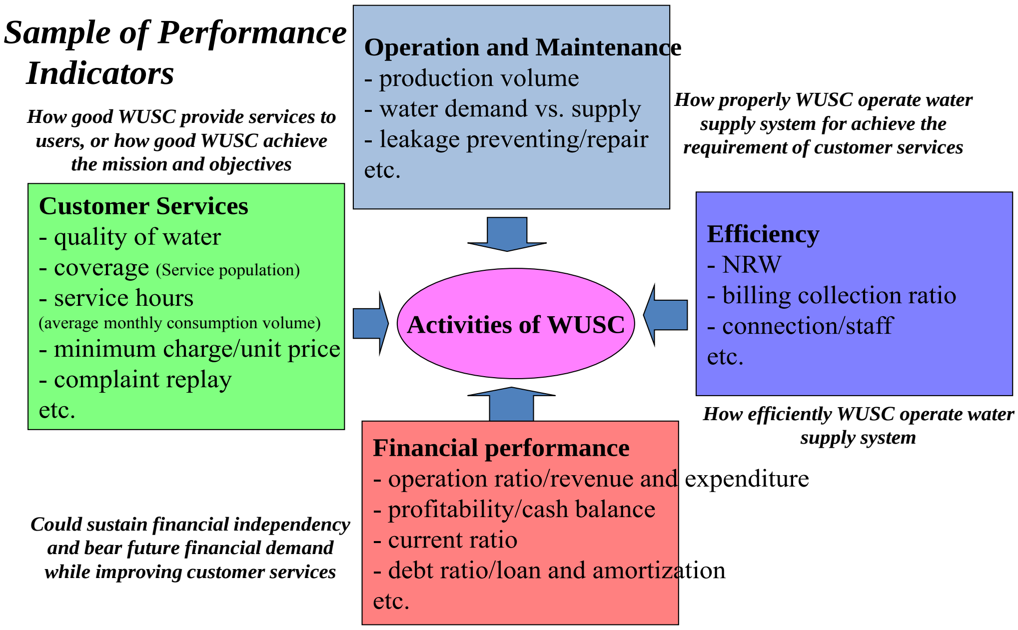



Figure 8-2: concept of M&E (2/2)

- How good WUSC provide services to users, or how good WUSC achieve the mission and objectives
- How properly WUSC operate water supply system for achieve the requirement of customer services
- How efficiently WUSC operate water supply system
- Could sustain financial independency and bear future financial demand while improving customer services

So, first question of “How good WUSC provide services to users, or how good WUSC achieve the mission and objectives”, evaluator may answer with information of actual performance and compare with target on business plan. So, using coverage ratio and consumption, check WUSC can achieve the target, but more important, judges improving speed of coverage ratio and consumption volume are satisfactory level, and align with national standard. If exceeding national standard, then evaluate “good”. If significantly improving, also evaluate “good”.

Same for second question of “How properly WUSC operate water supply system for achieve the requirement of customer services”. Check production volume and check capacity of facility meet with water demand, and then evaluate whether WUSC should set higher target of coverage ratio and water consumption, and considering financial capability, and get conclusion. If WUSC do very well to challenge higher target, evaluate good. But if not, evaluation is not so good. In this case, may be recommends to upgrade business plan and challenge higher target.

To third question of "How efficiently WUSC operate water supply system", is need to check management efficiency achieve the target on the business plan, and then consider with standard. In case of Philippines, standard of NRW is less than 25%, collection efficiency is more than 95%, and labor efficiency is 120 to 200, though depend on size of water supply system. In my observation, NRW of some WUSC is so bad, 45%, or sometimes 55%, and fluctuate by month. Also some of their on-time collection efficiency is less than 70%. If in this case, compare with standard, concluding "not good".

For last question of "Could sustain financial independency and bear future financial demand while improving customer services", update financial model with actual financial performance and check whether WUSC can maintaining positive cash balance to future. If it is, then evaluates "yes".

Note: In this introductory use cash balance, but also evaluator can use other financial performance indicator for judgment, for example operation ratio, liquidity ratio, debt ratio, and judges WUSC's financial soundness regarding stability, sustainability and safety.

(2) What check in M&E: Monitoring and Evaluation

1) Confirm progress of project/action plan or special activities required in business plan

- If facility improvement plan is scheduled, check the progress
    - Preparation must do before one year when the project starts
    - Cost estimate must review and update with most recent unit cost

- If facility improvement project is going on, check the progress
    - How much construction completed?
    - Is construction accomplished in schedule?
    - Are there any issues and program emerged?

- If facility improvement project is recently finished, check
    - Is there any issues and program emerged?
    - Difference with cost estimate
    - Confirm capacity of facility meet water demand

2) Water rate

- If water rate improvement is scheduled, check
- Conduct public hearing meeting, and how and what attendant comments?
- Water rate improvement is on schedule or late?
- Confirm new water rate makes financial soundness (need to increase more/soon?)

3) Confirmation of achieving targets

- User services:
  number of connection
  service coverage ratio
  population served
  consumption per capita per day
  average monthly consumption volume per connection

- Capacity of facility
  water quality test meet ratio
  daily production volume
  revenue water

- Management efficiency
  UFO
  NRW
  collection efficiency
  labor efficiency (connections per staff)

- Financial soundness
  revenue
  revenue from sales of water
  expenditure
  cash balance
  profit/loss
  operational ratio

So, WUSC check the achievement of these targets, and find reason when performances are not reaching the target. Important thing is, find the reason and fix the problem. Table 8-1 is sheet of M&E for that purpose, and evaluator may utilize this sheet and conducting M&E, during April to

May when WUSC could prepare 9 months performance data. Using 9 months actual data, and then projects annual performance, and lastly tries to answer these questions, and get conclusion.

Table 8-1 shows sample of monitoring and evaluation sheet for confirm performance.

Table 8-1: M&E sheet

| E: Target and key performance indicator | Unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% | 64% | 65% |
| (4) Population served | 0 | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 | 11,435 | 12,195 |
| (31) Avr. consumption per connection | cm/month | 14 | 14 | 14 | 14 | 14 | 15 | 15 |
| (29) Number of active connection | 0 | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 | 1,689 | 1,789 |
| (B) Engineering | | | | | | | | |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| ( C) Management Efficiency | | | | | | | | |
| (40) Number of staff | 0 | 7 | 7 | 8 | 8 | 9 | 9 | 10 |
| Number of connection per staff | 0 | 170 | 184 | 174 | 186 | 177 | 188 | 179 |
| (36) Collection efficiency | % | 98% | 98% | 98% | 98% | 98% | 98% | 98% |
| (D) Financial | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 | 5,962 |
| (56) Expenditure for operational activity | ,000 NR/ye | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 | 5,630 |
| (62) Revenue | ,000 NR/ye | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 | 5,962 |
| (63) Expenditure | ,000 NR/ye | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 | 5,630 |
| (64) Cash balance | ,000 NR/ye | 534 | -104 | -2,793 | -249 | -123 | 540 | 332 |

(3) Financial M&E

M&E mentioned above is qualitative M&E, not say quantitative M&E. Evaluator also should evaluate using financial model and confirm quantitatively, and confirm surely WUSC never falls into negative end balance.

1) Monitoring

- Reset baseline on actual data and monitoring:
  - cash balance is positive or negative?
  - future construction project would be feasible or not?

then

  - reconfirm cost estimation of construction project (specially when construction closes within two years)
  - reconfirm water rate improvement schedule
  - reconfirm financial resources arrangement

3) Evaluation

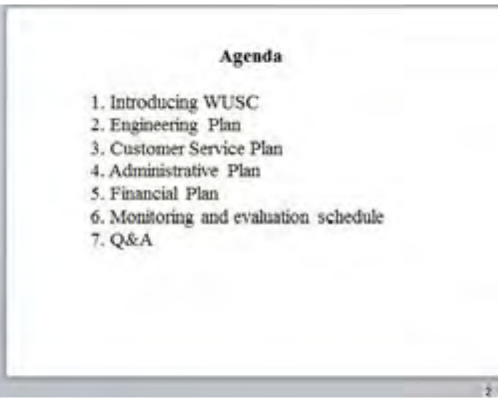
- End balance could maintain more than 5% of revenue from sales of water?
- Also, if possible, continues evaluate some financial ratio including operational ratio

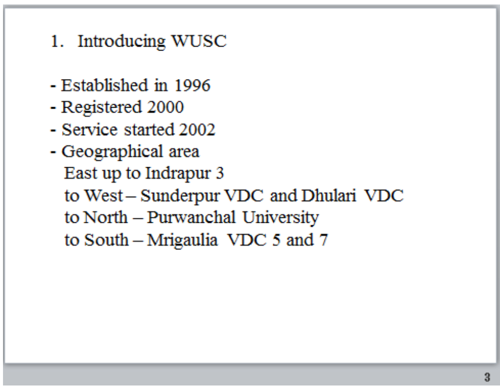
If it is difficult to understand, try to do exercise (M&E) attached with this introductory. You may find how future would be different with change of parameter on financial model.

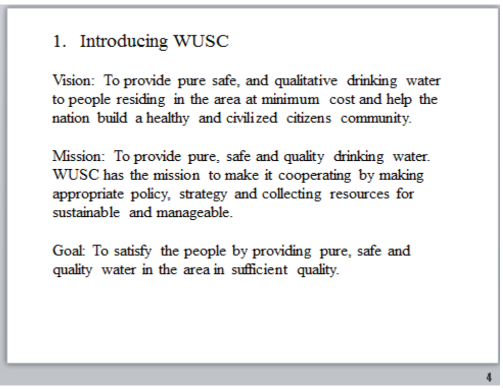
Note: Baseline of the financial model is set for planning year. But M&E is conducted one year after. During one year, may be some changes, specially assumptions. Main objective of this M&E is confirming how future would be change with reset baseline with actual performance data and re-simulate.

## 9. Presentation to stakeholders

Normally business plan is edited as report style and table of contents already show on Table 2-1. Planer contains more rich and detail information to table based business plan introduced in this introductory. It may mantions background, reason, condition, etc. naratively. However, this style busines plan aims to deliver to stakeholder, and aims to be read. WUSC may also need other type of material, for negotiation of grant, for explain and get understanding of water rate improvenet, so on, and on. For these purpose, report type business plan may sometimes not much sufficeint. It required time to read, but normally not nough time for read in the meeting or in the negotiation tables. Report type business plan would be just information or appendix in such situation. For those purposes, (for presenation), I recommend to prepare simplified presentation material. Here is sample.

1. Introducing WUSC

Objectives

- To manage, develop and sustain it by coordinating to the concerning stakeholders
- To manage all the resources collect
- To provide safe, pure and quality water by adapting dependable distribution, maintenance and management system
- To conduct public hygiene and health programs based on participation approach
- To provide maximum people by adapting governance, policy and following the both national and international standard as practicable.

5

Downtown area of Salakpur on weekly market

6

Downtown area of Salakpur

7

WUSC Office

8

9

10

2. Engineering Plan

Population Projection

| | unit | Base line | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|
| (1) Population | | 14,000 | 17,868 | 22,805 | 29,105 |
| (2) Population growth | % | 5.00% | 5.00% | 5.00% | 5.00% |
| (3) Coverage ratio | % | 60% | 64% | 69% | 74% |
| (4) Population served | | 8,400 | 11,435 | 15,735 | 21,538 |

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Water Demand Projection

| | unit | Base line | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|
| (5) Consumption/capita/day | litter | 65 | 70 | 75 | 79 |
| (6) Water Demand | cm/day | 546 | 800 | 1,180 | 1,701 |
| (7) Intake Water Volume | cm/day | 623 | 1,323 | 1,323 | 2,023 |
| (8) Production Volume | cm/day | 623 | 1,323 | 1,323 | 2,023 |
| (9) UFW | % | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 1,257 | 1,257 | 1,922 |
| (11) NRW | % | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 1,244 | 1,244 | 1,902 |

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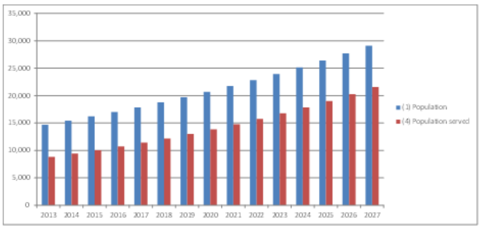
Population and population served

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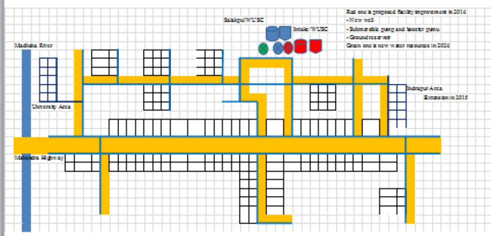
2. Engineering Plan



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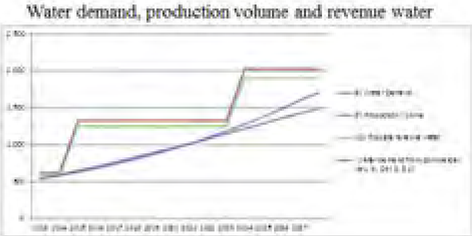
Water demand, production volume and revenue water



15

Facility improvement in 2014
- Joint project with DWSS
- 50% of cost is shouldered by the WUSC
- Enhance production 700 cubic meter per day additionally

(1) Facility improvement of 2014

| Items | Quantity | Unit Cost | Cost |
|---|---|---|---|
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Ground reservoir | 1 | 1,000 | 1,000 |
| 5) transmission line | 4,000 | 0.28 | 1,120 |
| 6) pipe fitting (20%) | | | 224 |
| 7) Contingency (25%) | | | 1,261 |
| total | | | 3,700 |
| 8) 50% cost share | | | 1,850 |

Unit ,000NR
Cost may necessary for reviewed and updated

16

Facility improvement in 2015
- Extension pipeline
- Provide water to University area and Indrapur area where population is growing and water demand is very high

(2) Extension project in 2015

| Items | Quantity | Unit Cost | Cost |
|---|---|---|---|
| 1) Pipleline | 1,000 | 0.40 | 400 |
| 2) Pipeline fiting (20%) | | | 80 |
| 3) Civil works | | | 100 |
| 4) Cntiengency (25%) | | | 145 |
| Total | | | 725 |

Unit ,000 NR
Cost may necessary for reviewed and updated

17

Rehabilitation in 2015
- Elevated tank
- Generator and submersible pump

(4) Rehabilitation of 2015

| Items | Quantity | Unit Cost | Cost |
|---|---|---|---|
| 1) Rehabilitation of elevated tank | 1 | 1,000 | 1,000 |
| 2) Rehabilitation of generator | 1 | 200 | 200 |
| 3) Rehabilitation of submersible pum | 1 | 400 | 400 |
| 4) Contingency (25%) | | | 400 |
| total | | | 2,000 |

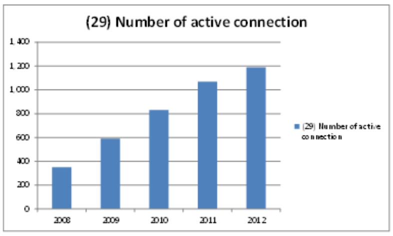
Unit ,000 NR
Cost may necessary for reviewed and updated

18

3. Customer Service Plan

Connection

| B: Customer service | unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 0 | 350 | 240 | 240 | 240 | 119 |
| (29) Number of active connection | | | 350 | 590 | 830 | 1,070 | 1,189 |

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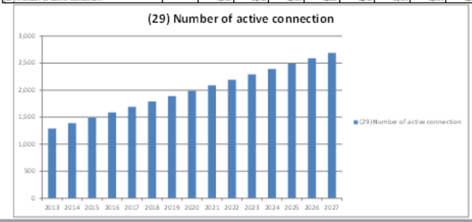
3. Customer Service Plan

Connection

| | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | n.a. | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 | 1,689 | 1,789 | 1,889 |

| | unit | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,989 | 2,089 | 2,189 | 2,289 | 2,389 | 2,489 | 2,589 | 2,689 |

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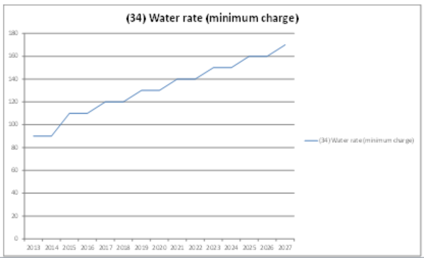
Water Rate

| | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 65 | 90 | 90 | 110 | 110 | 120 | 120 | 130 |
| (35) Water rate (commodity charge) | NR | 15 | 15 | 15 | 18 | 18 | 20 | 20 | 22 |

| | unit | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 130 | 140 | 140 | 150 | 150 | 160 | 160 | 170 |
| (35) Water rate (commodity charge) | NR | 22 | 25 | 25 | 27 | 27 | 29 | 29 | 32 |

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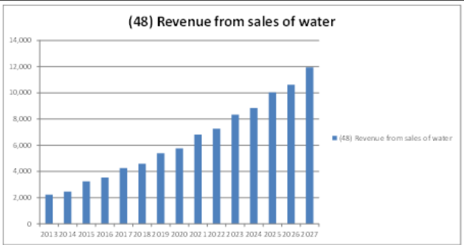
Revenue from sales of water

| | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 |
| (49) Revenue from others | ,000 NR/ye | 579 | 668 | 735 | 975 | 1,061 | 1,275 | 1,376 | 1,614 |

| | unit | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 5,768 | 6,817 | 7,272 | 8,326 | 8,841 | 10,031 | 10,611 | 11,953 |
| (49) Revenue from others | ,000 NR/ye | 1,730 | 2,045 | 2,182 | 2,498 | 2,652 | 3,009 | 3,183 | 3,586 |

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4. Administrative Plan

- Training of staff
- Computerized billing system
- Improving cashier's windows

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5. Financial Plan

| Financial performance 2009-2011 | unit | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | 837 | 1,256 | 1,450 | 1,831 |
| (44) Revenue from others | ,000 NR/year | 624 | 575 | 416 | 579 |
| (45) Operational revenue | ,000 NR/year | 1,460 | 1,831 | 1,866 | 2,430 |
| (46) Salaries | ,000 NR/year | 467 | 529 | 646 | 755 |
| (47) Power | ,000 NR/year | 312 | 348 | 487 | 735 |
| (48) Chemicals | ,000 NR/year | 0 | 0 | 0 | 0 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | 47 | 98 | 30 | 68 |
| (50) Other O&M and administration | ,000 NR/year | 520 | 475 | 227 | 682 |
| (51) Operational expenditure | ,000 NR/year | 1,166 | 1,450 | 1,390 | 2,215 |
| (52) Cash balance of operational activities | ,000 NR/year | 294 | 381 | 476 | 215 |
| | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | | 0 | 57 |
| (54) Capital expenditure | ,000 NR/year | | 0 | 0 | |
| (55) Revenue from financial activity | ,000 NR/year | 48 | 77 | 210 | 271 |
| (56) Financial cost | ,000 NR/year | | 0 | 0 | 0 |
| Revenue | ,000 NR/year | 1,508 | 1,903 | 2,076 | 2,761 |
| Expenditure | ,000 NR/year | 1,166 | 1,450 | 1,390 | 2,215 |
| (57) Cash balance | ,000 NR/year | 342 | 452 | 685 | 546 |
| (58) End balance | ,000 NR | 1,605 | 2,057 | 2,740 | 3,286 |

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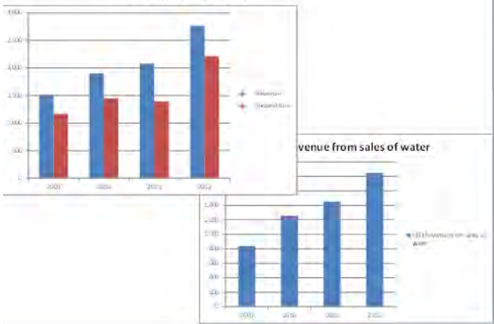
5. Financial Plan

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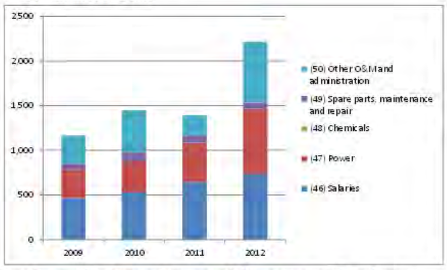
5. Financial Plan




Cost is rapidly increasing specially power and fuel cost

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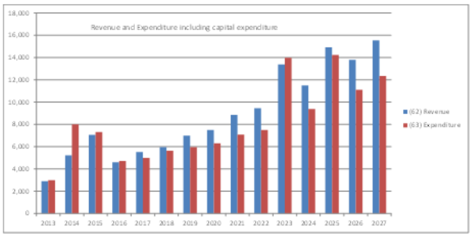
| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | '000 NR/year | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 |
| (49) Revenue from others | '000 NR/year | 579 | 668 | 735 | 975 | 1,061 | 1,275 | 1,376 | 1,614 |
| (50) Revenue from operational activity | '000 NR/year | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 | 5,962 | 6,995 |
| (51) Salaries | '000 NR/year | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 | 3,588 | 3,767 |
| (52) Power | '000 NR/year | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 | 1,517 | 1,593 |
| (53) Chemicals | '000 NR/year | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | '000 NR/year | 68 | 71 | 106 | 112 | 117 | 123 | 129 | 136 |
| (55) Other O&M and administration | '000 NR/year | 682 | 193 | 223 | 257 | 297 | 343 | 396 | 458 |
| (56) Expenditure for operational activity | '000 NR/year | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 | 5,630 | 5,954 |
| (57) Cash balance of operational activities | '000 NR/year | 215 | -104 | -753 | 66 | -123 | 540 | 332 | 1,041 |
| | | | | | | | | | |
| (58) Revenue for capital investment | '000 NR/year | 188 | 0 | 2,040 | 2,839 | 0 | 0 | 0 | 0 |
| (59) Capital expenditure | '000 NR/year | 0 | 0 | 4,079 | 3,155 | 0 | 0 | 0 | 0 |
| (60) Revenue from financial activity | '000 NR/year | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | '000 NR/year | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | '000 NR/year | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 | 5,962 | 6,995 |
| (63) Expenditure | '000 NR/year | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 | 5,630 | 5,954 |
| (64) Cash balance | '000 NR/year | 534 | -104 | -2,793 | -249 | -123 | 540 | 332 | 1,041 |
| (65) End balance | '000 NR | 2,286 | 2,182 | 389 | 140 | 17 | 557 | 889 | 1,930 |

| | unit | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | '000 NR/year | 5,768 | 6,817 | 7,272 | 8,326 | 8,841 | 10,031 | 10,611 | 11,953 |
| (49) Revenue from others | '000 NR/year | 1,730 | 2,045 | 2,182 | 2,498 | 2,652 | 3,009 | 3,183 | 3,586 |
| (50) Revenue from operational activity | '000 NR/year | 7,499 | 8,862 | 9,454 | 10,824 | 11,494 | 13,040 | 13,794 | 15,539 |
| (51) Salaries | '000 NR/year | 3,955 | 4,568 | 4,797 | 5,495 | 5,769 | 6,563 | 6,891 | 7,792 |
| (52) Power | '000 NR/year | 1,672 | 1,756 | 1,844 | 2,356 | 2,474 | 2,598 | 2,727 | 2,864 |
| (53) Chemicals | '000 NR/year | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | '000 NR/year | 143 | 150 | 157 | 197 | 207 | 217 | 228 | 239 |
| (55) Other O&M and administration | '000 NR/year | 529 | 611 | 705 | 815 | 941 | 1,087 | 1,255 | 1,450 |
| (56) Expenditure for operational activity | '000 NR/year | 6,299 | 7,085 | 7,503 | 8,862 | 9,391 | 10,464 | 11,101 | 12,345 |
| (57) Cash balance of operational activities | '000 NR/year | 1,199 | 1,777 | 1,951 | 1,962 | 2,103 | 2,577 | 2,693 | 3,195 |
| | | | | | | | | | |
| (58) Revenue for capital investment | '000 NR/year | 0 | 0 | 0 | 2,566 | 0 | 1,886 | 0 | 0 |
| (59) Capital expenditure | '000 NR/year | 0 | 0 | 0 | 5,131 | 0 | 3,771 | 0 | 0 |
| (60) Revenue from financial activity | '000 NR/year | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | '000 NR/year | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | '000 NR/year | 7,499 | 8,862 | 9,454 | 13,389 | 11,494 | 14,926 | 13,794 | 15,539 |
| (63) Expenditure | '000 NR/year | 6,299 | 7,085 | 7,503 | 13,993 | 9,391 | 14,235 | 11,101 | 12,345 |
| (64) Cash balance | '000 NR/year | 1,199 | 1,777 | 1,951 | -604 | 2,103 | 691 | 2,693 | 3,195 |
| (65) End balance | '000 NR | 3,129 | 4,906 | 6,857 | 6,253 | 8,356 | 9,047 | 11,740 | 14,935 |

27




Revenue and expenditure including subsidiary, grant and capital expenditure

28

## 6. Monitoring and evaluation schedule

29

Review every year when budgeting

30

## 7. Q&A

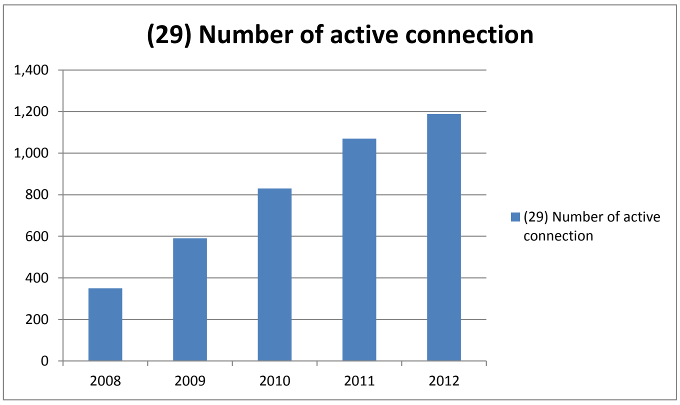
31

## 10. Data and information as attachment

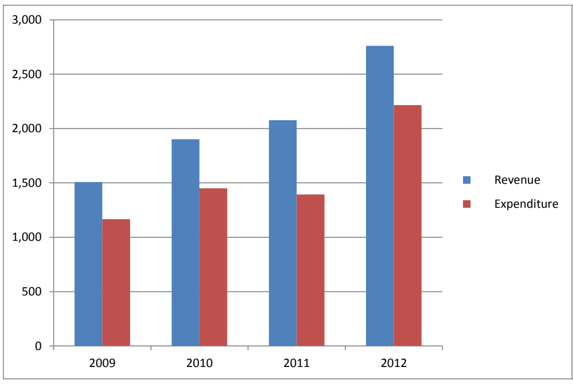
This is data and information from attachment of business plan from sample I use for this introductory. These data are recommendable for attach last part of business plan as appendix. Reader can know whole picture of the business plan with figures and charts.

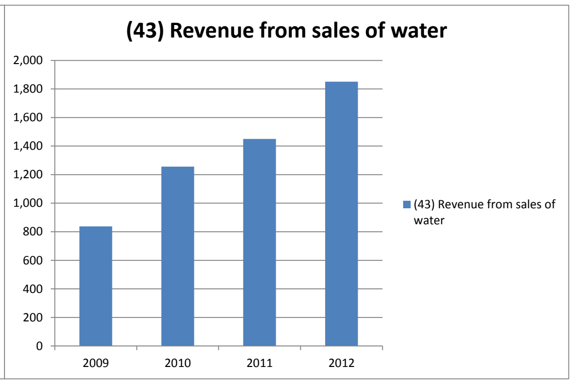
(1) Actual performance 2008-2011

| B: Customer service | unit | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 350 | 240 | 240 | 240 | 119 |
| (29) Number of active connection | | 350 | 590 | 830 | 1,070 | 1,189 |




| Financial performance 2009-2011 | unit | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/yea | 837 | 1,256 | 1,450 | 1,851 |
| (44) Revenue from others | ,000 NR/yea | 623 | 575 | 416 | 579 |
| (45) Operational revenue | ,000 NR/ye | 1,460 | 1,831 | 1,866 | 2,430 |
| (46) Salaries | ,000 NR/yea | 467 | 529 | 646 | 733 |
| (47) Power | ,000 NR/yea | 312 | 348 | 437 | 732 |
| (48) Chemicals | ,000 NR/yea | 0 | 0 | 0 | 0 |
| (49) Spare parts, maintenance and repair | ,000 NR/yea | 67 | 98 | 83 | 68 |
| (50) Other O&M and administration | ,000 NR/yea | 320 | 475 | 227 | 682 |
| (51) Operational expenditure | ,000 NR/yea | 1,166 | 1,450 | 1,393 | 2,215 |
| (52) Cash balance of operational activities | ,000 NR/yea | 294 | 381 | 473 | 215 |
| | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | | 0 | 57 |
| (54) Capital expenditure | ,000 NR/year | | 0 | 0 | |
| (55) Revenue from financial activity | ,000 NR/yea | 48 | 71 | 210 | 274 |
| (56) Financial cost | ,000 NR/year | | 0 | 0 | 0 |
| Revenue | ,000 NR/yea | 1,508 | 1,902 | 2,076 | 2,761 |
| Expenditure | ,000 NR/yea | 1,166 | 1,450 | 1,393 | 2,215 |
| (57) Cash balance | ,000 NR/yea | 342 | 452 | 683 | 546 |
| (58) End balance | ,000 NR | 1,605 | 2,057 | 2,740 | 3,286 |
| Descripancy | | | | | |
| (59) Additional fixed asset | ,000 NR/year | | | | |
| (60) Fixed asset *3) | ,000 NR | | 11,466 | 10,808 | |
| (61) Depreciation | ,000 NR/year | | 1,724 | 668 | |
| *3) Fixed asset for target of depreciation | | | | | |



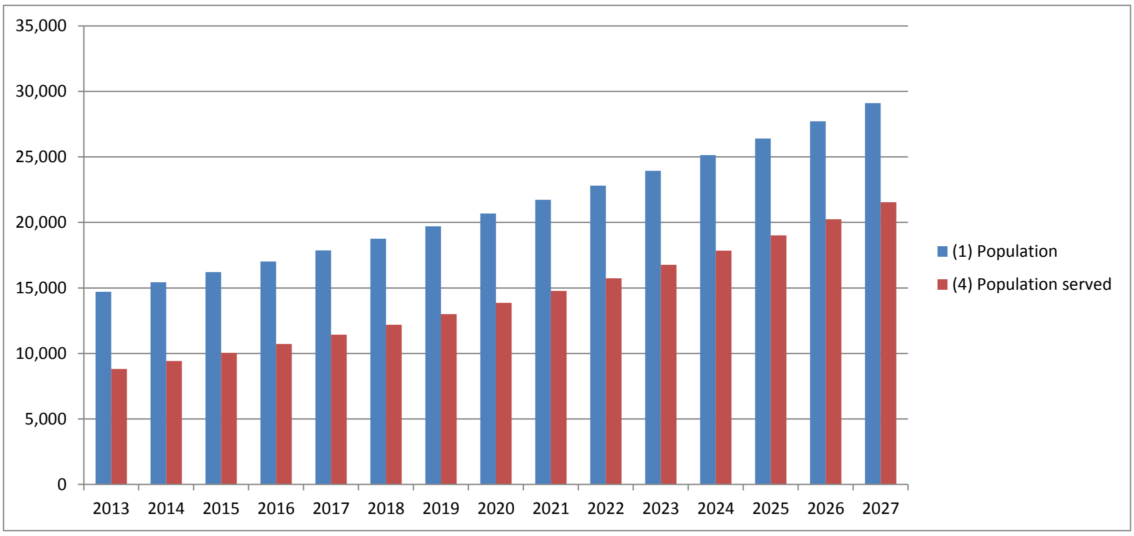




## (2) Supporting data for engineering plan

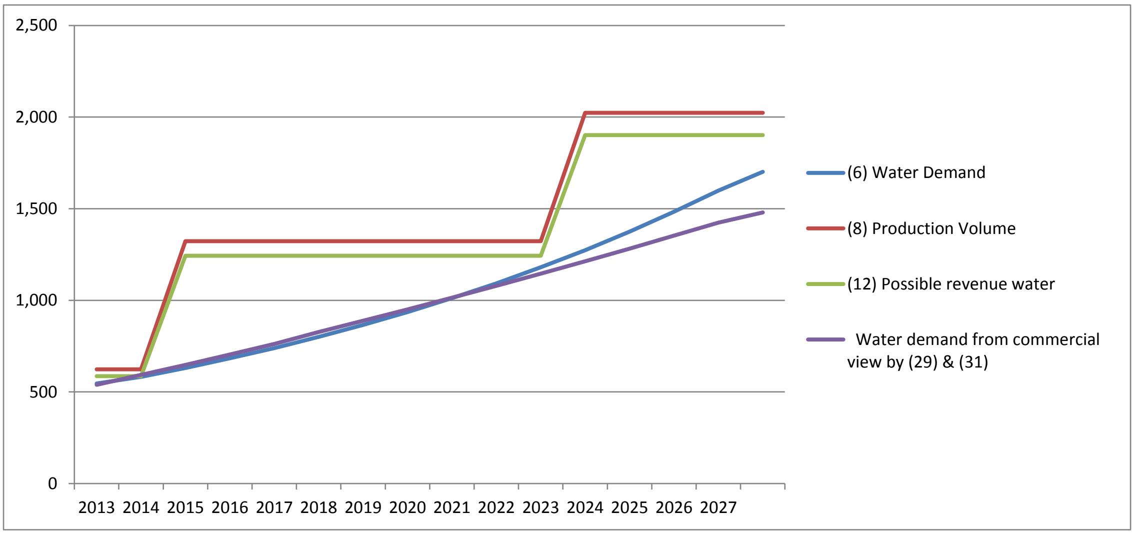
| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 | 17,868 | 18,761 | 19,699 | 20,684 | 21,719 | 22,805 | 23,945 | 25,142 | 26,399 | 27,719 | 29,105 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% | 64% | 65% | 66% | 67% | 68% | 69% | 70% | 71% | 72% | 73% | 74% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 | 11,435 | 12,195 | 13,002 | 13,859 | 14,769 | 15,735 | 16,761 | 17,851 | 19,007 | 20,235 | 21,538 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 | 11,435 | 12,195 | 13,002 | 13,859 | 14,769 | 15,735 | 16,761 | 17,851 | 19,007 | 20,235 | 21,538 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 79 |
| - domestic customer | | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 79 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 | 800 | 866 | 936 | 1,012 | 1,093 | 1,180 | 1,274 | 1,375 | 1,483 | 1,599 | 1,701 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 | 800 | 866 | 936 | 1,012 | 1,093 | 1,180 | 1,274 | 1,375 | 1,483 | 1,599 | 1,701 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | | | |
| (7) Intake Water Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 2,023 | 2,023 | 2,023 | 2,023 | 2,023 |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 2,023 | 2,023 | 2,023 | 2,023 | 2,023 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 592 | 1,257 | 1,257 | 1,257 | 1,257 | 1,257 | 1,257 | 1,257 | 1,257 | 1,257 | 1,922 | 1,922 | 1,922 | 1,922 | 1,922 |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 586 | 1,244 | 1,244 | 1,244 | 1,244 | 1,244 | 1,244 | 1,244 | 1,244 | 1,244 | 1,902 | 1,902 | 1,902 | 1,902 | 1,902 |
| | | | | | | | | | | | | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | 3,700 | 725 | | | | | | | | 3,000 | | | | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | 2,000 | | | | | | | | | 0 | 2,000 | | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 0 | 3,700 | 2,725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 | 2,000 | 0 | 0 |
| (16) Inflated capital investment | ,000 RP | | 0 | 4,079 | 3,155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,131 | 0 | 3,771 | 0 | 0 |
| (17) Inflation rate | % | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| | | | | | | | | | | | | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | | 400 | | | | | | | | | 400 | | | | |
| (20) Inflated (19) | ,000 NR/ | dummy | | 441 | 0 | | 0 | | | | | 0 | 420 | | | 0 | 0 |
| (21) Power and fuels for pumping | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 | 1,517 | 1,593 | 1,672 | 1,756 | 1,844 | 2,356 | 2,474 | 2,598 | 2,727 | 2,864 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 0 | | 0 | | | | | | | | | | | | |
| (23) Inflated (22) | ,000 NR/ | dummy | 0 | | 0 | | | | | | | 0 | | | | | |
| (24) Chemical for production | ,000 NR/ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | | 30 | | | | | | | | | 30 | | | | |
| (26) Inflated (25) | ,000 NR/ | dummy | | 32 | 0 | | | | | | | 0 | 32 | | | | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 68 | 71 | 106 | 112 | 117 | 123 | 129 | 136 | 143 | 150 | 157 | 197 | 207 | 217 | 228 | 239 |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 800 | 840 | 1,355 | 1,422 | 1,493 | 1,568 | 1,646 | 1,729 | 1,815 | 1,906 | 2,001 | 2,553 | 2,680 | 2,814 | 2,955 | 3,103 |

(*1) price of year 2012

Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009



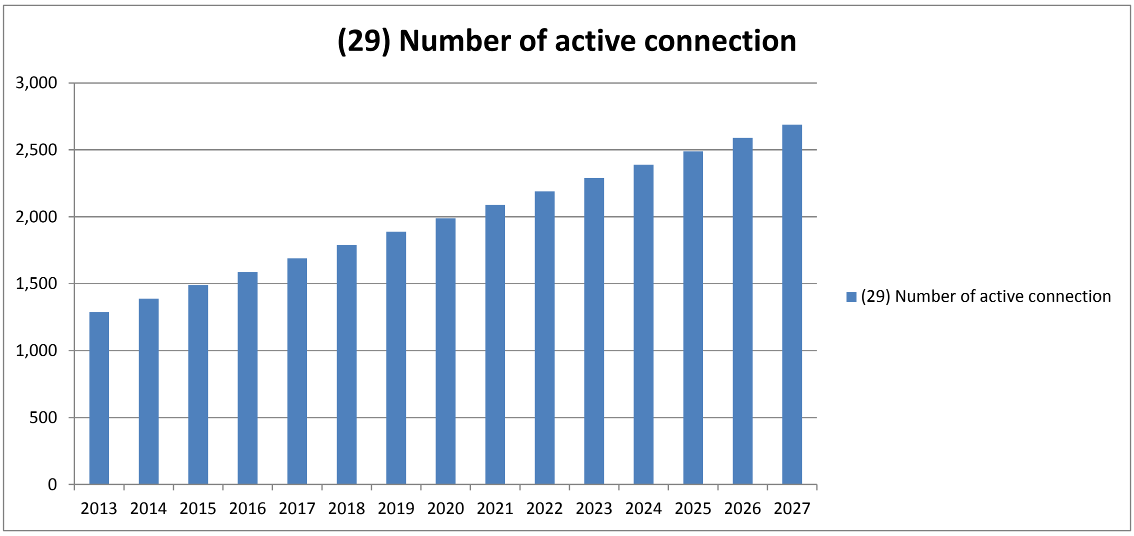

Population and population served



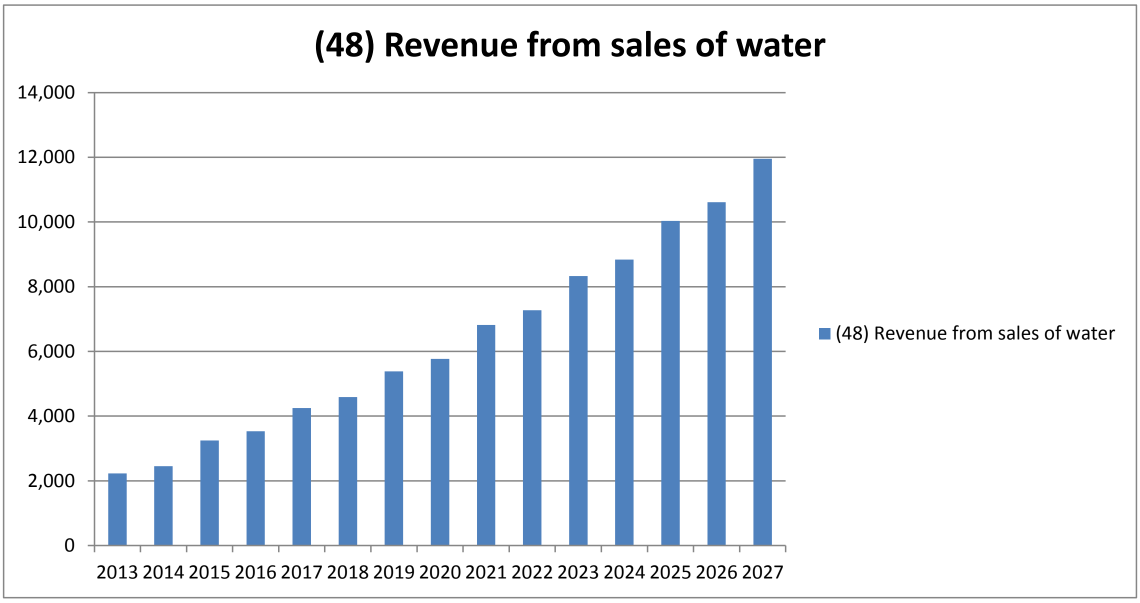

Water demand, production volume and revenue water

(3) Supporting data for customer service plan

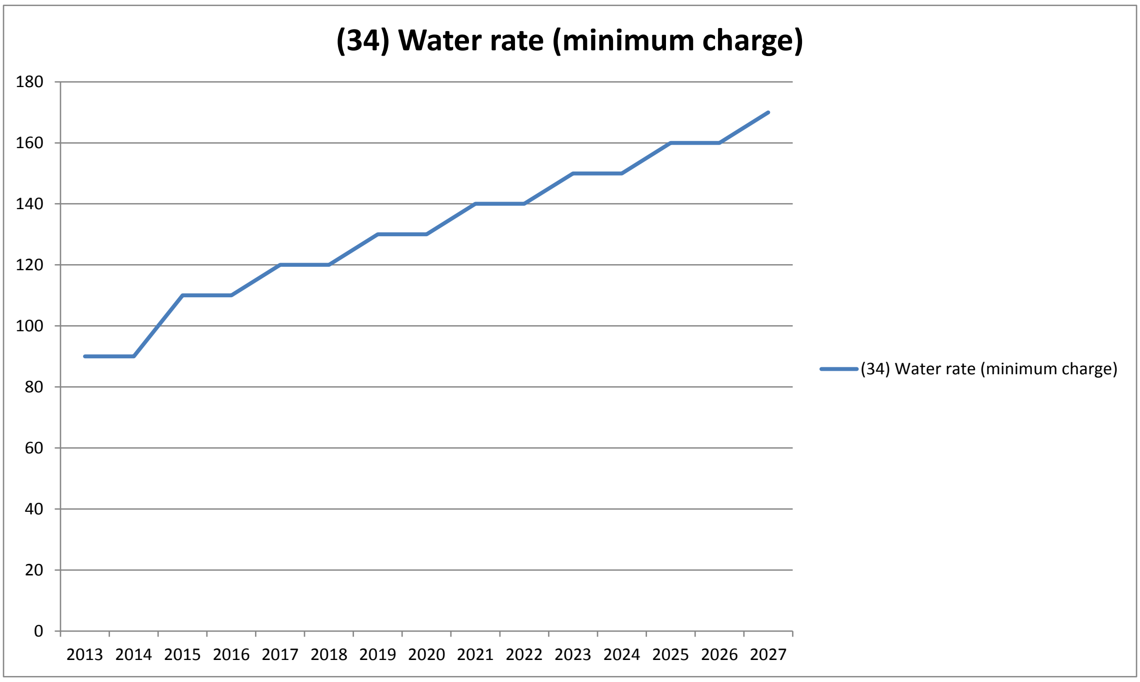
| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 | 1,689 | 1,789 | 1,889 | 1,989 | 2,089 | 2,189 | 2,289 | 2,389 | 2,489 | 2,589 | 2,689 |
| (30) Average family size | person/fa | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **(31) Avr. consumption per connection** | **cm/mont** | **13.6** | **13.8** | **14** | **14.2** | **14.4** | **14.7** | **14.9** | **15.1** | **15.3** | **15.5** | **15.7** | **15.9** | **16.1** | **16.3** | **16.5** | **16.5** |
| (32) Confirmation of (31) with (5) | cm/month | 13.65 | 13.86 | 14.07 | 14.28 | 14.49 | 14.7 | 14.91 | 15.12 | 15.33 | 15.54 | 15.75 | 15.96 | 16.17 | 16.38 | 16.59 | 16.59 |
| (33) Minimum charge volume | cm/month | 10 | 10 | 10 | 10 | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** |
| **(34) Water rate (minimum charge)** | **NR** | **65** | **90** | **90** | **110** | **110** | **120** | **120** | **130** | **130** | **140** | **140** | **150** | **150** | **160** | **160** | **170** |
| **(35) Water rate (commodity charge 10** | **NR** | **15** | **15** | **15** | **18** | **18** | **20** | **20** | **22** | **22** | **25** | **25** | **27** | **27** | **29** | **29** | **32** |
| **(35) Water rate (commodity charge 25** | **NR** | **20** | | | | | | | | | | | | | | **25** | **25** |
| **(36) Collection efficiency** | **%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 139 | 186 | 204 | 271 | 295 | 354 | 382 | 448 | 481 | 568 | 606 | 694 | 737 | 836 | 884 | 996 |
| (38) Expected annual revenue from sales | ,000 NR/ | 1,664 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 | 5,768 | 6,817 | 7,272 | 8,326 | 8,841 | 10,031 | 10,611 | 11,953 |
| Water demand from commercial view by | cm/day | 539 | 593 | 648 | 705 | 763 | 828 | 889 | 951 | 1,014 | 1,079 | 1,146 | 1,213 | 1,282 | 1,352 | 1,424 | 1,479 |




Number of connection




Revenue from sales of water




Water rate improvement plan

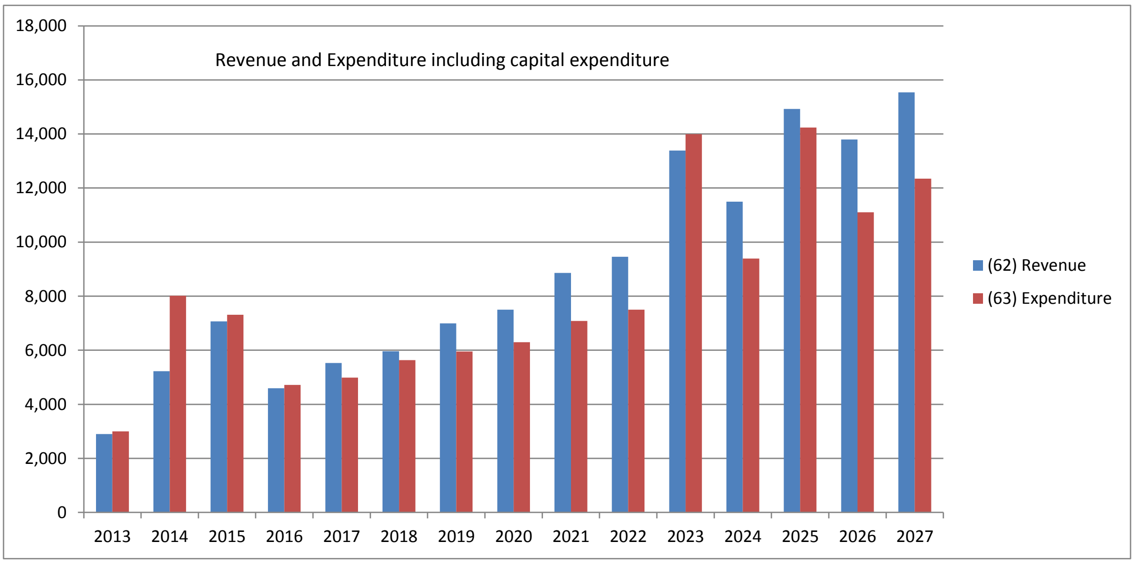
## (4) Supporting data for administrative plan

| C: Administrative plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | | 0 | 1 | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 |
| (40) Number of staff | | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 |
| (41) Increasing salaries | NR/staff | | 0 | 281 | 0 | 310 | 0 | 342 | 0 | 0 | 396 | 0 | 436 | 0 | 481 | 0 | 530 |
| (42) Inflated (41) | ,000 NR/ | dummy | 0 | 295 | 0 | 325 | 0 | 359 | 0 | 0 | 415 | 0 | 458 | 0 | 505 | 0 | 557 |
| (43) Salaries and wages | ,000 NR/ | 1,874 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 | 3,588 | 3,767 | 3,955 | 4,568 | 4,797 | 5,495 | 5,769 | 6,563 | 6,891 | 7,792 |
| (44) Increases admi cost (*1) | ,000 NR/year | | 17 | 19 | 22 | 26 | 30 | 34 | 40 | 46 | 53 | 61 | 71 | 81 | 94 | 109 | 126 |
| (45) Inflated (44) | ,000 NR/ | dummy | 18 | 20 | 23 | 27 | 31 | 36 | 42 | 48 | 56 | 64 | 74 | 86 | 99 | 114 | 132 |
| (46) Administrative cost | ,000 NR/ | 167 | 193 | 223 | 257 | 297 | 343 | 396 | 458 | 529 | 611 | 705 | 815 | 941 | 1,087 | 1,255 | 1,450 |
| (47) subtotal of salaries and admi cost | ,000 NR/ | 2,041 | 2,161 | 2,584 | 2,737 | 3,226 | 3,418 | 3,984 | 4,225 | 4,484 | 5,179 | 5,502 | 6,309 | 6,710 | 7,649 | 8,146 | 9,242 |

## (5) Supporting data for financial plan

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 | 5,768 | 6,817 | 7,272 | 8,326 | 8,841 | 10,031 | 10,611 | 11,953 |
| - domestic customer | | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 | 4,586 | 5,380 | 5,768 | 6,817 | 7,272 | 8,326 | 8,841 | 10,031 | 10,611 | 11,953 |
| - non domestci customer | | | | | | | | | | | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 579 | 668 | 735 | 975 | 1,061 | 1,275 | 1,376 | 1,614 | 1,730 | 2,045 | 2,182 | 2,498 | 2,652 | 3,009 | 3,183 | 3,586 |
| (50) Revenue from operational activity | ,000 NR/ | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 | 9,454 | 10,824 | 11,494 | 13,040 | 13,794 | 15,539 |
| (51) Salaries | ,000 NR/ | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 | 3,588 | 3,767 | 3,955 | 4,568 | 4,797 | 5,495 | 5,769 | 6,563 | 6,891 | 7,792 |
| (52) Power | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 | 1,517 | 1,593 | 1,672 | 1,756 | 1,844 | 2,356 | 2,474 | 2,598 | 2,727 | 2,864 |
| (53) Chemicals | ,000 NR/ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 68 | 71 | 106 | 112 | 117 | 123 | 129 | 136 | 143 | 150 | 157 | 197 | 207 | 217 | 228 | 239 |
| (55) Other O&M and administration | ,000 NR/ | 682 | 193 | 223 | 257 | 297 | 343 | 396 | 458 | 529 | 611 | 705 | 815 | 941 | 1,087 | 1,255 | 1,450 |
| (56) Expenditure for operational activity | ,000 NR/ | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 | 5,630 | 5,954 | 6,299 | 7,085 | 7,503 | 8,862 | 9,391 | 10,464 | 11,101 | 12,345 |
| (57) Cash balance of operational activities | ,000 NR/ | 215 | -104 | -753 | 66 | -123 | 540 | 332 | 1,041 | 1,199 | 1,777 | 1,951 | 1,962 | 2,103 | 2,577 | 2,693 | 3,195 |
| | | | | | | | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 188 | 0 | 2,040 | 2,839 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,566 | 0 | 1,886 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 0 | 0 | 4,079 | 3,155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,131 | 0 | 3,771 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 140 | | | | | | | | | | | | | | | |
| (61) Financial cost | ,000 NR/ | 9 | | | | | | | | | | | | | | | |
| (62) Revenue | ,000 NR/ | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 | 9,454 | 13,389 | 11,494 | 14,926 | 13,794 | 15,539 |
| (63) Expenditure | ,000 NR/ | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 | 5,630 | 5,954 | 6,299 | 7,085 | 7,503 | 13,993 | 9,391 | 14,235 | 11,101 | 12,345 |
| **(64) Cash balance** | **,000 NR** | **534** | **-104** | **-2,793** | **-249** | **-123** | **540** | **332** | **1,041** | **1,199** | **1,777** | **1,951** | **-604** | **2,103** | **691** | **2,693** | **3,195** |
| **(65) End balance** | **,000 NR** | **3,286** | **3,182** | **389** | **140** | **17** | **557** | **889** | **1,930** | **3,129** | **4,906** | **6,857** | **6,253** | **8,356** | **9,047** | **11,740** | **14,935** |

Note: Including capital investment and subsidiary from DWSSDO




Note: Including capital investment and subsidiary from DWSSDO

Revenue and expenditure

## (6) Supporting data for monitoring and evaluation

| E: Target and key performance indicator | Unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | | | | | | | | | |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% | 64% | 65% | 66% | 67% | 68% | 69% | 70% | 71% | 72% | 73% | 74% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 | 11,435 | 12,195 | 13,002 | 13,859 | 14,769 | 15,735 | 16,761 | 17,851 | 19,007 | 20,235 | 21,538 |
| (31) Avr. consumption per connection | cm/montl | 13.6 | 13.8 | 14 | 14.2 | 14.4 | 14.7 | 14.9 | 15.1 | 15.3 | 15.5 | 15.7 | 15.9 | 16.1 | 16.3 | 16.5 | 16.5 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 | 1,689 | 1,789 | 1,889 | 1,989 | 2,089 | 2,189 | 2,289 | 2,389 | 2,489 | 2,589 | 2,689 |
| (B) Engineering | | | | | | | | | | | | | | | | | |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 1,323 | 2,023 | 2,023 | 2,023 | 2,023 | 2,023 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| ( C) Management Efficiency | | | | | | | | | | | | | | | | | |
| (40) Number of staff | | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 |
| Number of connection per staff | | 170 | 184 | 174 | 186 | 177 | 188 | 179 | 189 | 199 | 190 | 199 | 191 | 199 | 191 | 199 | 192 |
| (36) Collection efficiency | % | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% | 98% |
| (D) Financial | | | | | | | | | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 | 9,454 | 10,824 | 11,494 | 13,040 | 13,794 | 15,539 |
| (56) Expenditure for operational activity | ,000 NR/ | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 | 5,630 | 5,954 | 6,299 | 7,085 | 7,503 | 8,862 | 9,391 | 10,464 | 11,101 | 12,345 |
| (62) Revenue | ,000 NR/ | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 | 5,962 | 6,995 | 7,499 | 8,862 | 9,454 | 13,389 | 11,494 | 14,926 | 13,794 | 15,539 |
| (63) Expenditure | ,000 NR/ | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 | 5,630 | 5,954 | 6,299 | 7,085 | 7,503 | 13,993 | 9,391 | 14,235 | 11,101 | 12,345 |
| (64) Cash balance | ,000 NR/ | 534 | -104 | -2,793 | -249 | -123 | 540 | 332 | 1,041 | 1,199 | 1,777 | 1,951 | -604 | 2,103 | 691 | 2,693 | 3,195 |

## 11. Exercise

This is exercise for workshop of “Basis of Management Consulting”. There are two exercises, first one is prepare business plan for conform your understating on Chapter 3 to 7 (business planning), and second one is for Chapter 8 (M&E).

(A) Business planning exercise:

Make table based business plan of base year 2012 and project next 10 years

(1) Technical plan

Basic data are as follows:

- Population: 25,000
- Household: 5,000
- No necessary to distinguish domestic customer and non-domestic customer (in this business plan is assumes there is no big hotel, guesthouse and restaurant in this town and no need to consider such large volume consumption user, at this time. But it is not true in future.)
- Population growth: 5%
- Connection: 2,000
- Coverage ratio: WUSC wants to increasing 2% annually
- Consumption per capita per day: 75 litter and WUSC wishes to increasing 3 litters more annually until user can use 105 litters per day per capita
- Production capacity: 30 litter per second and operate 18 hours a day (two 15 litter per second submersible pumps and one generator, one 350 cubic meters elevated tank)
- UFW: 15%
- NRW: 20%
- Facility was constructed 10 years ago
- New water source is available 2km away from existing facility compound
- Another new water source is also available from 5km away from existing facility compound
- 4 communities request to supply water, one is 2km, others are 5km from existing elevated tank

Question:

- Production and distribution capacity is enough for achieves their target?
- If not, when (year) water shortage would be happen?
- What is your recommendation and how much the cost for that facility improvement?

(2) Commercial plan

- Minimum charge for first 10 cubic meter is 100 NR

- Commodity charge between 11-20 is 12 NR per cubic meter
- Collection efficiency: 98%

Question:
- How many connection WUSC can increase annually?
- How much WUSC can expect revenue from sales of water?

(3) Administrative plan
- Number of staff: 13

Question:
- When and how many staff may recommendable to increasing?

(4) Financial plan
- Actual expenditure and revenue is as tables
- Inflation rate: 5%

Question:
- How much WUSC expect revenue and expenditure for next 10 years?
- What is your recommendation on water rate setting and financial resources arrangement?

(5) M&E plan
- Prepare recommendable M&E plan (table base) with condition mentioned, and your suggestion on technical plan, commercial plan, administrative plan and financial plan

| D: Financial plan | unit | Base line |
|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 2,634 |
| - domestic customer | | 2,634 |
| - non domestci customer | | |
| (49) Revenue from others | ,000 NR/ | 790 |
| (50) Revenue from operational activity | ,000 NR/ | 3,425 |
| (51) Salaries | ,000 NR/ | 2,000 |
| (52) Power | ,000 NR/ | 800 |
| (53) Chemicals | ,000 NR/ | 10 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 300 |
| (55) Other O&M and administration | ,000 NR/ | 200 |
| (56) Expenditure for operational activity | ,000 NR/ | 3,310 |
| (57) Cash balance of operational activities | ,000 NR/ | 115 |
| | | |
| (58) Revenue for capital investment | ,000 NR/year | |
| (59) Capital expenditure | ,000 NR/year | |
| (60) Revenue from financial activity | ,000 NR/ | 100 |
| (61) Financial cost | ,000 NR/ | 0 |
| (62) Revenue | ,000 NR/ | 3,525 |
| (63) Expenditure | ,000 NR/ | 3,310 |
| **(64) Cash balance** | **,000 NR** | **215** |
| **(65) End balance** | **,000 NR** | **5,000** |
| | | |
| (66) Additional fixed asset | ,000 NR/ | dummy |
| (67) Fixed asset *3) | ,000 NR | 30,000 |
| (68) Depreciation *2) | ,000 NR/ | 1,500 |

## Worksheet-1

| | | | | | | | mid-term | | | | long-term |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| (1) Population | | 25,000 | | | | | | | | | | |
| (2) Population growth | % | 5.0% | | | | | | | | | | |
| (3) Coverage ratio | % | 40% | | | | | | | | | | |
| (4) Population served | | 10,000 | | | | | | | | | | |
| - domestic customer | | 10,000 | | | | | | | | | | |
| - non domestci customer | | 0 | | | | | | | | | | |
| (5) Consumption/capita/day | litter | 75 | | | | | | | | | | |
| - domestic customer | | 75 | | | | | | | | | | |
| - non domestci customer | | 0 | | | | | | | | | | |
| (6) Water Demand | cm/day | 750 | | | | | | | | | | |
| - domestic customer | | 750 | | | | | | | | | | |
| - non domestci customer | | 0 | | | | | | | | | | |
| | | | | | | | | | | | | |
| (7) Intake Water Volume | cm/day | 1,944 | | | | | | | | | | |
| (8) Production Volume | cm/day | 1,944 | | | | | | | | | | |
| (9) UFW | % | 15% | | | | | | | | | | |
| (10) Accounting water | cm/day | 1,652 | | | | | | | | | | |
| (11) NRW | % | 20% | | | | | | | | | | |
| (12) Possible revenue water | cm/day | 1,555 | | | | | | | | | | |
| | | | | | | | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | | | | | | | | | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | | | | | | | | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | | | | | | | | | | |
| (16) Inflated capital investment | ,000 RP | | | | | | | | | | | |
| (17) Inflation rate | % | 5% | | | | | | | | | | |
| (18) Indicator for inflation | | 0 | | | | | | | | | | |
| | | | | | | | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | | | | | | | | | | |
| (20) Inflated (19) | ,000 NR/ | dummy | | | | | | | | | | |
| (21) Power and fuels for pumping | ,000 NR/ | 800 | | | | | | | | | | |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | | | | | | | | | | |
| (23) Inflated (22) | ,000 NR/ | dummy | | | | | | | | | | |
| (24) Chemical for production | ,000 NR/ | 10 | | | | | | | | | | |
| (25) Increases of spare parts, repair, main | ,000 NR/year | | | | | | | | | | | |
| (26) Inflated (25) | ,000 NR/year | | | | | | | | | | | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 300 | | | | | | | | | | |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 1,110 | | | | | | | | | | |
| (*1) price of year 2012 | | | | | | | | | | | | |
| Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009 | | | | | | | | | | | | |

## Worksheet-2

| | | | | | | | mid-term | | | | long-term |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| (28) Number of additional connection | | dummy | | | | | | | | | | |
| (29) Number of active connection | | 2,000 | | | | | | | | | | |
| (30) Average family size | person/fa | 5 | | | | | | | | | | |
| **(31) Avr. consumption per connection** | **cm/mont** | **11** | | | | | | | | | | |
| (32) Confirmation of (31) with (5) | cm/montl | 11 | | | | | | | | | | |
| (33) Minimum charge volume | cm/montl | 10 | | | | | | | | | | |
| **(34) Water rate (minimum charge)** | **NR** | **100** | | | | | | | | | | |
| **(35) Water rate (commodity charge 10** | **NR** | **12** | | | | | | | | | | |
| **(35) Water rate (commodity charge 21** | **NR** | **14** | | | | | | | | | | |
| **(36) Collection efficiency** | **%** | **98%** | | | | | | | | | | |
| (37) Expected monthly revenue from sale | ,000 NR/ | 220 | | | | | | | | | | |
| (38) Expected annual revenue from sales | ,000 NR/ | 2,634 | | | | | | | | | | |
| Water demand from commercial view by | cm/day | 733 | | | | | | | | | | |

## Worksheet-3

| | | | | | | | mid-term | | | | long-term |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C: Administrative plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| (39) Increases of staff | | | | | | | | | | | | |
| (40) Number of staff | | 13 | | | | | | | | | | |
| (41) Increasing salaries | NR/staff | | | | | | | | | | | |
| (42) Inflated (41) | ,000 NR/ | dummy | | | | | | | | | | |
| (43) Salaries and wages | ,000 NR/ | 2,000 | | | | | | | | | | |
| (44) Increases admi cost (*1) | ,000 NR/year | | | | | | | | | | | |
| (45) Inflated (44) | ,000 NR/ | dummy | | | | | | | | | | |
| (46) Administrative cost | ,000 NR/ | 200 | | | | | | | | | | |
| (47) subtotal of salaries and admi cost | ,000 NR/ | 2,200 | | | | | | | | | | |
| Connections per staff | #/staff | 154 | | | | | | | | | | |

Worksheet-4

| | | | | | | | mid-term | | | | | long-term |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| (48) Revenue from sales of water | ,000 NR/ | 2,634 | | | | | | | | | | |
| - domestic customer | | 2,634 | | | | | | | | | | |
| - non domestci customer | | | | | | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 790 | | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ | 3,425 | | | | | | | | | | |
| (51) Salaries | ,000 NR/ | 2,000 | | | | | | | | | | |
| (52) Power | ,000 NR/ | 800 | | | | | | | | | | |
| (53) Chemicals | ,000 NR/ | 10 | | | | | | | | | | |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 300 | | | | | | | | | | |
| (55) Other O&M and administration | ,000 NR/ | 200 | | | | | | | | | | |
| (56) Expenditure for operational activity | ,000 NR/ | 3,310 | | | | | | | | | | |
| (57) Cash balance of operational activities | ,000 NR/ | 115 | | | | | | | | | | |
| | | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/year | | | | | | | | | | | |
| (59) Capital expenditure | ,000 NR/year | | | | | | | | | | | |
| (60) Revenue from financial activity | ,000 NR/ | 100 | | | | | | | | | | |
| (61) Financial cost | ,000 NR/ | 0 | | | | | | | | | | |
| (62) Revenue | ,000 NR/ | 3,525 | | | | | | | | | | |
| (63) Expenditure | ,000 NR/ | 3,310 | | | | | | | | | | |
| **(64) Cash balance** | **,000 NR** | **215** | | | | | | | | | | |
| **(65) End balance** | **,000 NR** | **5,000** | | | | | | | | | | |
| | | | | | | | | | | | | |
| (66) Additional fixed asset | ,000 NR/ | dummy | | | | | | | | | | |
| (67) Fixed asset *3) | ,000 NR | 30,000 | | | | | | | | | | |
| (68) Depreciation *2) | ,000 NR/ | 1,500 | | | | | | | | | | |
| *2) assumes 5% (20 years) | | | | | | | | | | | | |
| *3) Fixed asset for target of depreciation | | | | | | | | | | | | |

Worksheet-5

| E: Target and key performance indicator | Unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | | | | |
| (3) Coverage ratio | % | 40% | | | | | | | | | | |
| (4) Population served | | 10,000 | | | | | | | | | | |
| (31) Avr. consumption per connection | cm/month | 11 | | | | | | | | | | |
| (29) Number of active connection | | 2,000 | | | | | | | | | | |
| (B) Engineering | | | | | | | | | | | | |
| (8) Production Volume | cm/day | 1,944 | | | | | | | | | | |
| (9) UFW | % | 15% | | | | | | | | | | |
| (11) NRW | % | 20% | | | | | | | | | | |
| ( C) Management Efficiency | | | | | | | | | | | | |
| (40) Number of staff | | 13 | | | | | | | | | | |
| Number of connection per staff | | 154 | | | | | | | | | | |
| (36) Collection efficiency | % | 98% | | | | | | | | | | |
| (D) Financial | | | | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ | 3,425 | | | | | | | | | | |
| (56) Expenditure for operational activity | ,000 NR/ | 3,310 | | | | | | | | | | |
| (62) Revenue | ,000 NR/ | 3,525 | | | | | | | | | | |
| (63) Expenditure | ,000 NR/ | 3,310 | | | | | | | | | | |
| (64) Cash balance | ,000 NR/ | 215 | | | | | | | | | | |

(B) Exercise:

(M&E)

Evaluate business plan prepared previously as following conditions:

- Number of connection increased 200 in 2013
- New developing plan is proposed and expects 200 new households two years after
- New public school is expected to open and 1,000 students would be expected also two years after

Question:

- Is business plan need to revise?
- If so, what is your suggestion?

(C ) Standard answer for Exercise (A)

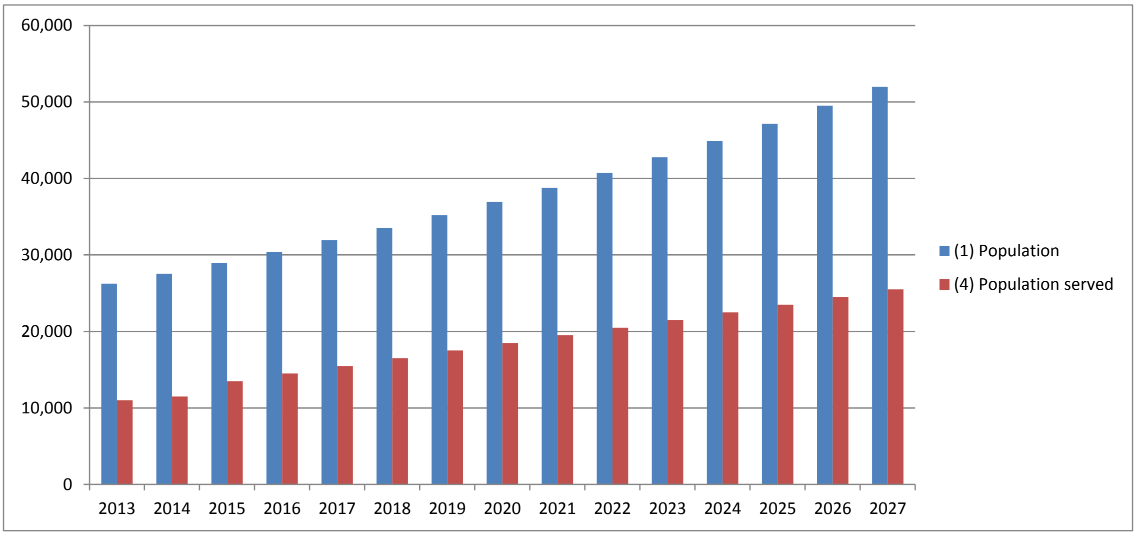
# Technical plan

This calculation form adapt average water consumption per connection up to 20 c.m.

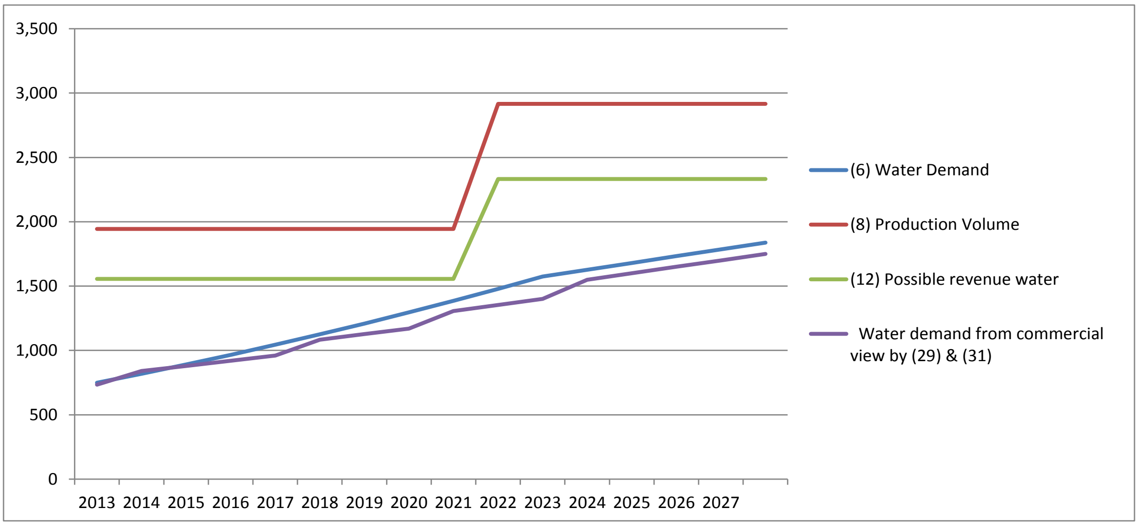
| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Population | | 25,000 | 26,250 | 27,563 | 28,941 | 30,388 | 31,907 | 33,502 | 35,178 | 36,936 | 38,783 | 40,722 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 40% | 42% | 44% | 46% | 48% | 50% | 52% | 54% | 56% | 58% | 60% |
| (4) Population served | | 10,000 | 10,500 | 11,000 | 11,500 | 12,000 | 12,500 | 13,000 | 13,500 | 14,000 | 14,500 | 15,000 |
| - domestic customer | | 10,000 | 10,500 | 11,000 | 11,500 | 12,000 | 12,500 | 13,000 | 13,500 | 14,000 | 14,500 | 15,000 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 |
| - domestic customer | | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 750 | 819 | 891 | 966 | 1,044 | 1,125 | 1,209 | 1,296 | 1,386 | 1,479 | 1,575 |
| - domestic customer | | 750 | 819 | 891 | 966 | 1,044 | 1,125 | 1,209 | 1,296 | 1,386 | 1,479 | 1,575 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

- Population project
- Coverage ratio and population served
- Water demand

## Business plan
## (1) Technical plan: Population and population served




## Business plan
## (1) Technical plan: Water demand and capacity of Facility



# Technical plan

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (7) Intake Water Volume | cm/day | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 2,916 | 2,916 |
| (8) Production Volume | cm/day | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 2,916 | 2,916 |
| (9) UFW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| (10) Accounting water | cm/day | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 2,479 | 2,479 |
| (11) NRW | % | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| (12) Possible revenue water | cm/day | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 2,333 | 2,333 |

## - Facility improvement plan

Water resources development in 2021

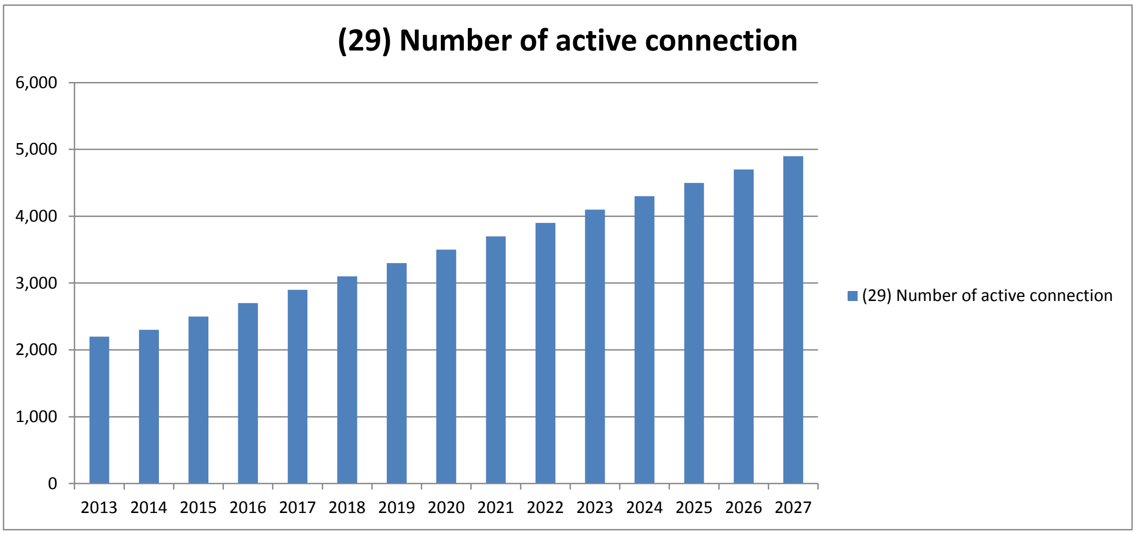
Increase additionally 15 litter per second intake facility

| (1) Facility improvement of 2021 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump (15hp) | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Filter tank | 1 | 5,000 | 5,000 |
| 5) Elevated tank (450 cm) | 1 | 10,000 | 10,000 |
| 6) Generator | 1 | 1,000 | 1,000 |
| 7) Transformer (100KVA) | 1 | 650 | 650 |
| 8) transmission line (m) | 2,000 | 0.8 | 1,600 |
| 9) Distribution line (m) | 17,000 | 0.5 | 8,500 |
| 10) pipe fitting (20%) | | | 2,020 |
| 11) others | | | 20,000 |
| 12) Contingency (15%) | | | 7,721 |
| total | | | 59,191 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

# Commercial plan

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 2,000 | 2,100 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 2,700 | 2,800 | 2,900 | 3,000 |
| (30) Average family size | person/fa | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **(31) Avr. consumption per connection** | **cm/mont** | **11** | **12** | **12** | **12** | **12** | **13** | **13** | **13** | **14** | **14** | **14** |
| (32) Confirmation of (31) with (5) | cm/month | 11 | 12 | 12 | 13 | 13 | 14 | 14 | 14 | 15 | 15 | 16 |
| (33) Minimum charge volume | cm/month | 10 | 10 | 10 | 10 | **10** | **10** | **10** | **10** | **10** | **10** | **10** |
| **(34) Water rate (minimum charge)** | **NR** | **100** | **100** | **100** | **110** | **110** | **120** | **120** | **140** | **140** | **160** | **160** |
| **(35) Water rate (commodity charge 10** | **NR** | **12** | **12** | **12** | **14** | **14** | **16** | **16** | **18** | **18** | **20** | **20** |
| **(35) Water rate (commodity charge 21** | **NR** | **14** | **14** | **14** | **20** | **20** | **24** | **24** | **28** | **28** | **32** | **32** |
| **(36) Collection efficiency** | **%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 220 | 255 | 267 | 311 | 325 | 412 | 428 | 513 | 582 | 682 | 706 |
| (38) Expected annual revenue from sales | ,000 NR/ | 2,634 | 3,062 | 3,208 | 3,733 | 3,895 | 4,939 | 5,137 | 6,160 | 6,981 | 8,185 | 8,467 |
| Water demand from commercial view by | cm/day | 733 | 840 | 880 | 920 | 960 | 1,083 | 1,127 | 1,170 | 1,307 | 1,353 | 1,400 |

# Business plan
## (2) Commercial plan: Number of connection

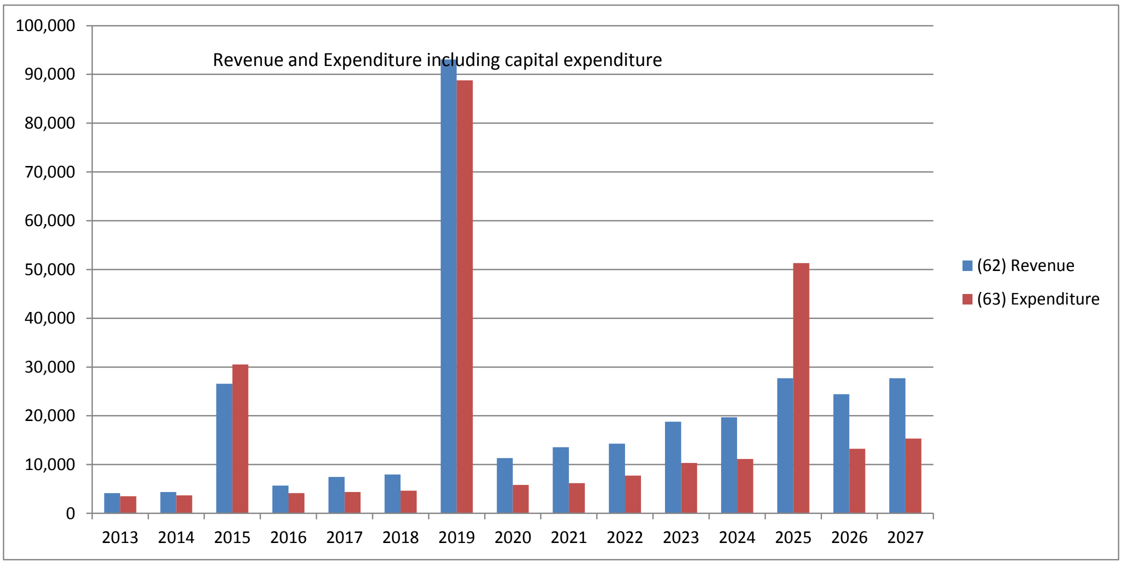



## Financial plan

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 2,634 | 3,062 | 3,208 | 3,733 | 3,895 | 4,939 | 5,137 | 6,160 | 6,981 | 8,185 | 8,467 |
| - domestic customer | | 2,634 | 3,062 | 3,208 | 3,733 | 3,895 | 4,939 | 5,137 | 6,160 | 6,981 | 8,185 | 8,467 |
| - non domestci customer | | | | | | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 790 | 919 | 962 | 1,120 | 1,168 | 1,482 | 1,541 | 1,848 | 2,094 | 2,455 | 2,540 |
| (50) Revenue from operational activity | ,000 NR/ | 3,425 | 3,981 | 4,171 | 4,852 | 5,063 | 6,421 | 6,678 | 8,008 | 9,075 | 10,640 | 11,007 |
| (51) Salaries | ,000 NR/ | 2,000 | 2,100 | 2,205 | 2,315 | 2,431 | 2,553 | 2,680 | 2,814 | 2,955 | 3,103 | 3,258 |
| (52) Power | ,000 NR/ | 800 | 840 | 882 | 926 | 972 | 1,021 | 1,072 | 1,126 | 1,182 | 1,766 | 1,854 |
| (53) Chemicals | ,000 NR/ | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 15 | 26 | 27 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 300 | 315 | 331 | 347 | 365 | 383 | 402 | 422 | 443 | 518 | 544 |
| (55) Other O&M and administration | ,000 NR/ | 200 | 231 | 267 | 308 | 356 | 411 | 475 | 548 | 633 | 732 | 845 |
| (56) Expenditure for operational activity | ,000 NR/ | 3,310 | 3,497 | 3,696 | 3,908 | 4,136 | 4,380 | 4,643 | 4,924 | 5,228 | 6,144 | 6,528 |
| (57) Cash balance of operational activities | ,000 NR/ | 115 | 484 | 475 | 944 | 927 | 2,041 | 2,035 | 3,083 | 3,847 | 4,496 | 4,479 |
| | | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/year | | 0 | 0 | 21,300 | 0 | 0 | 0 | 0 | 0 | 55,095 | 0 |
| (59) Capital expenditure | ,000 NR/year | | 0 | 0 | 26,625 | 0 | 0 | 0 | 0 | 0 | 91,825 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 100 | 0 | | | | | | | | 36,730 | |
| (61) Financial cost | ,000 NR/ | 0 | | | | | | | | | | |
| (62) Revenue | ,000 NR/ | 3,525 | 3,981 | 4,171 | 26,153 | 5,063 | 6,421 | 6,678 | 8,008 | 9,075 | 102,465 | 11,007 |
| (63) Expenditure | ,000 NR/ | 3,310 | 3,497 | 3,696 | 30,534 | 4,136 | 4,380 | 4,643 | 4,924 | 5,228 | 97,969 | 6,528 |
| **(64) Cash balance** | **,000 NR** | **215** | **484** | **475** | **-4,381** | **927** | **2,041** | **2,035** | **3,083** | **3,847** | **4,496** | **4,479** |
| **(65) End balance** | **,000 NR** | **5,000** | **5,484** | **5,959** | **1,578** | **2,506** | **4,546** | **6,582** | **9,665** | **13,512** | **18,008** | **22,487** |

- 60% grant and 40% share for capital investment in 2021
- 50% of profit will return to share holders after 3 years

Business plan
(4) Financial plan: revenue and expenditure



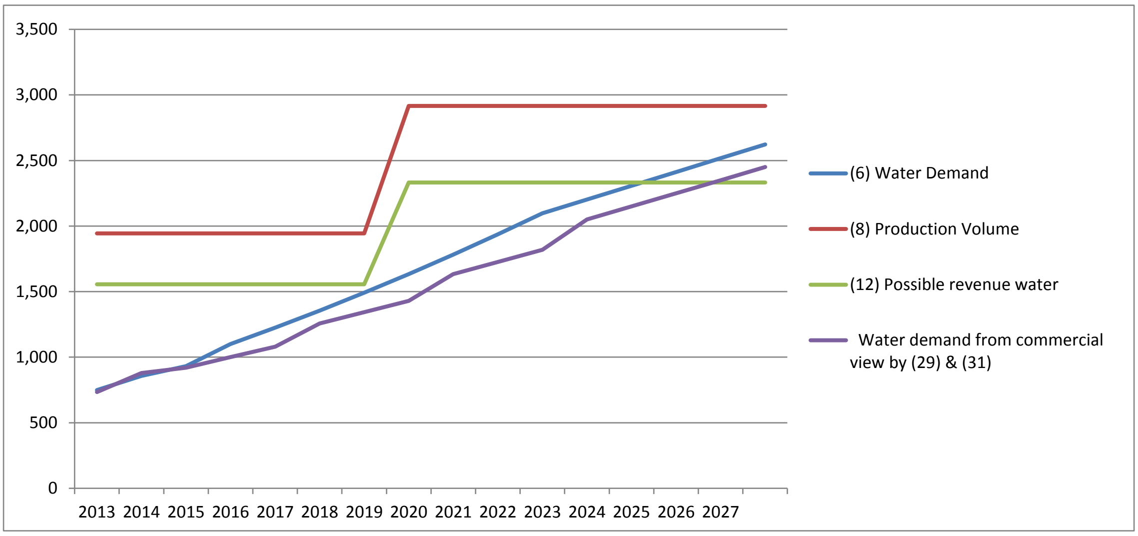
(D) Standard answer for Exercise (B)

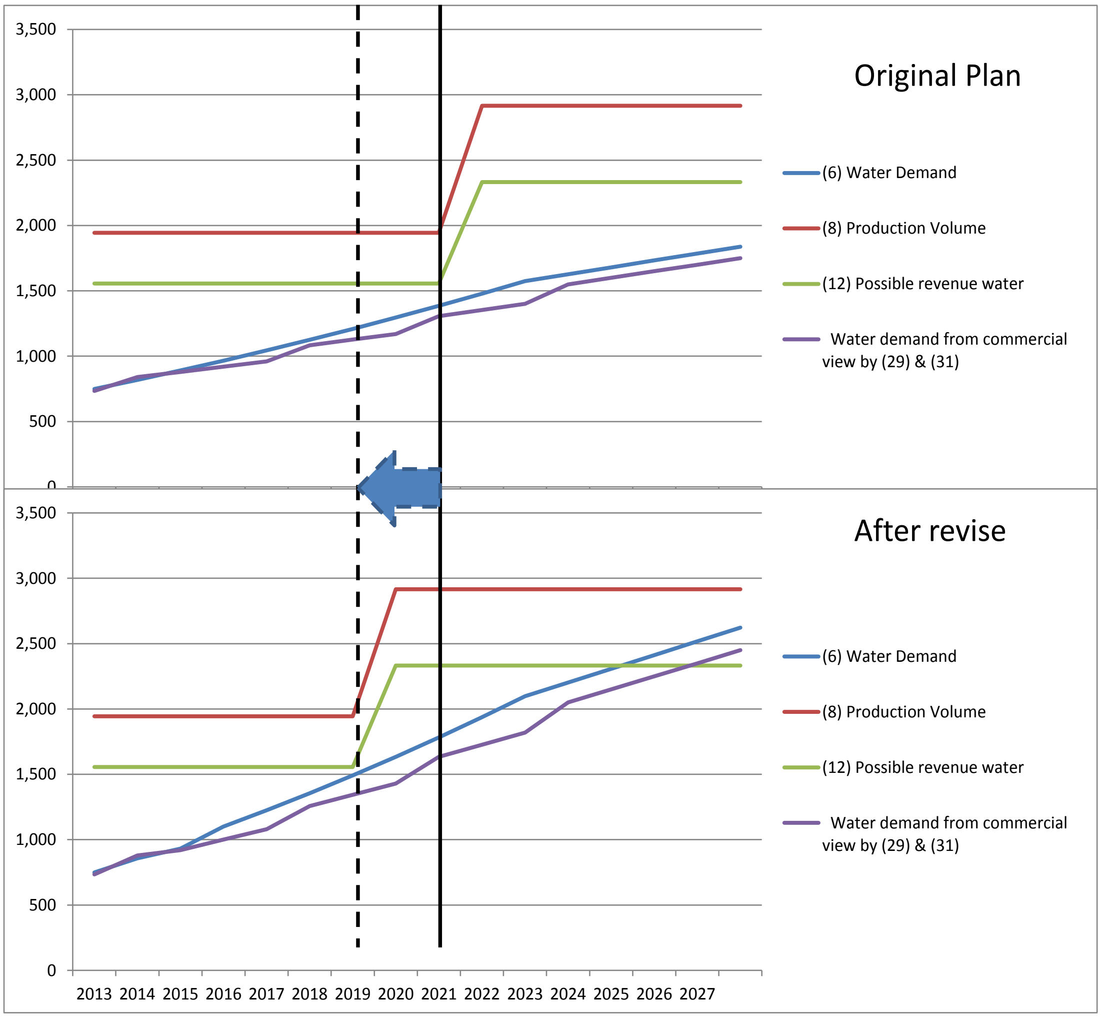
## M&E

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Population | | 25,000 | 26,250 | 27,563 | 28,941 | 30,388 | 31,907 | 33,502 | 35,178 | 36,936 | 38,783 | 40,722 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 40% | 42% | 44% | 46% | 48% | 50% | 52% | 54% | 56% | 58% | 60% |
| (4) Population served | | 10,000 | 11,000 | 11,500 | 13,500 | 14,500 | 15,500 | 16,500 | 17,500 | 18,500 | 19,500 | 20,500 |
| - domestic customer | | 10,000 | 11,000 | 11,500 | 12,500 | 13,500 | 14,500 | 15,500 | 16,500 | 17,500 | 18,500 | 19,500 |
| - non domestci customer | | 0 | 0 | 0 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| (5) Consumption/capita/day | litter | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 |
| - domestic customer | | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 |
| - non domestci customer | | 0 | 0 | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| (6) Water Demand | cm/day | 750 | 858 | 932 | 1,100 | 1,225 | 1,355 | 1,492 | 1,634 | 1,783 | 1,937 | 2,098 |
| - domestic customer | | 750 | 858 | 932 | 1,050 | 1,175 | 1,305 | 1,442 | 1,584 | 1,733 | 1,887 | 2,048 |
| - non domestci customer | | 0 | 0 | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | | | | | | | | | | | | |
| (7) Intake Water Volume | cm/day | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 2,916 | 2,916 | 2,916 | 2,916 |
| (8) Production Volume | cm/day | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 1,944 | 2,916 | 2,916 | 2,916 | 2,916 |
| (9) UFW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| (10) Accounting water | cm/day | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 1,652 | 2,479 | 2,479 | 2,479 | 2,479 |
| (11) NRW | % | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| (12) Possible revenue water | cm/day | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 1,555 | 2,333 | 2,333 | 2,333 | 2,333 |

- Need to accelerating capital investment from 2021 to 2019

## M&E
## (1) Technical plan: Water demand and capacity of Facility






# M&E

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 2,634 | 3,208 | 3,354 | 4,057 | 4,382 | 5,729 | 6,125 | 7,529 | 8,726 | 10,443 | 11,007 |
| - domestic customer | | 2,634 | 3,208 | 3,354 | 4,057 | 4,382 | 5,729 | 6,125 | 7,529 | 8,726 | 10,443 | 11,007 |
| - non domestci customer | | | | | 108 | 108 | 126 | 126 | 144 | 144 | 162 | 162 |
| (49) Revenue from others | ,000 NR/ | 790 | 962 | 1,006 | 1,217 | 1,315 | 1,719 | 1,837 | 2,259 | 2,618 | 3,133 | 3,302 |
| (50) Revenue from operational activity | ,000 NR/ | 3,425 | 4,171 | 4,360 | 5,274 | 5,696 | 7,448 | 7,962 | 9,787 | 11,344 | 13,576 | 14,310 |
| (51) Salaries | ,000 NR/ | 2,000 | 2,100 | 2,205 | 2,315 | 2,431 | 2,749 | 3,093 | 3,464 | 3,864 | 4,296 | 4,761 |
| (52) Power | ,000 NR/ | 800 | 840 | 882 | 926 | 972 | 1,021 | 1,072 | 1,651 | 1,733 | 1,820 | 1,911 |
| (53) Chemicals | ,000 NR/ | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 25 | 26 | 27 | 28 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 300 | 315 | 331 | 347 | 365 | 383 | 402 | 475 | 498 | 523 | 549 |
| (55) Other O&M and administration | ,000 NR/ | 200 | 231 | 267 | 308 | 356 | 411 | 475 | 548 | 633 | 732 | 845 |
| (56) Expenditure for operational activity | ,000 NR/ | 3,310 | 3,497 | 3,696 | 3,908 | 4,136 | 4,577 | 5,055 | 6,162 | 6,755 | 7,398 | 8,095 |
| (57) Cash balance of operational activities | ,000 NR/ | 115 | 674 | 665 | 1,366 | 1,560 | 2,872 | 2,907 | 3,625 | 4,589 | 6,178 | 6,214 |
| | | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/year | | 0 | 0 | 21,300 | 0 | 0 | 0 | 49,973 | 0 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/year | | 0 | 0 | 26,625 | 0 | 0 | 0 | 83,288 | 0 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 100 | 0 | | | | | | 33,315 | | 0 | |
| (61) Financial cost | ,000 NR/ | 0 | | | | | | | | | | 408 |
| (62) Revenue | ,000 NR/ | 3,525 | 4,171 | 4,360 | 26,575 | 5,696 | 7,448 | 7,962 | 93,075 | 11,344 | 13,576 | 14,310 |
| (63) Expenditure | ,000 NR/ | 3,310 | 3,497 | 3,696 | 30,534 | 4,136 | 4,577 | 5,055 | 89,450 | 6,755 | 7,398 | 8,503 |
| **(64) Cash balance** | **,000 NR** | **215** | **674** | **665** | **-3,959** | **1,560** | **2,872** | **2,907** | **3,625** | **4,589** | **6,178** | **5,806** |
| **(65) End balance** | **,000 NR** | **5,000** | **5,674** | **6,339** | **2,380** | **3,940** | **6,811** | **9,718** | **13,344** | **17,933** | **24,111** | **29,917** |

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# Draft Business Plan
# of
# Dhulabari
# Water Users and Sanitation Committee
# for
# 2012 to 2025

November 2011

Dhulabari Water Users and Sanitation Committee
Draft Business Plan for 2012 to 2025

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**Preface**

This business plan has been prepared to present in the joint workshop in the joint workshop of Dhulabari WUSC, Mangadh WUSC and Gaudadaha WUSC on $30^{th}$ of November 2011 organized by JICA Technical Cooperation Project Team in Dhulabari WUSC meetinghall.

This plan has been prepared by the Special Committee founded by Dhiulabari WUSC that consists of Mr. Bachang Nembang chairman, Mr. Tanka Pds. Bhattari vice chairman, Mr. Indra Brd. Budathoki, secretary and Mr. Surya Tamang, accountant. In plan the year 2011 is taken as the base year and it covers up to 2025. While preparing this plan, all the data are taken from previous records, tables and charts are prepared on the fact data analysis basis.

We would like to extend our sincerely gratitude to Mr. Toru Suetak, the NJs expert for tis invaluable guidance while preparing this business plan.

We are also grateful to Mr. Punya Rimal, NJS Interpreter who helped us interpreting the original ideas presented/ put forward by the above s mentioned expert.

Bachang Nembang
Chairman of
Dhulabari Water Users
and
Sanitation Committee

**Abbreviation and Definition**

cm: cubic meter
DWSSDO: District Water Supply and Sanitation Divisional Office
km: kilo meter
mm: mili meter
NRW: Non-Revenue Water
O&M: Operation and Maintenance
UFW: Unaccountable for Water
VDC: Village Development Committee
WTP: Water Treatment Plant
WUSC: Water User and sanitation Committee

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## Executive Summary

This business plan would implementing with three phases namely, (1) short term which covers 2012-2012, (2) medium term which covers 2013, and (3) long term which covers 2016 to after for focus on following subjects:

(1) Short term plan (2012-2013)
i) To construct a well-facilitated office building
ii) To conduct workshop/ training to enhance the skill and efficiency of the staffs
iii) To equip the WUSC with modern technology, computerized system and other tools
iv) To set up a temporary cash counter
v) Conduct public health awareness program
vi) To save environment program/ campaigns like plantation and sanitation will be conducted

(2) Medium term plan (2013-2015)
i) Run bottled water industry along with other income generation business to enlarge income structure
ii) Establish mutual cooperation among users
iii) Start shops dealing with plumbing tools, to provide consumers with such tools and other related item at reasonable cost
iv) Try to encourage the people having low income source to connect with affordable cost
v) Run social activities with the coordination of other social service organization

(3) Long term plan (2016-2025)
i) Plant other OH Tank as per requirement
ii) Extend pipe line as per requirement
iii) Plant deep boring to produce more water
iv) Plan filter facility
v) Manage a vehicle to work faster and more easily and provide the staff with transportation

### (1) Increases of service connection

Number of service connection rapidly increasing, average for 250 per year.

| B: Customer service | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | | 200 | 372 | 219 | 90 | 366 |
| (29) Number of active connection | | 1,000 | 1,200 | 1,572 | 1,791 | 1,881 | 2,247 |

### (2) Financial analysis

Although revenue is rapidly increasing, however, also cost is rapidly increase, especially power and fuel cost as well as salaries are significant.

| Financial performance 2007-2011 | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Base line |
|---|---|---|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | | 1,604 | 2,480 | 3,878 | 4,027 | 4,685 | 4,685 |
| (44) Revenue from others | ,000 NR/year | | 434 | 791 | 1,232 | 1,079 | 1,017 | 1,017 |
| (45) Operational revenue | ,000 NR/year | | 2,038 | 3,271 | 5,110 | 5,106 | 5,702 | 5,702 |
| (46) Salaries | ,000 NR/year | | 936 | 1,469 | 1,754 | 682 | 1,705 | 1,705 |
| (47) Power | ,000 NR/year | | 114 | 332 | 568 | 488 | 585 | 585 |
| (48) Chemicals | ,000 NR/year | | 0 | 15 | 21 | 6 | 7 | 7 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | | 192 | 277 | 903 | 731 | 1,491 | 1,491 |
| (50) Other O&M and administration | ,000 NR/year | | 706 | 744 | 1,281 | 1,777 | 540 | 540 |
| (51) Operational expenditure | ,000 NR/year | | 1,948 | 2,837 | 4,527 | 3,684 | 4,328 | 4,328 |
| (52) Cash balance of operational activities | ,000 NR/year | | 90 | 434 | 583 | 1,422 | 1,374 | 1,374 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (53) Revenue for capital investment | ,000 NR/year | 2,235 | 0 | 0 | 1,940 | 944 | 944 |
| (54) Capital expenditure | ,000 NR/year | 953 | 0 | 0 | 1,940 | 772 | 772 |
| (55) Revenue from financial activity | ,000 NR/year | 11 | 182 | 147 | 63 | 163 | 163 |
| (56) Financial cost | ,000 NR/year | 0 | 0 | 0 | 0 | 0 | 0 |
| Revenue | ,000 NR/year | 4,284 | 3,453 | 5,257 | 7,109 | 6,809 | 6,809 |
| Expenditure | ,000 NR/year | 2,901 | 2,837 | 4,527 | 5,624 | 5,100 | 5,100 |
| (57) Cash balance | ,000 NR/year | 1,383 | 616 | 730 | 1,485 | 1,709 | 1,709 |

### (3) Water demand

Present population in the jurisdiction of Dhulabari WUSC in 2011 is 40 thousands and population growth is 2.1%. The projection of population shows table below.

Service coverage in 2011 is 50%, and the WUSC hope to increasing coverage ratio to 73% in 2025.

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (1) Population | | 40,000 | 43,467 | 48,227 | 53,508 |
| (2) Population growth | % | 2.10% | 2.10% | 2.10% | 2.10% |
| (3) Coverage ratio | % | 50% | 59% | 67% | 73% |
| (4) Population served | | 20,000 | 25,598 | 32,198 | 38,798 |

Average consumption water volume per capita per day is 65 litters, and average family size is 6 people. Table shows water demand based on these conditions as well as planned production and distribution volume.

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (5) Consumption/capita/day | litter | 65 | 90 | 105 | 105 |
| (6) Water Demand | cm/day | 1,300 | 2,304 | 3,381 | 4,074 |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% |
| (10) Accounting water | cm/day | 2,200 | 2,728 | 3,784 | 4,400 |
| (11) NRW | % | 15% | 15% | 15% | 15% |
| (12) Possible revenue water | cm/day | 2,125 | 2,635 | 3,655 | 4,250 |

### (4) Engineering plan

The WUSC has facility improvement plan including rehabilitation of existing facilities as well as construction of new intake facilities for meet water demand:

- Construction of new well and intake (2012)
- Construction of new well and intake (2018)
- Construction of new well and intake (2020)
- Construction of new well and intake (2023)
- Rehabilitation of existing facility (2018)

### (5) Customer service plan

The WUSC plans to increasing 220 connections annually as table below.

| Numberof connectrion by zone | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | average |
| Zone 1 | 795 | 845 | 895 | 945 | 995 | 1,045 | 1,095 | 1,145 | 1,195 | 1,245 | 50 |
| Zone 2 | 220 | 250 | 280 | 310 | 340 | 370 | 400 | 430 | 460 | 490 | 30 |
| Zone 3 | 405 | 445 | 485 | 525 | 565 | 605 | 645 | 685 | 725 | 765 | 40 |
| Zone 4 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 30 |
| Zone 5 | 430 | 465 | 500 | 535 | 570 | 605 | 640 | 675 | 710 | 745 | 35 |
| Zone 6 | 300 | 335 | 370 | 405 | 440 | 475 | 510 | 545 | 580 | 615 | 35 |
| Total | 2,300 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 220 |

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | n.a. | 273 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |

### (6) Water rate improving plan

The WUSC plans to improving water rate as table below:

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 80 | 90 | 90 | 100 | 100 | 100 | 100 | 125 |
| (35) Water rate (commodity charge) | NR | 12 | 12 | 12 | 14 | 14 | 14 | 14 | 16 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| (35) Water rate (commodity charge) | NR | 16 | 16 | 16 | 16 | 16 | 16 | 16 |

Increasing to 90 Rupees in 2013 and then increasing to 100 Rupees in 2014, again increasing 125 Rupees and maintaining.

### (7) Administrative plan

The WUSC plans to increasing staff gradually for maintaining labor efficiency as around 150 connections per staff.

### (8) Financial plan

The WUSC projected revenue and expenditure as following tables. The WUSC expects financial assistance from the government for their capital investment.

| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ye | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (51) Salaries | ,000 NR/ye | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 |
| (52) Power | ,000 NR/ye | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 |
| (53) Chemicals | ,000 NR/ye | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 |
| (55) Other O&M and administration | ,000 NR/ye | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (57) Cash balance of operational activities | ,000 NR/ye | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (59) Capital expenditure | ,000 NR/ye | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (60) Revenue from financial activity | ,000 NR/ye | 163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| (65) End balance | ,000 NR | 2,457 | 2,537 | 2,593 | 3,383 | 6,806 | 10,393 | 13,722 | 18,016 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |
| (49) Revenue from others | ,000 NR/ye | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 | 6,389 |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (51) Salaries | ,000 NR/ye | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 | 7,621 |
| (52) Power | ,000 NR/ye | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 | 3,440 |
| (53) Chemicals | ,000 NR/ye | 19 | 25 | 27 | 29 | 38 | 41 | 44 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 | 8,486 |
| (55) Other O&M and administration | ,000 NR/ye | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 | 6,365 |
| (56) Expenditure for operational activity | ,000 NR/ye | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (57) Cash balance of operational activities | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| (65) End balance | ,000 NR | 21,587 | 27,195 | 32,052 | 35,932 | 37,984 | 38,508 | 41,759 |

## (9) Monitoring and evaluation

The WUSC plans to monitoring and reviewing ever year focus on following target and indicators, when annual budget is formulating (April-May), and update this business plan, if necessary. The WUSC respects this business plan for framework of their budget.

| E: Target and key performance indicator | Unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% | 64% |
| (4) Population served | 0 | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 | 29,558 |
| (31) Avr. consumption per connection | cm/month | 12 | 12 | 12 | 12 | 16 | 16 | 16 | 16 |
| (29) Number of active connection | 0 | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |
| (B) Engineering | | | | | | | | | |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | | |
| (40) Number of staff | 0 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |
| Number of connection per staff | 0 | 98 | 110 | 119 | 129 | 138 | 148 | 157 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,303 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,766 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,470 |

| E: Target and key performance indicator | Unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | |
| (3) Coverage ratio | % | 65% | 67% | 68% | 69% | 70% | 72% | 73% |
| (4) Population served | | 30,878 | 32,198 | 33,518 | 34,838 | 36,158 | 37,478 | 38,798 |
| (31) Avr. consumption per connection | cm/month | 16 | 19 | 19 | 19 | 19 | 19 | 21 |
| (29) Number of active connection | 0 | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |
| (B) Engineering | | | | | | | | |
| (8) Production Volume | cm/day | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 |
| Number of connection per staff | | 150 | 159 | 155 | 152 | 159 | 156 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (56) Expenditure for operational activity | ,000 NR/ye | 11,611 | 13,509 | 15,179 | 17,057 | 19,839 | 22,238 | 24,939 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 11,611 | 41,479 | 15,179 | 17,057 | 55,073 | 22,238 | 24,939 |
| (64) Cash balance | ,000 NR/ye | 4,009 | 6,081 | 5,419 | 4,547 | 2,772 | 1,380 | 4,267 |

Target:
- Number of connection
- NRW
- Number of connection per staff
- Collection Efficiency
- Revenue, specially revenue from operational activity
- Expenditure, specially expenditure for operational activity
- Cash balance, it should be positive

Monitoring:
- Coverage
- Population served
- Production volume
- Average consumption volume per connection
- UFW

## 1. Background

### 1.1 History, Objectives, Vision and mission of WUSC

**(1) History and objective of establishing the committee**

The Dhulabari Water Users and Sanitation Committee (WUSC) was established in 2050 B.S. (some 18 years ago) with the loan-granted by ADB amounted 26.4 million NRS with a vision to provide pure and safe drinking water in Dhulabari. Later the Government of Japan helped it with donation of NRS 420 million to plant water filter.

**(2) Vision**

To provide pure safe, and qualitative drinking water to people residing in the area at minimum cost and help the nation build a healthy and civilized citizens community.

**(3) Mission**

To provide pure, safe and quality drinking water. WUSC has the mission to make it cooperating by making appropriate policy, strategy and collecting resources for sustainable and manageable.

**(4) Goal:**

To satisfy the people by providing pure, safe and quality water in the area in sufficient quality.

**(5) Objectives**

- To manage, develop and sustain it by coordinating to the concerning stakeholders
- To manage all the resources collect
- To provide safe, pure and quality water by adapting dependable distribution, maintenance and management system
- To conduct public hygiene and health programs based on participation approach
- To provide maximum people by adapting governance, policy and following the both national and international standard as practicable.

### 1.2 Geopolitical information

The WUSC jurisdiction extended in the:

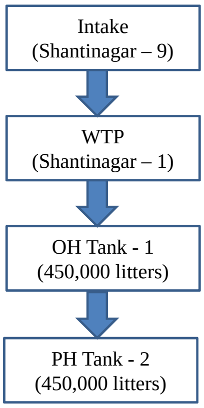
East – ward No. 1, 6, Dhulabari (Ninda Khola)
West- ward No. 2, 3, 5 Lulpani
North – ward No. 4 Magurmani
South – ward No.1 Dhulabari Campus (Kharedayi)

### 1.3 Present status

The Dhulabari WUSC gets its water from intake located in Shantinagar VDC – 9, just 17 km from the WUSC office. The intake water is brought to WTP located at Shantinagar VDC 1. There is always a risk for the transmission pipe as it has to cross the mountain river. The range of intake volume capacity ranges from 600 litter a minutes during dry season that we can’t supply to required quantity of water.

We have used different type and size pipe line HDPE 20 mm to 400 mm, GI 300 mm and DC 250 mm etc. About 5.5 km pipeline extension is estimated.

There are two overhead tanks with the capacity of 450,000 litters each and a deep boring.




**1.4 Review of previous business plan**

This business plan is first one for the committee, and impossible to review previous plan, however, objective of this section is analysis of actual management performance for setting basis of projection and planning for next 10 years.

Unfortunately, the Committee has not keep non-financial data and just starts to consider as monthly report including both financial and non-financial data.

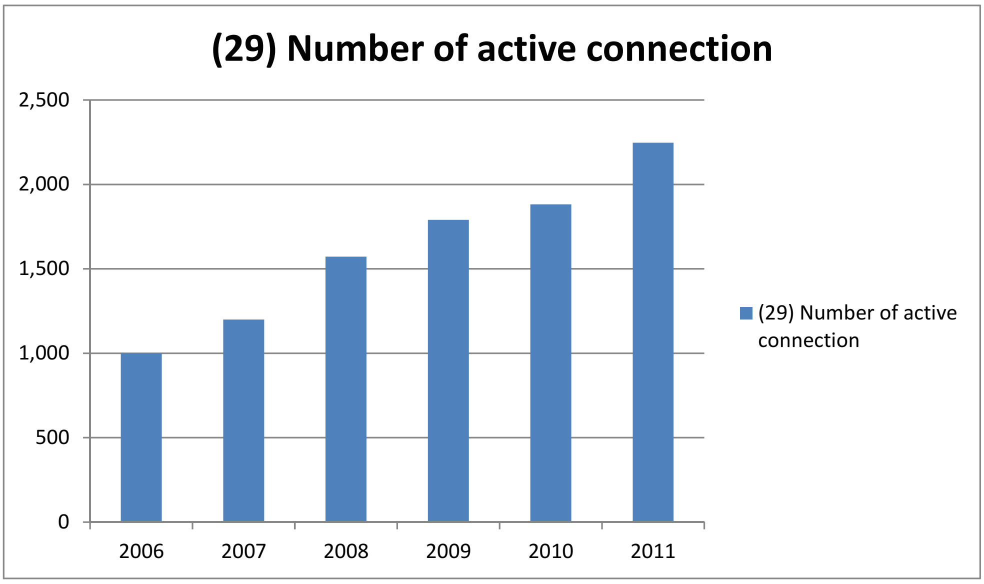
Consider these situation, this planning report simply focus to analysis on increasing of service connection and increasing of revenue and operational cost.

**(1) Increases of service connection**

Here below the Table 1.3A and Chart 1.3A shows the yearly increments of service connection for past 5 years. However, number of 2006 and 2007 are assumed, though WUSC lost record. It observed significant increasing of connection and average is around 250 per year. The committee has been try to be best for replay request to provide safe water affordable from members but still coverage ratio is 50% and need more facility improvement to achieves water demand.

Table 1.3A: active service connection 2007-2011

| B: Customer service | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | | 200 | 372 | 219 | 90 | 366 |
| (29) Number of active connection | | 1,000 | 1,200 | 1,572 | 1,791 | 1,881 | 2,247 |




Note: number of 2006 and 2007 are assumed

Chart 1.3A: active service connection 2007-2011

**(2) Financial analysis**

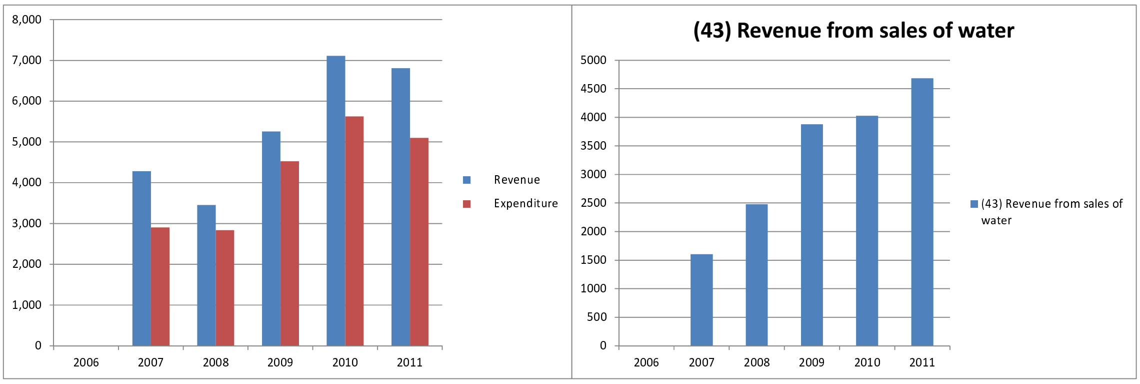
Table 1.3B shows financial performance including revenue from sales of water and other operational revenue, expenditures including salaries, power and fuel for pumping, chemical and administrative cost. Although revenue is rapidly increasing, however, also cost is rapidly increase, especially maintenance cost as well as salaries are significant. The Committee tries to reduce total cost for water supply and improving management efficiency, and success to reduce cost for office management, however, high inflation, more than 8% sometimes, makes so difficult to maintaining requirements of customer services and still shortage of staff.

Fluctuation of revenue and expenditure causes by government subsidiary for facility improvement and expansion, and capital expenditure. Revenue from sales of water is increasing stable manner.

Table 1.3B: financial performance and expenses 2007-2011

| Financial performance 2007-2011 | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | | 1,604 | 2,480 | 3,878 | 4,027 | 4,685 |
| (44) Revenue from others | ,000 NR/year | | 434 | 791 | 1,232 | 1,079 | 1,017 |
| (45) Operational revenue | ,000 NR/year | | 2,038 | 3,271 | 5,110 | 5,106 | 5,702 |
| (46) Salaries | ,000 NR/year | | 936 | 1,469 | 1,754 | 682 | 1,705 |
| (47) Power | ,000 NR/year | | 114 | 332 | 568 | 488 | 585 |
| (48) Chemicals | ,000 NR/year | | 0 | 15 | 21 | 6 | 7 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | | 192 | 277 | 903 | 731 | 1,491 |
| (50) Other O&M and administration | ,000 NR/year | | 706 | 744 | 1,281 | 1,777 | 540 |
| (51) Operational expenditure | ,000 NR/year | | 1,948 | 2,837 | 4,527 | 3,684 | 4,328 |
| (52) Cash balance of operational activities | ,000 NR/year | | 90 | 434 | 583 | 1,422 | 1,374 |
| | | | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | 2,235 | 0 | 0 | 1,940 | 944 |
| (54) Capital expenditure | ,000 NR/year | | 953 | 0 | 0 | 1,940 | 772 |
| (55) Revenue from financial activity | ,000 NR/year | | 11 | 182 | 147 | 63 | 163 |
| (56) Financial cost | ,000 NR/year | | 0 | 0 | 0 | 0 | 0 |
| Revenue | ,000 NR/year | | 4,284 | 3,453 | 5,257 | 7,109 | 6,809 |
| Expenditure | ,000 NR/year | | 2,901 | 2,837 | 4,527 | 5,624 | 5,100 |
| (57) Cash balance | ,000 NR/year | | 1,383 | 616 | 730 | 1,485 | 1,709 |
| (58) End balance | ,000 NR | | 1,383 | 1,999 | 2,729 | 4,214 | 5,923 |

Note: Revenue including subsidiary from DWSSDO and expenditure including capital investment




Note: Including capital investment and subsidiary from DWSSDO (in left chart)

Chart 1.3B: financial performance and expenses 2007-2011

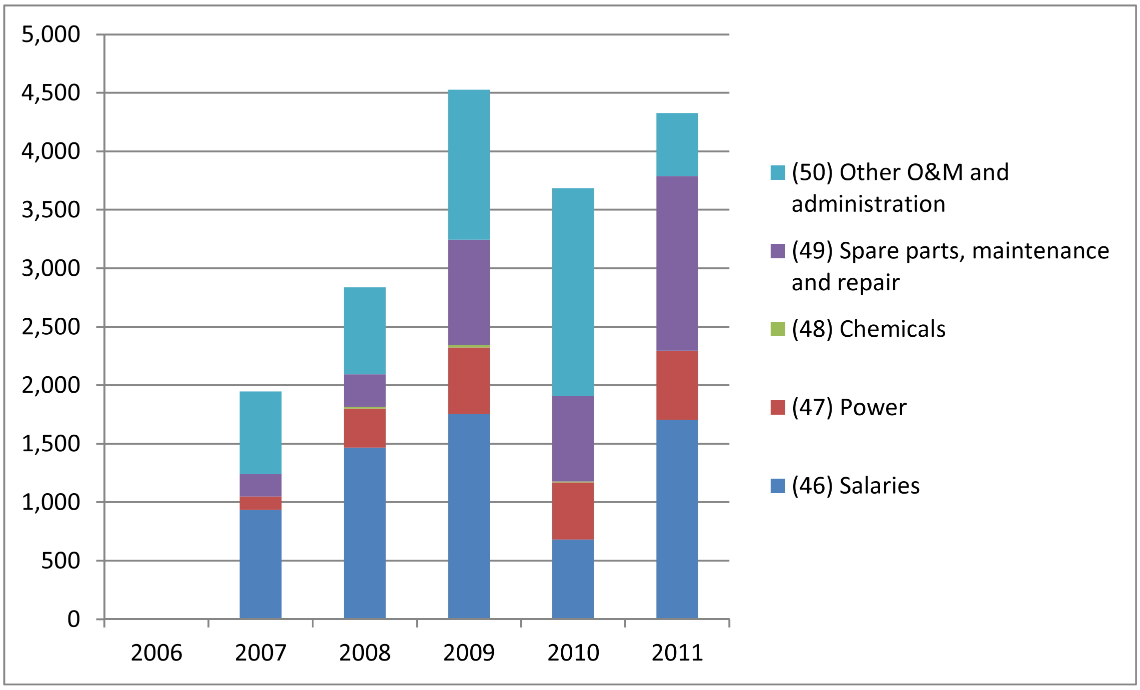


Chart 1.3C: expenditure by cost elements 2007-2011

**1.5 Issues and problems, and objectives in the plan**

The objective of this business plan is gives more long term view of water supply and necessary action for achieves bright future in the jurisdiction.

Since these are not comes from the result of reviewing previous business plan, however, following issues and problems are significantly observed:

- Necessary of facility improvement and rehabilitation of existing facilities to enhance water supply in existing area
- Renovation and improvement of casher's windows
- Increasing number of staff after 2018
- Computerization of billing and collection system

(1) Necessary of facility improvement

For maintaining present water supply capability, maintaining existing facility for keep providing safe water to users, the WUSC need to improving intake facility capability. Already water shortage is phenomena on dry season and using grand water, but need more water resources in near future is obvious.

Also, rehabilitation may need to consider for maintaining full capacity of existing facility in certain period.

(2) Increasing number of staff

It may necessary to increasing number of staff gradually for maintaining high quality user services, and also JICA Expert recommend to improving building structure of cashier's window for avoiding long cue line for waiting payment. The WUSC plans to maintain labor efficiency of 150 connections per staff, and that may requires increasing of staff after 2018, when number of connection reaches to 3,800 connections.

Also, the WUSC need to consider skilled staff, including manager and chief engineer. Presently, these two posts are vacant.

(3) Computerization of billing and collection system as well as improving building structure of cashier's window

Since number of connection exceed more than 2,000, volume of work for customer services is rapidly increasing. For avoiding crowded and long cue of cashier's window for accept payment of water bill, JICA Expert recommend to computerizing billing and collection system, increasing cashier, and improving structure of cashier's window.

**1.6 Implementing phases**

This business plan would implementing with three phases namely, (1) short term which covers 2012-2012, (2) medium term which covers 2013, and (3) long term which covers 2016 to after for focus on following subjects:

(4) Short term plan (2012-2013)

vii) To construct a well-facilitated office building
viii) To conduct workshop/ training to enhance the skill and efficiency of the staffs
ix) To equip the WUSC with modern technology, computerized system and other tools
x) To set up a temporary cash counter
xi) Conduct public health awareness program
xii) To save environment program/ campaigns like plantation and sanitation will be conducted

(5) Medium term plan (2013-2015)

vi) Run bottled water industry along with other income generation business to enlarge income structure
vii) Establish mutual cooperation among users
viii) Start shops dealing with plumbing tools, to provide consumers with such tools and other related item at reasonable cost
ix) Try to encourage the people having low income source to connect with affordable cost
x) Run social activities with the coordination of other social service organization

(6) Long term plan (2016-2025)

vi) Plant other OH Tank as per requirement
vii) Extend pipe line as per requirement
viii) Plant deep boring to produce more water
ix) Plan filter facility
x) Manage a vehicle to work faster and more easily and provide the staff with transportation

**1.7 Others**

JICA Experts introduce and recommends to improving:

- Improving and standardizing facility operation and management by SOP, Standard Operation Procedures in area of facility operation and maintenance, meter reading and meter carburation, and water quality management
- Implementing and improving user's complaint management system
- Implementing and improving monthly data sheet (monthly management report)
- Improving style and enrich contents of annual report
- Activating awareness program and enlighten necessity of good hygiene practice and roles of water supply for effective use of safe water

## 2. Engineering plan

### 2.1 Population and service coverage

Present population in the jurisdiction of Dhulabari WUSC in 2011 is around 40,000 and population growth is 2.1%. Thus the projection of population shows Table 2.1A. With this projection, population in 2015 is 43.5 thousands, in 2020 is 48.2 thousands and in 2025, it would be 53.5 thousands.

Service coverage in 2011 is 50%, and the WUSC hope to increasing this coverage ratio to 73% in 2025.

Table 2.1A: Projection of population and service coverage

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (1) Population | | 40,000 | 43,467 | 48,227 | 53,508 |
| (2) Population growth | % | 2.10% | 2.10% | 2.10% | 2.10% |
| (3) Coverage ratio | % | 50% | 59% | 67% | 73% |
| (4) Population served | | 20,000 | 25,598 | 32,198 | 38,798 |

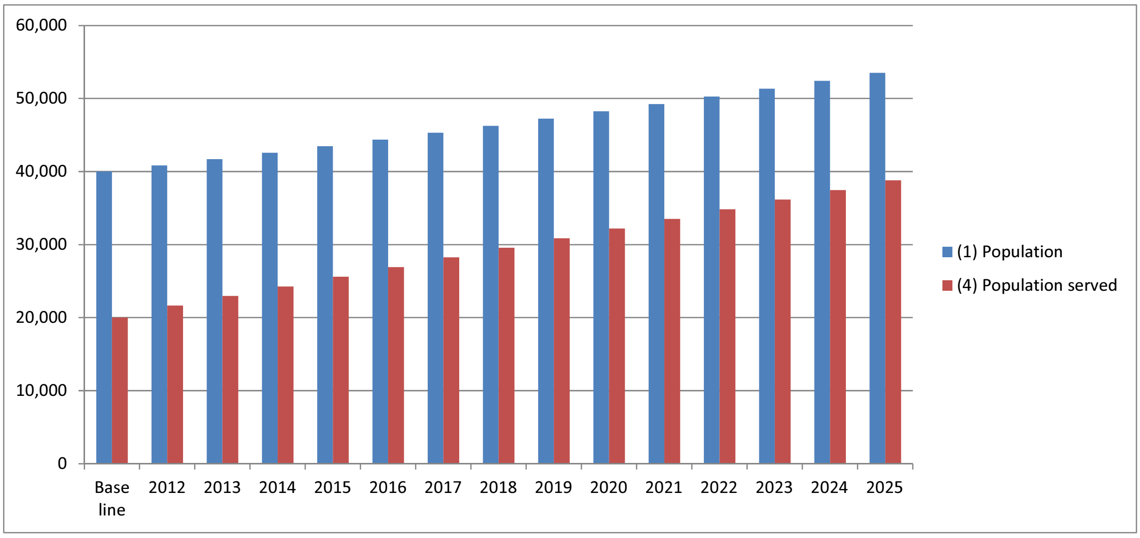



Chart 2.1A: Projection of population and service coverage

### 2.2 Water demand

Average consumption water volume per capita per day is 65 litters, and average family size is 6 people. Table 2.2A shows water demand based on these conditions as well as planned production and distribution volume.

Table 2.2A: Water demands

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (5) Consumption/capita/day | litter | 65 | 90 | 105 | 105 |
| (6) Water Demand | cm/day | 1,300 | 2,304 | 3,381 | 4,074 |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% |
| (10) Accounting water | cm/day | 2,200 | 2,728 | 3,784 | 4,400 |
| (11) NRW | % | 15% | 15% | 15% | 15% |
| (12) Possible revenue water | cm/day | 2,125 | 2,635 | 3,655 | 4,250 |

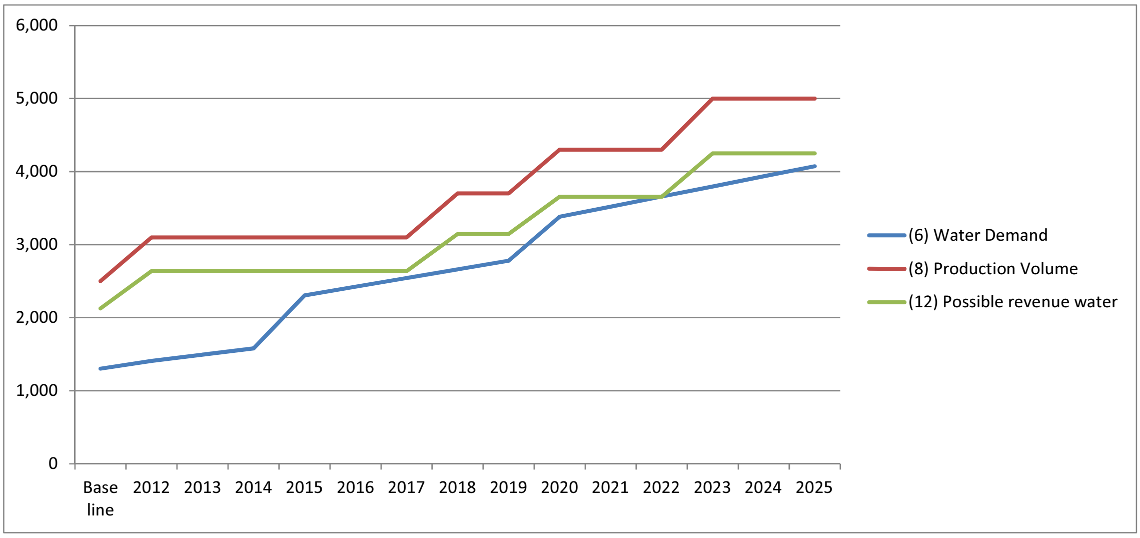



Chart 2.2A: Water demands

## 2.3 Facility improvement plan

The WUSC has 4 facility improvement plans and 1 rehabilitation plan up to 2025. Chart 2.3A shows whole map of facility improvement and rehabilitation concept.

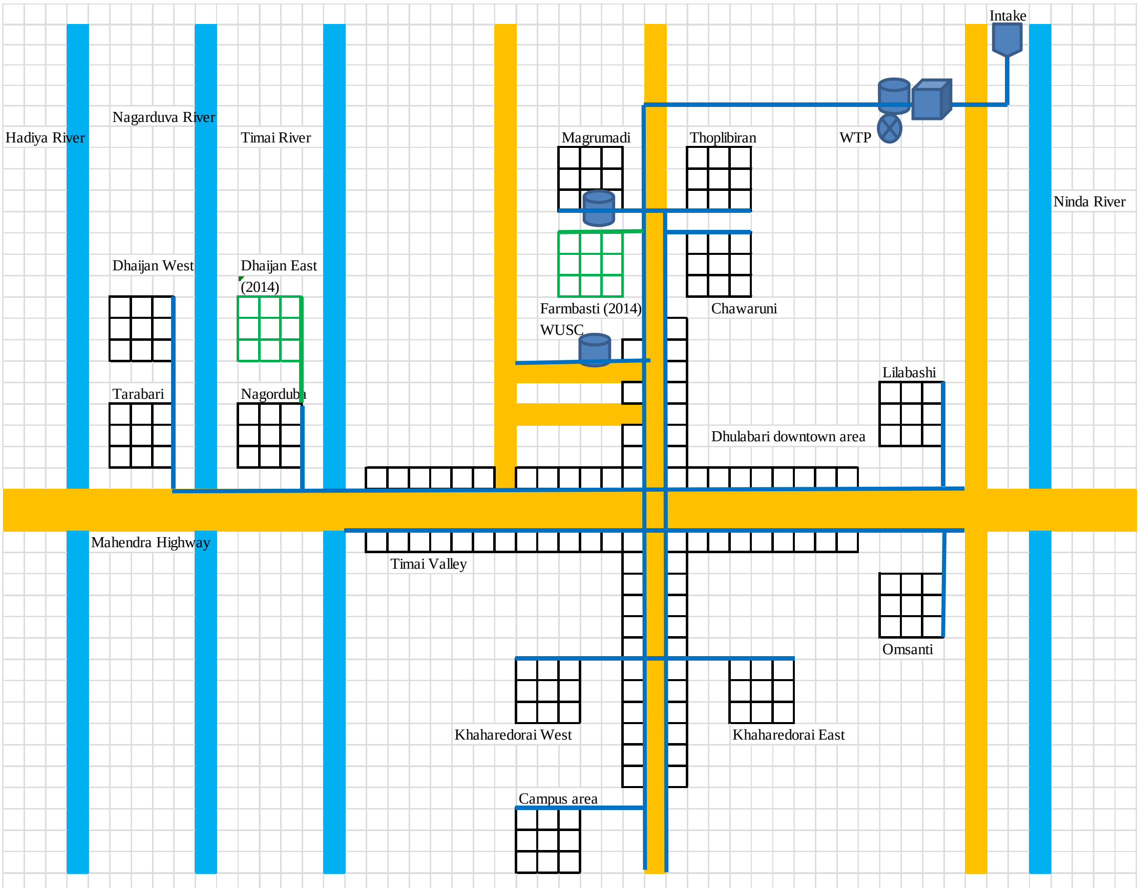



Chart 2.3A: Scheme Map of Dhulabari WUSC jurisdiction

1) Construction of new facility (2012, 2018, 2020 and 2023)

This project aims to constructing new intake facility for meet increasing water demand. However, further study may necessary and this draft business plan assumes almost same cost in price of 2011 for these 4 constructions of new intake facilities.

Table 2.3A: Cost estimate of construction of new intake facility

| (1) New Tubewell, 2012, 2018, 2020 and 2023 | | | |
|---|---|---|---|
| Items | Unit | Unit Cost | Cost |
| 1) Development of new well and intake | | | 10,000 |
| 2) Pump | | | 600 |
| 3) pipes | | | |
| 3) Supervision | | | 1,060 |
| 3) Contingency | | | 2,332 |
| total | | | 13,992 |
| Unit: Million NR | | | |

### 2.4 Facility maintenance plan

The WUSC has one facility maintenance plans.

1) Rehabilitation of existing facility
   The WUSC wishes to maintain existing facility granted by the Government of Japan to maintaining providing safe water to present users in certain time. This business plan assumes 6.7 million Nepal Rupees that may covered by the WUSC' own financial resources, though the WUSC expected financial assistance from their government.

Table 2.4A: Cost estimation for rehabilitation in existing facility

| (2) Rehabilitation of purification plant 2017 | | | |
|---|---|---|---|
| Items | Unit | Unit Cost | Cost |
| 1) Facilities renovation | | | 5.0 |
| 2) Pipeline and fitting | | | 0.1 |
| 3) Supervising | | | 0.5 |
| 4) Contingency | | | 1.1 |
| total | | | 6.7 |
| Unit: Million NR | | | |

### 2.5 Operation and maintenance plan

Operation and maintenance plan to maintaining necessary capacity for water supply is shows as Table 2.5A.

Power and fuel for pumping, chemicals, spare parts and maintenance cost would be increasing by new facilities.

Table 2.5A: O&M plan

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (21) Power and fuels for pumping | ,000 NR/ | 585 | 987 | 2,019 | 3,440 |
| (24) Chemical for production | ,000 NR/ | 7 | 12 | 25 | 44 |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 1491 | 2,434 | 4,979 | 8,486 |

### 2.6 Cost of engineering plan

Cost for engineering plan would be like Table 2.6A. Already capital costs are mentioned previously.

Table 2.6A: Cost for Engineering Plan

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (19) Increases of power cost (*1) | ,000 NR/ye | n.a | 140 | 0 | 0 | 0 | 0 | 0 | 230 |
| (20) Inflated (19) | ,000 NR/ye | n.a | 152 | 0 | 0 | 0 | 0 | 0 | 249 |
| (21) Power and fuels for pumping | ,000 NR/ye | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 |
| (22) Increases of chemical cost (*1) | ,000 NR/ye | n.a | 2 | 0 | 0 | 0 | 0 | 0 | 3 |
| (23) Inflated (22) | ,000 NR/ye | n.a | 2 | 0 | 0 | 0 | 0 | 0 | 3 |
| (24) Chemical for production | ,000 NR/ye | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 |
| (25) Increases of spare parts, repair, maintenance (*1) | ,000 NR/ye | n.a | 298 | 0 | 0 | 0 | 0 | 0 | 568 |
| (26) Inflated (25) | ,000 NR/ye | n.a | 322 | 0 | 0 | 0 | 0 | 0 | 613 |
| (26) Spare parts, repair and maintenance | ,000 NR/ye | 1491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 |
| (27) O&M cost excluding salares and admi. | ,000 NR/ye | 2083 | 2,725 | 2,943 | 3,179 | 3,433 | 3,708 | 4,004 | 5,189 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (19) Increases of power cost (*1) | ,000 NR/ye | 0 | 258 | 0 | 0 | 377 | 0 | 0 |
| (20) Inflated (19) | ,000 NR/ye | 0 | 278 | 0 | 0 | 407 | 0 | 0 |
| (21) Power and fuels for pumping | ,000 NR/ye | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 | 3,440 |
| (22) Increases of chemical cost (*1) | ,000 NR/ye | 0 | 4 | 0 | 0 | 6 | 0 | 0 |
| (23) Inflated (22) | ,000 NR/ye | 0 | 4 | 0 | 0 | 6 | 0 | 0 |
| (24) Chemical for production | ,000 NR/ye | 19 | 25 | 27 | 29 | 38 | 41 | 44 |
| (25) Increases of spare parts, repair, maintenance (*1) | ,000 NR/ye | 0 | 636 | 0 | 0 | 929 | 0 | 0 |
| (26) Inflated (25) | ,000 NR/ye | 0 | 687 | 0 | 0 | 1,003 | 0 | 0 |
| (26) Spare parts, repair and maintenance | ,000 NR/ye | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 | 8,486 |
| (27) O&M cost excluding salares and admi. | ,000 NR/ye | 5,604 | 7,022 | 7,584 | 8,191 | 10,262 | 11,083 | 11,970 |

(*1) price of year 2011

Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009

## 2.7 others

Cost estimation of facility improvement (both rehabilitation of existing purification facility and planned new purification facility) may necessary to exam more detail, as well as consider possibility of financial assistance from the government.

## 3. Customer service plan

### 3.1 Connection

Present active connection is 2,247 and increasing 250 connections annually for last 5 years. But such rapid increasing may slow down after coverage ratio exceed more than 50%, thus the WUSC estimates increasing 220 new connections every year to 2025 may sufficient for focus on water supply covered area. Table 3.1A shows the WUSC's plan of service connection up to 2025.

Table 3.1A: Service Connection Plan by Zones 2011-2020

| Numberof connectrion by zone | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | average |
| Zone 1 | 795 | 845 | 895 | 945 | 995 | 1,045 | 1,095 | 1,145 | 1,195 | 1,245 | 50 |
| Zone 2 | 220 | 250 | 280 | 310 | 340 | 370 | 400 | 430 | 460 | 490 | 30 |
| Zone 3 | 405 | 445 | 485 | 525 | 565 | 605 | 645 | 685 | 725 | 765 | 40 |
| Zone 4 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 30 |
| Zone 5 | 430 | 465 | 500 | 535 | 570 | 605 | 640 | 675 | 710 | 745 | 35 |
| Zone 6 | 300 | 335 | 370 | 405 | 440 | 475 | 510 | 545 | 580 | 615 | 35 |
| Total | 2,300 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 220 |

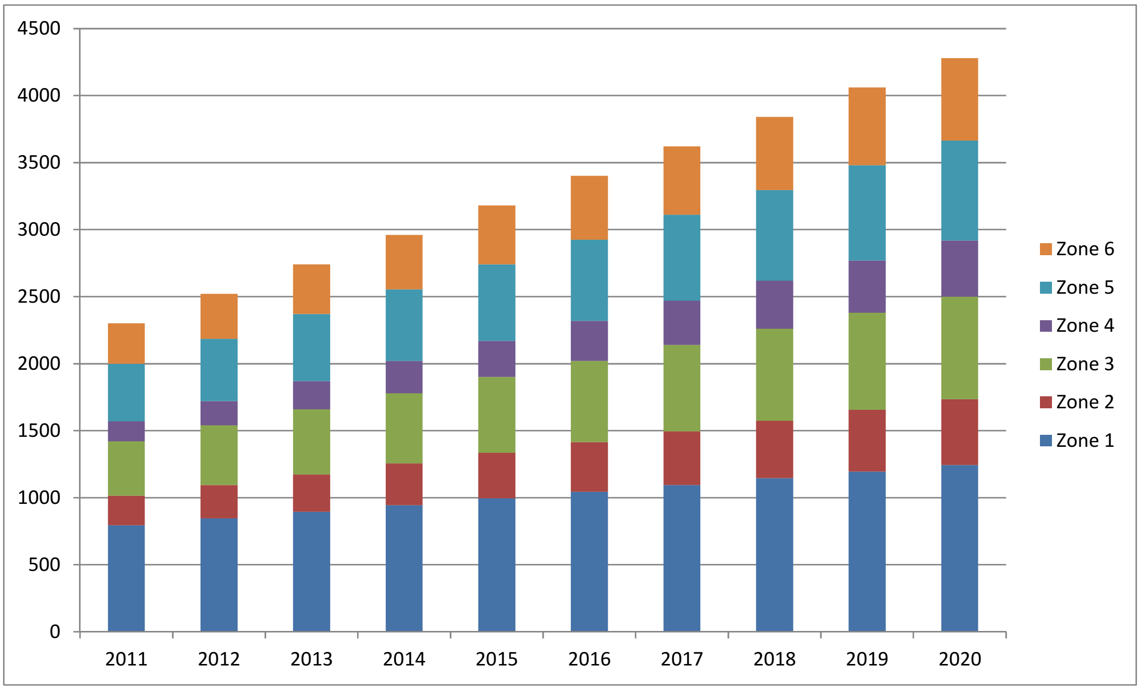



Chart 3.1A: Service Connection Plan by Zones 2011-2020

Table 3.1B: Service Connection Plan

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | n.a. | 273 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |

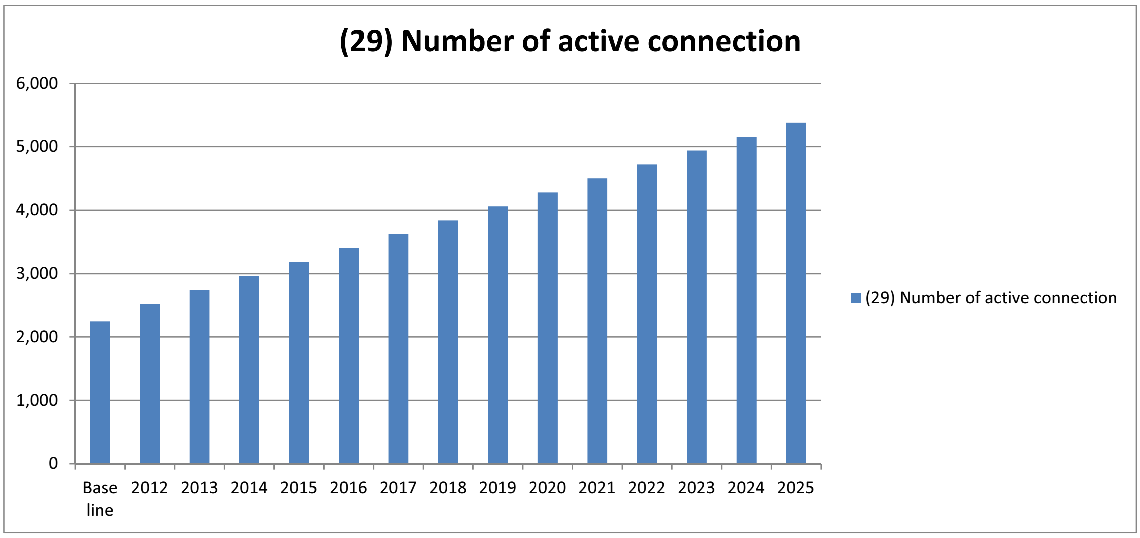



Chart 3.1B: Service Connection Plan

## 3.2 Water rate

Table 3.2A shows WUSC's plan for improving water rate. This water rate plan does not consider cost recover for their capital investment and assumes their government provides 100% of cost as grant.

Around 10% increasing to 2012, 2013 and 2014, then maintaining this level of water rate for a while to 2017, but need reexamination of this water rate improvement plan after gathering more data on inflation and operational expenditure. It may need to increase in 2017 for cover increased operation and maintenance cost but could maintaining for a while after.

Table 3.2A: Water rate improvement plan

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 80 | 90 | 90 | 100 | 100 | 100 | 100 | 125 |
| (35) Water rate (commodity charge) | NR | 12 | 12 | 12 | 14 | 14 | 14 | 14 | 16 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| (35) Water rate (commodity charge) | NR | 16 | 16 | 16 | 16 | 16 | 16 | 16 |

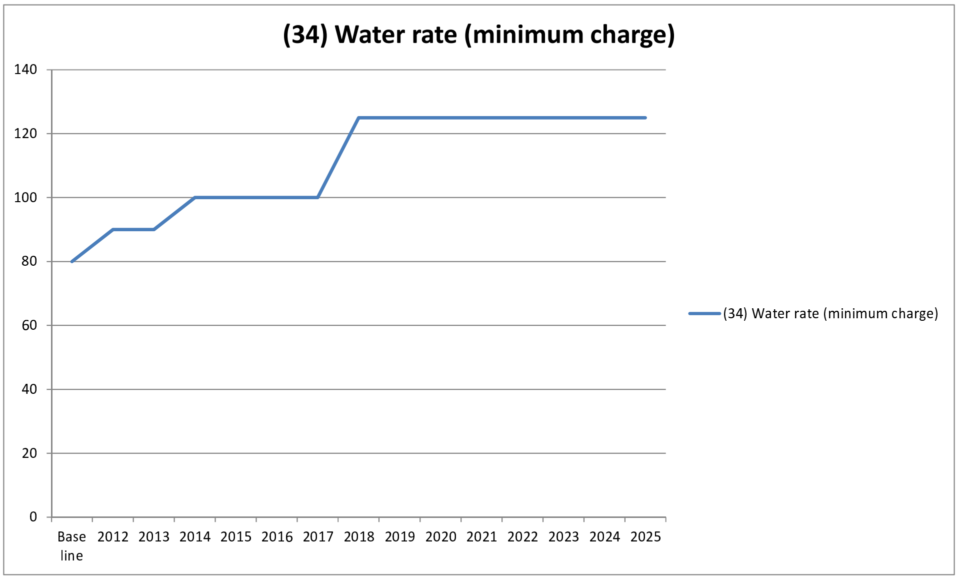



Chart 3.2A: Water rate improvement plan

### 3.3 Collection efficiency

The WUSC plans to maintain present collection efficiency of 99% to 2025.

### 3.4 Revenue from sales of water

The revenue from sales of water and other operational revenue would be shows as Table 3.4A, considering requirement of cost recovery and increasing of operation and maintenance cost. Revenue from others assumes 28% of revenue from sales of water, but further consideration may necessary after collect more detail data on revenue from penalty, material sold and revenue from new connection services.

Table 3.4A: Plan of revenue from sales of water

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ye | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |
| (49) Revenue from others | ,000 NR/ye | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 | 6,389 |

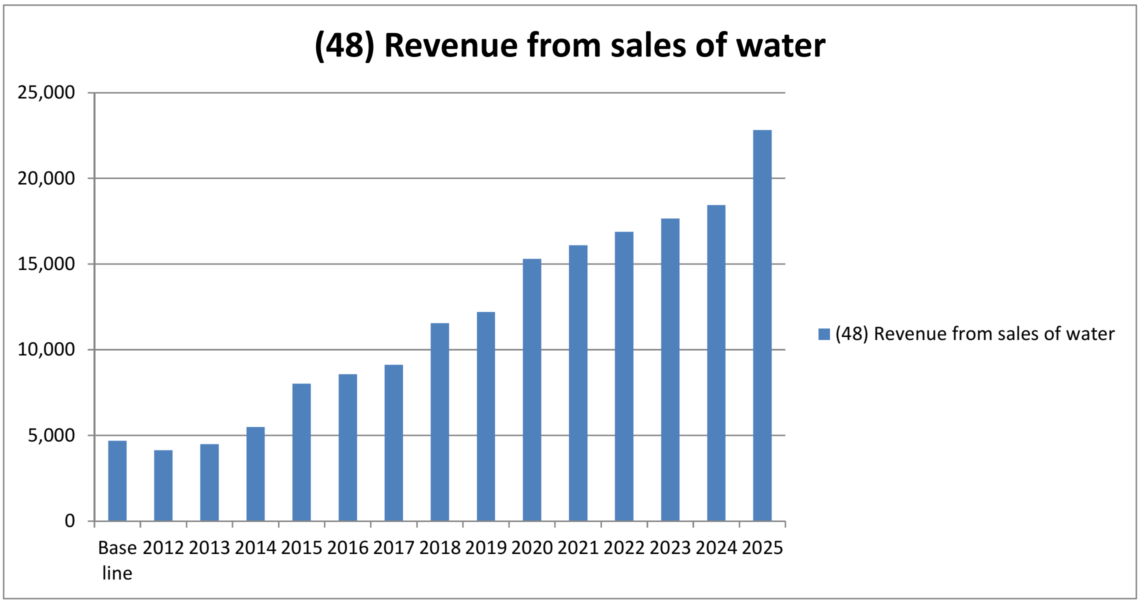



Chart 3.4A: Plan of revenue from sales of water

### 3.5 Cost of customer service plan

Number of staff may need to increase for meeting demanding customer service volume. Thus number of staff, salaries and office management cost may include in administrative plan in this report.

### 3.6 others

Rapidly increasing volume of customer service requires improvement of procedure for customer services specially billing and collection process and casher's window structure.

JICA Expert recommend to computerizing billing and collection procedure and insists benefit is not only improve efficiency of casher's work, but also management could get management performance data more easily including average consumption per connection, average consumption per capita, revenue water volume, billing amount and collection amount timely manner.

## 4. Administrative plan

### 4.1 Human Resources plan and number of staff

The WUSC plans to increasing almost 2 additional staff to maintaining labor efficiency of 150 connections per staff after 2017 to 2025. Table 4.2A shows their human resources plan regarding increasing number of staff.

Table 4.1: Staffing plan

| C: Administrative plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| (40) Number of staff | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |
| | | | | | | | | | |
| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | |
| (39) Increases of staff | | 2 | 0 | 2 | 2 | 0 | 2 | 2 | |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 | |

### 4.2 Human resources development plan

The WUSC wish to have human resources development plan for maintaining and further developing skill of operator and staff using program provided from DWSS and other training program provided from other agencies.

### 4.3 Cost of administrative plan

The cost of administrative works including salaries and office works would be shown as Table 4.3A.

Table 4.3A: Administrative cost

| C: Administrative plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| (40) Number of staff | 0 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |
| (41) Increasing salaries | NR/staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 235.27137 |
| (42) Inflated (41) | ,000 NR/ye | n.a. | 0 | 0 | 0 | 0 | 0 | 0 | 254 |
| (43) Salaries and wages | ,000 NR/ye | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 |
| (44) Increases admi cost (*1) | ,000 NR/ye | 0 | 54 | 64 | 76 | 91 | 0 | 349 | 326 |
| (45) Inflated (44) | ,000 NR/ye | n.a. | 58 | 69 | 82 | 98 | 0 | 376 | 352 |
| (46) Administrative cost | ,000 NR/ye | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 |
| (47) subtotal of salaries and admi cost | ,000 NR/ye | 2,245 | 2,483 | 2,751 | 3,053 | 3,395 | 3,667 | 4,337 | 5,290 |
| | | | | | | | | | |
| | unit | 2,019 | 2,020 | 2,021 | 2,022 | 2,023 | 2,024 | 2,025 | |
| (39) Increases of staff | | 2 | 0 | 2 | 2 | 0 | 2 | 2 | |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 | |
| (41) Increasing salaries | NR/staff | 254 | 0 | 296 | 320 | 0 | 373 | 403 | |
| (42) Inflated (41) | ,000 NR/ye | 274 | 0 | 320 | 346 | 0 | 403 | 435 | |
| (43) Salaries and wages | ,000 NR/ye | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 | 7,621 | |
| (44) Increases admi cost (*1) | ,000 NR/ye | 423 | 0 | 296 | 351 | 0 | 451 | 536 | |
| (45) Inflated (44) | ,000 NR/ye | 457 | 0 | 320 | 380 | 0 | 487 | 579 | |
| (46) Administrative cost | ,000 NR/ye | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 | 6,365 | |
| (47) subtotal of salaries and admi cost | ,000 NR/ye | 6,444 | 6,960 | 8,156 | 9,534 | 10,296 | 12,010 | 13,985 | |
| (*1) price of year 2011 | | | | | | | | | |

### 4.4 others

JICA Experts recommends for increasing number of customer staff and cashier for manage increased billing and collection works and other customer services, as well as improving cashier’s window for improving cashier’s work process.

Also consider computerizing accounting system for more timely submit financial report to management.

## 5. Financial Plan

### 5.1 Revenue and expenditure

Projection of revenue and expenditure based on actual data on July 2010 to June 2011 is shown as Table 5.1A. In this financial plan, assumes not consider financial arrangement for capital investment with loan. The WUSC expected DWSSDO would provide full financial assistance to capital investment in 2012, 2018, 2020 and 2023.

The WUSC respects this financial plan for framework of their budget.

Table 5.1A: Financial Plan (Projected Cash Flow Statement)

| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ye | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (51) Salaries | ,000 NR/ye | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 |
| (52) Power | ,000 NR/ye | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 |
| (53) Chemicals | ,000 NR/ye | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 |
| (55) Other O&M and administration | ,000 NR/ye | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (57) Cash balance of operational activities | ,000 NR/ye | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (59) Capital expenditure | ,000 NR/ye | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (60) Revenue from financial activity | ,000 NR/ye | 163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| (65) End balance | ,000 NR | 2,457 | 2,537 | 2,593 | 3,383 | 6,806 | 10,393 | 13,722 | 18,016 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |
| (49) Revenue from others | ,000 NR/ye | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 | 6,389 |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (51) Salaries | ,000 NR/ye | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 | 7,621 |
| (52) Power | ,000 NR/ye | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 | 3,440 |
| (53) Chemicals | ,000 NR/ye | 19 | 25 | 27 | 29 | 38 | 41 | 44 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 | 8,486 |
| (55) Other O&M and administration | ,000 NR/ye | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 | 6,365 |
| (56) Expenditure for operational activity | ,000 NR/ye | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (57) Cash balance of operational activities | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| (65) End balance | ,000 NR | 21,587 | 27,195 | 32,052 | 35,932 | 37,984 | 38,508 | 41,759 |

Note: Including capital investment and subsidiary from DWSSDO

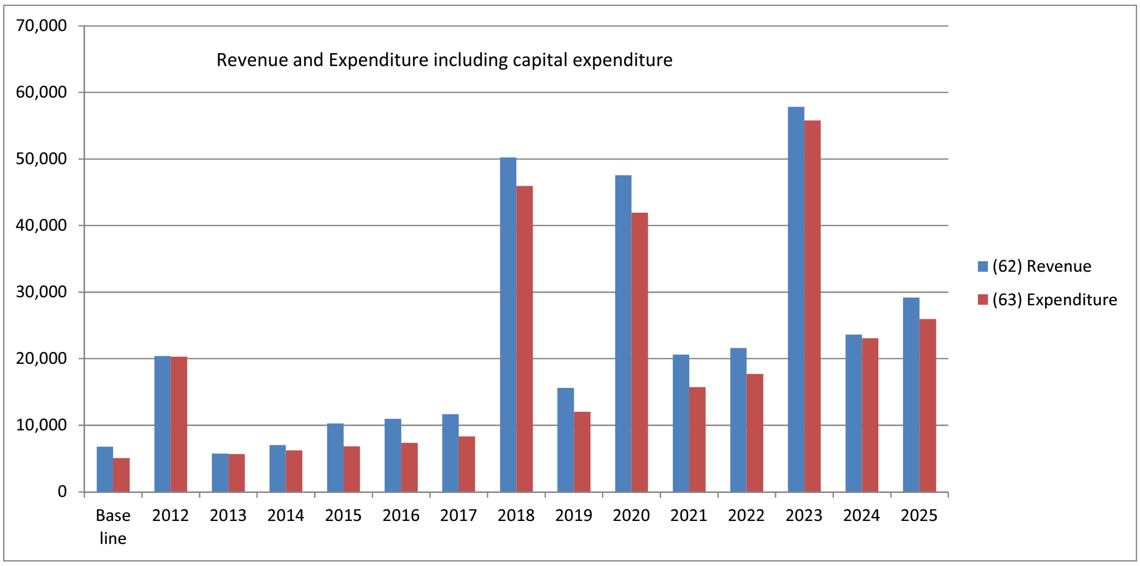



Chart 5.1A: Financial Plan (Projected Cash Flow Statement)

Note: Including capital investment and subsidiary from DWSSDO

**5.2 Financial resources arrangement**

The WUSC plans to do capital investment in 2012, 2018, 2020 and 2023. Detail is already mentioned in the part of engineering plan. The WUSC expected 100% of cost for capital investment would be provided by WUSSDO, however, has wiliness to shoulder some portion of these capital investment if necessary and if in that case until the WUSC still can maintain positive cash balance.

Full cost for capital investment in 2012, 2018 and 2020 may impossible, but may shoulder for 50% of these cost. 100% shoulder by WUSC for investment in 2023 may possible but needs further consideration.

**5.3 others**

Further discussion and negotiation may necessary for financial resources to capital investment.

## 6. Monitoring and evaluation

### 6.1 Targets and key performance indicators

Table 6.1A shows target and key performance indicator for monitoring progress of this business plan.

There are 4 views for monitoring and evaluation namely,

(A) Customer Service indicator
- Coverage ratio
- Population served
- Average consumption volume per connection per month
- Number of active connection

(B) Engineering
- Production Volume
- UFW
- NRE

(C) Management Efficiency
- Number of connection per staff

(D) Financial
- Revenue from operational activity (Sales of water and other revenue)
- Expenditure for operational activity

  These are not consider capital investment and financial cost
- Revenue (including subsidiary and non-operational revenue)
- Expenditure (including capital expenditure and financial cost)
- Cash Balance

Table 6.1A: Target and Key Performance Indicator

| E: Target and key performance indicator | Unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% | 64% |
| (4) Population served | 0 | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 | 29,558 |
| (31) Avr. consumption per connection | cm/month | 12 | 12 | 12 | 12 | 16 | 16 | 16 | 16 |
| (29) Number of active connection | 0 | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |
| (B) Engineering | | | | | | | | | |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | | |
| (40) Number of staff | 0 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |
| Number of connection per staff | 0 | 98 | 110 | 119 | 129 | 138 | 148 | 157 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |

| E: Target and key performance indicator | Unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | |
| (3) Coverage ratio | % | 65% | 67% | 68% | 69% | 70% | 72% | 73% |
| (4) Population served | | 30,878 | 32,198 | 33,518 | 34,838 | 36,158 | 37,478 | 38,798 |
| (31) Avr. consumption per connection | cm/month | 16 | 19 | 19 | 19 | 19 | 19 | 21 |
| (29) Number of active connection | 0 | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |
| (B) Engineering | | | | | | | | |
| (8) Production Volume | cm/day | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 |
| Number of connection per staff | | 150 | 159 | 155 | 152 | 159 | 156 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (56) Expenditure for operational activity | ,000 NR/ye | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |

Target:

- Number of connection: should be more than this
- NRW: should be less than this
- Number of connection per staff
- Collection Efficiency: should be maintaining this efficiency
- Revenue, specially revenue from operational activity should be more than this
- Expenditure, specially expenditure for operational activity should be less than this
- Cash balance, it should be positive

Monitoring:

- Coverage
- Population served
- Production volume
- Average consumption volume per connection
- UFW

**6.2 Monitoring and evaluation schedule**

The WUSC plans to monitoring and reviewing ever year focus on these targets and indicators, when annual budget is formulating (April-May), and update this business plan, if necessary. The WUSC respects this business plan for framework of their budget.

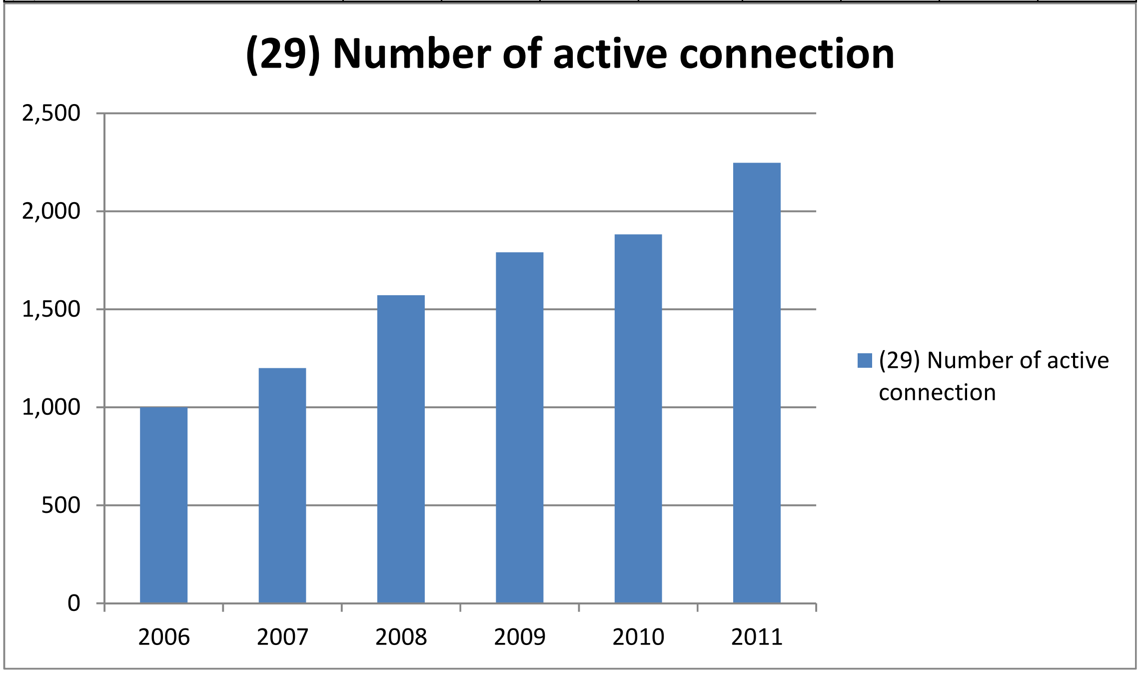
**6.3 others**

Reviewing and updating, modification of targets and indicator may necessary for further discussion among management committee members.

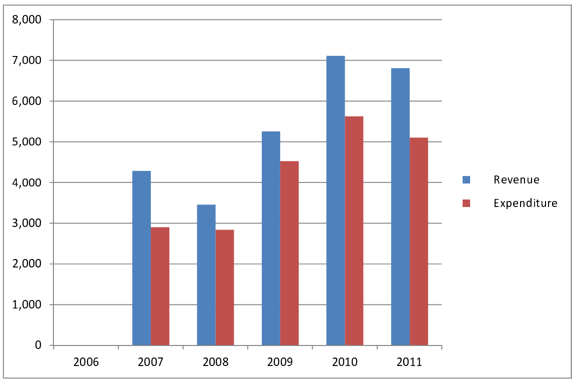
**Attachment and supporting tables**

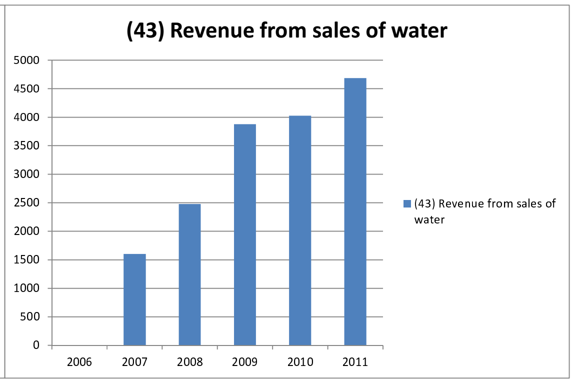
(1) Actual performance 2007-2011

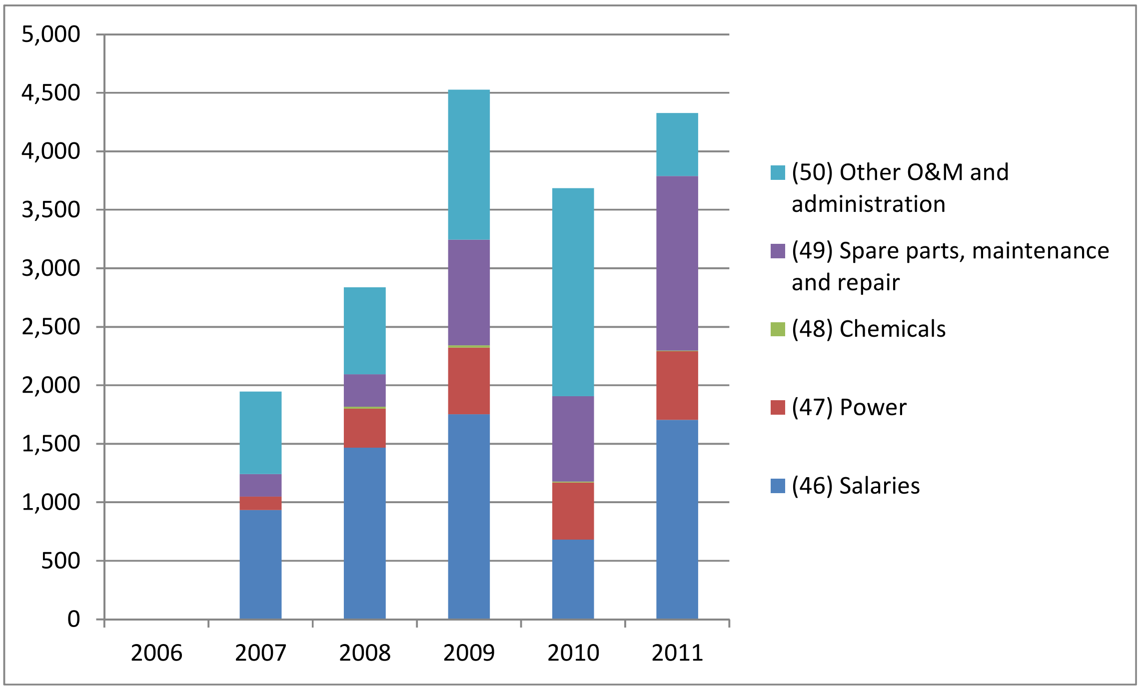
| B: Customer service | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Base line |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | | 200 | 372 | 219 | 90 | 366 | 250 |
| (29) Number of active connection | | 1,000 | 1,200 | 1,572 | 1,791 | 1,881 | 2,247 | 2,247 |




| Financial performance 2007-2011 | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | | 1,604 | 2,480 | 3,878 | 4,027 | 4,685 |
| (44) Revenue from others | ,000 NR/year | | 434 | 791 | 1,232 | 1,079 | 1,017 |
| (45) Operational revenue | ,000 NR/year | | 2,038 | 3,271 | 5,110 | 5,106 | 5,702 |
| (46) Salaries | ,000 NR/year | | 936 | 1,469 | 1,754 | 682 | 1,705 |
| (47) Power | ,000 NR/year | | 114 | 332 | 568 | 488 | 585 |
| (48) Chemicals | ,000 NR/year | | 0 | 15 | 21 | 6 | 7 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | | 192 | 277 | 903 | 731 | 1,491 |
| (50) Other O&M and administration | ,000 NR/year | | 706 | 744 | 1,281 | 1,777 | 540 |
| (51) Operational expenditure | ,000 NR/year | | 1,948 | 2,837 | 4,527 | 3,684 | 4,328 |
| (52) Cash balance of operational activities | ,000 NR/year | | 90 | 434 | 583 | 1,422 | 1,374 |
| | | | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | 2,235 | 0 | 0 | 1,940 | 944 |
| (54) Capital expenditure | ,000 NR/year | | 953 | 0 | 0 | 1,940 | 772 |
| (55) Revenue from financial activity | ,000 NR/year | | 11 | 182 | 147 | 63 | 163 |
| (56) Financial cost | ,000 NR/year | | 0 | 0 | 0 | 0 | 0 |
| Revenue | ,000 NR/year | | 4,284 | 3,453 | 5,257 | 7,109 | 6,809 |
| Expenditure | ,000 NR/year | | 2,901 | 2,837 | 4,527 | 5,624 | 5,100 |
| (57) Cash balance | ,000 NR/year | | 1,383 | 616 | 730 | 1,485 | 1,709 |



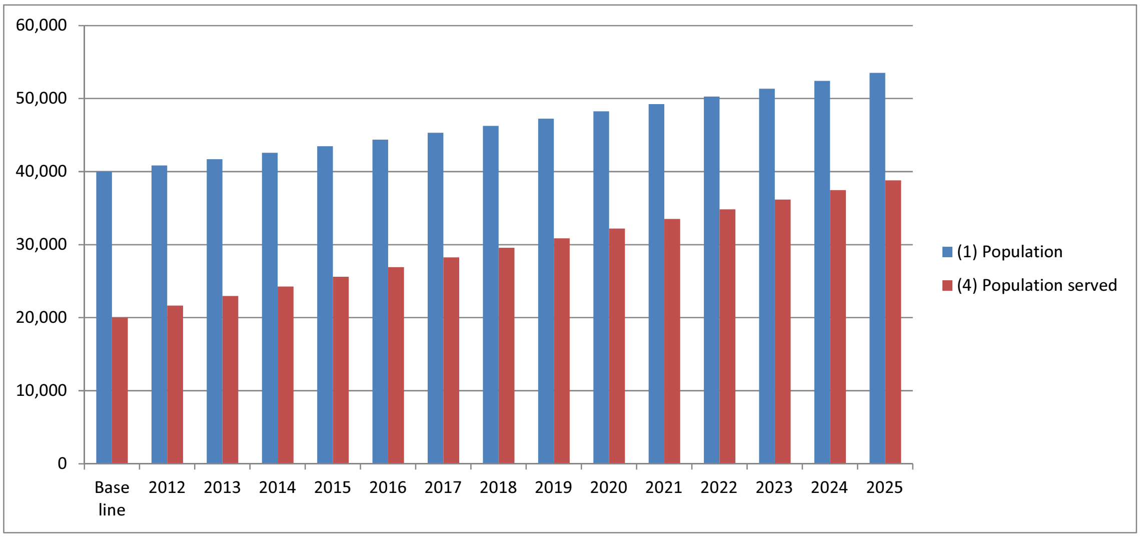




## (2) Supporting data for engineering plan

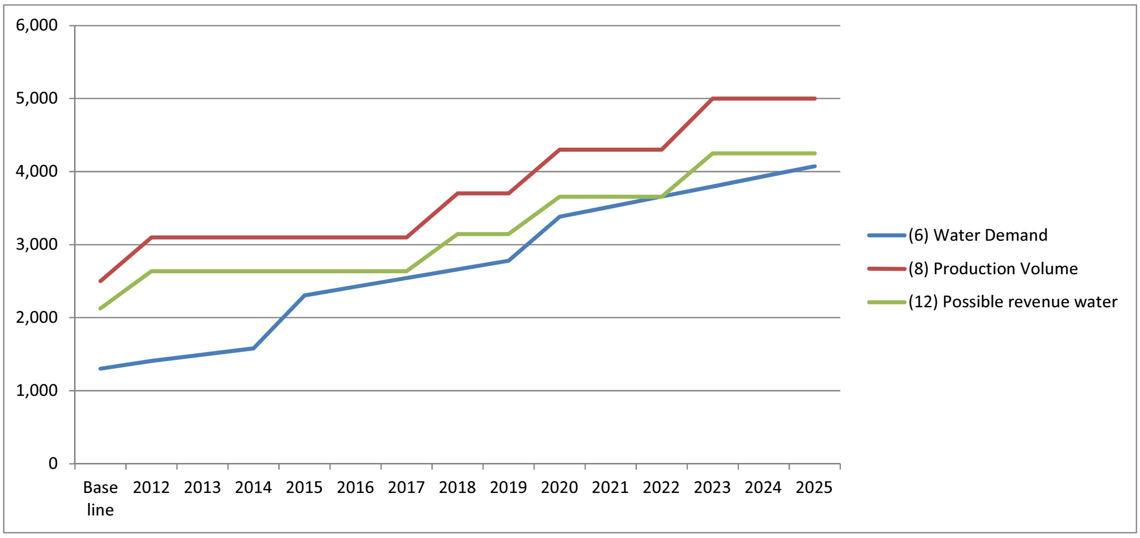
| A: Engineering plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Population | | 40,000 | 40,840 | 41,698 | 42,573 | 43,467 | 44,380 | 45,312 | 46,264 | 47,235 | 48,227 | 49,240 | 50,274 | 51,330 | 52,408 | 53,508 |
| (2) Population growth | % | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% | 64% | 65% | 67% | 68% | 69% | 70% | 72% | 73% |
| (4) Population served | | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 | 29,558 | 30,878 | 32,198 | 33,518 | 34,838 | 36,158 | 37,478 | 38,798 |
| (5) Consumption/capita/day | litter | 65 | 65 | 65 | 65 | 90 | 90 | 90 | 90 | 90 | 105 | 105 | 105 | 105 | 105 | 105 |
| (6) Water Demand | cm/day | 1,300 | 1,406 | 1,492 | 1,578 | 2,304 | 2,423 | 2,541 | 2,660 | 2,779 | 3,381 | 3,519 | 3,658 | 3,797 | 3,935 | 4,074 |
| | | | | | | | | | | | | | | | | |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (10) Accounting water | cm/day | 2,200 | 2,728 | 2,728 | 2,728 | 2,728 | 2,728 | 2,728 | 3,256 | 3,256 | 3,784 | 3,784 | 3,784 | 4,400 | 4,400 | 4,400 |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| (12) Possible revenue water | cm/day | 2,125 | 2,635 | 2,635 | 2,635 | 2,635 | 2,635 | 2,635 | 3,145 | 3,145 | 3,655 | 3,655 | 3,655 | 4,250 | 4,250 | 4,250 |
| | | | | | | | | | | | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | 13,992 | | | | | | 20,692 | | 13,992 | | | 13,992 | | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | | | | | | | | | | | | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 13,992 | 0 | 0 | 0 | 0 | 0 | 20,692 | 0 | 13,992 | 0 | 0 | 13,992 | 0 | 0 |
| (16) Inflated capital investment | ,000 RP | | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (17) Inflation rate | % | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% | 8% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | | | | | | | | | | | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | 140 | | | | | | 230 | | 258 | | | 377 | | |
| (20) Inflated (19) | ,000 NR/ | dummy | 152 | | | | | | 249 | | 278 | | | 407 | | |
| (21) Power and fuels for pumping | ,000 NR/ | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 | 3,440 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 2 | | | | | | 3 | | 4 | | | 6 | | |
| (23) Inflated (22) | ,000 NR/ | dummy | 2 | | | | | | 3 | | 4 | | | 6 | | |
| (24) Chemical for production | ,000 NR/ | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 | 19 | 25 | 27 | 29 | 38 | 41 | 44 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | 298 | | | | | | 568 | | 636 | | | 929 | | |
| (26) Inflated (25) | ,000 NR/ | dummy | 322 | | | | | | 613 | | 687 | | | 1,003 | | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 | 8,486 |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 2,083 | 2,725 | 2,943 | 3,179 | 3,433 | 3,708 | 4,004 | 5,189 | 5,604 | 7,022 | 7,584 | 8,191 | 10,262 | 11,083 | 11,970 |

(*1) price of year 2011

Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009




Population and population served

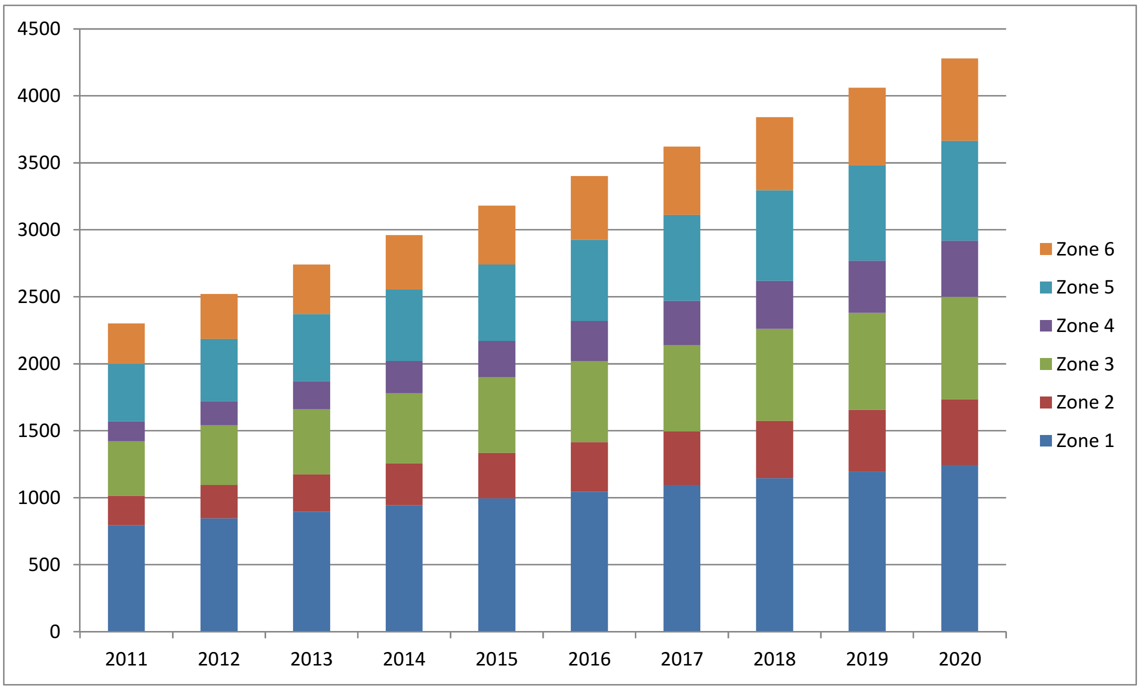



Water demand, production volume and revenue water

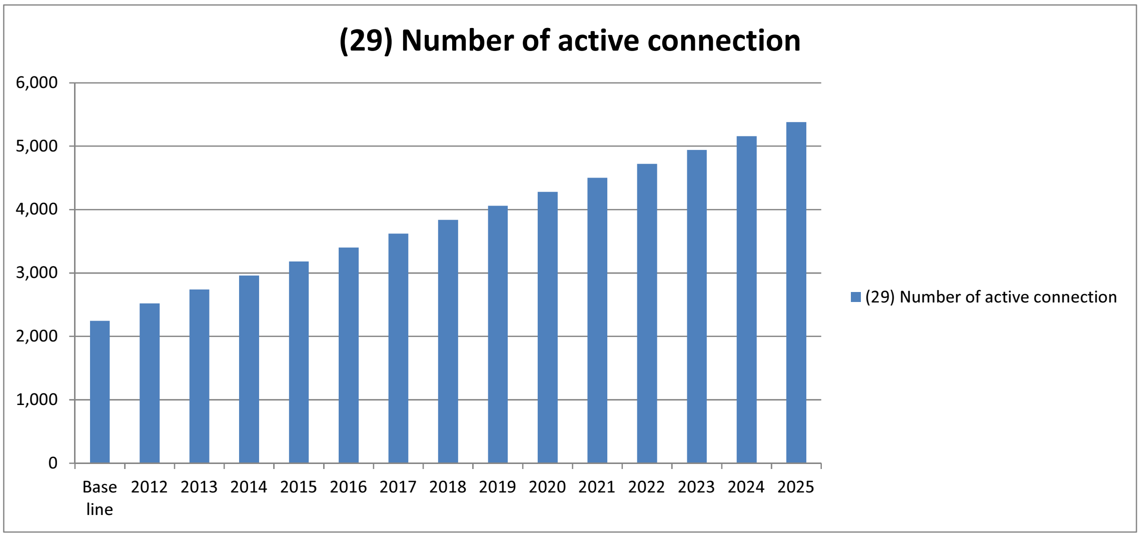
## (3) Supporting data for customer service plan

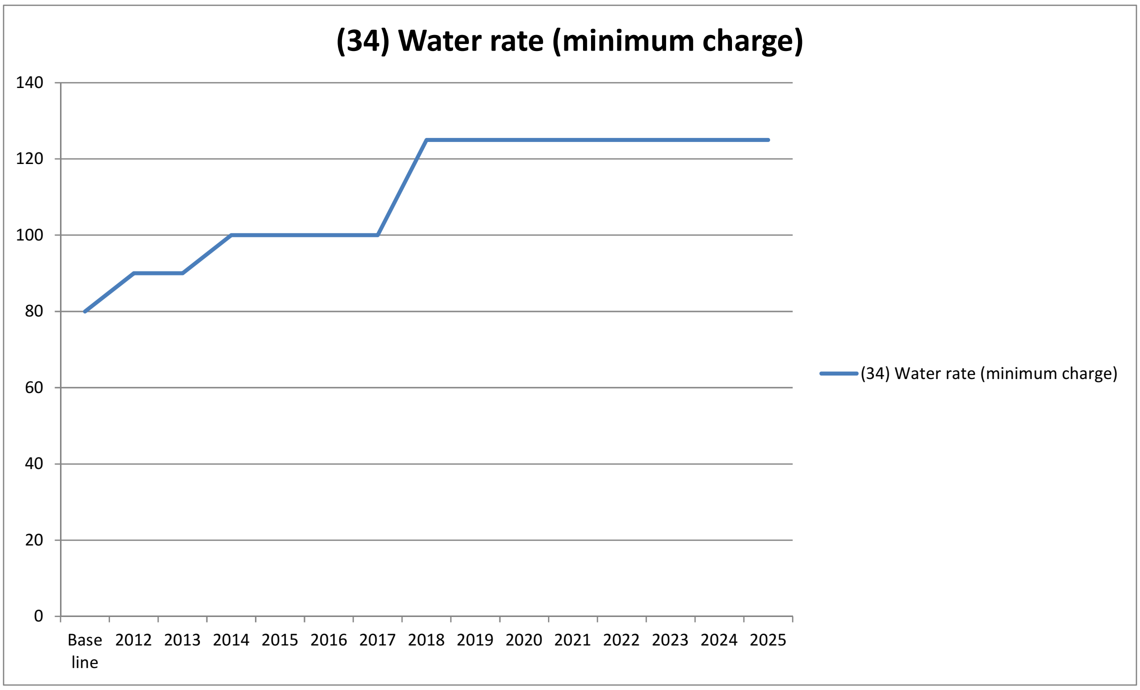
Numberof connectrion by zone

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Zone 1 | 795 | 845 | 895 | 945 | 995 | 1,045 | 1,095 | 1,145 | 1,195 | 1,245 | 50 |
| Zone 2 | 220 | 250 | 280 | 310 | 340 | 370 | 400 | 430 | 460 | 490 | 30 |
| Zone 3 | 405 | 445 | 485 | 525 | 565 | 605 | 645 | 685 | 725 | 765 | 40 |
| Zone 4 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 30 |
| Zone 5 | 430 | 465 | 500 | 535 | 570 | 605 | 640 | 675 | 710 | 745 | 35 |
| Zone 6 | 300 | 335 | 370 | 405 | 440 | 475 | 510 | 545 | 580 | 615 | 35 |
| Total | 2,300 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 220 |

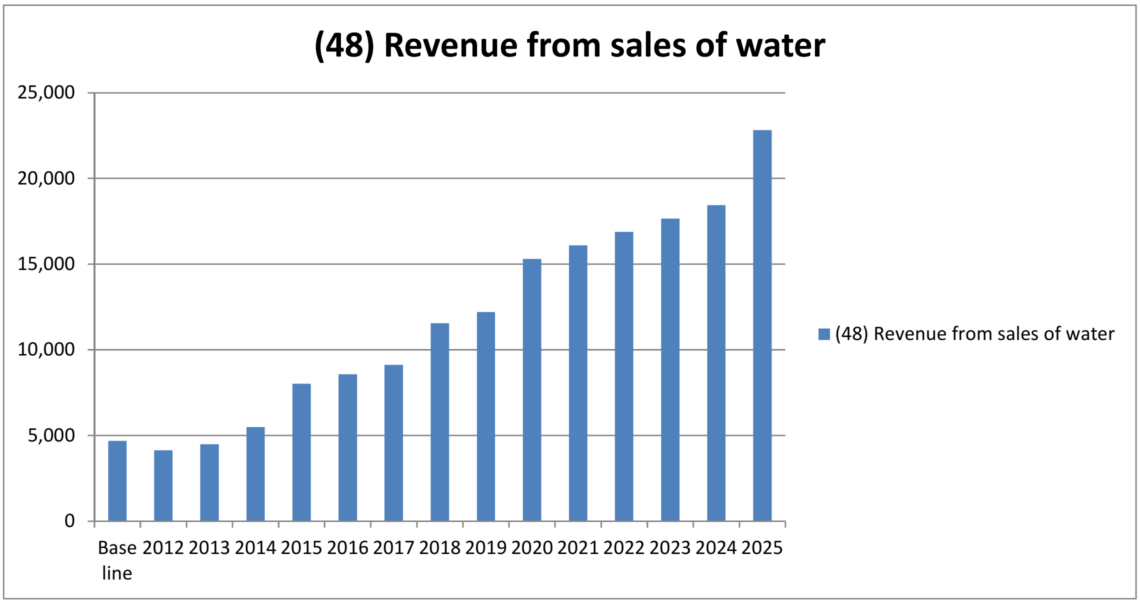



| B: Customer service plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 273 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |
| (30) Average family size | person/fa | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| **(31) Avr. consumption per connection** | **cm/mont** | **12** | **12** | **12** | **12** | **16** | **16** | **16** | **16** | **16** | **19** | **19** | **19** | **19** | **19** | **21** |
| (32) Confirmation of (31) with (5) | cm/montl | 11.7 | 11.7 | 11.7 | 11.7 | 16.2 | 16.2 | 16.2 | 16.2 | 16.2 | 18.9 | 18.9 | 18.9 | 18.9 | 18.9 | 18.9 |
| (33) Minimum charge volume | cm/montl | 8 | 8 | 8 | 8 | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** |
| **(34) Water rate (minimum charge)** | **NR** | **80** | **90** | **90** | **100** | **100** | **100** | **100** | **125** | **125** | **125** | **125** | **125** | **125** | **125** | **125** |
| **(35) Water rate (commodity charge 9-** | **NR** | **12** | **12** | **12** | **14** | **14** | **14** | **14** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** |
| **(35) Water rate (commodity charge 16** | **NR** | **15** | | | | | | | | | | | | | | **20** |
| **(36) Collection efficiency** | **%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 285 | 344 | 374 | 457 | 667 | 714 | 760 | 962 | 1,017 | 1,275 | 1,341 | 1,407 | 1,472 | 1,538 | 1,901 |
| (38) Expected annual revenue from sales | ,000 NR/ | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |






Water rate improvement plan

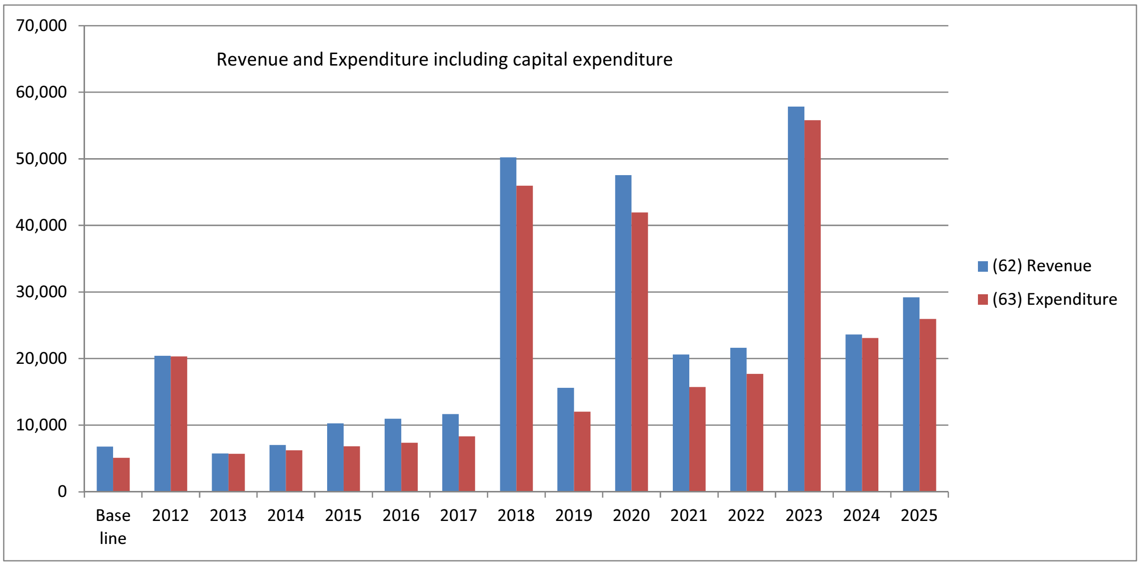



## (4) Supporting data for administrative plan

| C: Administrative plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | | | | | | | | 2 | 2 | | 2 | 2 | | 2 | 2 |
| (40) Number of staff | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 | 27 | 27 | 29 | 31 | 31 | 33 | 35 |
| (41) Increasing salaries | NR/staff | | 0 | 0 | 0 | 0 | 0 | 0 | 235 | 254 | 0 | 296 | 320 | 0 | 373 | 403 |
| (42) Inflated (41) | ,000 NR/ | dummy | 0 | 0 | 0 | 0 | 0 | 0 | 254 | 274 | 0 | 320 | 346 | 0 | 403 | 435 |
| (43) Salaries and wages | ,000 NR/ | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 | 7,621 |
| (44) Increases admi cost (*1) | ,000 NR/year | | 54 | 64 | 76 | 91 | | 349 | 326 | 423 | | 296 | 351 | | 451 | 536 |
| (45) Inflated (44) | ,000 NR/ | dummy | 58 | 69 | 82 | 98 | 0 | 376 | 352 | 457 | 0 | 320 | 380 | 0 | 487 | 579 |
| (46) Administrative cost | ,000 NR/ | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 | 6,365 |
| (47) subtotal of salaries and admi cost | ,000 NR/ | 2,245 | 2,483 | 2,751 | 3,053 | 3,395 | 3,667 | 4,337 | 5,290 | 6,444 | 6,960 | 8,156 | 9,534 | 10,296 | 12,010 | 13,985 |

## (5) Supporting data for financial plan

| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 |
| (49) Revenue from others | ,000 NR/ | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 |
| (50) Revenue from operational activity | ,000 NR/ | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 |
| (51) Salaries | ,000 NR/ | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 |
| (52) Power | ,000 NR/ | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 |
| (53) Chemicals | ,000 NR/ | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 | 19 | 25 | 27 | 29 | 38 | 41 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 |
| (55) Other O&M and administration | ,000 NR/ | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 |
| (56) Expenditure for operational activity | ,000 NR/ | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 |
| (57) Cash balance of operational activities | ,000 NR/ | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 |
| | | | | | | | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 | 0 | 27,970 | 0 | 0 | 35,234 | 0 |
| (59) Capital expenditure | ,000 NR/ | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 | 0 | 27,970 | 0 | 0 | 35,234 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 163 | | | | | | | | | | | | | |
| (61) Financial cost | ,000 NR/year | | | | | | | | | | | | | | |
| (62) Revenue | ,000 NR/ | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 |
| (63) Expenditure | ,000 NR/ | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 |
| **(64) Cash balance** | **,000 NR** | **1,709** | **80** | **56** | **790** | **3,423** | **3,586** | **3,329** | **4,294** | **3,571** | **5,608** | **4,857** | **3,880** | **2,052** | **524** |
| **(65) End balance** | **,000 NR** | **2,457** | **2,537** | **2,593** | **3,383** | **6,806** | **10,393** | **13,722** | **18,016** | **21,587** | **27,195** | **32,052** | **35,932** | **37,984** | **38,508** |




Note: Including capital investment and subsidiary from DWSSDO

## (6) Supporting data for monitoring and evaluation

| E: Target and key performance indicator | Unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | | | | | | | | |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% | 64% | 65% | 67% | 68% | 69% | 70% | 72% | 73% |
| (4) Population served | | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 | 29,558 | 30,878 | 32,198 | 33,518 | 34,838 | 36,158 | 37,478 | 38,798 |
| (31) Avr. consumption per connection | cm/montl | 12 | 12 | 12 | 12 | 16 | 16 | 16 | 16 | 16 | 19 | 19 | 19 | 19 | 19 | 21 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |
| (B) Engineering | | | | | | | | | | | | | | | | |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | | | | | | | | | |
| (40) Number of staff | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 | 27 | 27 | 29 | 31 | 31 | 33 | 35 |
| Number of connection per staff | | 98 | 110 | 119 | 129 | 138 | 148 | 157 | 154 | 150 | 159 | 155 | 152 | 159 | 156 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (56) Expenditure for operational activity | ,000 NR/ | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (62) Revenue | ,000 NR/ | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |

**Business Plan 2012-2025**

**Dhulabari WUSC, November 2011**

**Agenda**

1. Introducing WUSC
2. Engineering Plan
3. Customer Service Plan
4. Administrative Plan
5. Financial Plan
6. Monitoring and evaluation schedule
7. Q&A

1. Introducing WUSC

- Established in 1994
- Registered 1994
- Service started 1996
- Geographical area
  - East – ward No. 1, 6, Dhulabari (Ninda Khola)
  - West- ward No. 2, 3, 5 Lulpani
  - North – ward No. 4 Magurmani
  - South – ward No.1 Dhulabari Campus (Kharedayi)

1. Introducing WUSC

Vision: To provide pure safe, and qualitative drinking water to people residing in the area at minimum cost and help the nation build a healthy and civilized citizens community.

Mission: To provide pure, safe and quality drinking water. WUSC has the mission to make it cooperating by making appropriate policy, strategy and collecting resources for sustainable and manageable.

Goal: To satisfy the people by providing pure, safe and quality water in the area in sufficient quality.

## 1. Introducing WUSC

Objectives

- To manage, develop and sustain it by coordinating to the concerning stakeholders
- To manage all the resources collect
- To provide safe, pure and quality water by adapting dependable distribution, maintenance and management system
- To conduct public hygiene and health programs based on participation approach
- To provide maximum people by adapting governance, policy and following the both national and international standard as practicable.

Downtown area of Dhulabari

Office Building

Intake facility

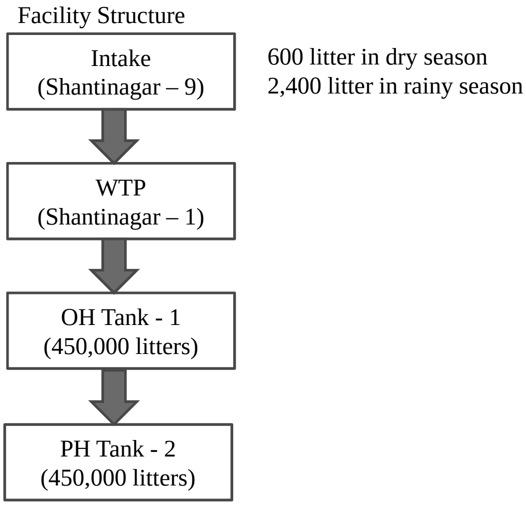
Water treatment plant


Water treatment plant and No.1 elevated tank

No. 2 elevated tank

NO. 3 Elevated tank and WUSC office Building

## Present situation




## Implementation

(1) Short term plan (2012-2013)

i) To construct a well-facilitated office building
ii) To conduct workshop/ training to enhance the skill and efficiency of the staffs
iii) To equip the WUSC with modern technology, computerized system and other tools
iv) To set up a temporary cash counter
v) Conduct public health awareness program
vi) To save environment program/ campaigns like plantation and sanitation will be conducted

Implementation

(2) Medium term plan (2013-2015)
i) Run bottled water industry along with other income generation business to enlarge income structure
ii) Establish mutual cooperation among users
iii) Start shops dealing with plumbing tools, to provide consumers with such tools and other related item at reasonable cost
iv) Try to encourage the people having low income source to connect with affordable cost
v) Run social activities with the coordination of other social service organization

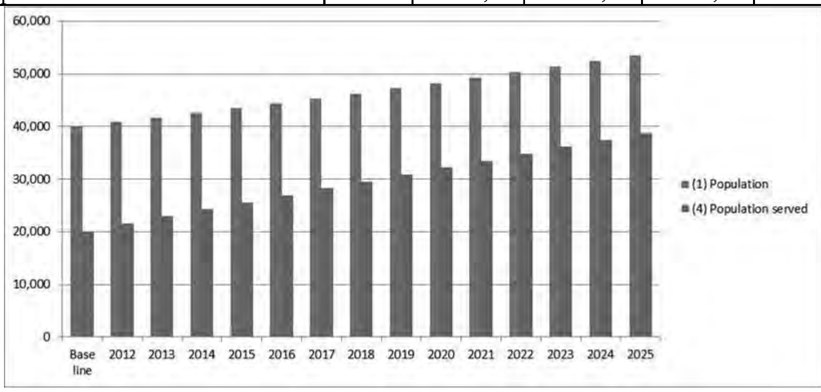
Implementation

(3) Long term plan (2016-2025)
i) Plant other OH Tank as per requirement
ii) Extend pipe line as per requirement
iii) Plant deep boring to produce more water
iv) Plan filter facility
v) Manage a vehicle to work faster and more easily and provide the staff with transportation

# 2. Engineering Plan

## Population Projection

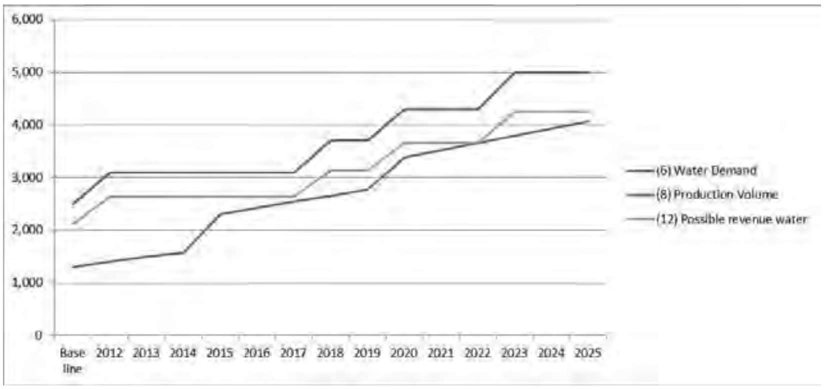
| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (1) Population | | 40,000 | 43,467 | 48,227 | 53,508 |
| (2) Population growth | % | 2.10% | 2.10% | 2.10% | 2.10% |
| (3) Coverage ratio | % | 50% | 59% | 67% | 73% |
| (4) Population served | | 20,000 | 25,598 | 32,198 | 38,798 |



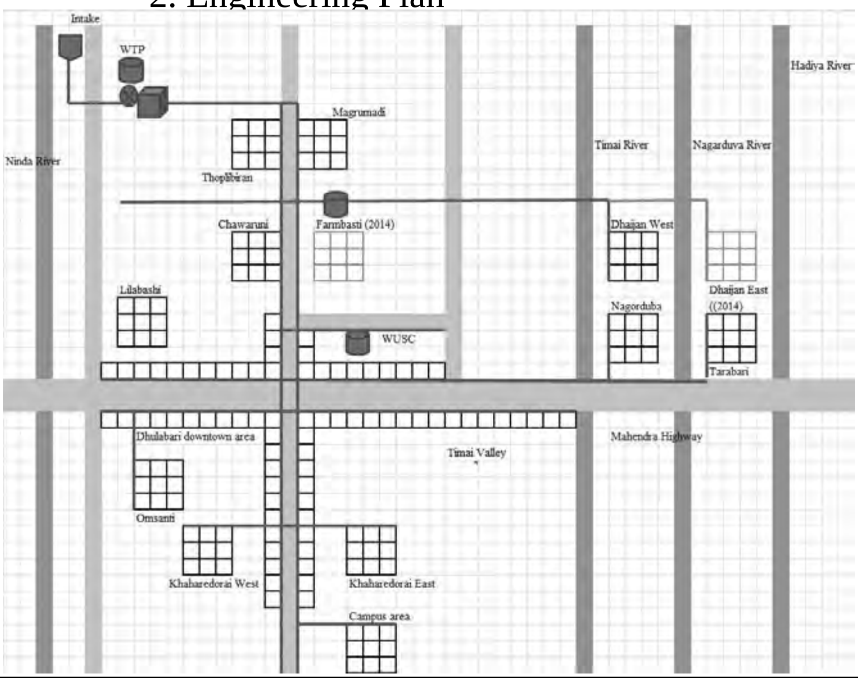

## Water Demand Projection

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (5) Consumption/capita/day | litter | 65 | 90 | 105 | 105 |
| (6) Water Demand | cm/day | 1,300 | 2,304 | 3,381 | 4,074 |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 4,300 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% |
| (10) Accounting water | cm/day | 2,200 | 2,728 | 3,784 | 4,400 |
| (11) NRW | % | 15% | 15% | 15% | 15% |
| (12) Possible revenue water | cm/day | 2,125 | 2,635 | 3,655 | 4,250 |

Water demand, production volume and revenue water




2. Engineering Plan



Facility improvement:
(1) Rehabilitation of existing facility
- 2017
- Rehabilitating WTP

(2) New facility in 2012, 2018, 2020 and 2023
- Improving intake volume by grand water

| (1) New Tubewell, 2012, 2018, 2020 and 2023 | | | |
|---|---|---|---|
| Items | Unit | Unit Cost | Cost |
| 1) Development of new well and intake | | | 10,000 |
| 2) Pump | | | 600 |
| 3) pipes | | | |
| 3) Supervision | | | 1,060 |
| 3) Contingency | | | 2,332 |
| total | | | 13,992 |
| Unit: Million NR | | | |

| (2) Rehabilitation of purification plant 2017 | | | |
|---|---|---|---|
| Items | Unit | Unit Cost | Cost |
| 1) Facilities renovation | | | 5.0 |
| 2) Pipeline and fitting | | | 0.1 |
| 3) Supervising | | | 0.5 |
| 4) Contingency | | | 1.1 |
| total | | | 6.7 |
| Unit: Million NR | | | |

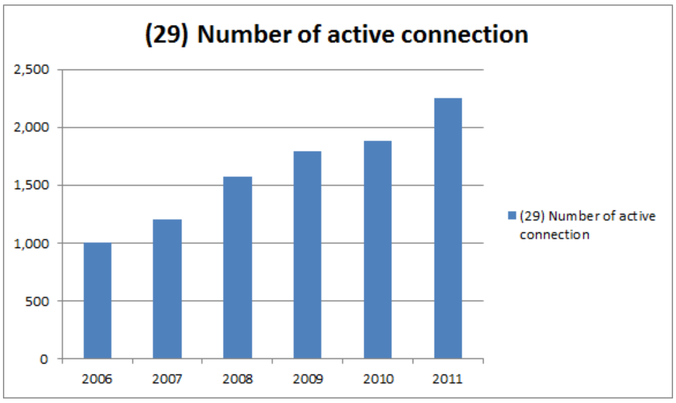
## Operation cost

| | unit | Base line | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| (21) Power and fuels for pumping | ,000 NR/ | 585 | 987 | 2,019 | 3,440 |
| (24) Chemical for production | ,000 NR/ | 7 | 12 | 25 | 44 |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 1491 | 2,434 | 4,979 | 8,486 |

## 3. Customer Service Plan – analysis of 2006-2011

Connection – average 250 connections increasing annually

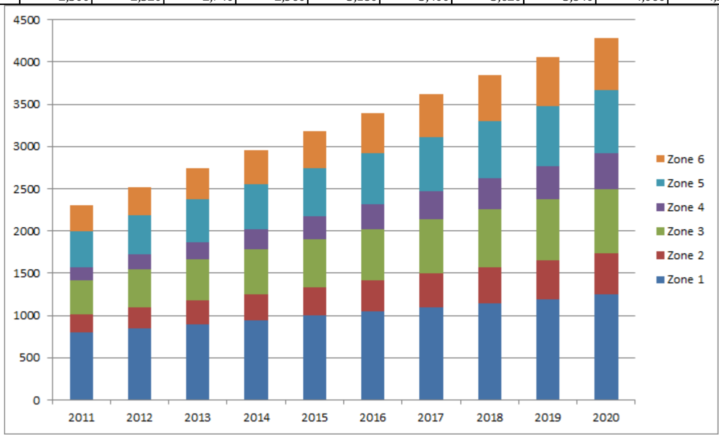
| B: Customer service | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | | 200 | 372 | 219 | 90 | 366 |
| (29) Number of active connection | | 1,000 | 1,200 | 1,572 | 1,791 | 1,881 | 2,247 |



## 3. Customer Service Plan – by zone

Numberof connectrion by zone

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Zone 1 | 795 | 845 | 895 | 945 | 995 | 1,045 | 1,095 | 1,145 | 1,195 | 1,245 | 50 |
| Zone 2 | 220 | 250 | 280 | 310 | 340 | 370 | 400 | 430 | 460 | 490 | 30 |
| Zone 3 | 405 | 445 | 485 | 525 | 565 | 605 | 645 | 685 | 725 | 765 | 40 |
| Zone 4 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 30 |
| Zone 5 | 430 | 465 | 500 | 535 | 570 | 605 | 640 | 675 | 710 | 745 | 35 |
| Zone 6 | 300 | 335 | 370 | 405 | 440 | 475 | 510 | 545 | 580 | 615 | 35 |
| Total | 2,300 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 | 4,060 | 4,280 | 220 |

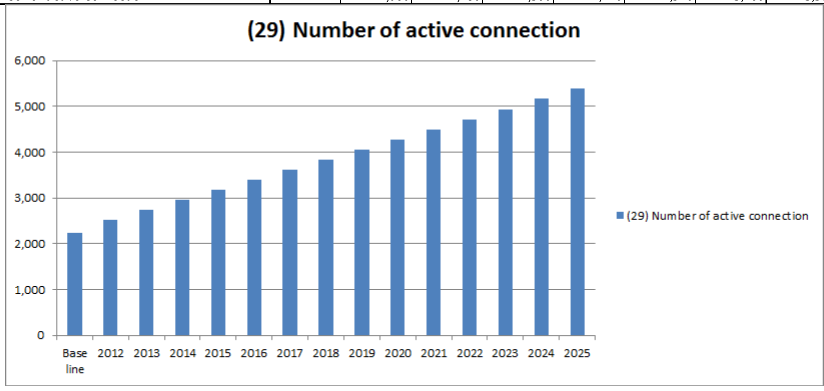



## 3. Customer Service Plan

## Connection – plan to increasing 220 annually

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | n.a. | 273 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |

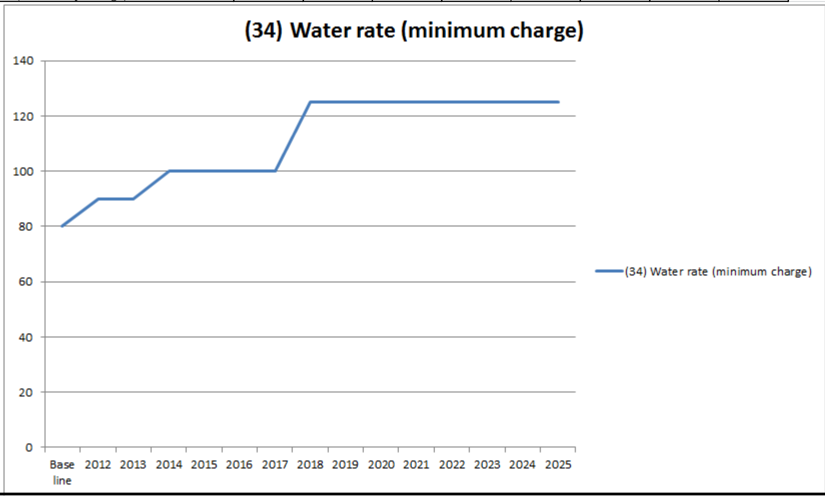
| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |



# Water Rate

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 80 | 90 | 90 | 100 | 100 | 100 | 100 | 125 |
| (35) Water rate (commodity charge) | NR | 12 | 12 | 12 | 14 | 14 | 14 | 14 | 16 |

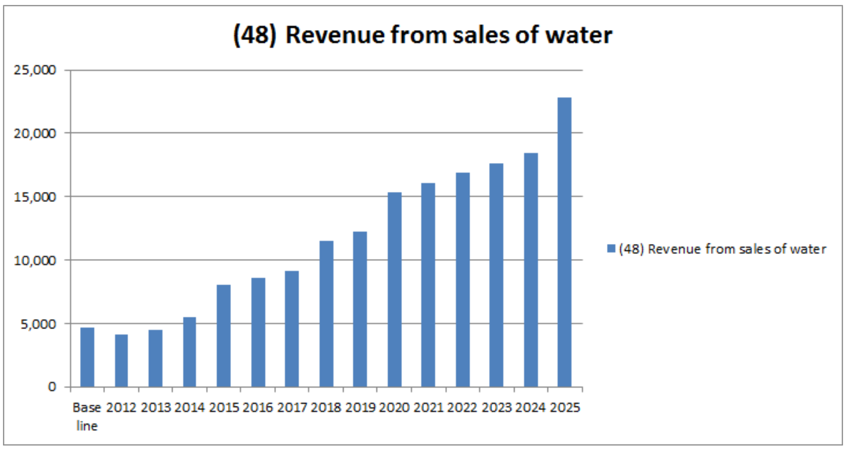
| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (34) Water rate (minimum charge) | NR | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| (35) Water rate (commodity charge) | NR | 16 | 16 | 16 | 16 | 16 | 16 | 16 |




# Revenue from sales of water

| | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ye | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |
| (49) Revenue from others | ,000 NR/ye | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 | 6,389 |



## 4. Administrative Plan

| C: Administrative plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| (40) Number of staff | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |

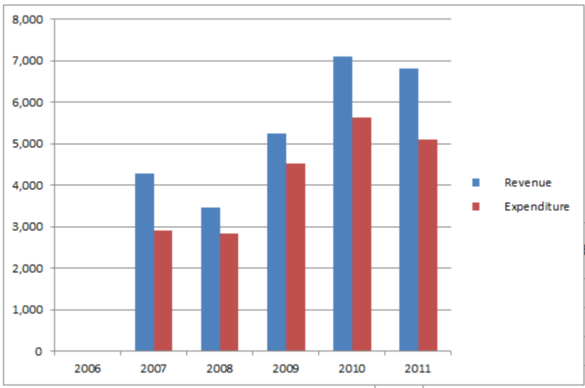
| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | 2 | 0 | 2 | 2 | 0 | 2 | 2 |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 |

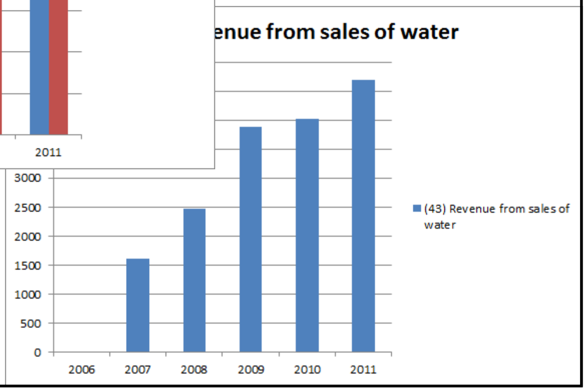
- Staffing: Presently over staff, but improving and maintaining 150 connections per staff
- Recruiting manager and chief engineer
- Training of staff
- Computerized billing system
- Improving cashier's windows

## 5. Financial Plan – last 5 years performance

| Financial performance 2007-2011 | unit | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| (43) Revenue from sales of water | ,000 NR/year | | 1,604 | 2,480 | 3,878 | 4,027 | 4,685 |
| (44) Revenue from others | ,000 NR/year | | 434 | 791 | 1,232 | 1,079 | 1,017 |
| (45) Operational revenue | ,000 NR/year | | 2,038 | 3,271 | 5,110 | 5,106 | 5,702 |
| (46) Salaries | ,000 NR/year | | 936 | 1,469 | 1,754 | 682 | 1,705 |
| (47) Power | ,000 NR/year | | 114 | 332 | 568 | 488 | 585 |
| (48) Chemicals | ,000 NR/year | | 0 | 15 | 21 | 6 | 7 |
| (49) Spare parts, maintenance and repair | ,000 NR/year | | 192 | 277 | 903 | 731 | 1,491 |
| (50) Other O&M and administration | ,000 NR/year | | 706 | 744 | 1,281 | 1,777 | 540 |
| (51) Operational expenditure | ,000 NR/year | | 1,948 | 2,837 | 4,527 | 3,684 | 4,328 |
| (52) Cash balance of operational activities | ,000 NR/year | | 90 | 434 | 583 | 1,422 | 1,374 |
| | | | | | | | |
| (53) Revenue for capital investment | ,000 NR/year | | 2,235 | 0 | 0 | 1,940 | 944 |
| (54) Capital expenditure | ,000 NR/year | | 953 | 0 | 0 | 1,940 | 772 |
| (55) Revenue from financial activity | ,000 NR/year | | 11 | 182 | 147 | 63 | 163 |
| (56) Financial cost | ,000 NR/year | | 0 | 0 | 0 | 0 | 0 |
| Revenue | ,000 NR/year | | 4,284 | 3,453 | 5,257 | 7,109 | 6,809 |
| Expenditure | ,000 NR/year | | 2,901 | 2,837 | 4,527 | 5,624 | 5,100 |
| (57) Cash balance | ,000 NR/year | | 1,383 | 616 | 730 | 1,485 | 1,709 |

## 5. Financial Plan – last 5 years performance

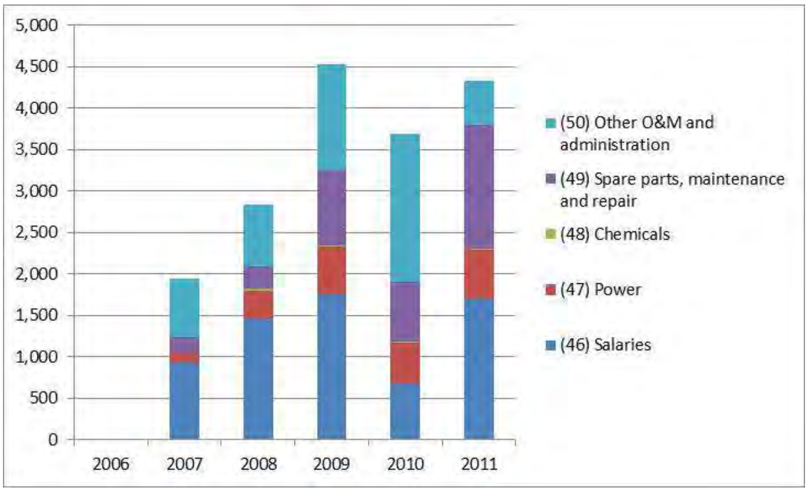



Note; including capital investment and subsidiary from WSSDO

Drop of revenue in 2008 and 2011 comes no government subsidiary in these years

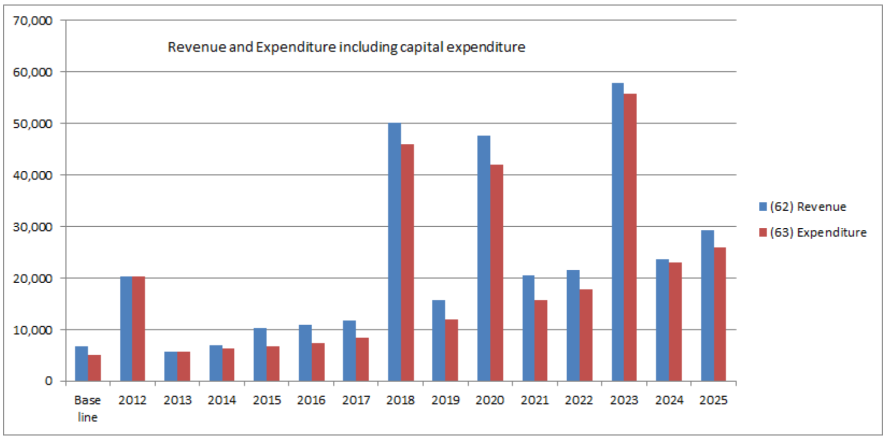
## 5. Financial Plan – analysis of 2007-2011




Cost is rapidly increasing specially power and fuel cost

| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ye | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (51) Salaries | ,000 NR/ye | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 |
| (52) Power | ,000 NR/ye | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 |
| (53) Chemicals | ,000 NR/ye | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 |
| (55) Other O&M and administration | ,000 NR/ye | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (57) Cash balance of operational activities | ,000 NR/ye | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (59) Capital expenditure | ,000 NR/ye | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (60) Revenue from financial activity | ,000 NR/ye | 163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| (65) End balance | ,000 NR | 2,457 | 2,537 | 2,593 | 3,383 | 6,806 | 10,393 | 13,722 | 18,016 |

| | unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ye | 12,203 | 15,305 | 16,091 | 16,878 | 17,665 | 18,452 | 22,817 |
| (49) Revenue from others | ,000 NR/ye | 3,417 | 4,285 | 4,506 | 4,726 | 4,946 | 5,166 | 6,389 |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (51) Salaries | ,000 NR/ye | 3,705 | 4,001 | 4,641 | 5,358 | 5,787 | 6,653 | 7,621 |
| (52) Power | ,000 NR/ye | 1,611 | 2,019 | 2,180 | 2,354 | 2,950 | 3,186 | 3,440 |
| (53) Chemicals | ,000 NR/ye | 19 | 25 | 27 | 29 | 38 | 41 | 44 |
| (54) Spare parts, maintenance and repair | ,000 NR/ye | 3,974 | 4,979 | 5,377 | 5,807 | 7,275 | 7,857 | 8,486 |
| (55) Other O&M and administration | ,000 NR/ye | 2,739 | 2,959 | 3,515 | 4,176 | 4,510 | 5,357 | 6,365 |
| (56) Expenditure for operational activity | ,000 NR/ye | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (57) Cash balance of operational activities | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ye | 0 | 27,970 | 0 | 0 | 35,234 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (61) Financial cost | ,000 NR/ye | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |
| (65) End balance | ,000 NR | 21,587 | 27,195 | 32,052 | 35,932 | 37,984 | 38,508 | 41,759 |




Revenue and expenditure including subsidiary, grant and capital expenditure in 2012, 2018, 2020 and 2023

# 6. Monitoring and evaluation schedule

| E: Target and key performance indicator | Unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | | |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% | 64% |
| (4) Population served | 0 | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 | 29,558 |
| (31) Avr. consumption per connection | cm/month | 12 | 12 | 12 | 12 | 16 | 16 | 16 | 16 |
| (29) Number of active connection | 0 | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 | 3,840 |
| (B) Engineering | | | | | | | | | |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,700 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | | |
| (40) Number of staff | 0 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 25 |
| Number of connection per staff | 0 | 98 | 110 | 119 | 129 | 138 | 148 | 157 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (56) Expenditure for operational activity | ,000 NR/ye | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (62) Revenue | ,000 NR/ye | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 50,236 |
| (63) Expenditure | ,000 NR/ye | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| (64) Cash balance | ,000 NR/ye | 1,709 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |

| E: Target and key performance indicator | Unit | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| (A) Customer services indicator | | | | | | | | |
| (3) Coverage ratio | % | 65% | 67% | 68% | 69% | 70% | 72% | 73% |
| (4) Population served | | 30,878 | 32,198 | 33,518 | 34,838 | 36,158 | 37,478 | 38,798 |
| (31) Avr. consumption per connection | cm/month | 16 | 19 | 19 | 19 | 19 | 19 | 21 |
| (29) Number of active connection | 0 | 4,060 | 4,280 | 4,500 | 4,720 | 4,940 | 5,160 | 5,380 |
| (B) Engineering | | | | | | | | |
| (8) Production Volume | cm/day | 3,700 | 4,300 | 4,300 | 4,300 | 5,000 | 5,000 | 5,000 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| ( C) Management Efficiency | | | | | | | | |
| (40) Number of staff | | 27 | 27 | 29 | 31 | 31 | 33 | 35 |
| Number of connection per staff | | 150 | 159 | 155 | 152 | 159 | 156 | 154 |
| (36) Collection efficiency | % | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| (D) Financial | | | | | | | | |
| (50) Revenue from operational activity | ,000 NR/ye | 15,620 | 19,590 | 20,597 | 21,604 | 22,611 | 23,618 | 29,206 |
| (56) Expenditure for operational activity | ,000 NR/ye | 12,049 | 13,982 | 15,740 | 17,724 | 20,559 | 23,094 | 25,956 |
| (62) Revenue | ,000 NR/ye | 15,620 | 47,560 | 20,597 | 21,604 | 57,845 | 23,618 | 29,206 |
| (63) Expenditure | ,000 NR/ye | 12,049 | 41,952 | 15,740 | 17,724 | 55,793 | 23,094 | 25,956 |
| (64) Cash balance | ,000 NR/ye | 3,571 | 5,608 | 4,857 | 3,880 | 2,052 | 524 | 3,251 |

Target:
- Number of connection: should be more than this
- NRW: should be less than this
- Number of connection per staff 150
- Collection Efficiency: should be maintaining this efficiency
- Revenue, specially revenue from operational activity should be more than this
- Expenditure, specially expenditure for operational activity should be less than this
- Cash balance, it should be positive

- Review every year when budgeting
- Update if necessary

7. Q&A

# CONCEPT AND OBJECTIVE OF BUSINESS PLAN

## MANAGEMENT MODEL OF WUSC

**Ideal state of WUSC**

To provide safe water affordably in stable manner to maximum people in their jurisdiction with reasonable cost

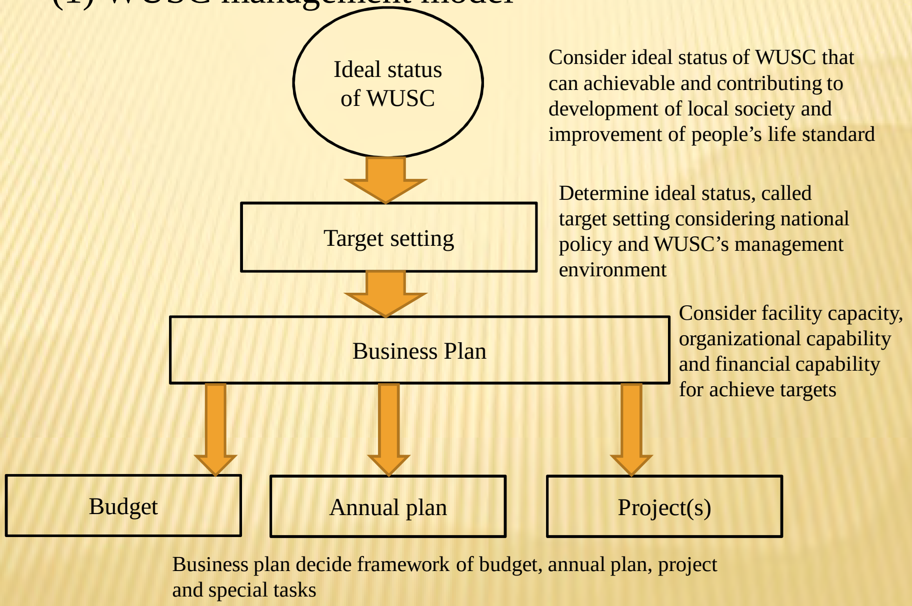
## IDEAL STATUS

- Ideal status is explained with **Mission and Vision**
- **Mission** is what WUSC must do like to provide safe water to maximum people in a reasonable price and stable manner
- **Vision** is what WUSC want to be in the future for e.g. be the best service provider in NEPAL by 20 years.

- For realizing this status,WUSC must set **target** step by step
- For e.g.: provide safe water to 75% people in jurisdiction after 10 years
- The means for achieving this ideal status is

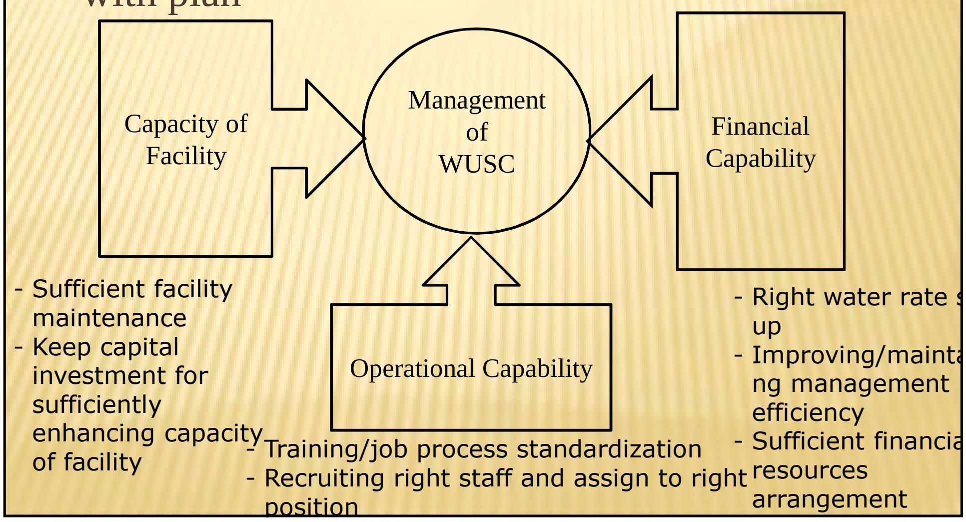
**<u>BUSINESS PLAN</u>**

## (1) WUSC management model




## FOR REALIZING THIS IDEAL STATUS

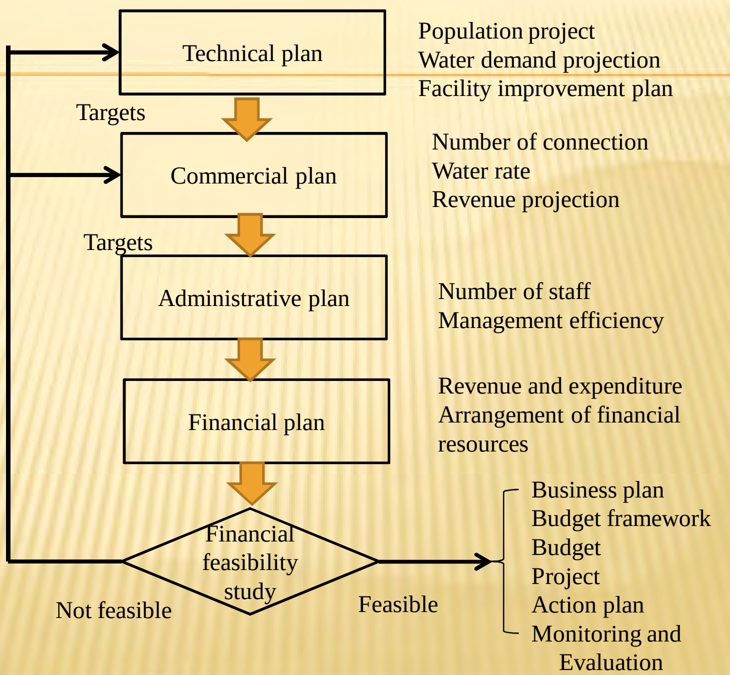
It may necessary to enhancing 3 capabilities with plan



# CONCEPT OF BUSINESS PLAN

## BUISNESS PLAN CONCEPT

Targets
- Production
- Revenue
- NRW
etc.



## TECHNICAL PLAN

- Main aim of technical plan to know whether existing facility meet the water demand or not
- If not we suggest them for facility improvement (for eg:construction of new bore well, installation of generator),here we can help WUSC to make cost estimation
- This information should be shown in business plan
- The capital cost and O and M cost are also shown in the plan

## PROCEDURE TO FORMULATE BUSINESS PLAN

## TECHNICAL PLAN

- (1) Technical planning
- 1) Projection of population:
- = BP*(1+PG)

- BP: baseline population, normally VDC data, census
- PG: population growth rate, VDC data, census

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |

## TECHNICAL PLAN(SOME INFORMATION)

- We should collect the population data from past 5 years /10 years to know the trend of population growth rate.
- This information may be collected from VDC(village development committee)

# TECHNICAL PLAN

(1) Technical planning
2) Coverage ratio and population served:
PS = PoP*SC

PS: population served
PpP: population
SC: Service coverage, decide based on policy

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |

# TECHNICAL PLAN(SOME INFORMATION)

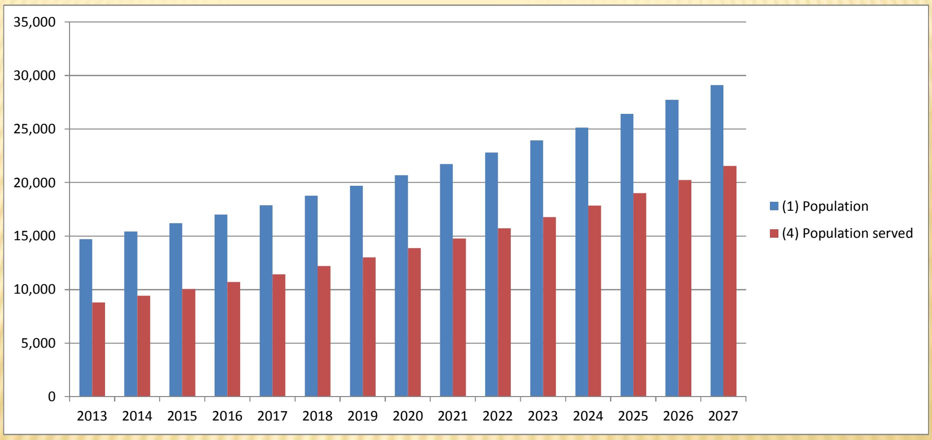
- Service coverage ratio depends upon political condition
- Better to determine for first five years(mid term) ,then ten years(long term) ,15 years(far long term) then adjust to annual base ,e.g if present is 60%,set mid term target as 65% and long term as 70% and far long term as 75%

# TECHNICAL PLAN

PRESENT POPULATION SERVED CAN BE ALSO CALCULATED AS:

**PRESENT POPULATION SERVED=NUMBER OF ACTIVE CONNECTION*ANHM**

**ANHM=AVERAGE NUMBER OF HOUSE MEMBER,VDC CAN PROVIDE THIS INFORMATION**



(1) Technical planning
3) Water demand:
= PS*C
PS: population served
C: Consumption, normally consumption per capita per day, decide by policy
60 l/d/c is minimum, and standard is 105 l/d/c

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
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| (4) Population served | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - domestic customer | | 8,400 | 8,820 | 9,415 | 10,048 | 10,721 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (5) Consumption/capita/day | litter | 65 | 66 | 67 | 68 | 69 |
| - domestic customer | | 65 | 66 | 67 | 68 | 69 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |

## TECHNICAL PLAN(SOME INFORMATION0

- **65 LPCD** IS MINIMUM FOR SUSTAINING HUMAN LIFE
- IN STANDARD,**105 LPCD** IS TARGET FOR DEVELOPING COUNTRY
- **TECHNICAL PLAN** AIMS TO INCREASE THE CONSUMPTION e.g:if present water consumption per day per capita is 65 litre, they decide to make 69 after 5 years by annually increasing by 1 litre and this is shown in this plan
- WATER DEMAND CONSISTS OF **DOMESTIC** AND **NON-DOMESTIC CONSUMER**;NON DOMESTIC LIKE HOTELS,INDUSTRIES ETC

## SOME OF THE EXAMPLES OF NON DOMESTIC CONSUMER

- In case of salakpur,WUSC provide water for animals such as :
- 30 litre/day/cow,15 litre/day/goat and sheep and 5 litre/day/chicken
- In chandragadhi,WUSC provide water to hospitals,schools etc

(1) Technical planning
4) Consider capacity of facility and water demand
- If capacity would be less than demand, need enhancement

FC = Prd*(1-NRW)

FC: Capacity of facility for provide water
Prd: Production volume
NRW: Non Revenue Water

FC is more than water demand or not?

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
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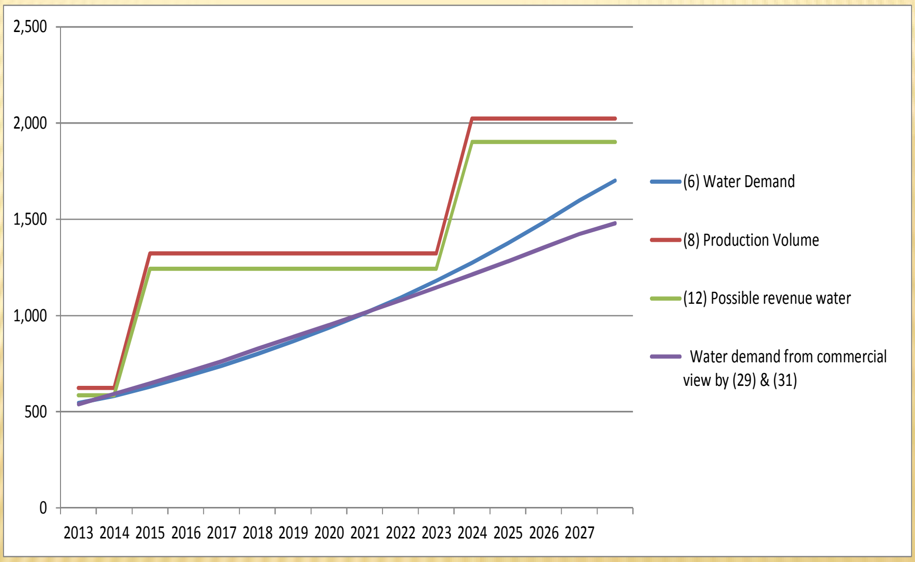
| - domestic customer | | 65 | 66 | 67 | 68 | 69 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
| - domestic customer | | 546 | 582 | 631 | 683 | 740 |
| - non domestci customer | | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| (7) Intake Water Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 592 | 1,257 | 1,257 | 1,257 |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 586 | 1,244 | 1,244 | 1,244 |
| | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | 3,700 | 725 | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | 2,000 | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 0 | 3,700 | 2,725 | 0 |



# TECHNICAL PLAN(SOME INFORMATION)

- The water demand might be scarcity at some year,in that period may advise on facility improvement such as: construction of new bore well, new submersible pump, generetor,pipeline extension etc.
- The cost estimation of these capital cost should be mentioned on the plan(WUSC Usually donot have knowledge of cost estimation, so we can advise them)
- In this year, require huge investment called capital cost ,WUSC have to arrange financial resources from DO OR DWSS

(1) Technical planning

5) Cost estimation of facility improvement

| (1) Facility improvement of 2014 | | | |
|---|---|---|---|
| Items | Quantity | Unit Cost | Cost |
| 1) Drilling of new well | 1 | 2,000 | 2,000 |
| 2) submersible pump | 1 | 400 | 400 |
| 3) Booster pump | 1 | 300 | 300 |
| 4) Graund reservor | 1 | 1,000 | 1,000 |
| 5) transmission line | 4,000 | 0.28 | 1,120 |
| 6) pipe fitting (20%) | | | 224 |
| 7) Contingency (25%) | | | 1,261 |
| total | | | 3,700 |
| 8) 50% cost share | | | 1,850 |
| Unit: ,000 NR | | | |
| Cost may necessary for reviewed and updated | | | |

## TECHNICAL PLAN(SOME INFORMATION)

- Usually large scale rehabilitation and maintenance is done in every 10 years.
- The Life of submersible pump and generator is generally 10 years
- For facility rehabilitation and maintenance require large cost and it should be located on technical plan

(1) Technical planning

6) O&M cost

- **If facility is improved, O&M cost would be changed, more power and fuel for pumping cost, more chemical, and may need more pump operator**

| A: Engineering plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (1) Population | | 14,000 | 14,700 | 15,435 | 16,207 | 17,017 |
| (2) Population growth | % | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |
| (3) Coverage ratio | % | 60% | 60% | 61% | 62% | 63% |
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| (6) Water Demand | cm/day | 546 | 582 | 631 | 683 | 740 |
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| (7) Intake Water Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (8) Production Volume | cm/day | 623 | 623 | 1,323 | 1,323 | 1,323 |
| (9) UFW | % | 5% | 5% | 5% | 5% | 5% |
| (10) Accounting water | cm/day | 592 | 592 | 1,257 | 1,257 | 1,257 |
| (11) NRW | % | 6% | 6% | 6% | 6% | 6% |
| (12) Possible revenue water | cm/day | 586 | 586 | 1,244 | 1,244 | 1,244 |
| | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | | 3,700 | 725 | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | 2,000 | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 0 | 3,700 | 2,725 | 0 |
| (16) Inflated capital investment | ,000 RP | | 0 | 4,079 | 3,155 | 0 |
| (17) Inflation rate | % | 5% | 5% | 5% | 5% | 5% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 |
| | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | | 400 | | |
| (20) Inflated (19) | ,000 NR/ | dummy | | 441 | 0 | |
| (21) Power and fuels for pumping | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 0 | | 0 | |
| (23) Inflated (22) | ,000 NR/ | dummy | 0 | | 0 | |
| (24) Chemical for production | ,000 NR/ | 0 | 0 | 0 | 0 | 0 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | | 30 | | |
| (26) Inflated (25) | ,000 NR/ | dummy | | 32 | 0 | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 68 | 71 | 106 | 112 | 117 |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 800 | 840 | 1,355 | 1,422 | 1,493 |

# COMMERCIAL PLAN

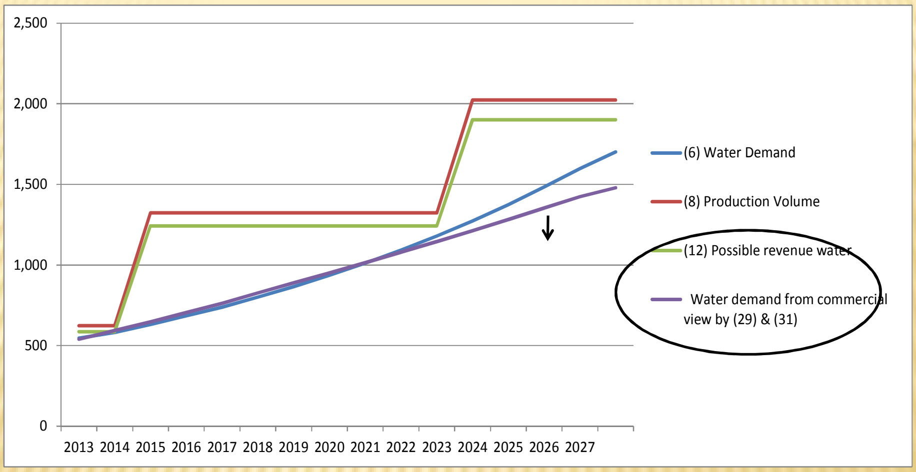
(2) Non-technical planning
1) Number of connection
- Up to capacity of facility, it could possible to increasing

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 1,189 | 1,289 | 1,389 | 1,489 | 1,589 |

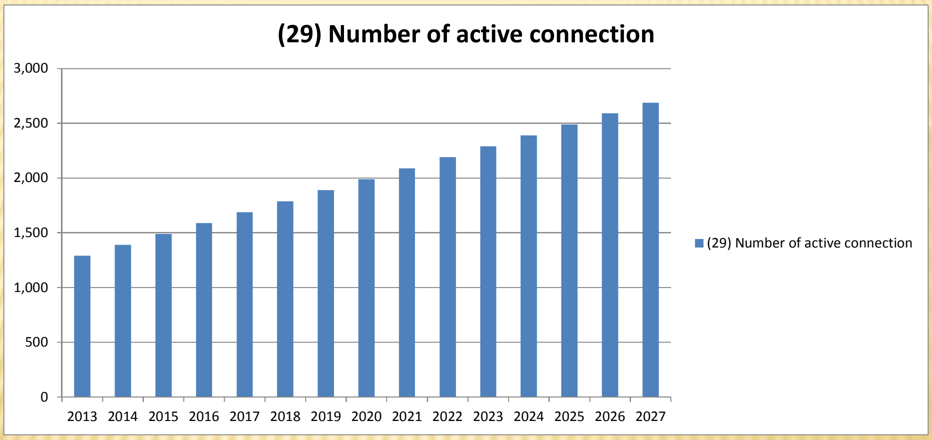
## COMMERCIAL PLAN(SOME INFORMATION)

- We need to know the trend of increment of connection from past 5 years data

| B: Customer service plan | unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | baseline |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | 0 | 350 | 240 | 240 | 240 | 119 | |
| (29) Number of active connection | | | 350 | 590 | 830 | 1,070 | 1,189 | 1,189 |




Water demand based on number of connection



## COMMERCIAL PLAN(CUSTOMER SERVICE PLAN)

- Commercial plan mainly focus on additional connection and water rate and based on this revenue from sales of water is calculated
- This information is very important for financial plan
- Design of water rate is link with financial plan

(2) Non-technical planning
2) Water rate and revenue from sales of water
- Minimum charge coves fixed cost
- Commodity charge covers flexible cost
- Cost including depreciation

RevS = ((Min + Com*(Con-10))*NoC)*ColE*12 months

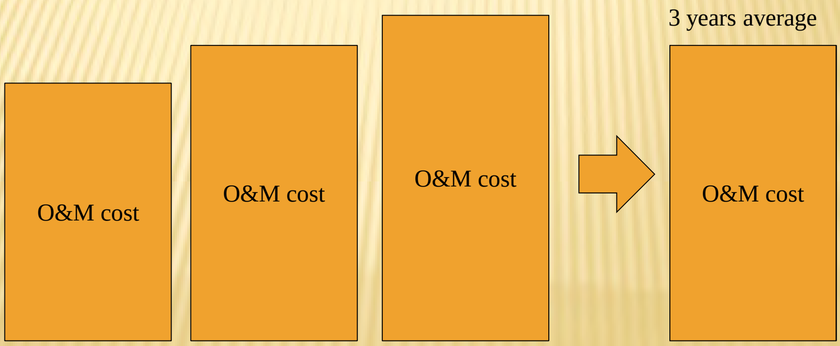
RevS: Revenue from sales of water
Min: Minimum charge
Com: Commodity charge
Con: average monthly consumption volume per connection
NoC: Number of connection
ColE: Collection efficiency

## COMMERCIAL PLAN(SOME INFORMATION)

- Water rate is decided by minimum and commodity charge
- Example: Jhapa adapts 8 cubic meter and Morang adapts 10 cubic meter as minimum charge

AI: adjustment for inflation and increases of cost in future

- Using 3 years average O&M cost for target to be recover and setting water rate to 3 years (e.g.)



## COMMERCIAL PLAN(SOME INFORMATION)

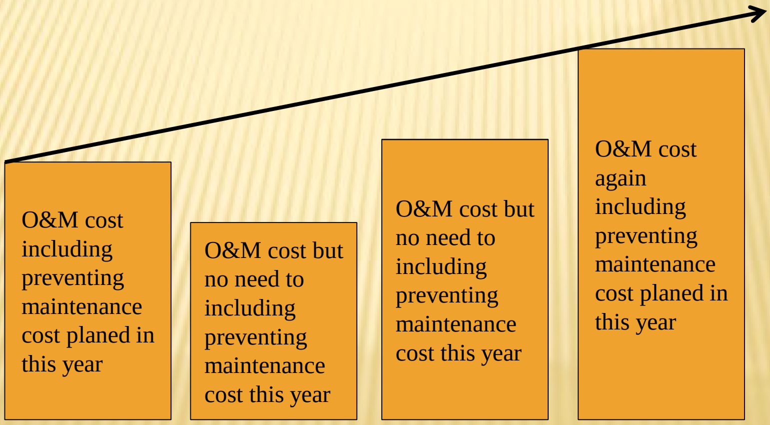
- While setting water rate, avoid fluctuation in water rate
- e.g. If the O and M cost is increasing every 3 years continuosly,then set the water rate average of 3 years and increasing every 2 years
- Rapid increase in water rate might leads to the user complaint and negative impression about WUSC
- Water rate setting should maintain positive cash balance at the end, if not change the water rate

## COMMERCIAL PLAN(SOME INFORMATION)

- Water rate should be set and increased such that revenue from sales of water cover O and M cost
- But for large capital investment revenue from sales of water might not be enough, in that case they contribute 10% and for 90%,they can take grant from DWSS/DO/VDC
- This grant cost should be also located on business plan

AS: adjustment for avoid rapid fraction of water rate

- Smoothing and avoid rapid increases, ideally increasing stable ratio, e.g. 3% by every two years




## COMMERCIAL PLAN

| B: Customer service plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (29) Number of active connection | | 2,000 | 2,100 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 2,700 | 2,800 | 2,900 | 3,000 |
| (30) Average family size | person/family | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **(31) Avr. consumption per connection** | **cm/month** | **11** | **12** | **12** | **12** | **12** | **13** | **13** | **13** | **14** | **14** | **14** |
| (32) Confirmation of (31) with (5) | cm/month | 11 | 12 | 12 | 13 | 13 | 14 | 14 | 14 | 15 | 15 | 16 |
| (33) Minimum charge volume | cm/month | 10 | 10 | 10 | 10 | **10** | **10** | **10** | **10** | **10** | **10** | **10** |
| **(34) Water rate (minimum charge)** | **NR** | **100** | **100** | **100** | **110** | **110** | **120** | **120** | **140** | **140** | **160** | **160** |
| **(35) Water rate (commodity charge 10-25)** | **NR** | **12** | **12** | **12** | **14** | **14** | **16** | **16** | **18** | **18** | **20** | **20** |
| **(35) Water rate (commodity charge 21-30)** | **NR** | **14** | **14** | **14** | **20** | **20** | **24** | **24** | **28** | **28** | **32** | **32** |
| **(36) Collection efficiency** | **%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** | **98%** |
| (37) Expected monthly revenue from sales of water | ,000 NR/month | 220 | 255 | 267 | 311 | 325 | 412 | 428 | 513 | 582 | 682 | 706 |
| (38) Expected annual revenue from sales of water | ,000 NR/year | 2,634 | 3,062 | 3,208 | 3,733 | 3,895 | 4,939 | 5,137 | 6,160 | 6,981 | 8,185 | 8,467 |
| Water demand from commercial view by (29) & (31) | cm/day | 733 | 840 | 880 | 920 | 960 | 1,083 | 1,127 | 1,170 | 1,307 | 1,353 | 1,400 |

# ADMINISTRATIVE PLAN

## ADMINISTRATIVE PLAN

- Focus on number of staff considering labor efficiency and maintaining quality of services
- If staff is shortage, quality is drop, if over staffed, effect management efficiency

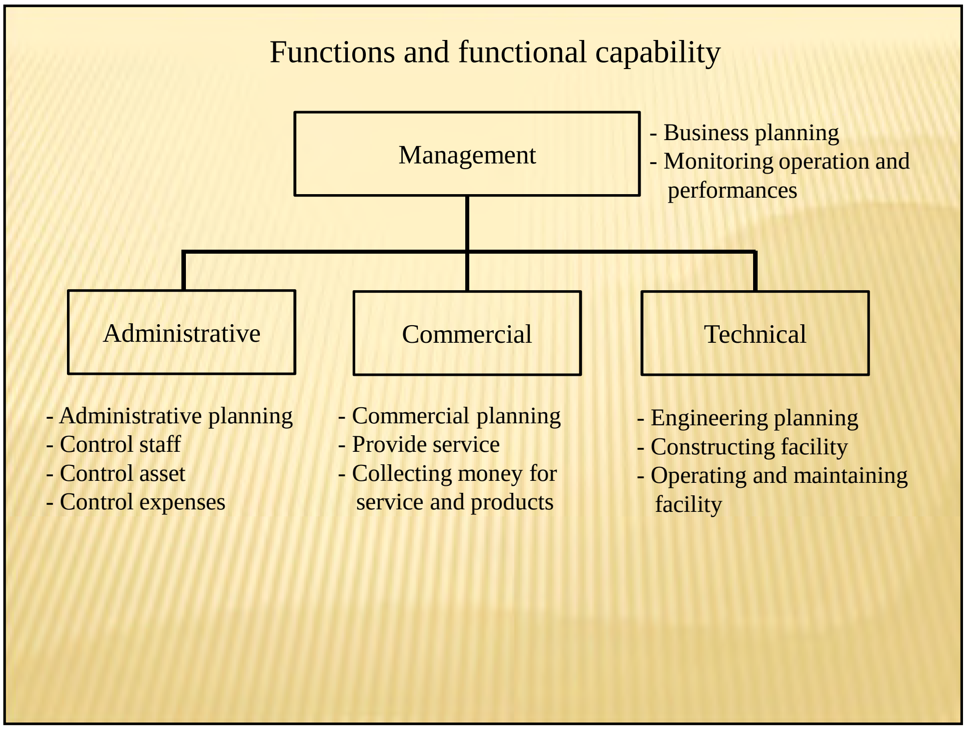
## ADMINISTRATIVE PLAN

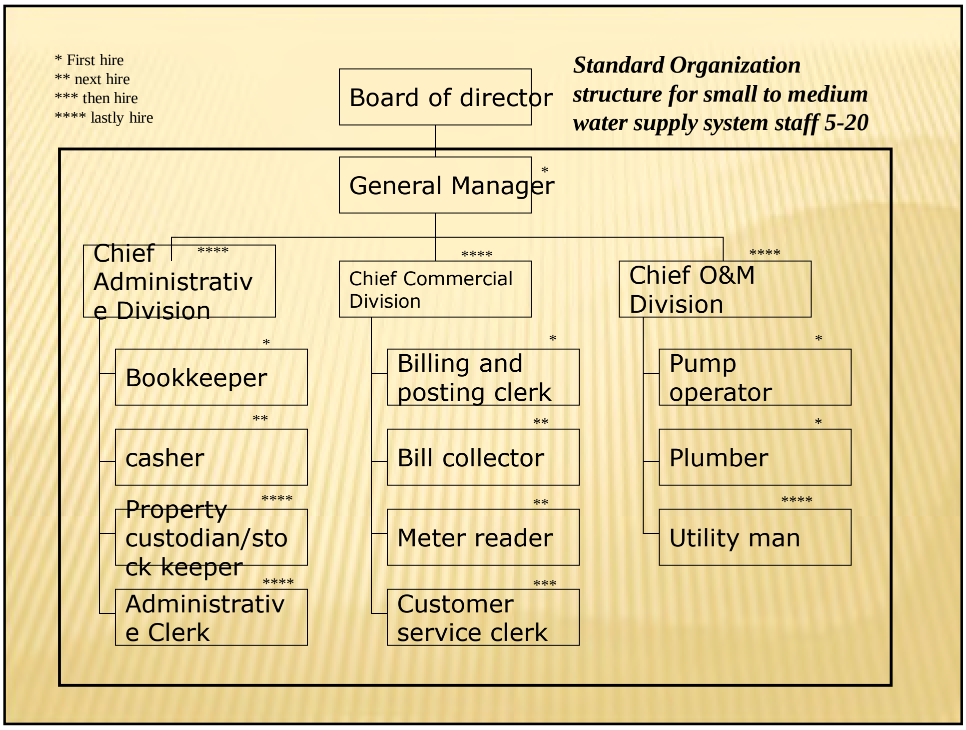
**Non-technical planning**

- 4) Staffing
- - Based on requirement for facility operation
- - Based on job flow standardization (including computerization)
- - Based on organizational standardization
- - Based on labor efficiency
-   - not makes over loading to staff, for maintaining quality of work
-   - not too much staff
-   - 120 to 200 connections per staff

## ADMINSTRATIVE PLAN

- First decide how many number of technical staff(pump operator,plumber,engineer) is required depending on facility but in case of WUSC of NEPAL engineer is not yet recruited.
- Decide how many number of customer service clerk(meter reader, plumber for connection, cashier) is required and also determine administrative clerk(store keeper,security,gardener etc)
- It may be recommendable to control the staff to obtain the labor efficiency such as **per staff connection should be between 120 and 200,if per staff number of connection is less than 120,it may be overstaff or exceeds 200 might be staff shortage**


Functions and functional capability
Management
- Business planning
- Monitoring operation and performances
Administrative
Commercial
Technical
- Administrative planning
- Control staff
- Control asset
- Control expenses
- Commercial planning
- Provide service
- Collecting money for service and products
- Engineering planning
- Constructing facility
- Operating and maintaining facility


* First hire
** next hire
*** then hire
**** lastly hire
Board of director
Standard Organization structure for small to medium water supply system staff 5-20
General Manager *
Chief Administrative Division ****
Chief Commercial Division ****
Chief O&M Division ****
Bookkeeper *
casher **
Property custodian/stock keeper ****
Administrative Clerk ****
Billing and posting clerk *
Bill collector **
Meter reader **
Customer service clerk ***
Pump operator *
Plumber *
Utility man ****

# AMINISTRATIVE PLAN(SOME INFORMATION)

- Similarly this plan included inflated salaries and inflated administrative cost
- Increasing salaries can be also include in this plan, it is basically decided when number of staff is increased

| C: Administrative plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | | 0 | | | | | | | 1 | | 1 |
| (40) Number of staff | | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 14 | 14 | 15 |
| (41) Increasing salaries | NR/staff | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 216 | 0 | 239 |
| (42) Inflated (41) | ,000 NR/year | dummy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 227 | 0 | 251 |
| (43) Salaries and wages | ,000 NR/year | 2,000 | 2,100 | 2,205 | 2,315 | 2,431 | 2,553 | 2,680 | 2,814 | 3,182 | 3,341 | 3,759 |
| (44) Increases admi cost (*1) | ,000 NR/year | | 20 | 23 | 27 | 31 | 36 | 41 | 47 | 55 | 63 | 73 |
| (45) Inflated (44) | ,000 NR/year | dummy | 21 | 24 | 28 | 32 | 37 | 43 | 50 | 58 | 67 | 77 |
| (46) Administrative cost | ,000 NR/year | 200 | 231 | 267 | 308 | 356 | 411 | 475 | 548 | 633 | 732 | 845 |
| (47) subtotal of salaries and admi cost | ,000 NR/year | 2,200 | 2,331 | 2,472 | 2,623 | 2,787 | 2,964 | 3,155 | 3,363 | 3,816 | 4,073 | 4,604 |
| Connections per staff | #/staff | 154 | 162 | 169 | 177 | 185 | 192 | 200 | 208 | 200 | 207 | 200 |

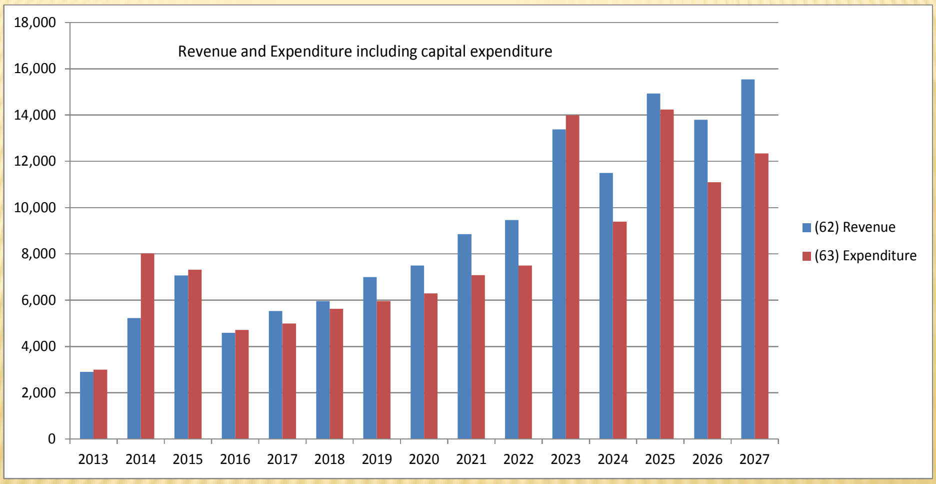
# FINANCIAL PLAN

Non-technical planning

5) Financial plan

- Expenditure:
  - Capital investment (facility improvement)
  - Operation and maintenance cost (salaries, power and fuel of pumping, chemical for purification, spare parts, repair and maintenance and office management cost)
  - Financial cost, if any
- Revenue
  - Sales of water and other operational revenue
  - grant, subsidiary
  - loan disbursement

| D: Financial plan | unit | Base line | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 |
| - domestic customer | | 1,851 | 2,228 | 2,450 | 3,250 | 3,536 | 4,251 |
| - non domestci customer | | | | | | | |
| (49) Revenue from others | ,000 NR/ | 579 | 668 | 735 | 975 | 1,061 | 1,275 |
| (50) Revenue from operational activity | ,000 NR/ | 2,430 | 2,897 | 3,185 | 4,225 | 4,596 | 5,526 |
| (51) Salaries | ,000 NR/ | 733 | 1,968 | 2,361 | 2,479 | 2,929 | 3,075 |
| (52) Power | ,000 NR/ | 732 | 769 | 1,248 | 1,310 | 1,376 | 1,445 |
| (53) Chemicals | ,000 NR/ | 0 | 0 | 0 | 0 | 0 | 0 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 68 | 71 | 106 | 112 | 117 | 123 |
| (55) Other O&M and administration | ,000 NR/ | 682 | 193 | 223 | 257 | 297 | 343 |
| (56) Expenditure for operational activity | ,000 NR/ | 2,215 | 3,001 | 3,938 | 4,159 | 4,719 | 4,986 |
| (57) Cash balance of operational activities | ,000 NR/ | 215 | -104 | -753 | 66 | -123 | 540 |
| | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 188 | 0 | 2,040 | 2,839 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 0 | 0 | 4,079 | 3,155 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 140 | | | | | |
| (61) Financial cost | ,000 NR/ | 9 | | | | | |
| (62) Revenue | ,000 NR/ | 2,758 | 2,897 | 5,225 | 7,064 | 4,596 | 5,526 |
| (63) Expenditure | ,000 NR/ | 2,224 | 3,001 | 8,018 | 7,313 | 4,719 | 4,986 |
| **(64) Cash balance** | **,000 NR** | **534** | **-104** | **-2,793** | **-249** | **-123** | **540** |
| **(65) End balance** | **,000 NR** | **3,286** | **3,182** | **389** | **140** | **17** | **557** |



Non-technical planning
6) Financial resources arrangement
- Grant (in many case)
- Zero interest loan
- Low interest loan
- Deposit

- Share hold among members
50% vs. 50% in Shalakpur WUSC
60% vs. 40% in Urlabari WUSC
after 3 years of construction project accomplished, share 50% of the profit with share holder and WUSC

## FINANCIAL PLAN(SOME INFORMATION)

- Financial plan mainly focus on revenue and expenditure, revenue of sales of water but it may not be sufficient mainly during capital investment, so in this case may required grant or loan
- If WUSC take loan, financial cost is emerged and should be included in financial plan
- End balance may better keep at least 3-5% positive against revenue from sales of water (this is cash on hand for emergency)

## FINANCIAL PLAN(SOME INFORMATION)

- Expenditure is escalating with inflation rate (though adjust when in capital investment and when increasing number of staff)
- - 10% equity contribution is required as minimum condition for grant from DWSS
- -10% grant may expected as construction when WUSC try to construct by themselves

## FINANCIAL PLAN

- Financial feasibility is checked with end balance, if not feasible re check the technical plan and commercial plan
- Change the scope of activities such as: postponed of pipeline extension of pipeline for certain year etc
- Postponed the facility improvement plan change the scope of capital investment
- Increase water rate

- After financial plan becomes feasible, compile all the data and BUSINESS PLAN is prepared
- BUSINESS PLAN is implemented in terms of budget framework, project etc
- Business plan should be reviewed such that it is implemented in right truck or not, it can be done through **MONITORING AND EVALUATION**

THANK YOU

# Draft Guideline
# on
# Monitoring and Evaluating
# of
# Business Plan
# for
# Implementing
# WUSC Management Model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**August 2013**

# 1. Objectives

Objectives of this draft guideline are simply two, 1) introduce basic knowledge and technique on M&E: monitoring and evaluation to staff of DWSS and staff working for WUSC, and 2) encourage to do M&E by themselves.

This draft guideline stands on, or assumes as:

- WUSC has wiliness to implementing WUSC management model
- For implementing, WUSC prepare business plan determined on the WUSC management model
- For realize WUSC's ideal status, WUSC implementing their business plan

For WUSC management model and supporting system, another draft guideline "***Draft Guideline for WUSC management model and Support Model***" was developed in ***August 2012***. This draft guideline on M&E is based on that draft guideline and supporting chapter on M&E. In this term, this draft guideline is supporting document or supporting draft guideline. The title of this draft guideline is somehow so long and reader may feel strange. It is not simply "draft Guideline for Monitoring and Evaluating Business Plan", but added "Business plan for Implementing WUSC Management Model". Therefore, business model aims to implement WUSC management model. Business model is tool or vehicles for realizing ideal status of WUSC mentioned in the WUSC management model.

Again, M&E mention in this draft guideline is designed for WUSC management model and business model for implementing WUSC model. If no need to stand on WUSC management model, M&E introduced in this draft guideline may no need to be same. Actually, there are so many different concepts of M&E for different type and different objective business plans.

Added more, standardizing movement of KPI: Key Performance Indicators is proposed by group of Japanese and the World Bank. But they have different evaluation concept with this draft guideline. Author request to reader for understand what is different on objectives. ***Objectives of M&E introduced in this draft guideline are simply assist and accelerating implementation of WUSC management model.***

For convenience to reader, this draft guideline, first briefly explains about WUSC management model and business plan realizing WUSC management model.

## 2. WUSC management model

WUSC management model aims to realize ideal status of WUSC, when ***WUSC provides safe water affordably in stable manner, to maximum people in their jurisdiction with reasonable cost***. This status can be translating and explain with several key performance indicator such as service coverage ratio become 100% for provide water to maximum people in their jurisdiction, or water sampling test meet 100% with national water quality standard as provide safe water, or minimum charge is less than 3% for average house income of low income group as reasonable cost.

For realizing this ideal status, WUSC must strengthening three capabilities and maintaining sufficient level, as 1) capacity of facility, 2) financial capability and 3) operational capability.

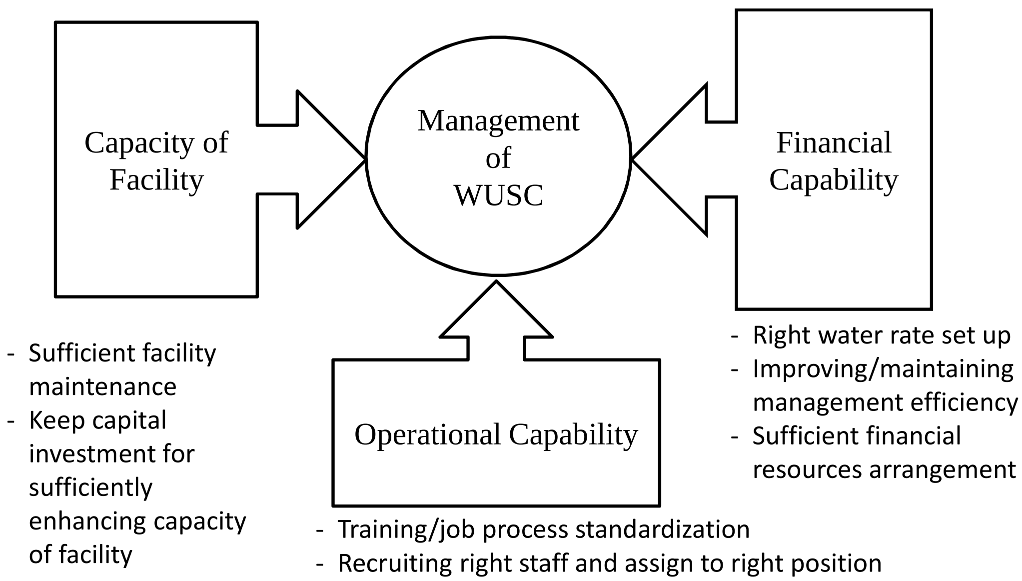



Fig-2.1: MWSC management model

(1) Capacity of facility

Capacity of WUSC's facility is required for cover water demand and this may realized with sufficient facility maintenance and sufficiently enhancing capacity of facility for always meet with water demand. Water demand may increase by growth of population and people's request to improving life standard. And improving facility, it required capital investment.

(2) Financial capability

For maintaining facility, operating facility and adjusting capacity of facility for meet growth of water demand, WUSC should maintain sound financial capability. This is simply mentioned maintaining positive cash balance. Since main revenue source is sales of water and services, WUSC may need to maintain sufficient level of water rate and ensure revenue for sales of water and services are in sufficient level. But sometimes capital investment for improving facility requires huge financial resources and may need financial resources arrangement including arrangement of loan, grant or subsidiary.

(3) Operational capability

WUSC also should maintaining organizational capability and personal capability for ensure to maintaining and operate facility and office management to maintaining sufficient level of user services. For maintaining organizational capability on sufficient facility operation and business operation, recruiting right staff, maintaining skill development in human resources management side, and standardizing job process based on manual, guideline, and SOP: Standard Operation Procedure for maintain quality of work.

(4) Implementing WUSC management model

For implementing WUSC management model, this draft guideline encourages to do following steps:

1) Target setting
2) Business planning
3) Implementing
and
4) Job standardization and skill development with training based on SOP

In another word, prepare business plan and implementing, and realizing target is one of way to implementing WUSC management model. Of course, first organizational capability strengthening and then shifting planning may possible.

Regarding strengthening organizational capability strengthening, WUSC management model prepares so many SOPs, guidelines and manuals. WUSC can utilize these effectively.

## 3. Business Planning

***Business plan mentioned in this draft guideline mean business plan formed for implementing WUSC management model.*** There is many different type of business plan. Normal business plan for private and profit oriented organization starts marketing and commercial plan, that is different style with this business plan mentioned in this draft guideline. Also, if objective is different, focus point and style is different. Business plan requested from lending agencies may more focus on financial plan and consider how WUSC can maintain sound financial management and could keep repayment to loan. But financial plan in this business plan is very simplified and not much consider income statement view and balance sheet view, but only concern WUSC can keep maintain sufficient level of cash balance.

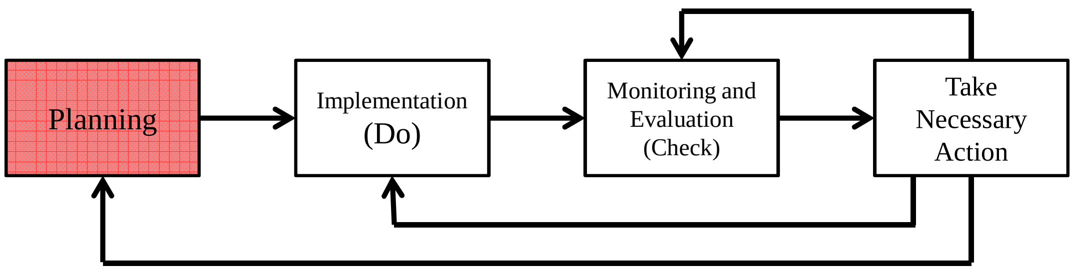



Fig-3.1: Business planning cycle

Also reader must mind as business planning mean business planning cycle, and not only mean make plan. Plan should be implemented. So, normally, first prepare plan, and then implementing and time to time, doing monitoring and evaluation, and take necessary action for keep implementation on right truck to achieve objectives of the plan. This planning cycle is called PDCA cycle, P stand on planning, D: do and means implementing, C: check means M&E, and A means action, take necessary action.

This chapter focus on first step, P: prepare plan.

Show process of prepare business plan in figure 3.2. Business plan starts from technical plan, then shifting to commercial plan, administrative plan and lastly financial plan for confirm financial feasibility. If technical plan and commercial plan are financially infeasible, planner must go back and re-planning until meet financial demand on feasibility.

(1) Technical plan

Technical plan mainly focus on capacity of facility meets water demand. However, if capacity of facility is same, under growth of population and increasing consumption, on some time, water shortage is emerged, or capacity of facility does not meet with water demand. So, calculate water demand and check capacity of facility, and if necessary, enhancing capacity for always capacity meets with demand.

From this technical plan, following data are prepared and hand over to other plans:

- Population
- Service Coverage
- Population served
- Consumption per day per capita
- Facility improvement plan and capital cost
- Facility operation and maintenance cost

(power/fuel for pumping, chemical for purification, spare parts, repair and maintenance cost)

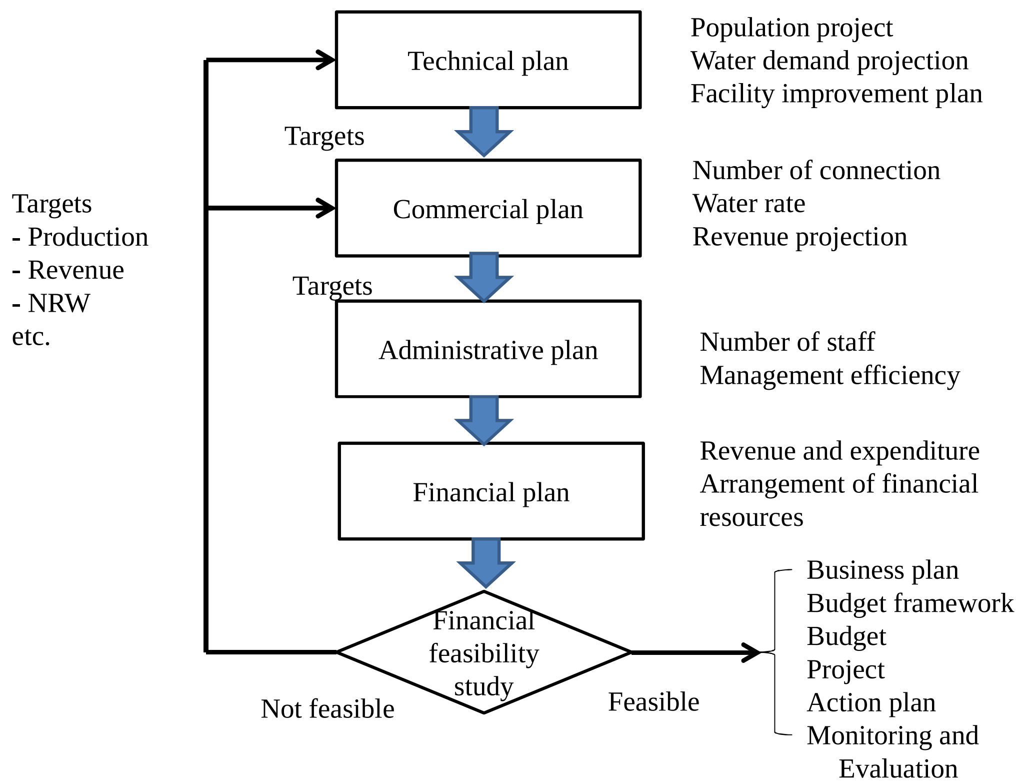



Fig-3.2: process to prepare business plan

(2) Commercial plan

Commercial plan mainly focus on how to provide good service to user, and also consider revenue collection for provide safe water and good services. Since WUSC is non profitable organization, however, minimum profitability is necessary to keep maintaining water supply and services to user. Otherwise, bankrupt makes stop to provide safe water and good services. For this purpose, commercial plan design number of connection, sufficient level of water rate, and project revenue from sales of water, and keep monitoring water consumption by user.

From this commercial plan, following data are prepared and hand over to other plans:

- Number of additional connection
- Number of connection
- Average consumption per connection
- Water rate
- Collection Efficiency
- Revenue from sales of water and services

(3) Administrative plan

Administrative plan design and ensure management efficiency while keep maintaining quality of work. For this purpose, administrative plan design staffing and project salaries and administrative cost.

From this administrative plan, following data are prepared and hand over to other plans:

- Number of staff
- Salaries and wages
- Office management cost

- Labor efficiency

(4) Financial plan and financial feasibility

Financial plan may simply project expected revenue and expected expenditure and check balanced or unbalanced. Balanced means expected revenue is more than expected expenditure and called positive cash balance. However, if visa versa, expected revenue is shortage and makes negative cash balance, WUSC cannot maintain sound operation. Maintaining positive cash balance called financially feasible. However, sometimes when capital investment for facility improvement or extension of pipeline network cause negative cash balance. If this situation emerged, some financial resources arrangement including get grant or subsidiary for cover shortage of cash may necessary. If financial resources arrangement is not work, change scope of technical plan until not emerge negative cash balance.
From this financial plan, following data are prepared:

- Revenue
- Expenditure
- Financial resources arrangement plan

(5) Completion of business plan

When financially feasible technical plan, commercial plan (as well as administrative plan) are ready, and supporting by financial plan (including financial arrangement plan), these plans are compiled as report type business plan and sometimes also prepare presentation type format.
Business plan is implemented as budget/budget control, construction project and annual activities.

Typical table of contents of business plan is:
1) executive summary
2) Mission, vision and core value, objectives
3) review of previous year's plan
   analysis (performance vs. target/budget)
   issues and problem/management environment
4) business strategy/implementation strategy
5) technical plan (population, service coverage, water demand, facility improvement plan and capital cost, technical activities, etc.)
6) customer service plan (connection, water rate, revenue from sales of water and services, commercial activities, etc.)
7) administrative plan (staffing, management efficiency, administrative activities, etc.)
8) financial plan (revenue and expenditure, financial resources arrangement)
9) M&E plan
10) appendix/attachment

(6) Period and M&E

Business plan normally covers 10 to 15 years, and set target or mile stone of future 5 years called medium term targets, and future 10 years called long term targets.
For convenient of M&E, mainly for monitoring, some data of targets are prepared from business plan.

# 4. Monitoring and Evaluation

M&E: Monitoring and Evaluation introduced in this draft guideline aims to watch and gives necessary information for implementation of business plan on right truck. Or, in other word, ***M&E aims for implanting WUSC model on right truck.*** If not stand on this concept, style and procedure of M&E may different, or indicators selected would be different. There is no reason to adapt this concept of M&E to other concept business plan and WUSC management model.

Also in this chapter, author introduce sample format for M&E, but this is just sample. Reader can and should modify based on target business plan and target core management issues. Sample format is very simplified and also selected indicators are limited. For example, if management issue is more on loan and how to repay, reader should enrich financial indicator and more focus on M&E to financial aspects as well as sufficiency of water tariff level and management efficiency. In that case, may be change style of financial plan to prepare also projected income statement, projected balance sheet. Business plan in this draft guideline also be too much simplified.

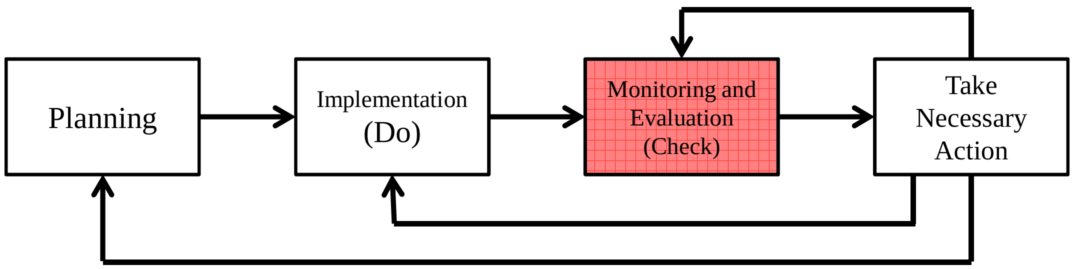



Fig-3.1: Business planning cycle

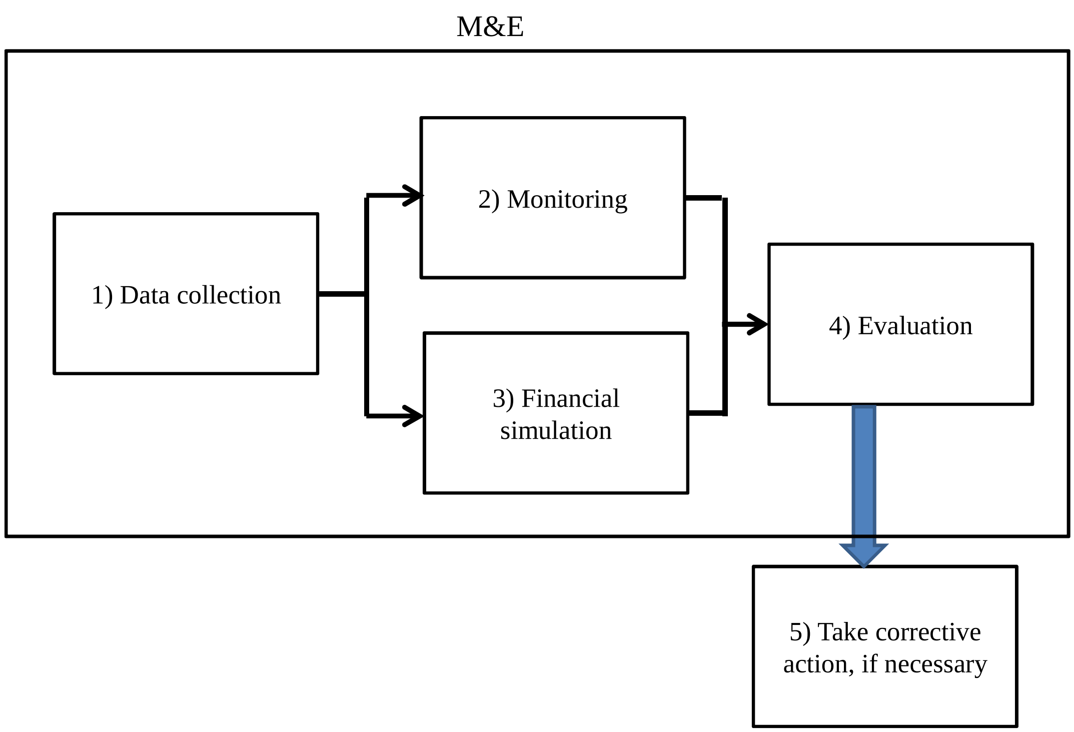



Fig-4.1: M&E process

M&E called as one word, however actually monitoring and evaluation are slightly different. Monitoring is focus on keep watching actual performance meet with target, or WUSC can achieve

target or not. If there is gap, take action for catch up. Monitoring is activity for watching gap of outputs and target.
While evaluation is making judgment to outcomes achieves objectives of business plan or not. Evaluation in this chapter defines evaluating or judging WUSC do good practice in term of user services, water supply system maintaining capability, maintaining management efficiency as well as maintaining financial soundness, based on concept of Balanced Scorecard. There are several different concepts of M&E in this world.

Figure 4.1 shows process of M&E.

(1) Data collection
This process does following activities:
- Collect data on performance for monitoring and evaluation
- Design format
- Fulfill collected data
- Some calculation (e.g. ratio)

First activity is collect data on performance. Targets (or key performance indicators) are mentioned on business plan.
Then design format for M&E. Reader can adapt sample format mentioned in this draft guideline. Then fulfill column with collected data. Reader may also requested to do some calculation mainly ratio analysis such as collection efficiency, or labor efficiency.

A) Sample format for monitoring technical plan

Table 4.1: Sample monitoring format for technical plan

| | from: / / to: / / | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A: Monitoring Sheet | unit | Target | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total | Average |
| T | (1) Technical | | | | | | | | | | | | | | | | |
| T01 | 1) Population | | | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - |
| T02 | 2) Service coverage ratio | % | 0% | - | - | - | - | - | - | - | - | - | - | - | - | 0% | - |
| T03 | 3) Population Served | | 0 | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - |
| T04 | 4) Water demand | litter/day/capita | | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - |
| T05 | 5) Production Volume | cubic meters/day | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| T06 | - Spring | cubic meters/day | | | | | | | | | | | | | | 0 | 0 |
| T07 | - Borehole | cubic meters/day | | | | | | | | | | | | | | 0 | 0 |
| T08 | 6) Accounted water | cubic meters/day | | | | | | | | | | | | | | 0 | 0 |
| T09 | 7) UFW | % | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T10 | 8) Water quality test | | | | | | | | | | | | | | | | |
| T11 | - Bacteriological test | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T12 | - Sample taken | | | | | | | | | | | | | | | 0 | 0 |
| T13 | - Sample meet with standard | | | | | | | | | | | | | | | 0 | 0 |
| T14 | - Chlorination test | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T15 | - Sample taken | | | | | | | | | | | | | | | 0 | 0 |
| T16 | - Sample meet with standard | | | | | | | | | | | | | | | 0 | 0 |
| T17 | 9) Service hours | hours/day | 0 | | | | | | | | | | | | | 0 | 0 |
| T18 | 10) Leakage repair | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T19 | - Leakage | | - | | | | | | | | | | | | | 0 | 0 |
| T20 | - Leakage repaired | | - | | | | | | | | | | | | | 0 | 0 |

Table 4.1 shows sample monitoring format for technical plan. Orange color is non input column and yellow color is automatically calculated column. Reader can only need to input to blue colored column.

1) Population: transfer data on technical plan and set target column. Same population set Total, but this “Total” rather mean actual. Normally WUSC may not conduct census, thus just fulfill projected population use in the business plan. This data is used for calculate service coverage ratio.
2) Service coverage ratio: This data is calculated by number of connections and average household size on commercial plan. First calculate population served and divided by projected population.
T02=T03/T01
3) Population Served: This data is calculated by number of connections and multiple with average household size on commercial plan

T03=C01*C06

4) Water demand: transfer data on technical plan and set target column. In Total column, production divided by population-served and calculates water demand.
   T04=((T05/T03)*30)/1000
5) Production Volume: Total of intake from spring and boreholes. If WUSC use surface water, also add.
6) Accounted water: fulfill measured accounted water by month and divided with 30 days.
7) UFW: calculate with production volume and accounted water.
   T09=(T05-T08)/T05
8) Water quality test: fulfill measured data of each month
   - Bacteriological test
     - Sample taken
     - Sample meets with standard
   - Chlorination test
     - Sample taken
     - Sample meets with standard
9) Service hours: fulfill measured data of each month
10) Leakage repair: fulfill measured data of each month
    - Leakage: leakage found/noticed
    - Leakage repaired

B) Sample format for monitoring commercial plan

Table 4.2 shows sample monitoring format for commercial plan.

Table 4.2: Sample monitoring format for commercial plan

| C | (2) Commercial | | Target | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | 1) Average member of household | | | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - |
| C02 | 2) Billed water | cubic meters/day | | | | | | | | | | | | | | 0 | 0 |
| C03 | 3) NRW | % | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| C04 | 4) Average consumption per connection | cubic meters/month | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C05 | 5) Number of Connection | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C06 | - Domestic | | | | | | | | | | | | | | | 0 | 0 |
| C07 | - Others | | | | | | | | | | | | | | | 0 | 0 |
| C08 | 6) New connection | | | | | | | | | | | | | | | 0 | 0 |
| C09 | 7) Disconnection | | | | | | | | | | | | | | | 0 | 0 |
| C10 | 8) Billing amount | ,000 R | | | | | | | | | | | | | | 0 | 0 |
| C11 | 9) Collection amount | ,000 R | | | | | | | | | | | | | | 0 | 0 |
| C12 | 10) Collection Efficiency | % | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| C13 | 11) Water Rate | | | | | | | | | | | | | | | | |
| C14 | - Minimum charge (up to 10 cu.m.) | R | | | | | | | | | | | | | | 0 | - |
| C15 | - Commodity charge (up to 20 cu.m.) | R | | | | | | | | | | | | | | 0 | - |
| C16 | 12) Customer complaints | | | | | | | | | | | | | | | | |
| C17 | - Average response time | working days | 2 | | | | | | | | | | | | | 0 | 0 |
| C18 | - Number of complaints | | - | | | | | | | | | | | | | 0 | 0 |
| C19 | - Number of complaints response | in 2 working days | - | | | | | | | | | | | | | 0 | 0 |
| C20 | - Response ratio | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| C21 | 13) Customer surveyed | | | | | | | | | | | | | | | | |
| C22 | - Questionnaire | | | - | - | - | - | - | - | - | - | - | - | - | - | | - |
| C23 | - Effective Replay | | | - | - | - | - | - | - | - | - | - | - | - | - | | - |
| C24 | - Customer satisfaction | % | | - | - | - | - | - | - | - | - | - | - | - | - | | - |

1) Average member of household: transfer data on commercial plan and set target column. Same average household member set Total, but this “Total” rather mean actual. Normally WUSC may not conduct census, thus just fulfill projected house members use in the business plan. This data is used for calculate population served and service coverage ratio.
2) Billed water: fulfill measured data of each month and divide with 30 days
3) NRW: Calculate with differ between production volume and billed water and divide with production volume
   C03=(T05-C02)/T05
4) Average consumption per connection: billed water divide with number of connection by month
   C04=(C02*30/C06)
5) Number of Connection: measured
   - Domestic
   - Others

6) New connection: counted
7) Disconnection: counted
8) Billing amount: counted, total of billing amount in the month
9) Collection amount: counted, total of collected amount to billing in the month
10) Collection Efficiency: calculate with collection amount divide with billing amount
C12=C11/C10
11) Water Rate
- Minimum charge (up to 10 cu.m.) *in case of minimum charge is first 10 cubic meter
- Commodity charge (up to 20 cu.m.) *in case of minimum charge is first 10 cubic meter
12) Customer complaints: counted
- Average response time: counted and divide with number of complaints
- Number of complaints: counted
- Number of complaints response: counted number of response in 2 business days
- Response ratio: calculate number of complaints response divide with complaints
C20=C19/C18
13) Customer surveyed: count if WUSC do customer survey
- Questionnaire: number of questionnaire delivers to target user
- Effective Replay: number of effective replay WUSC success to collect
- Customer satisfaction: calculate in effective replay

C) Sample format for monitoring administrative plan
Table 4.3 shows sample monitoring format for administrative plan.

Table 4.3: Sample monitoring format for administrative plan

| A | (3) Administrative | | Target | Actual |
|---|---|---|---|---|
| A01 | 1) Number of staff | | | |
| A02 | 2) Labor Efficiency | connections/staff | 0 | 0 |

1) Number of staff: transfer data on administrative plan and set target column. Counted number of staff at end of the fiscal year for column of “Actual”.
2) Labor Efficiency: calculate connections divide by number of staff
A02=C06/A01

D) Sample format for monitoring financial plan
Table 4.4 shows sample monitoring format for financial plan.

Since there is two types of accounting systems, managerial accounting and reporting accounting. Normally WUSC follows reporting accounting system aims to report financial situation and result to stakeholders including members and users. In this system, cash flow statement is prepared by indirect method. Therefore, main information resources come from their income statement. But income statement includes depreciation that normally not realized cash transaction.

On the other hand, financial plan on the business plan rather stand on managerial accounting system, rather based on cash based transaction. Thus this business plan does not prepare projected balance sheet as well as cash based cash flow statement. And assumes income statement may similar with direct system cash flow statement excepts depreciation and not count account receivable and account payable.

Reader first transfer some target data and then collect financial report and fulfill column. But please understand financial plan on business plan is not same as structure of financial reports.

1) Income Statement
A) Operational Income
- Sales of water and services: target is from business plan. Actual is from income statement.
- Other non-core revenue: target is from business plan. Actual is from income statement.
B) Operational Expense

- Personnel: target is from business plan. Actual is from income statement.
- Power and fuel for pumping: target is from business plan. Actual is from income statement.
- Chemical for purification: target is from business plan. Actual is from income statement.
- Spare parts/repair/maintenance: target is from business plan. Actual is from income statement.
- Office management: target is from business plan. Actual is from income statement.
- Others (excluding depreciation): Actual is from income statement.
- Depreciation: Actual is from income statement.
- Others: Actual is from income statement.

Capital investment is normally not count in operational expenses, however, if depreciation of fixed asset is in short term, sometimes count for maintaining sound financial management, specially when in profit is too good and may better adjust for future.

Table 4.4: Sample monitoring format for financial plan

| F | (4) Financial | | Target | Actual |
|---|---|---|---|---|
| F01 | 1) Income Statement | | | |
| F02 | A) Operational Income | ,000 R | 0 | 0 |
| F03 | - Sales of water and services | ,000 R | | |
| F04 | - Other non core revenue | ,000 R | | |
| F05 | B) Operational Expense | ,000 R | 0 | 0 |
| F06 | - Personnel | ,000 R | | |
| F07 | - Power and fuel for pumping | ,000 R | | |
| F08 | - Chemical for purification | ,000 R | | |
| F09 | - Spare parts/repair/maintenance | ,000 R | | |
| F10 | - Office management | ,000 R | | |
| F11 | - Others (excluding depreciation) | ,000 R | | |
| F12 | - Depreciation | ,000 R | - | |
| F13 | - Others | ,000 R | - | |
| F14 | C) Operational Profit/loss | ,000 R | - | 0 |
| F15 | D) Non Operational revenue | ,000 R | 0 | 0 |
| F16 | - Grant/Subsidiary/Donation | ,000 R | | |
| F17 | - Financial revenue | ,000 R | | |
| F18 | E) Non Operational exenses | ,000 R | 0 | 0 |
| F19 | - Capital Investment | ,000 R | | |
| F20 | - Financial and other cost | ,000 R | | |
| F21 | F) Profit before Tax | ,000 R | - | 0 |
| F22 | 2) Balance Sheet | | | |
| F23 | A) Asset | ,000 R | - | 0 |
| F24 | - Current asset | ,000 R | - | |
| F25 | - Fixed asset | ,000 R | - | |
| F26 | - Others | ,000 R | - | |
| F27 | B) Liability | ,000 R | - | 0 |
| F28 | - Current liability | ,000 R | - | |
| F29 | - Long term liability | ,000 R | - | |
| F30 | C) Capital and R&E | ,000 R | - | 0 |
| F31 | - Capital | ,000 R | - | |
| F32 | - Retain and Earning | ,000 R | - | |
| F33 | 3) Cash Flow | | | |
| F34 | A) Revenue | ,000 R | | |
| F35 | B) Disbursement | ,000 R | | |
| F36 | C) Cash balance | ,000 R | 0 | 0 |
| F37 | D) End cash balance | ,000 R | | |
| F38 | 4) Unit cost | R/cubic meter | 0 | 0 |

C) Operational Profit/loss: calculate drawing operational expense from operational income. If capital investment is target of cost recovery, this amount should be categorized in operational expenses, however, this draft guideline does not take this concept. Therefore, separately count capital investment.

D) Non Operational revenue
- Grant/Subsidiary/Donation: Actual is from income statement.
- Financial revenue: Actual is from income statement.

E) Non Operational expenses
- Capital Investment: Actual is from income statement.
- Financial and other cost: Actual is from income statement.

F) Profit before Tax: calculate draw expense (operational expense + non-operational expenses) from revenue (operational revenue + non-operational revenue)

2) Balance Sheet

A) Asset
- Current asset: Actual is from balance sheet.
- Fixed asset: Actual is from balance sheet.
- Others: Actual is from balance sheet.

B) Liability
- Current liability: Actual is from balance sheet.
- Long term liability: Actual is from balance sheet.

C) Capital and R&E
- Capital: Actual is from balance sheet.
- Retain and Earning: Actual is from balance sheet.

3) Cash Flow

A) Revenue: target is from business plan. Actual is from cash flow statement.

B) Disbursement: target is from business plan. Actual is from cash flow statement.

C) Cash balance: target is from business plan. Actual is from cash flow statement.

D) End cash balance: target is from business plan. Actual is from cash flow statement.

4) Unit cost: calculate operational expense excluding depreciation divide with production volume. Please aware unit, as production volume is cubic meters per day and expenses is annual amount.
F38=(((F06+F07+F08+F09+F10+F11)/365)*1000)/T05

(2) Monitoring

Monitoring is just compare target and actual. Normally first check achievement, then check performance against target for confirm achievement is more than expectation, or performance reach to target, e.g. budget vs. disbursement, revenue vs. expected revenue.
In construction project, check progress for check schedule is on time. In this term, monitoring is activity watching output(s).

Important thing is, if there is gap between target and actual performance, ***find reason of why target is not achieved and try to fix the causes of problem.*** This is true objective of monitoring.

A) Technical plan

If there is construction project, confirm progress of project/action plan or special activities required in business plan

1) If facility improvement plan is scheduled, check the progress
- Preparation must do before one year when the project starts
- Cost estimate must review and update with most recent unit cost

2) If facility improvement project is going on, check the progress
- How much construction completed?
- Is construction accomplished in schedule?
- Are there any issues and program emerged?

3) If facility improvement project is recently finished, check
- Is there any issues and program emerged?
- Difference with cost estimate
- Confirm capacity of facility meet water demand

Then check gap between target and actual on list items of table 4.1.
- Service coverage ratio
- Population Served
- Water demand: also check gap between water demand and actual water supply
- Production Volume: also check gap between water demand and capacity
- Accounted water
- UFW: normally his should be less than 20%
- Water quality test: target is 100%

B) Commercial plan
1) If water rate improvement is scheduled, check
- Conduct public hearing meeting, and how and what attendant comments?
- Water rate improvement is on schedule or late?
- Confirm new water rate makes financial soundness
  (need to increase more/soon?)

Then check gap between target and actual on list items of table 4.2.
- NRW: normally this should be less than 25%
- Billed water: also check gap between water demand and actual water supply
- Average consumption per connection
- Number of Connection
- New connection
- Collection amount
- Collection Efficiency: normally required more than 95%

C) Administrative plan
Check gap between target and actual on list items of table 4.3.
- Number of staff
- Labor Efficiency: normally around 120 for 500 to 1,000 connections, 150 for 1,000 to 2,000, and 200 for 2,000 to 3,000, but depend on facility and system.

D) Financial plan
If financial resources arrangement is planned for covering capital investment:
1) Before disbursement
- Negotiation is progress?
- Condition meet requirement?

2) After disbursement
- Amount is satisfied?
(need additionally? Need to arrange another resources?)

Then check gap between target and actual on list items of table 4.4.
3) Revenue
- Sales of water and services
- Other non-core revenue
- Grant/Subsidiary/Donation

4) Expense
- Personnel
- Power and fuel for pumping
- Chemical for purification
- Spare parts/repair/maintenance
- Office management

- Capital Investment:

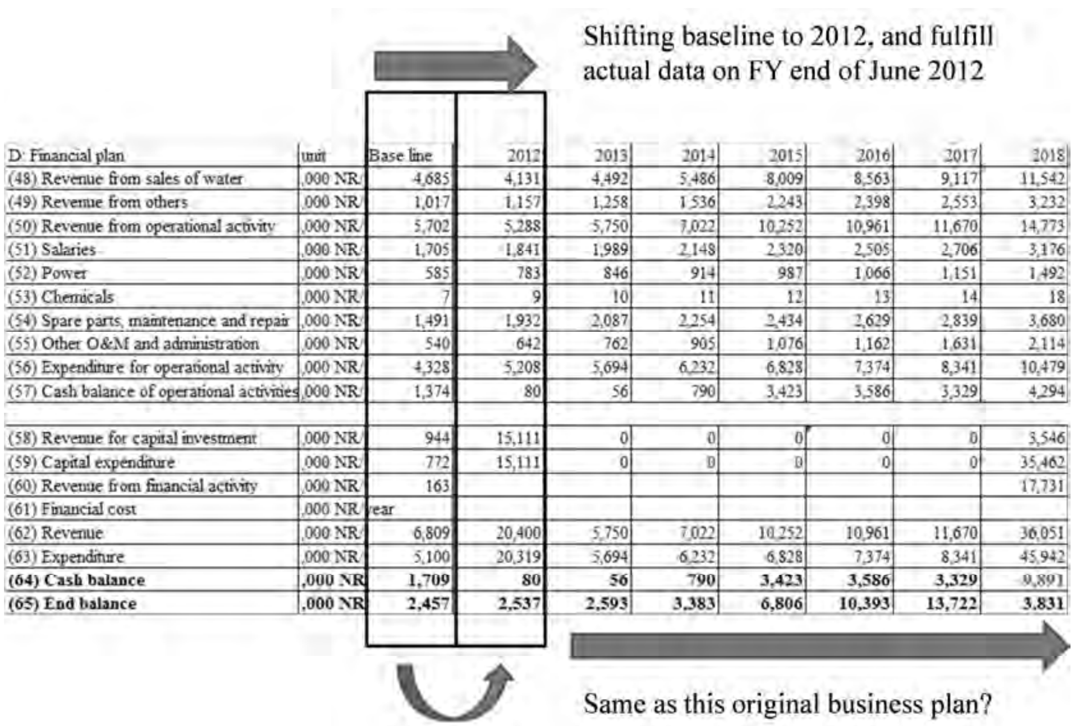
5) Cash balance

6) End cash balance

(3) Financial simulation
When geopolitical situation is change, or management environment is change, business plan may not effective. Financial simulation for confirm sufficiency of financial plan may necessary to confirm no need to change financial plan/business plan. May be accelerating facility improvement plan may necessary. May be increase water tariff more. May be need more financial assistance. Without simulation, reader may not answer to these.

Use original table based business plan, and reset baseline with actual performance data and:
- cash balance is positive or negative?
- future construction project would be feasible or not?
  then
- reconfirm cost estimation of construction project (specially when construction closes within two years)
- reconfirm water rate improvement schedule
- reconfirm financial resources arrangement

If financially feasible, means maintaining positive cash balance, reader can use this business plan, but if may makes negative cash balance in future, reader may consider updating this business plan.




| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 | 11,542 |
| (49) Revenue from others | ,000 NR/ | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 | 3,232 |
| (50) Revenue from operational activity | ,000 NR/ | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 14,773 |
| (51) Salaries | ,000 NR/ | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 | 3,176 |
| (52) Power | ,000 NR/ | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 | 1,492 |
| (53) Chemicals | ,000 NR/ | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 18 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 | 3,680 |
| (55) Other O&M and administration | ,000 NR/ | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 | 2,114 |
| (56) Expenditure for operational activity | ,000 NR/ | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 10,479 |
| (57) Cash balance of operational activities | ,000 NR/ | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 | 4,294 |
| | | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 | 3,546 |
| (59) Capital expenditure | ,000 NR/ | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 | 35,462 |
| (60) Revenue from financial activity | ,000 NR/ | 163 | | | | | | | 17,731 |
| (61) Financial cost | ,000 NR/year | | | | | | | | |
| (62) Revenue | ,000 NR/ | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 | 36,051 |
| (63) Expenditure | ,000 NR/ | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 | 45,942 |
| **(64) Cash balance** | **,000 NR** | **1,709** | **80** | **56** | **790** | **3,423** | **3,586** | **3,329** | -9,891 |
| **(65) End balance** | **,000 NR** | **2,457** | **2,537** | **2,593** | **3,383** | **6,806** | **10,393** | **13,722** | **3,831** |

Fig 4.2: concept of financial simulation

Figure 4.2 shows concept and process. Data of this original financial plan is based on actual (and adjusted) financial data of 2011. Data of 2011 is baseline. So, simply overwriting actual financial data on 2012 and make this columns as baseline. Baseline is shifting one year. Then check still keep positive cash balance in future. Same as when cost estimation of construction project is change.

Note: financial simulation mentioned here is not only means change baseline figure with actual on part of financial plan. Most data on financial plan comes from other plans. Reader must change first technical plan, then commercial plan, and administrative plan. If reader uses Excel format, changing these plans automatically effects to financial plan.
These are data reader must update baseline with actual data:

1) Technical plan:
- Production volume
- Accounting water volume (for UFW)
- Billing water (for NRW)
- Capital investment
- Power cost
- Chemical cost
- Repair and maintenance cost

2) Commercial plan
- Number of connection
- Average consumption per connection
- Water rate

3) Administrative plan
- Number of staff
- Salaries and wages
- Administration cost

Therefore update data on financial plan are:
- Revenue from sales of water
- Revenue from other services
- Financial revenue and expenditure
- Revenue for capital investment (grant/subsidiary) and capital investment (if there is differ on capital investment for technical plan)

(4) Evaluation
Evaluation is judge result and effort meets with objectives or not. Objective of WUSC is, ***WUSC provides safe water affordably in stable manner, to maximum people in their jurisdiction with reasonable cost***. So, evaluate outcome(s) of WUSC contributing achievement of this objective in term of customer services, capability, management efficiency and financial soundness. In other word, evaluate achievement of objectives from 4 views, view from customer service, view from capacity, view from management efficiency and view from financial soundness. This concept adapted from Balanced Score Card.*) So, first question is, “customer service enhance customer satisfaction?”, as example, and answer may, “Yes, WUSC enhance quality of customer service and improve customer satisfaction in term of keep providing safe water, and user satisficed enough water more than national standard of water demand. Also price is not change for last three years.”, or “No, there are so many spaces for improving customer service and service coverage is not much improved.”
Typically following question may settles for evaluation, and reader can use answers to these questions for evaluation.

## Judge 4 items

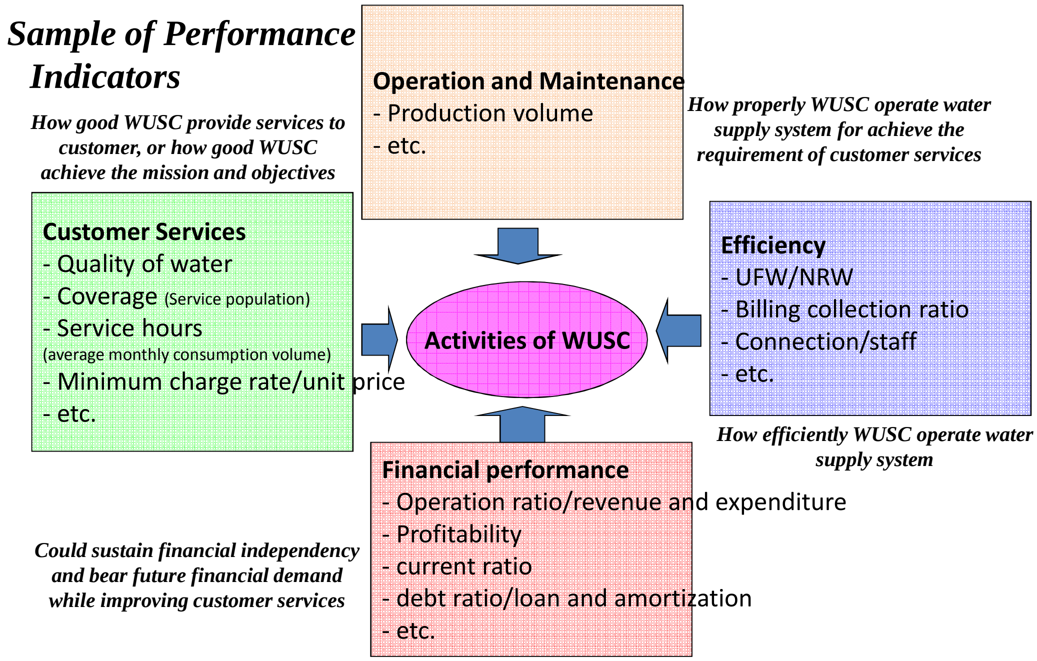



Fig 4.3: concept of indicators use for evaluation of 4 criteria

1) Customer services
- How good WUSC provide services to customer?
- How good WUSC achieve the mission and objectives?

2) Capability
- How properly WUSC operate water supply system for achieve the requirement of customer services?

3) Management Efficiency
- How efficiently WUSC operate water supply system?

4) Financial soundness
- Could sustain financial independency and bear future financial demand while improving customer services?

Reader may not so easily answer to these 4 questions, and may need to use result of monitoring. Typical indicator use for evaluating is shows on Figure 4.3.
Also reader may need some standard for evaluation. If actual performance is more than standard performance, it may say, “good”.

(1) Customer services
- How good WUSC provide services to customer?
- How good WUSC achieve the mission and objectives?

| | | | | |
|---|---|---|---|---|
| | from: / / to: / / | | | |
| | Evaluation Sheet | | | |
| | (1) Customer service | unit | Target | Result |
| | 1) Water Quality | | | |
| E11 | - Bacteriological test | % | 100% | 0% |
| E12 | - Chlorination test | % | 100% | 0% |
| E13 | 2) Service coverage ratio | % | 0% | 0% |
| E13 | 3) consumption | litter/day/capita | 0 | 0 |
| E14 | 4) Service hours | hours/day | 0 | 0 |
| E15 | 5) Unit price/minimum charge | % | 0% | 0% |
| E16 | 6) Complaints response ratio | % | 100% | 0% |
| E19 | Evaluation: | | | |

Fig 4.4: sample evaluation format on customer services

Figure 4.4 shows sample evaluation format on customer services. Make your evaluation using following indicators and standard performance:

1) Water Quality
- Bacteriological test: test result should be 100% meet with national standard
- Chlorination test: test result should be 100% meet with national standard

2) Service coverage ratio: should be more than target. Actual calculated based on number of connection.
3) consumption: should be more than national standard. Normally minimum requirement is 65 litter per day per capita and ideally 115 litter per day per capita.
4) Service hours: 24 hours
5) Unit price/minimum charge: better more than 75% but less than 90%.
   E15=(F38*10)/C14 *in case of minimum charge is first 10 cubic meter
6) Complaints response ratio: 100%?

(2) Capability
- How properly WUSC operate water supply system for achieve the requirement of customer services?

| | (2) Capability | unit | Target | Result |
|---|---|---|---|---|
| E21 | 1) Water demand | cubic meters/day | 0 | 0 |
| E22 | 2) Production volume | cubic meters/day | 0 | 0 |
| E23 | 3) Accounted water | cubic meters/day | 0 | 0 |
| E24 | 4) Billed Water | cubic meters/day | 0 | 0 |
| E25 | 5) Gap with water demand | % | 0 | 0 |
| E29 | Evaluation: | | | |

Fig 4.5: sample evaluation format on capability

Figure 4.5 shows sample evaluation format on capability of facility.

1) Water demand: calculate water demand per day per capita on plan multiples population served on plan as target, and compare water demand calculated by number of connection. If water demand is more than 75 litter per day per capita, it is more than minimum level. If more than national standard, it is good.
   E21=(T04*T03)/1000
2) Production volume: target is planned. Compare with actual production.
3) Accounted water: target is planned. Compare with actual accounted water measured.
4) Billed Water: target is planned. Compare with actual billed water measured.

5) Gap with water demand: differ of 1) and 2).
E25=E22 - E21

(3) Management Efficiency
- How efficiently WUSC operate water supply system?

| | (3) Management efficiency | unit | Target | Result |
|---|---|---|---|---|
| E31 | 1) UFW | % | 0% | 0% |
| E32 | 2) NRW | % | 0% | 0% |
| E33 | 3) Collection Efficiency | % | 0% | 0% |
| E34 | 4) Labor efficiency | connections/staff | 0 | 0 |
| E39 | Evaluation: | | | |

Fig 4.6: sample evaluation format on management efficiency

Figure 4.6 shows sample evaluation format on management efficiency.
1) UFW: better less than 20%.
2) NRW: better less than 25%.
3) Collection Efficiency: better more than 95%.
4) Labor efficiency: normally around 120 for 500 to 1,000 connections, 150 for 1,000 to 2,000, and 200 for 2,000 to 3,000, but depend on facility and system.

(4) Financial soundness
- Could sustain financial independency and bear future financial demand while improving customer services?

| | (4) Financial soundness | unit | Target | Result |
|---|---|---|---|---|
| E41 | 1) Revenue (cash) | ,000 R | 0 | 0 |
| E42 | 2) Expenditure (cash) | ,000 R | 0 | 0 |
| E43 | 3) Profit/loss (cash base) | ,000 R | 0 | 0 |
| E44 | 4) Profitability (cash base) | % | 0% | 0% |
| E45 | 5) Profitability (income statement base) | % | - | 0% |
| E46 | 5) Operating ratio | % | - | 0% |
| E47 | 6) Current ratio | % | - | 0% |
| E49 | Evaluation: | | | |
| | | | | |
| | (5) Evaluation and recommendation: | | | |

Fig 4.7: sample evaluation format on financial soundness and final conclusion

Figure 4.7 shows sample evaluation format on financial soundness and final conclusion.
1) Revenue (cash): target on financial plan and actual on cash flow statement.
2) Expenditure (cash): target on financial plan and actual on cash flow statement.
3) Profit/loss (cash base): cash balance target on financial plan and actual on cash flow statement. Simply calculate 1) minus 2) and it should be positive.
4) Profitability (cash base): Simply calculated 3) divided by 1) and better more than 5%.
E44=E43/E41
5) Profitability (income statement base): simply calculate figured on income statement. Profit before tax divide with revenue, and better more than 3% but also better less than 5%.

E45=F21/(F02+F15)

4) Operating ratio: calculate operation expense divide by operation revenue (both on income statement) and should be less than 100%. Smaller is better.
   E46=F05/F02
6) Current ratio: calculate current liability divided by current asset (both on balance sheet) and should be more than 100%. Larger is better.
   E47=F24/F28

So, what is your evaluation?

Note:
Using concept of balanced score card makes easier for find causes of gap between key performance indicator as these are linking between 4 areas, customer services, capacity, management efficiency and finance. Improving one key performance indicator means improving another linked key performance indicator too. For example, NRW link with revenue in financial area and billed water in commercial area. Improving NRW improves commercial performance and financial performance. Also concept on view of 4 different areas is clear and easy to understanding how WUSC should be improving toward achieving objective. Comprehensive approach is required. Not only improving customer service but also need to improving other area too. That is reason author adapt concept of balances score card for evaluation.

# 5. Case

(1) Data collection:

Here is case for M&E of business plan prepared by to Dhurabari WUSC in 2011. More detail of their original business plan, you may find attachment of “Draft Guideline for WUSC management model and Support Model”, August 2012.

However, collection of data, specially non-financial data is collected with hearing base. Author cannot have enough time and chance to visit before prepare this case. Also, they do not prepare and use standard format for collect their management data, with MIS: Management Information System.

Therefore, this is for sake of making case and for making sample, but not official M&E for Dhulabari WUSC. There is so many not applicable column and blank column, as well as some data is based on author’s assumption. Please remain these limitations.

Here is their original business plan from 2011 (base line year) to 2017. Yellow marker columns are data for transfer to monitoring sheet and orange marker columns are automatically calculated data based on data on yellow marker column.

Table 5.1 Original Business Plan (Technical Plan)

| A: Engineering plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (1) Population | | 40,000 | 40,840 | 41,698 | 42,573 | 43,467 | 44,380 | 45,312 |
| (2) Population growth | % | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% |
| (4) Population served | | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 |
| (5) Consumption/capita/day | litter | 65 | 65 | 65 | 65 | 90 | 90 | 90 |
| (6) Water Demand | cm/day | 1,300 | 1,406 | 1,492 | 1,578 | 2,304 | 2,423 | 2,541 |
| | | | | | | | | |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 |
| (8) Production Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 |
| (9) UFW | % | 12% | 12% | 12% | 12% | 12% | 12% | 12% |
| (10) Accounting water | cm/day | 2,200 | 2,728 | 2,728 | 2,728 | 2,728 | 2,728 | 2,728 |
| (11) NRW | % | 15% | 15% | 15% | 15% | 15% | 15% | 15% |
| (12) Possible revenue water | cm/day | 2,125 | 2,635 | 2,635 | 2,635 | 2,635 | 2,635 | 2,635 |
| | | | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | 13,992 | | | | | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | | | | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 13,992 | 0 | 0 | 0 | 0 | 0 |
| (16) Inflated capital investment | ,000 RP | | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (17) Inflation rate | % | 8% | 8% | 8% | 8% | 8% | 8% | 8% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | 140 | | | | | |
| (20) Inflated (19) | ,000 NR/ | dummy | 152 | | | | | |
| (21) Power and fuels for pumping | ,000 NR/ | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 2 | | | | | |
| (23) Inflated (22) | ,000 NR/ | dummy | 2 | | | | | |
| (24) Chemical for production | ,000 NR/ | 7 | 9 | 10 | 11 | 12 | 13 | 14 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | 298 | | | | | |
| (26) Inflated (25) | ,000 NR/ | dummy | 322 | | | | | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 |
| (27) O&M cost excluding salaries and adı | ,000 NR/ | 2,083 | 2,725 | 2,943 | 3,179 | 3,433 | 3,708 | 4,004 |
| (*1) price of year 2011 | | | | | | | | |
| Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009 | | | | | | | | |

Table 5.2 Original Business Plan (Commercial Plan)

| B: Customer service plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 273 | 220 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,520 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 |
| (30) Average family size | person/fa | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| **(31) Avr. consumption per connection** | **cm/mont** | **12** | **12** | **12** | **12** | **16** | **16** | **16** |
| (32) Confirmation of (31) with (5) | cm/montl | 11.7 | 11.7 | 11.7 | 11.7 | 16.2 | 16.2 | 16.2 |
| (33) Minimum charge volume | cm/montl | 8 | 8 | 8 | 8 | **8** | **8** | **8** |
| **(34) Water rate (minimum charge)** | **NR** | **80** | **90** | **90** | **100** | **100** | **100** | **100** |
| **(35) Water rate (commodity charge 9-** | **NR** | **12** | **12** | **12** | **14** | **14** | **14** | **14** |
| **(35) Water rate (commodity charge 16** | **NR** | **15** | | | | | | |
| **(36) Collection efficiency** | **%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** | **99%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 285 | 344 | 374 | 457 | 667 | 714 | 760 |
| (38) Expected annual revenue from sales | ,000 NR/ | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 |

Table 5.3 Original Business Plan (Administrative Plan)

| C: Administrative plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | | | | | | | |
| (40) Number of staff | | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| (41) Increasing salaries | NR/staff | | 0 | 0 | 0 | 0 | 0 | 0 |
| (42) Inflated (41) | ,000 NR/ | dummy | 0 | 0 | 0 | 0 | 0 | 0 |
| (43) Salaries and wages | ,000 NR/ | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 |
| (44) Increases admi cost (*1) | ,000 NR/year | | 54 | 64 | 76 | 91 | | 349 |
| (45) Inflated (44) | ,000 NR/ | dummy | 58 | 69 | 82 | 98 | 0 | 376 |
| (46) Administrative cost | ,000 NR/ | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 |
| (47) subtotal of salaries and admi cost | ,000 NR/ | 2,245 | 2,483 | 2,751 | 3,053 | 3,395 | 3,667 | 4,337 |

Table 5.4 Original Business Plan (Financial Plan)

| D: Financial plan | unit | Base line | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 4,685 | 4,131 | 4,492 | 5,486 | 8,009 | 8,563 | 9,117 |
| (49) Revenue from others | ,000 NR/ | 1,017 | 1,157 | 1,258 | 1,536 | 2,243 | 2,398 | 2,553 |
| (50) Revenue from operational activity | ,000 NR/ | 5,702 | 5,288 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 |
| (51) Salaries | ,000 NR/ | 1,705 | 1,841 | 1,989 | 2,148 | 2,320 | 2,505 | 2,706 |
| (52) Power | ,000 NR/ | 585 | 783 | 846 | 914 | 987 | 1,066 | 1,151 |
| (53) Chemicals | ,000 NR/ | 7 | 9 | 10 | 11 | 12 | 13 | 14 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 1,491 | 1,932 | 2,087 | 2,254 | 2,434 | 2,629 | 2,839 |
| (55) Other O&M and administration | ,000 NR/ | 540 | 642 | 762 | 905 | 1,076 | 1,162 | 1,631 |
| (56) Expenditure for operational activity | ,000 NR/ | 4,328 | 5,208 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 |
| (57) Cash balance of operational activities | ,000 NR/ | 1,374 | 80 | 56 | 790 | 3,423 | 3,586 | 3,329 |
| | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 163 | | | | | | |
| (61) Financial cost | ,000 NR/year | | | | | | | |
| (62) Revenue | ,000 NR/ | 6,809 | 20,400 | 5,750 | 7,022 | 10,252 | 10,961 | 11,670 |
| (63) Expenditure | ,000 NR/ | 5,100 | 20,319 | 5,694 | 6,232 | 6,828 | 7,374 | 8,341 |
| **(64) Cash balance** | **,000 NR** | **1,709** | **80** | **56** | **790** | **3,423** | **3,586** | **3,329** |
| **(65) End balance** | **,000 NR** | **2,457** | **2,537** | **2,593** | **3,383** | **6,806** | **10,393** | **13,722** |

Also hearing but the WUSC answer as follows to several non-financial data:
Regarding the additional information you asked it is as follows:-

- Water Quality Test: Dhulabari WUSC tested water on June 6th 2012 and that time only Fecal coliform was high i.e 5 and it was due to new boring. And recently they sent the sample for test and result is yet to come.
- Water Production per day: Rainy season: 3,600 m3/day, dry season 1,008 m3/day
- NRW & UFW: They told that they have not such data and they count those all as leakage and that is 42.07%
- Tariff Collection Rate: 80% per month
- Number of connection: 2,703 according to the data of last month

- Consumed water volume per connection per month: 15.88 unit per month.
- No. of employees: permanent 22 and 5 daily wages.

Plus their financial report fiscal year at end of June 30th, 2012.

According with original business plan, they plan to construct new grand water resources and improving their intake water capability from 2,500 cubic meters per day to 3,100 cubic meters per day, but could not confirm progress of this construction project as well as result.

These are all data author have and this case is based on this situation. Therefore, there may many misunderstanding and confusion. If these are happened, all responsibilities are follows to author.

(2) Monitoring

Following are monitoring sheet fulfill data, yellow marker column from original business plan and transfer to target column, and then fulfill from collected data (hearing and financial report).

Table 5.5 Monitoring sheet (technical plan)

| | from:JUL 1st, 2011 to: JUN 30th, 2012 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A: Monitoring Sheet | unit | Target | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total | Average |
| T | (1) Technical | | | | | | | | | | | | | | | | |
| T01 | 1) Population | | 21,638 | - | - | - | - | - | - | - | - | - | - | - | - | 21,638 | - |
| T02 | 2) Service coverage ratio | % | 70% | - | - | - | - | - | - | - | - | - | - | - | - | 75% | - |
| T03 | 3) Population Served | | 15,120 | - | - | - | - | - | - | - | - | - | - | - | - | 16,218 | - |
| T04 | 4) Water demand | litter/day/capita | 65 | - | - | - | - | - | - | - | - | - | - | - | - | 57 | - |
| T05 | 5) Production Volume | cubic meters/day | 3,100 | 3,600 | 3,600 | 3,600 | 3,600 | 1,008 | 1,008 | 1,008 | 1,008 | 1,008 | 1,008 | 3,600 | 3,600 | 27,648 | 2,304 |
| T06 | - Spring/surface | cubic meters/day | 3,100 | 3,600 | 3,600 | 3,600 | 3,600 | 1,008 | 1,008 | 1,008 | 1,008 | 1,008 | 1,008 | 3,600 | 3,600 | 27,648 | 2,304 |
| T07 | - Borehole | cubic meters/day | | | | | | | | | | | | | | 0 | 0 |
| T08 | 6) Accounted water | cubic meters/day | 2,728 | 2,592 | 2,592 | 2,592 | 2,592 | 726 | 726 | 726 | 726 | 726 | 726 | 2,592 | 2,592 | 19,907 | 1,659 |
| T09 | 7) UFW | % | 12% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% | 28% |
| T10 | 8) Water quality test | | | | | | | | | | | | | | | | |
| T11 | - Bacteriological test | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T12 | - Sample taken | | | | | | | | | | | | | | | 0 | 0 |
| T13 | - Sample meet with standard | | | | | | | | | | | | | | | 0 | 0 |
| T14 | - Chlorination test | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T15 | - Sample taken | | | | | | | | | | | | | | | 0 | 0 |
| T16 | - Sample meet with standard | | | | | | | | | | | | | | | 0 | 0 |
| T17 | 9) Service hours | hours/day | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 288 | 24 |
| T18 | 10) Leakage repair | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| T19 | - Leakage | | | | | | | | | | | | | | | 0 | 0 |
| T20 | - Leakage repaired | | | | | | | | | | | | | | | 0 | 0 |

They may do grand water resources development, however, not ensure, or need to confirm they can achieve target of water production to 3,100 cubic meter per day. Result of this monitoring sheet is negative. This follows negative results to accounting water and UFW.

Table 5.6 Monitoring sheet (commercial plan)

| C | (2) Commercial | | Target | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | 1) Average member of household | | 6 | - | - | - | - | - | - | - | - | - | - | - | - | 6 | - |
| C02 | 2) Billed water | cubic meters/day | 2,635 | 2,088 | 2,088 | 2,088 | 2,088 | 585 | 585 | 585 | 585 | 585 | 585 | 2,088 | 2,088 | 16,036 | 1,336 |
| C03 | 3) NRW | % | 15% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% | 42% |
| C04 | 4) Average consumption per connection | cubic meters/month | 12 | 28 | 27 | 27 | 27 | 7 | 7 | 7 | 7 | 7 | 7 | 24 | 23 | 178 | 15 |
| C05 | 5) Number of Connection | | 2,520 | 2,247 | 2,285 | 2,323 | 2,361 | 2,399 | 2,437 | 2,475 | 2,513 | 2,551 | 2,589 | 2,627 | 2,703 | 2,703 | 2,703 |
| C06 | - Domestic | | 2,520 | 2,247 | 2,285 | 2,323 | 2,361 | 2,399 | 2,437 | 2,475 | 2,513 | 2,551 | 2,589 | 2,627 | 2,703 | 2,703 | 2,703 |
| C07 | - Others | | | | | | | | | | | | | | | 0 | 0 |
| C08 | 6) New connection | | | | | | | | | | | | | | | 0 | 0 |
| C09 | 7) Disconnection | | | | | | | | | | | | | | | 0 | 0 |
| C10 | 8) Billing amount | ,000 R | 4,173 | | | | | | | | | | | | 6,671 | 6,671 | 556 |
| C11 | 9) Collection amount | ,000 R | 4,131 | | | | | | | | | | | | 5,337 | 5,337 | 445 |
| C12 | 10) Collection Efficiency | % | 99% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 80% | 80% | 80% |
| C13 | 11) Water Rate | | | | | | | | | | | | | | | | |
| C14 | - Minimum charge (up to 10 cu.m.) | R | 90 | | | | | | | | | | | | 90 | 90 | - |
| C15 | - Commodity charge (up to 20 cu.m.) | R | 12 | | | | | | | | | | | | 12 | 12 | - |
| C16 | 12) Customer complaints | | | | | | | | | | | | | | | | |
| C17 | - Average response time | working days | 2 | | | | | | | | | | | | | 0 | 0 |
| C18 | - Number of complaints | | - | | | | | | | | | | | | | 0 | 0 |
| C19 | - Number of complaints response | in 2 working days | - | | | | | | | | | | | | | 0 | 0 |
| C20 | - Response ratio | % | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| C21 | 13) Customer surveyed | | | | | | | | | | | | | | | | |
| C22 | - Questionnaire | | | - | - | - | - | - | - | - | - | - | - | - | - | | - |
| C23 | - Effective Replay | | | - | - | - | - | - | - | - | - | - | - | - | - | | - |
| C24 | - Customer satisfaction | % | | - | - | - | - | - | - | - | - | - | - | - | - | | - |

They may achieves target of average consumption per connection (12 cubic meters), but need to confirm. Also billing amount and collection amount are exceed than target, however, NRW and collection efficiency are not so good at all.

Table 5.7 Monitoring sheet (administrative plan)

| A | (3) Administrative | | Target | Actual |
|---|---|---|---|---|
| A01 | 1) Number of staff | | 23 | 22 |
| A02 | 2) Labor Efficiency | connections/staff | 110 | 123 |

Labor efficiency looks improved, but this is because not count contract base causal staff. If count them, drop to 100 connection per staff, and not good efficiency at all. However, situation of increasing grand water resources and need more pump operator may consider.

Table 5.8 Monitoring sheet (financial plan)

| F | (4) Financial | | Target | Actual |
|---|---|---|---|---|
| F01 | 1) Income Statement | | | |
| F02 | A) Operational Income | ,000 R | 5,288 | 10,674 |
| F03 | - Sales of water and services | ,000 R | 4,131 | 5,337 |
| F04 | - Other non core revenue | ,000 R | 1,157 | 1,522 |
| F05 | B) Operational Expense | ,000 R | 5,208 | 6,956 |
| F06 | - Personnel | ,000 R | 1,841 | 2,958 |
| F07 | - Power and fuel for pumping | ,000 R | 783 | 324 |
| F08 | - Chemical for purification | ,000 R | 9 | 18 |
| F09 | - Spare parts/repair/maintenance | ,000 R | 1,932 | 1,472 |
| F10 | - Office management | ,000 R | 642 | 2,184 |
| F11 | - Others (excluding depreciation) | ,000 R | 0 | 0 |
| F12 | - Depreciation | ,000 R | - | |
| F13 | - Others | ,000 R | - | |
| F14 | C) Operational Profit/loss | ,000 R | - | 3,718 |
| F15 | D) Non Operational revenue | ,000 R | 15,111 | 954 |
| F16 | - Grant/Subsidiary/Donation | ,000 R | 15,111 | 954 |
| F17 | - Financial revenue | ,000 R | 0 | 0 |
| F18 | E) Non Operational exenses | ,000 R | 15,111 | 1,405 |
| F19 | - Capital Investment | ,000 R | 15,111 | 1,405 |
| F20 | - Financial and other cost | ,000 R | 0 | 0 |
| F21 | F) Profit before Tax | ,000 R | - | 3,267 |
| F22 | 2) Balance Sheet | | | |
| F23 | A) Asset | ,000 R | - | 434,379 |
| F24 | - Current asset | ,000 R | - | 2,706 |
| F25 | - Fixed asset | ,000 R | - | 431,673 |
| F26 | - Others | ,000 R | - | 0 |
| F27 | B) Liability | ,000 R | - | 0 |
| F28 | - Current liability | ,000 R | - | 0 |
| F29 | - Long term liability | ,000 R | - | 0 |
| F30 | C) Capital and R&E | ,000 R | - | 431,673 |
| F31 | - Capital | ,000 R | - | 434,255 |
| F32 | - Retain and Earning | ,000 R | - | -2,582 |
| F33 | 3) Cash Flow | | | |
| F34 | A) Revenue | ,000 R | 20,400 | 7,813 |
| F35 | B) Disbursement | ,000 R | 20,319 | 8,361 |
| F36 | C) Cash balance | ,000 R | 80 | -548 |
| F37 | D) End cash balance | ,000 R | 2,537 | 2,138 |
| F38 | 4) Unit cost | R/cubic meter | 5 | 8 |

Original plan is maintaining positive cash balance, however, actual performance may negative cash balance as well as deficit. Although operational revenue exceeds more than target, however, salaries and office management + other cost are too high. Also unit cost may more than target.

(3) Financial simulation

Financial simulation is simply replay projected data with actual data on 2012. So, baseline shifts to 2012. Here is result up to 2017. Yellow marker column are data replaced with actual data. Other part is not touched.

Table 5.9 Financial simulation (technical part)

| A: Engineering plan | unit | 2011 | Baseline | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (1) Population | | 40,000 | 40,840 | 41,698 | 42,573 | 43,467 | 44,380 | 45,312 |
| (2) Population growth | % | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% |
| (3) Coverage ratio | % | 50% | 53% | 55% | 57% | 59% | 61% | 62% |
| (4) Population served | | 20,000 | 21,638 | 22,958 | 24,278 | 25,598 | 26,918 | 28,238 |
| (5) Consumption/capita/day | litter | 65 | 65 | 65 | 65 | 90 | 90 | 90 |
| (6) Water Demand | cm/day | 1,300 | 1,406 | 1,492 | 1,578 | 2,304 | 2,423 | 2,541 |
| | | | | | | | | |
| (7) Intake Water Volume | cm/day | 2,500 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 |
| (8) Production Volume | cm/day | 2,500 | 2,304 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 |
| (9) UFW | % | 12% | 28% | 28% | 28% | 28% | 28% | 28% |
| (10) Accounting water | cm/day | 2,200 | 1,659 | 2,232 | 2,232 | 2,232 | 2,232 | 2,232 |
| (11) NRW | % | 15% | 42% | 42% | 42% | 42% | 42% | 42% |
| (12) Possible revenue water | cm/day | 2,125 | 1,336 | 1,798 | 1,798 | 1,798 | 1,798 | 1,798 |
| | | | | | | | | |
| (13) Facility improvement (*1) | ,000 RP | | 13,992 | | | | | |
| (14) Preventing maintenance (*1) | ,000 RP | | | | | | | |
| (15) sub total of capital investment (*1) | ,000 RP | 0 | 13,992 | 0 | 0 | 0 | 0 | 0 |
| (16) Inflated capital investment | ,000 RP | | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (17) Inflation rate | % | 8% | 8% | 8% | 8% | 8% | 8% | 8% |
| (18) Indicator for inflation | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | | | | |
| (19) Increases of power cost (*1) | ,000 NR/ | dummy | 140 | | | | | |
| (20) Inflated (19) | ,000 NR/ | dummy | 152 | | | | | |
| (21) Power and fuels for pumping | ,000 NR/ | 585 | 324 | 350 | 378 | 408 | 441 | 476 |
| (22) Increases of chemical cost (*1) | ,000 NR/ | dummy | 2 | | | | | |
| (23) Inflated (22) | ,000 NR/ | dummy | 2 | | | | | |
| (24) Chemical for production | ,000 NR/ | 7 | 18 | 19 | 21 | 23 | 24 | 26 |
| (25) Increases of spare parts, repair, main | ,000 NR/ | dummy | 298 | | | | | |
| (26) Inflated (25) | ,000 NR/ | dummy | 322 | | | | | |
| (26) Spare parts, repair and maintenance | ,000 NR/ | 1,491 | 1,472 | 1,590 | 1,717 | 1,854 | 2,003 | 2,163 |
| (27) O&M cost excluding salaries and ad | ,000 NR/ | 2,083 | 1,814 | 1,959 | 2,116 | 2,285 | 2,468 | 2,665 |
| (*1) price of year 2011 | | | | | | | | |
| Notes: Fiscal year shows year end, e.g. July 2008-June 2009 shows 2009 | | | | | | | | |

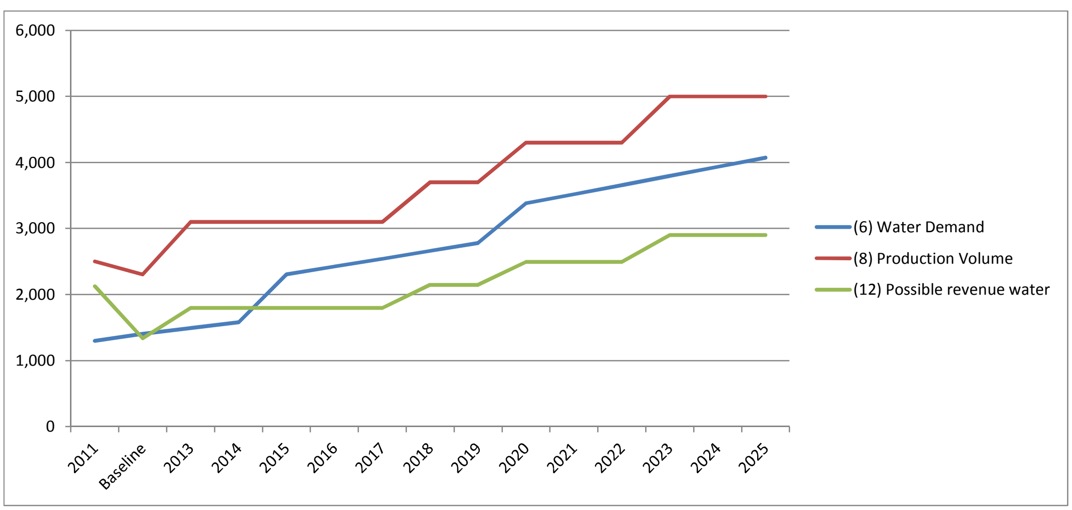



Figure 5.1 Financial simulation (technical part)

It is necessary for further consideration, however, graph of Figure 5.1 shows their capacity of facility may not meet water demand and need to improve as soon as possible. However, they may develop new grand water resources but may not affected collected data.

Table 5.10 Financial simulation (commercial part)

| B: Customer service plan | unit | 2011 | Baseline | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (28) Number of additional connection | | dummy | 456 | 37 | 220 | 220 | 220 | 220 |
| (29) Number of active connection | | 2,247 | 2,703 | 2,740 | 2,960 | 3,180 | 3,400 | 3,620 |
| (30) Average family size | person/fa | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| **(31) Avr. consumption per connection** | **cm/mont** | **12** | **12** | **12** | **12** | **16** | **16** | **16** |
| (32) Confirmation of (31) with (5) | cm/montl | 11.7 | 11.7 | 11.7 | 11.7 | 16.2 | 16.2 | 16.2 |
| (33) Minimum charge volume | cm/montl | 8 | 8 | 8 | 8 | **8** | **8** | **8** |
| **(34) Water rate (minimum charge)** | **NR** | **80** | **90** | **90** | **100** | **100** | **100** | **100** |
| **(35) Water rate (commodity charge 9-** | **NR** | **12** | **12** | **12** | **14** | **14** | **14** | **14** |
| **(35) Water rate (commodity charge 16** | **NR** | **15** | | | | | | |
| **(36) Collection efficiency** | **%** | **99%** | **80%** | **80%** | **80%** | **80%** | **80%** | **80%** |
| (37) Expected monthly revenue from sales | ,000 NR/ | 285 | 298 | 302 | 369 | 539 | 577 | 614 |
| (38) Expected annual revenue from sales | ,000 NR/ | 4,685 | 4,337 | 3,630 | 4,433 | 6,472 | 6,920 | 7,367 |

Table 5.11 Financial simulation (administrative part)

| C: Administrative plan | unit | 2011 | Baseline | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (39) Increases of staff | | | | | | | | |
| (40) Number of staff | | 23 | 22 | 22 | 22 | 22 | 22 | 22 |
| (41) Increasing salaries | NR/staff | | 0 | 0 | 0 | 0 | 0 | 0 |
| (42) Inflated (41) | ,000 NR/ | dummy | 0 | 0 | 0 | 0 | 0 | 0 |
| (43) Salaries and wages | ,000 NR/ | 1,705 | 2,958 | 3,195 | 3,450 | 3,726 | 4,024 | 4,346 |
| (44) Increases admi cost (*1) | ,000 NR/year | | 54 | 218 | 259 | 308 | | 1,186 |
| (45) Inflated (44) | ,000 NR/ | dummy | 58 | 236 | 280 | 333 | 0 | 1,281 |
| (46) Administrative cost | ,000 NR/ | 540 | 2,184 | 2,595 | 3,082 | 3,662 | 3,955 | 5,553 |
| (47) subtotal of salaries and admi cost | ,000 NR/ | 2,245 | 5,142 | 5,789 | 6,533 | 7,388 | 7,979 | 9,899 |

Table 5.12 Financial simulation (financial part)

| D: Financial plan | unit | 2011 | Baseline | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| (48) Revenue from sales of water | ,000 NR/ | 4,685 | 5,337 | 3,630 | 4,433 | 6,472 | 6,920 | 7,367 |
| (49) Revenue from others | ,000 NR/ | 1,017 | 1,522 | 1,016 | 1,241 | 1,812 | 1,938 | 2,063 |
| (50) Revenue from operational activity | ,000 NR/ | 5,702 | 6,859 | 4,646 | 5,674 | 8,284 | 8,857 | 9,430 |
| (51) Salaries | ,000 NR/ | 1,705 | 2,958 | 3,195 | 3,450 | 3,726 | 4,024 | 4,346 |
| (52) Power | ,000 NR/ | 585 | 324 | 350 | 378 | 408 | 441 | 476 |
| (53) Chemicals | ,000 NR/ | 7 | 18 | 19 | 21 | 23 | 24 | 26 |
| (54) Spare parts, maintenance and repair | ,000 NR/ | 1,491 | 1,472 | 1,590 | 1,717 | 1,854 | 2,003 | 2,163 |
| (55) Other O&M and administration | ,000 NR/ | 540 | 2,184 | 2,595 | 3,082 | 3,662 | 3,955 | 5,553 |
| (56) Expenditure for operational activity | ,000 NR/ | 4,328 | 6,956 | 7,748 | 8,648 | 9,673 | 10,447 | 12,564 |
| (57) Cash balance of operational activities | ,000 NR/ | 1,374 | -97 | -3,102 | -2,974 | -1,389 | -1,590 | -3,134 |
| | | | | | | | | |
| (58) Revenue for capital investment | ,000 NR/ | 944 | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (59) Capital expenditure | ,000 NR/ | 772 | 15,111 | 0 | 0 | 0 | 0 | 0 |
| (60) Revenue from financial activity | ,000 NR/ | 163 | | | | | | |
| (61) Financial cost | ,000 NR/year | | | | | | | |
| (62) Revenue | ,000 NR/ | 6,809 | 21,970 | 4,646 | 5,674 | 8,284 | 8,857 | 9,430 |
| (63) Expenditure | ,000 NR/ | 5,100 | 22,067 | 7,748 | 8,648 | 9,673 | 10,447 | 12,564 |
| **(64) Cash balance** | **,000 NR** | **1,709** | -97 | **-3,102** | **-2,974** | **-1,389** | **-1,590** | **-3,134** |
| **(65) End balance** | **,000 NR** | **2,457** | **2,138** | **-964** | **-3,938** | **-5,327** | **-6,917** | **-10,051** |

Table 5.12 shows their financial situation is not so bright and may need to improving water rate more rapidly, as well as improving collection efficiency for improving financial situation. Not so good scenario shown as negative cash balance may continue after 2013. Reader could find how to solve with financial simulation, change water rate, change collection efficiency, change NRW, change number of connections, etc.

Anyway, it need further consideration because author is not collect accurate data and collected data is basically hearing base and not conform with their monitoring sheet. But if financial data is this and management efficiency is also these, they must take action as soon as possible to worse scenario author show in this table.

(4) Evaluation

Author's evaluation is as follows. However, evaluation is judgment based on your standard and your idea to gap. Author uses metaphor of half water filled glass in many times to explain nature of evaluation. Pessimist may complain "only half is fulfilled, but not completely filled", while optimist appraises "already half of glass is fulfilled and only remained another half".

Table 5.13 Evaluation of customer service

| | | | | |
|---|---|---|---|---|
| | from:JUL 1st, 2011 to: JUN 30th, 2012 | | | |
| | Evaluation Sheet | | | |
| | (1) Customer service | unit | Target | Result |
| | 1) Water Quality | | | |
| E11 | - Bacteriological test | % | 100% | na |
| E12 | - Chlorination test | % | 100% | na |
| E13 | 2) Service coverage ratio | % | 70% | 75% |
| E13 | 3) consumption | litter/day/capita | 65 | 57 |
| E14 | 4) Service hours | hours/day | 24 | 24 |
| E15 | 5) Unit price/minimum charge | % | 41% | 74% |
| E16 | 6) Complaints response ratio | % | 100% | na |
| E19 | Evaluation: Lots of space for improving custmer services | | | |
| | - Need to improving water quality test | | | |
| | - Also consumption per day per capita is less than national standard | | | |

Water quality test result is missing but believes water quality may still more than national standard. Service coverage ratio is more than target, but consumption per capita per day is less than target as well as less than national target of 75 litter per day per capita and improving to 115 litter in 2015. No data on complaints response time. Although it is difficult to judge,

Table 5.14 Evaluation of capacity

| | (2) Capability | unit | Target | Result |
|---|---|---|---|---|
| E21 | 1) Water demand | cubic meters/day | 983 | 922 |
| E22 | 2) Production volume | cubic meters/day | 3,100 | 2,304 |
| E23 | 3) Accounted water | cubic meters/day | 2,728 | 1,659 |
| E24 | 4) Billed Water | cubic meters/day | 2,635 | 1,336 |
| E25 | 5) Gap with water demand | % | 2,117 | 1,382 |
| E29 | Evaluation: lots of space for improving, specially for dry season | | | |
| | - Capacity is less than target and need to improving | | | |
| | | | | |

As shows on Table 5.14, capacity may not level of satisfaction.

| | (3) Management efficiency | unit | Target | Result | * |
|---|---|---|---|---|---|
| E31 | 1) UFW | % | 12% | 28% | |
| E32 | 2) NRW | % | 15% | 42% | |
| E33 | 3) Collection Efficiency | % | 99% | 80% | |
| E34 | 4) Labor efficiency | connections/staff | 110 | 123 | 100 |
| E39 | Evaluation: lots of space for improving | | | | |
| | - NRW is too high as well as colletion efficiency is too low | | | | |
| | | | | | |

Again, management efficiency is most part for need to improving. Standard of NRW is less than

25%, and standard of collection efficiency is more than 95%.

| | (4) Financial soundness | unit | Target | Result | * |
|---|---|---|---|---|---|
| E41 | 1) Revenue (cash) | ,000 R | 20,400 | 7,813 | 4,131 |
| E42 | 2) Expenditure (cash) | ,000 R | 20,319 | 8,361 | 5,208 |
| E43 | 3) Profit/loss (cash base) | ,000 R | 80 | -548 | |
| E44 | 4) Profitability (cash base) | % | 0.4% | -7.0% | |
| E45 | 5) Profitability (income statement base) | % | - | 28% | |
| E46 | 5) Operating ratio | % | - | 65% | |
| E47 | 6) Current ratio | % | - | 0% | |
| E49 | Evaluation: need to improve and shifting to positive cash balance | | | | |
| | However effort for incresing reveneu and reduce expenditure may significant | | | | |
| | * excluding capital investment on original plan | | | | |
| | | | | | |
| | (5) Evaluation and recommendation: | | | | |
| | WUSC may need to improving and may need comprehensive approach | | | | |

WUSC should keep maintaining positive cash balance, unless in special occasion such as could not avoid for negative cash balance from capital investment and WUSC required to shoulder some cost.

As conclusion from monitoring, financial simulation and evaluation of 4 items, WUSC need to improving and may need comprehensive approach.

However, this is author’s evaluation, and no need to agree or follows this case. Reader may better get more accurate and rich data and also need to modify indicator or form for easiness of your M&E, because you are the evaluator.

## 6. Bibliography

Following bibliographies are essential and should better understand concepts mentioned on these literatures.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(Her workshop material)

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JICA Project Team, "***Business Planning (2)***",February 2011
(workshop material use for joint workshop, May 2011)

JICA Project Team, "***Draft Guideline for WUSC management model and Support Model***", August 2012
(Attachment including original draft business plan of Dhulabari WUSC)

JICA Project Team, "***Draft Introductory of Business Planning***", February 2013
(Including equation of calculate several projection including population, population served, water demand, revenue from sales of water and cash flow projection)

Kaplan, R. S. and Norton, D. P., "***Balanced Scorecard: Translating Strategy into Action***", Harvard Business School Press, 1996
(concept of evaluation in this draft guideline stand on this concept of balanced score card)

# Guideline for Prepare Annual Report

Draft January 2011

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## 1. Objectives

Objective of this guideline is gives knowledge and technique for prepare better annual report. However, this is not manual, and not cover all necessary knowledge for prepare annual report, specially basic one.

(1) Objective of annual report

- Provide necessary information and data to major stakeholders to get their understanding and continuous support/assistance
- Provide information and data of accountability
- Report of performance to agency's strategic plan, budget papers, resources agreement and other strategic document *)

*) Strategy plan including short term and medium-long term business plan and project plans

1) Target reader

- Accountability: It may better focus or intend major stakeholders including as WUSC members and WSSDO for provide information about accountability
- Other purpose: If necessary, you may make different version of annual report for purpose or target stakeholders including NGO and donor agencies, or WSSDO committee to change the focus points, for provide information of reliability or situation, rather than accountability

WUSC may have several objectives to provide information about their WUSC with media of annual report. Format, style and contents could be changeable for objectives, or target reader. However, normally main objective of normal annual report focus to achieve accountability to WUSC members as pay membership and contributing formation of the organization. WUSC stands for their membership fee and have duty to explain accountability to them. WUSC is the organization for aim to provide safe water to members and member agree for formulate WUSC and provide money as membership objects to establish and maintaining organization for sustaining water supply and other user services. Therefore, WUSC have duty to explain how their organization is operate, how it may operate for next year, how effectively and efficiently use their money and plan of future to person whom contributing and provide money.

WUSC may have other stakeholders provide financially and technically support, including WSSDO and donor agencies, and has also duty to explain accountability.

But if WUSC is required other objectives, such as provide information of present financial status, it may better provide information with other style and format, such as financial reports in this case.

Some governments decide standard format and style of annual report and mandatory to submit to their central government such as Russia and Australia, but Japan and USA do not set such mandatory style and format for annual report and request to submit. They have another mandatory style and format for annual business report and request to submit to their government. This mandatory report use for taxation, government statistics, policy making, and disclose for stakeholders widely.

Although companies in Japan are not requested to prepare annual report mandatory, however, normally they also prepare and disclose their annual report to achieve accountability for their stakeholders, and follows generally accepted style and format worldwide like bibliography [2].

(2) Timing

Government of Japan requests to private company for submitting their business report within 60 days after the end of fiscal year to the Minister of Economy, Trade and Industry. Other government such as Government of Russia requests to submit within 90 days.

In Japan, private company prepares draft annual report and report their activity and performance to general stakeholders meeting for get their approval. After this meeting, company officially discloses annual report. Most company discloses their annual report within 90 days after end of the fiscal year.

(3) Preparation process

In Japan, public relation unit normally prepares both draft annual report and final annual report.

Based on the schedule, in-charge and staff are appointed. Then they make editorial policy, and collect data based on the policy. Based on the collected data and information, then they arrange writer and request to write draft articles of each chapter. They also write some articles by themselves. Sometimes, they interview and write articles based on the interviews, such as interview with president and write articles based on the interview.

After prepared draft articles, and first editor's grammar check, then they arrange proof reader and request for proof reading. Normally two to three proof readers are assigned to each article. Proof reader is appointed from professional in the organization or expert in the organization, and they check the fact, or sufficient wording. After this professional reading, then board of members confirm and give their comments. Considering comments, editor does last editorial work and get final approval from CEO: chief executive officer before printing.

**2. Structure**

For purpose to achieve accountability, normally, following structure may widely adapt for annual report.

Chapter 1: Introduction and overview
Chapter 2: Performance highlights and management discussion
Chapter 3: Organizational Management
Chapter 4: Auditor's statement and related financial statement
Chapter 5: Supportive information and functionally area service report

Chapter 1 provides overview and reader can know briefly about business environment, trend, major issues and problems. Reader can know the situation organization is stand.

Chapter 2 provides performance highlight and reader can know briefly what organization achieves, or how good the organization performs for the year. Normally this chapter also including management discussion and manager explains how he or she manages the business, and how he or she plans to manage the business. If actual performance is not achieve the target, manager explains that is not avoidable but he do his best and success to avoid worse situation. If issues and problems emerge, manager may warning these risks and suggests to taking preventing activity.

If there is big issue, sometimes make independent chapter and focus discussion on that theme. For example, environment and corporate social responsibility are one of big issues for company in Japan and they make special independent chapter for explain more detail on their policy, activity and performance in those area. For WUSC, big construction project may topic on this case.

Chapter 3 provides organization management and focus on corporate governance, or in other word, how the organization was managed and will be managed. Normally this chapter covers internal control and guarantee mechanism of management quality.

Chapter 4 provides financial accountability information. Normally, external financial auditor reviews financial results, accounting process, accounting system and mechanism to make financial results and guarantees accuracy of the financial data. This independent expert reviewer's review gives trustable confidence to reader, specially shareholders. In this chapter normally contains auditor's report, financial statements and notes, or discussion of financial performance. For WUSC, it may recommendable to attach budget and explains plan of next fiscal year.

Chapter 5 is reference and could also provide functional area report, if necessary. Normally, detail information and data are not including in the discussion in chapter 2 and 3, but just inquires. Detail information and data are attached in this chapter for reference. This style makes discussion streamline clearer in chapter 2.

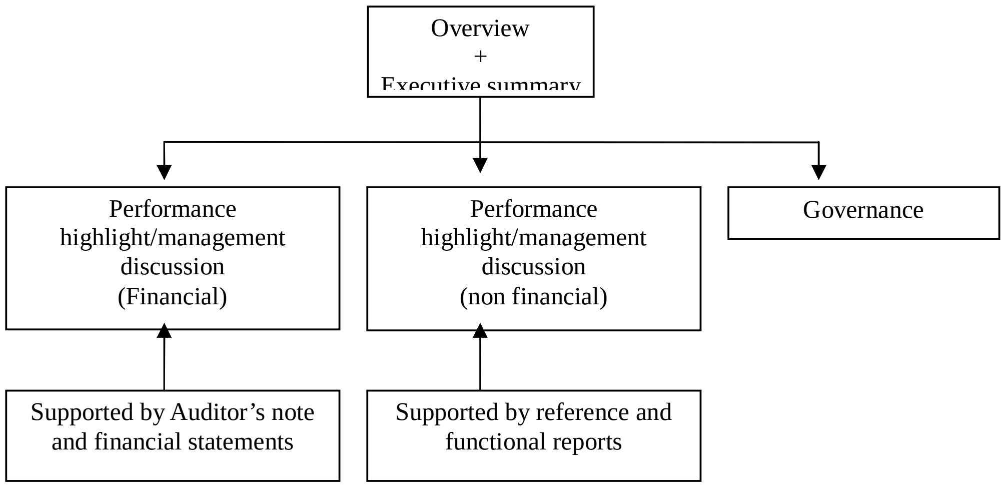



Figure 1: structure of annual report

Thus structure is like figure 1, as overview gives brief but whole image and comprehensive information, and further discuss of financial, non financial and governance are followings. Financial discussion would support by auditor’s report and financial statements.

**3. Recommendable content**

For considering situation of WUSC, and for accountability to 3 major stakeholders, committee members, WSSDO and international donor agencies through WSSDO, following table of contents may recommendable. But please mind as WUSC can modify the streamline and contents by objectives.

- Overview
- Address of chairperson
- Information of WUSC
- Management discussion, performance and activity overview
- Governance, management board and committee
- Auditor’ report
- Financial statements, notes and comments
- Budget and performance target
- Reference and functional report

(1) Overview

This chapter mentions key events and significant issues briefly and may say mostly like executive summary of annual report. But if it is not convenient, WUSC can possible to eliminating this chapter, or independents executive summary from this chapter. In this case, “Address of Chairperson” may come on top of main report.

TEPCO’s annual report of 2010 explains their marketing environment, energy demand, their major management issues and financial highlights. Reader can know briefly what is going on to this company [1].

(2) Address of chairperson

Although there is no rule of topic and theme for address of chairpersons, however it may no necessary to insisting choose sufficient theme or topics. Following topics are typical item including address of chairperson:

- general discussion about financial results and highlights

- service environment (=business environment)
- water demand
- new service
- increases/decreases of connections
- business strategy and plan, targets and achievements
- changes of management structure

It may no necessary to explain detail in this address as it may discuss in chapter 4, "Management Discussion". In this sense, this chapter may make very simple address. TEPCO's annual report 2010 shows very simple one page address of their CEO: chairman and chief executive officer, almost just simply say hello. But they also added more detail information by their COO: President and chief operational officer, and explain their business environment, issue and problems, plan and expectation with more detail data and information. No necessary to follow this style because they are one of biggest company in Japan, they have so many reason to explain issues and problems more detail, and their business is very complicated compare with WUSC. WUSC do only single business, sale of water, but TEPCO do so many businesses, not only sale of electric power but Internet business to technical support for power companies in abroad.

As I mentioned earlier, if WUSC eliminate overview, this chapter comes top of the annual report.

(3) Information of WUSC

In this chapter, WUSC briefly introduce their history, trend and major achievements, as well as facility and capacity. Following topics are typically including in this section:
- Chronology
- Trend of connections
- Trend of revenue and expenditure
- Major facility with capacity
- Map of water supply networks and location of facilities
- Chart of organization structure

This chapter aims to give mainly background information for discussion in next chapter "Management Discussion". In this sense, basically information would be give as table and graph with simple explanation. Again, but this chapter is not for discussion, rather gives background information to reader. Bibliography [3], Tokyo Waterworks shows table and charts usefully to explain their profile including history, facility and facility location map and their volume of business.

(4) Management discussion, performance and activity overview

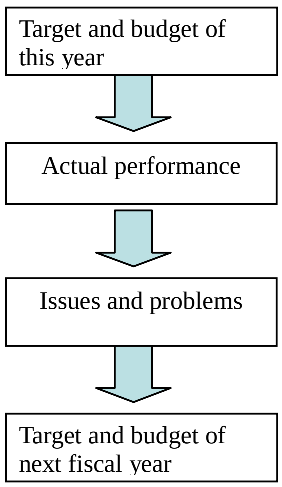
This chapter is one of pillow for explain performance results and achieves accountability to stakeholders. WUSC may discuss performance and business activities, target of business plan and achievement, analysis, problem, emerged problem, issues, concerns for future, etc. Normally following item would be covered in this chapter:

- target on business plan and achievement of the year
- analysis with assessment and evaluation to achievements and performance
- existing problem and activity for resolving, achievement
- emerged problem/issues and activity for resolving, achievement
- concerns for futures, risks, and policy/plan for risk management
- expectation/opportunity for future, policy/plan for next fiscal year for achieve expectation/opportunity
- explains these things on user service, technical area, financial and administrative area

As shown in figure 2, discussion is mainly focus on how much WUSC achieves to target in annual, medium and long term business plan both financially and non financially. Annual financial targets are mentioned on budget and how much WUSC achieves to, both revenue and disbursement. Non financial targets and financial target of medium term may not mentioned on budget, though WUSC must prepare medium term business plan and settles target performance such as connections, coverage ratio, as well as management efficiency including NRW: non revenue water, collection efficiency and connections per staff.

Then explain reason of why undershoot or overshot of the targets, if in that case. Some may non evitable, but improve management do best and avoid worst situation.

Lastly assess the performance and effort, and make conclusion leads to why the policy is necessary to achieve expectation of following year.




- What is major target (both financial and non financial target in the business plan)?

- How much WUSC can achieve these financial and non financial targets in the business plan?

- What is the reason for undershoot or overshoot?
- Are there any emerged issues and problem in this year?
- Is there any change of existing issues and problems WUSC already noticed as business risk?

- Policy and plan for overcome business risk
- Expected financial and non financial performance

Figure 2: Structure to explain management discussion

Bibliography [4], Orange Country Water District explains so much detail of non financial performance results even on their comprehensive financial report. Also bibliography [3] Tokyo Waterworks explain how much they can achieves in the year compare with their 3 years plan. For adaptation of this recommendable table, WUSC should have performance target, however, some WUSC do not have such target, except financial target in budget plan. Again, some WUSC do not have perspectives as form of business plan. Without showing medium and long term target, stakeholder could not understand direction of WUSC.

(5) Governance, management board and committee

Explain policy and system of corporate governance, but WUSC is not complicated organization and business structure, thus this may very simple. Normally this chapter includes list of management board member and special committee member with their roles and responsibility.

If these is any business risk, it may better mentions how to preventing these risks, or policy to preventing. Normally, this chapter at least mentions policy of internal control and financial audit.

It may because in early establishment stage of the organization and manager may not has much qualified, some WUSC does not empower to manager and take over management roles to management board. Issue is, this management board do not do much about supervising and policy making, but so busy for management of operation. Such luck of governance should also be argued and management board should shows policy for empower to manager on daily management of operational organization, and the management board should focus more on governance or policy making. Again, management board looked not much pay attention to demand and requirement from users and not shows policy for business risk such as future water shortage or keeps ignoring request of water supply from presently non service covered area, although understandable as these issue may exceed their given capability and political frameworks relation with government.

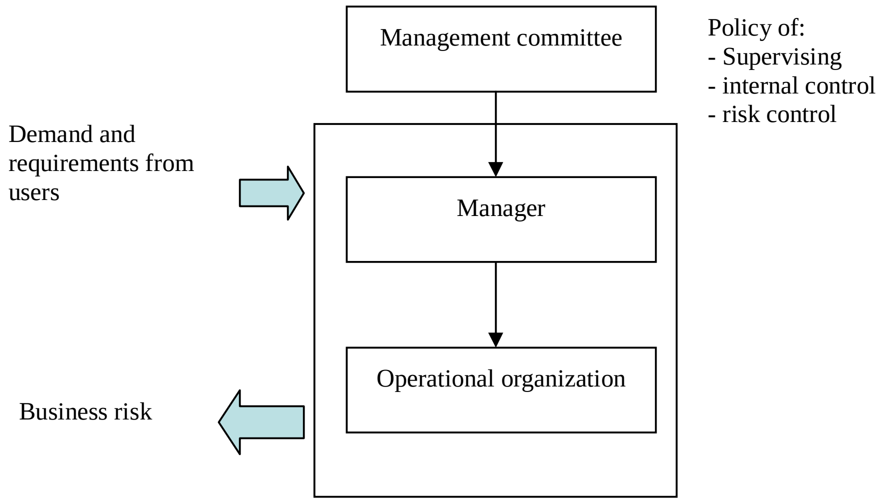


Figure 3: structure of governance system

(6) Auditor's report

This chapter shows auditor's report and comments. This report guarantees accountability of WUSC's accounting activities thus very important, as well as mandatory part of the annual report. Normally annual report includes whole report from auditor. If auditor's report including detail financial statements, notes and comments, and WUSC has no objection or no further notes and comments, WUSC has no necessary to attach financial report on chapter 7.

In Japan and USA, auditor's report is normally very simple and just assures accuracy of financial report, except they find some problem and concerns. TEPCO'n annual report of 2010 shows only one page of auditor's report, and this is normal situation in Japan. Normally, CPA audits and gives comments, and company accepts and improves immediately, thus auditor can ensure to assure accuracy that concludes their very short report in Japan. If not, that comes as thick auditor's report and it means existing of so many problems on their financial system. Auditor has no duty to explain company's accountability, but just assure. Duty of explaining accountability is shouldered by the company in Japan and USA. But it may not case for Nepal.

(7) Financial statements, notes and comments

If auditor's report including sufficient financial statements, no necessary to including additionally in this part. But, if WUSC needs additional notes and comments for explain about financial performance and/or results, WUSC must mentions, such as explanation of items including the chart of account, meaning of the results, etc. for make clearer to explain accountability of WUSC. If there is discrepancy between results of financial statements between previous year and this years including balance forward of previous year and beginning balance of this year, or changes of budget and target, or off the books record, WUSC must mentions with reasons on the footnote. It is also recommendable to mentions non financial performance related with financial performance, if necessary, on the footnotes, for example, disbursement of salaries, number of staff for target of this salary disbursement, or sales of water meter, how many water mater was sold.

TEPCO's annual report of 2010 shows quite rich information with footnotes on their financial statements.

In Philippines, government recommends to attaches cash flow statements, retaining and earning statement as well as working fund report as supplementary to main financial report. Attaching such supportive financial statement is also strongly recommendable, if necessary. Although attaching cash flow statement is mandatory for many countries including Japan, USA and Philippines, but it does not means changing their account system to cash base. It means simply company also should concerns cash based revenue and disbursement and keep positive cash balance. If organization falls into negative cash balance, it means bankruptcy and end of the organization, even financially profit on their income statement.

(8) Budget and performance target

This chapter mentions budget for next fiscal year. It is recommendable to mentions also non financial performance targets of the next fiscal year such as connections and collection efficiency, if in case WUSC do not discuss on chapter 4 “Management Discussion”.

(9) Reference and functional report

It may recommendable to attach detail figures and charts, or supporting documents as reference in this chapter for support discussion and explanations in the main report. Or with other word, avoid detail supporting data and information in chapter 2 to 8 and mentioned as reference and describe in this chapter. In this way, WUSC can focus for discussion on main report and makes discussion more streaming.

If necessary, attach functional report in this chapter. In case of TEPCO, because they do many businesses by subsidiary company, they explain activities and performance of these subsidiary companies in this chapter. If WUSC do another business, such as mineral water bottling business, it may recommendable for attach the summary report of this mineral water bottling business in this chapter.

Lastly, author hopes to WUSC for prepare good quality annual report, that is easy to read and easy to understand well for reader. Author hopes this simple guideline may help to prepare such good quality annual report.

## 4. Bibliography

[1] TEPCO, “***Annual Report 2010***”, Tokyo Electric Power Corporation, 2010

This is useful sample of annual report from one of biggest and excellent utility service organization in Japan, though utility services are provided by private sector in Japan mostly.

[2] International Trade Administration, U.S. Department of Commerce, ***“Guideline on the Annual Report”***, Annex 29 of “The Russia Corporate Governance Manual”, International Trade Administration, U.S. Department of Commerce, 2008

This IFC, SECO and ITA cooperative developed manual for corporation in Russia contains “Guideline on the Annual Report” in the annex and provides useful knowledge for prepare annual report.

[3] Tokyo Waterworks, “***Water Supply in Tokyo***”, Bureau of Waterworks, Tokyo Metropolitan Government, 2009.

Overview of Tokyo Waterworks and their performance of 2009 to business plan 20007-2009.

[4] Orange Country Water District, “***Comprehensive Annual Financial Report 2009”***, Orange Country Water District, California, USA.

[5] JICA, “***Prepare Annual Report (2)***”, workshop material, 2011.

Referred pages of annual report prepared by TEPCO, Tokyo Waterworks and Orange Country Water District are included in this workshop material. This guideline is written based on the author’s presentation for this workshop of annual report using this training material.

Monthly Data Sheet of _____________, 2011

२०६७/ / ____को मासीक तथ्याङ्क

Name of WUSC:

खानेपानी तथा सरसफाई उपभोक्ता समितिको नाम:

1. Service connection data

१. सेवा जडान तथ्याङ्क

1.1 Total service ________________

१.१ जम्मा सेवा ________________

1.2 Total active ________________

१.२ जम्मा सक्रिय ________________

1.3 Total metered ________________

१.३ जम्मा मिटर जडान गरिएको ________________

1.4 Total billed ________________

१.४ जम्मा बिल बनाइएको ________________

1.5 Population served ________________

१.५ सेवा प्राप्त गरेका जनसंख्या ________________

1.6 Changes:

१.६ बदलाभहरु:

1.6a New connection ________________

१.६क नयाँ जडान ________________

1.6b Reconnected ________________

१.६ख पुन जडित ________________

1.6c Disconnected ________________

१.६ग काटिएको ________________

1.7 Customer in areas: number ________ % active ____________

१.७ सेवा क्षेत्रहरु भित्रका ग्राहक: संख्या ________ % सक्रिय ____________

2. Present and effective water rate

२. हालको र प्रभावकारी पानी दर

2.1 Minimum charge ________________ Rupee

२.१ न्यूनतम शुल्क रु. ________________

2.2 Commodity charge ________________ Rupee

२.२ सामग्री शुल्क रु. ________________

3. Billing and collection data

३. बिलिङ्ग र संकलन तथ्याङ्क

| | this month | year-to-date |
|---|---|---|
| 3.1 Billing (Water Sales) | this month | year-to-date |
| ३.१ बिलिङ्ग (पानी बिक्री) | हाल महिनाको | बर्षको अन्त्यको |
| - Bill forwarded from previous month | ______ | ______ |
| - अघिल्लो महिनाको बिल | ______ | ______ |
| a. current (metered) | ______ | ______ |
| क. हाल (मिटर जडान गरिएको) | ______ | ______ |
| b. current (flat rate) | ______ | ______ |
| ख. हाल (फ्ल्याट दर) | ______ | ______ |
| c. penalty charges | ______ | ______ |
| ग. जरिवाना शुल्कहरु | ______ | ______ |
| - total | ______ | ______ |
| - जम्मा | ______ | ______ |
| 3.2 Collection (Water Sales) | | |
| ३.२ संकलन ( पानी बिक्री) | | |
| a. current account | ______ | ______ |
| क. हालको खाता | ______ | ______ |
| b1. arrears (current month) | ______ | ______ |
| ख१. समयमा नतिरेको पैसा (हाल महिनाको) | ______ | ______ |
| b2. arrears (previous month) | ______ | ______ |
| ख२. समयमा नतिरेको पैसा (अघिल्लो महिनाको) | ______ | ______ |
| c. arrears (previous year) | ______ | ______ |
| ग. समयमा नतिरेको पैसा (अघिल्लो महिनाको) | ______ | ______ |
| - total | ______ | ______ |
| - जम्मा | ______ | ______ |
| 3.3 on time paid in this month | ______ | |
| ३.३ हालको महिनामा समयमा तिरेको पैसा | ______ | |
| 3.4 year-to-date collection efficiency | ______ | |
| ३.४ बर्षको अन्त्यको संकलन निपुणता | ______ | |
| 3.5 year to date collection ratio | ______ | |
| ३.५ बर्षको अन्त्यको संकलन अनुपात | ______ | |
| 3.6 Account Receivable | ______ | |
| ३.६ प्राप्त गर्नुपर्ने हिसाब | ______ | |

| 4. Financial data | this month | year-to-date |
|---|---|---|
| ४. आर्थिक तथ्याङ्क | हाल महिनाको | बर्षको अन्त्यको |

4.1 Revenue ____________ ____________

४.१ बार्षिक आय ____________ ____________

a. operating ____________ ____________

क. संचालनमा रहेको ____________ ____________

b. non-operating ____________ ____________

ख. संचालनमा नरहेको ____________ ____________

- total ____________ ____________

- जम्मा ____________ ____________

4.2 Expenses

४.२ खर्चहरु

a. salaries and wages ____________ ____________

क. तलबहरु तथा मज्दूरीहरु ____________ ____________

b. pumping cost (fuel, oil, electricity)____________ ____________

ख. पम्प चलाउँदा लाग्ने खर्च (इन्धन, तेल, बिद्युत) ____________ ____________

c. chemicals (treatment) ____________ ____________

ग. रसायनहरु (प्रशोधन) ____________ ____________

d. other O&M expenses ____________ ____________

घ. अन्य संचालन तथा मर्मत संभार खर्च ____________ ____________

e. depreciation ____________ ____________

ङ. ह्रास कट्टा ____________ ____________

f. financial cost ____________ ____________

च. आर्थिक शुल्क ____________ ____________

g. others ____________ ____________

छ. अन्य ____________ ____________

- total ____________ ____________

- जम्मा ____________ ____________

4.3 net income (loss) ____________ ____________

४.३ खुद आम्दानी (घाटा) ____________ ____________

4.4 cash flow report ____________ ____________

४.४ नगद आउने जाने प्रतिवेदन ____________ ____________

a. receipt ____________ ____________

क. रसिद ____________ ____________

b. disbursement ____________ ____________

ख. व्यय ____________ ____________

c. net receipt (after disbursement) ____________ ____________

ग. खुद रसिद ( व्यय पछिको) ____________ ____________

d. cash balance, beginning ____________ ____________

घ. नगद मौज्दात, सुरुको ____________ ____________

e. cash balance, ending ____________ ____________

ङ. नगद मौज्दात, अन्त्यको ____________ ____________

4.5 miscellaneous financial data

४.५ विविध आर्थिक तथ्याङ्क

a. Loan funds (total) ____________ ____________

क. ऋण कोषहरु (जम्मा) ____________ ____________

1. cash on hand ____________ ____________

१. आफु संग भएको रकम ____________ ____________

2. cash in bank ____________ ____________

२. बैंकमा भएको नगद ____________ ____________

b. WUSC funds (total) ____________ ____________

ख. खानेपानी तथा सरसफाई उपभोक्ता समिति कोषहरु(जम्मा)____________ ____________

1. cash on hand ____________ ____________

१. आफु संग भएको रकम ____________ ____________

2. cash in bank ____________ ____________

२. बैंकमा भएको नगद ____________ ____________

3. investment ____________ ____________

३. लगानी ____________ ____________

4. working fund ____________ ____________

४. संचालन कोष ____________ ____________

5. reserves ____________ ____________

५. जगेडाहरु ____________ ____________

c. inventories ____________ ____________

ग. सामानहरुको सूची ____________ ____________

d. A/R customer ____________ ____________

घ. ग्राहकले पाउनु पर्ने हिसाब ____________ ____________

e. customer deposit ____________ ____________

ङ. ग्राहकको धरौती ____________ ____________

f. loan payable ____________ ____________

च. तिर्नु पर्ने ऋण ____________ ____________

g. payable (supplier, other creditors)____________ ____________

छ. तिर्नु पर्ने (वितरणकर्ता, अन्य ऋणदाताहरु) ____________ ____________

h. total debt service ________________ ________________

ज. जम्मा उधारो सेवा ________________ ________________

5. Water production data

५. पानी उत्पादन तथ्याङ्क

| 5.1 Sources of supply | number of wells | total rate of capacity | basis of data |
|---|---|---|---|
| ५.१ वितरणका स्रोतहरु | इनारहरुको संख्या | क्षमताको कूल दर | तथ्याङ्कको मूल आधार |
| a. wells | ________ | ______________ | ________________ |
| क. इनारहरु | ________ | ______________ | ________________ |

| 5.2 Water production | this month | year to date | method of measurement |
|---|---|---|---|
| ५.२ पानी उत्पादन | हाल महिनाको | बर्षको अन्त्यको | नाप्ने तरिका |
| a. pumped (cubic meters) | ________________ | _______________ | ________________ |
| क. पम्प गरेको (घन मिटर) | ________________ | _______________ | ________________ |
| b. gravity (cubic meters) | ________________ | _______________ | ________________ |
| ख. गुरुत्व (घन मिटर) | ________________ | _______________ | ________________ |
| c. totals (cubic meters) | ________________ | _______________ | ________________ |
| ग. जम्मा (घन मिटर) | ________________ | _______________ | ________________ |

| 5.3 Water production cost | this month | year-to-date |
|---|---|---|
| ५.३ पानी उत्पादन शुल्क | हाल महिनाको | बर्षको अन्त्यको |
| a. total power consumption for pumping (Kwh) | _______________ | ________________ |
| क. पम्प चलाउँदा खपत हुने कूल विद्युत (Kwh) | _______________ | ________________ |
| b. total power cost for pumping (N. Rupee) | _______________ | ________________ |
| ख. पम्प चलाउँदा लाग्ने कूल विद्युत खर्च (रु.) | _______________ | ________________ |
| c. other energy cost for pumping (N. Rupee) | _______________ | ________________ |
| ग. पम्प चलाउँदा लाग्ने अन्य इन्धन खर्च (रु.) | _______________ | ________________ |
| d. total pumping hours (motor drive, hrs.) | _______________ | ________________ |
| घ. जम्मा पम्प चलाएको घण्टाहरु (मोटर चलाउँदा, घण्टाहरु) | _______________ | ________________ |
| e. total pumping hours (engine drive, hrs.) | _______________ | ________________ |
| ङ. जम्मा पम्प चलाएको घण्टाहरु (इन्जिन चलाउँदा, घण्टाहरु) | _______________ | ________________ |
| f. total gas chlorine consumed (kg.) | _______________ | ________________ |
| च. जम्मा खपत भएको ग्याँस क्लोरिन (के.जी) | _______________ | ________________ |
| g. total powder chlorine consumed (kg.) | _______________ | ________________ |
| छ. जम्मा खपत भएको पाउडर क्लोरिन (के.जी) | _______________ | ________________ |
| h. total chlorine cost (N. Rupee) | _______________ | ________________ |
| ज. जम्मा क्लोरिन शुल्क (रु) | _______________ | ________________ |
| i. total cost of other chemical (N. Rupee) | _______________ | ________________ |

अन्य रसायनको जम्मा शुल्क (रु.) ______ ______

5.4 Accounted water use

५.४ पानी प्रयोगको हिसाब गरिएको

a. metered billed (cubic meters) ______ ______

क. मिटर भएको ठाँउको बिलिङ्ग (घन मिटर) ______ ______

b. unmetered billed (cubic meters) ______ ______

ख. मिटर नभएको ठाँउको बिलिङ्ग (घन मिटर) ______ ______

c. other billed (cubic meters) ______ ______

ग. अन्य कुराको बिलिङ्ग (घन मिटर) ______ ______

d. metered unbilled (cubic meters) ______ ______

घ. मिटर भएको ठाँउको बिलिङ्ग नभएको (घन मिटर) ______ ______

e. unmetered unbilled (cubic meters) ______ ______

ङ. मिटर नभएको ठाँउको बिलिङ्ग नभएको (घन मिटर) ______ ______

f. total accounted (cubic meters) ______ ______

च. जम्मा हिसाब गरिएको (घन मिटर) ______ ______

g. total powder chlorine consumed (kg.) ______ ______

छ. जम्मा खपत गरिएको पाउडर क्लोरिन (के.जी) ______ ______

5.5 Water use assessment

पानी प्रयोग कर निर्धारण

a. average monthly consumption/connection ______

क. औसत मासिक खपत/जडान ______

b. accounted water (%) ______

ख. हिसाब गरिएको पानी (%) ______

c. revenue production water (%) ______

ग. पानी उत्पादनको बार्षिक आय (%) ______

6. Miscellaneous data

६. विविध तथ्याङ्क

6.1 Employees

६.१ कर्मचारीहरु

a. total ______ regular ______ contract (casual) ______

क. जम्मा ______ नियमित ______ ठेक्का (भैपरी आउने) ______

b. number of connection per employee ______

ख. जडान संख्या प्रति कर्मचारी ______

c. average monthly salaries/employee (N. Rupee) ______

ग. औसत मासिक तलबहरु प्रति कर्मचारी (रु.) ______

6.2 Bacteriological

६.२ किटाणु विषयक (ब्याक्टेरियोलोजिकल)

a. total sample taken ____________

क. लिइएको कूल नमूना ____________

b. number of samples meeting standards ____________

ख. मापडण्डसंग मेल खान जाने नमूनाहरुको संख्या ____________

c. number of days full chlorination ____________

ग. पुरा क्लोरिनेसन गर्ने दिनहरुको संख्या ____________

6.3 Chlorination

६.३ क्लोरिनेसन

a. total sample taken ____________

क. लिइएको कूल नमूना ____________

b. number of samples meeting standards ____________

ख. मापडण्डसंग मेल खान जाने नमूनाहरुको संख्या ____________

c. number of days full chlorination ____________

ग. पुरा क्लोरिनेसन गर्ने दिनहरुको संख्या ____________

| 6.4 Board of directors<br>६.४ निर्देशकहरुको समूह | this month<br>हाल महिनाको | year-to-date<br>बर्षको अन्त्यको |
|---|---|---|
| a. resolution approved | ____________ | ____________ |
| क. पारित भएको प्रस्ताव | ____________ | ____________ |
| b. policies passed | ____________ | ____________ |
| ख. पारित भएको नितिहरु | ____________ | ____________ |
| c. directors' fee paid (N. Rupee) | ____________ | ____________ |
| ग. निर्देशकको शुल्क भुक्तानी (रु.) | ____________ | ____________ |
| d. meeting (number) | | |
| घ. गोष्ठी (संख्या) | | |
| 1. held | ____________ | ____________ |
| १. आयोजना गरेको | ____________ | ____________ |
| 2. regular | ____________ | ____________ |
| २. नियमित | ____________ | ____________ |
| 3. special | ____________ | ____________ |
| ३. विशेष | ____________ | ____________ |

7. Status of various development

७. विभिन्न विकासको अवस्था

7.1 financial arrangement

७.१ आर्थिक व्यवस्था (बन्दोबस्त)

7.2 repayment to loan

७.२ ऋण पुन भुक्तानी

7.3 engineering arrangement and progress of construction

७.३ इन्जिनियरिङ्ग व्यवस्था र निर्माण प्रगति

8. Status of institutional development

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8.1 development progress

८.१ विकासको प्रगति

8.2 user service and business system

८.२ उपभोक्ता सेवा तथा व्यापार प्रणाली

a. computerization of accounting system

क. लेखा प्रणालीलाई कम्प्युटराइजड गर्नु

b. computerization of billing and collection system

ख. बिलिङ्ग तथा संकलन प्रणालीलाई कम्प्युटराइजड गर्नु

c. management audit

ग. व्यवस्थित लेखा परिक्षण

d. PR and awareness activity

घ. जन सम्पर्क तथा जनचेतना मुलक कार्य

e. marketing

ङ. खरिद तथा बिक्री गर्ने (क्रय-विक्रय)

f. financial audit

च. आर्थिक लेखा परिक्षण

g. others

छ. अन्य

Submitted by ________________

बुझाउने ________________

Date ____/______/____

मिति ____/______/____

# User Complaints Management Manual

(Draft 04/26/10)

The Project for Capacity Development
on Water Supply in Semi-Urban Area in Nepal

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Abbreviation

CEO: Chief Executive Officer, for WUSC, it may chairperson
WUSC: Water Users and Sanitation Committee

## 1. Objectives

This manual explains concept of user complaints management for staff and manager work for solve complaints and requirements from users. This manual covers concept, major job flow, typical analysis method and case of feedback to improving management system. However, not cover all possible job flow for replay complaints and requests from users. Complaints and request from users are so diversity and could not cover all types of these by this manual. Important thing is understand concept and work based on concept. Thus not cover all possible type of complaints and requirement from user is not much important.

Secondly, this manual is not aims to use as sort of dictionary. Some technical manual may aims to use with such style when reader has question and want to find answer on the manual. But nature of user complaints is different. It is more puzzle solving work to find core problem that causes the complaint. Thus staff of WUSC has no way but find himself the way based on the concept. This manual is aims to understand concept and apply the concept to complaints management. If necessary, author recommends to having group discussion time to time using this manual for solving the complaint or managing the job process based on the concept mentioned in this manual.

As summary of objectives:
- Target Reader: staff and manager of WUSC
- Objective: understand concept of user complaints management

## 2. Concept

### (1) Attitudes to complaints: Negative or Positive

There could be two types of attitudes when staff of WUSC accepts complaints from users, negative and positive. Negative attitudes typically phenomena as “again complaints and I’m tired”, or feel “if this is not my job, I wish to escape”. Indeed replay to complaints is energy consumption type work that sometimes hard to find meaning or effort. Use user complains with anger. But real problem sometimes hide deeply and not so clear to see. It is so easy to handle with very bureaucratic manner, such as ask to submit letter, request agreement for cost share, and do with standard protocol, and then replay based on the result comes from standard protocol. Well, say “no serious problem is find by water quality test”, or “not find any serious problem on the water meter by shop test”.

However, good water supply system rather welcomes to user complaints because they believe user complaints make them the opportunity for improving their management system and enhance quality of customer services as well as improving more customer satisfactions. Without user complaints, they cannot find bottle neck for enhance quality of customer services, they insists. Therefore, they think user complaints are useful for:
- Improving quality of customer service
- Improving management and process of customer services
- Improving customer satisfactions

### (2) Difference of operation and management

Fig. 1 shows some concept of user complaints management. There are two layers or level of management, operational level and management level. Operational level is, accept complaints and requests from users, and replay case by case. If complains is categorized in water quality, chemist visit resident of user, take sample, bring back to laboratory and do chemical analysis, report to manager and replay to customer. If chemist finds come contamination, he or she may further visit neighbor user and take sample, and do chemical analysis until success to find sources of contamination, for example, leakage of pipe near the sewerage pipe. If complaints categorized into meter failure, meter reader visit user and re-read water meter, do field test, or further, bring water meter to shop and do shop test until confirm accuracy of that water meter. If staff finds some failure on that water meter, he may report to manager and accept civil work of meter replacement and inspection. These job flow from accept complaints and replay to users is called operational level user complaints management.

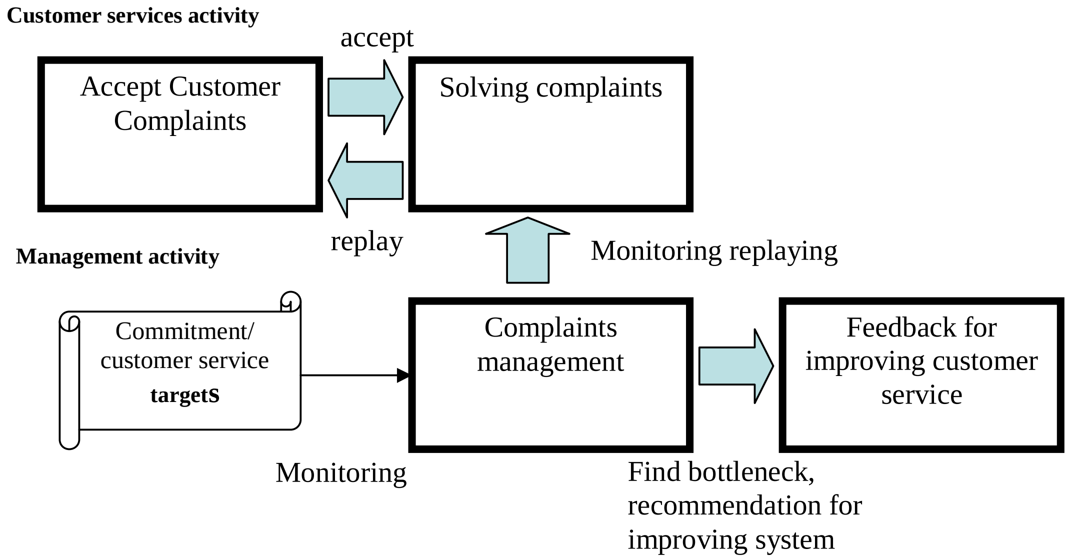



Fig. 1: Concept of User Complaints Management

This daily routine job process of user complaints management is very important, however, also manage complaints is important. If lack of management, complaints may not reduced, or not touched core problems that cause the complaints. Management of good water supply system keep monitoring two items, 1) speed and effectiveness of replay to user complaints and 2) achievement of customer services target. Normally, complaints and requests are recorded on log booking system and keep monitoring until sufficiently replay to user, or in other word, until solve the problem and user is satisfied. Thus all accepted complaints and requests should be replay sufficiently. Also, manager keep monitoring achievement of customer service target, such as “replay to user complaints within 2 business days”, or “repair leakage within 24 hours”. If manager finds failure to achieve these targets, he tries to find bottle neck that makes failure to achieve and try to removing that bottleneck. If necessary, he may change the system or enforce capability, such as increasing staff or re-training, change the job flow, or protocol. Thus manager always try to maintaining operational level user complaint management process very smoothly.

As summary of this section, three things are very important:
- Management task is make smoothly operation for solve complaints and request from users
- For that purpose, many organizations have targets or measurements to judge efficiency and effectiveness of the user complaints management
- Also, for that purpose, management improving job flow or business system in necessary

In this manual, business system means organizational structure, roles and responsibility allocated to job or staff, and process of works.

**(3) Why good customer service is required?**

What is the objective of your organization (WUSC)? Please think with your own word. Normally any organization determined their objective with vision or mission statement and make clear to stakeholders. Also, normally, any water supply system has determined their objective or mission as “provide safe water affordably to maximum number of users with reasonable cost”. Your water supply system has different wording, however, almost everyone who involving with water supply system may agree with this determination, I hope. Provide safe water is priority task, and then provide enough quantity of that safe water, and increasing number of people who lives or stay in your jurisdiction who can access with your safe water, and lastly provide your safe water with reasonable cost that these users can pay without much trouble. These are missions and with these missions achieve higher standard of living. That means good service. If user complains something wrong for water quality, he may point as violation of your mission for provide safe water.

However, always you do not know your business system has qualified to achieving your mission mentioned before. Customer complaints are only way to notice or confirm as your business system is sufficient to achieving missions of the organization.

Secondly, your organization needs support from users, in term of water tariff payment, or voluntary works for assist to achieving mission of your organization. Customer satisfaction is surely required to keep getting support from users for achieving mission. If user has complains to your services and stop to support, how you can achieving mission of your organization? Normally, I say with other words, as “water supply system (= your organization) is utility service oriented organization”. Thus please avoid bureaucratic manner to customer service works. Although your organization is NPO: Non Profit Organization, or quasi government organization, but should be service oriented. Thus you need to response to reasonable requirement from customer speedy and effectively. But also you must always consider what is principle requirement your user requesting. Or in other word, what is real cause of the complaint. Solving that real cause is essential part for make customer complaint, although speedy, timely responses with user friendly attitudes are required. This manual mentioned more about what is “solving real cause of user complaint” in section 3.

As the summary of this section, it may conclude into three items:

- Objective of the organization for water supply is, “provide safe water affordably to maximum number of users with reasonable cost”. And you are required to provide high quality, speedy and effective customer service.
- Reasonable complaints and requests from user are important opportunity to confirm ensure to achieve the organizational objective
- Also your organization requires support from users and without support from users, your organization and your work could not accomplish. Thus keep providing high quality service and keep maintaining customer satisfaction are most important things for carry on your work.

**3. Job flow of user complaints management**

Manager of WUSC should always maintaining job flow of user complaints management smoothly. Only manager (or person who empowered) can change the system for that purpose. Fig. 2 and 3 show sample and typical job flow for user complaints management.

Complaints and requests from users are mainly categorized into three groups. Manager can set standard job process and allocate staff based on this concept. Three groups are namely, (1) customer service: billing and meter reading, (2) technical problems: leakage, (3) water quality problems.

**(1) Billing and meter reading**

Complaints in this category are mostly tries to insist something wrong on billing amount and doubt accuracy of meter reading or accuracy of water meter. Fig. 2 shows typical job flow for user complaints in this category. Normally meter reader may be assigned as in-charge for solving this type of complaints. He or she takes care for find causes of the complaint.

1) Simple calculation mistake

Normally, user comes to complain for something wrong on billing amount, such as billing amount increases rapidly. If it comes from simple calculation mistake, just correct billing amount with apology.

2) Re-reading and filed test

But argument comes on normally consumption volume and user has question to meter reading or accuracy of water meter, or possibility of in-house area leakage. In this case, meter reader visits resident of user and re-reading water meter with attendance of user. If consumption volume is not much different with record of the read on billing, then ask user for they have any special occasion and using water more than usual, such as have party or family cerebration. Also, close all water faucets and check dial of water meter is running or not. This is called field test. If both re-reading result and filed test are sufficient, under user insist they do not consume water irregularly, discuss with user and keep mentoring next meter reading. But if re-reading result is doubtful but filed test ensure accuracy of water meter, it is simply misreading and correct record of meter reading with result of re-reading, and re-issues water bill with apology.

In some countries, water supply system has simple and mobile-able water meter test facility and do water meter test and calibration on site.

3) Workshop test

If even in close all faucets and still dial of water meter is running, then there would be two possibilities, something wrong for that water meter or in-house leakage. In this case, temporary replace that water meter with new one and bring to workshop of WUSC and test the water meter. If shop test ensures accuracy of water meter, then move for in-house area leakage detection. Also, replace back that water meter. Basically water meter is property of user. Method of shop test is mentioned in “Meter Reading and Water Meter Test/Calibration Manual”.

4) In-house leakage detective

If there is no problem on water meter, then visit resident of user and detect in-house area leakage detection. Normally, check the water spots or wet part of in-house area pipe lines one by one. Check carefully joint of pipeline, connection of faucets, taps or valves. Also check the quality and condition of pipe. If pipe become old or user uses low quality material, leakage is easily happen from pipe broken. These are most possible leakage area. If success to find in-house area leakage, recommends to user for repair that leakage.

5) If still could not success to find causes

If still could not find the cause of the complaint, discuss with customer and keep monitoring to next meter reading. If still same phenomena will happen when during next meter reading, consider more rigorous shop test or rigorous in-house area leakage detection.

6) Cost sharing

It depends on the rules and regulation of WUSC, but if cost is required for shop test and in-house leakage detections, you may need agreement and approval from users.

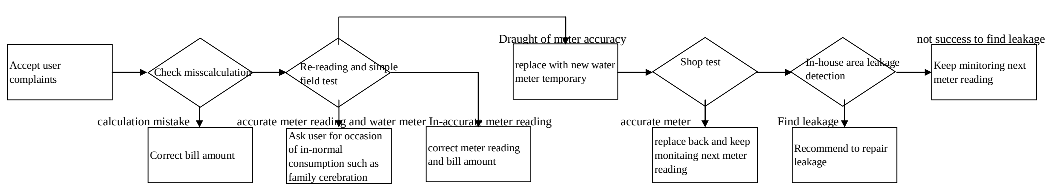



Fig. 2: Sample job flow for complaints on billing amount and meter reading

**(2) Leakage**

Secondly or thirdly frequent complaints are leakage. If leakage is happen in low water pressure, contamination could be easily happen and water become no more potable. Thus if user notices the leakage, WUSC should immediately repair that leakage. If leakage point is in in-house area of user, repair is response to user. If leakage is in property area of WUSC, WUSC should repair immediately. Normally, inspector is assigned in-charge of detection and repair works, and commands to plumber for this type of work.

**(3) Water Quality**

Again, secondly or thirdly frequent complaints are water quality, such as ordure, smell, or color. If WUSC accepts complaints of this type, normally chemist visit resident of user and take sample of water and try to find the cause. Mostly it comes from leakage or pipe connection work on upper stream of distribution line. Fig. 3 shows typical job flow for complaints in this category. For method of water quality test, it is covered by “Water Quality Management Manual”.

1) Water quality test

Chemist takes several samples from taps in house of user as well as neighbors, house located upstream and house located downstream connected with same water distribution pile. If complaint about water quality is observable, such as color, or testable with portable test kit, chemist can rather easy to find the start point of the problem. If problem starts from upper stream of the distribution line, then consider what causes that problem. If test result is not so sure by portable test kit, bring back samples and conduct laboratory test.

2) Quality problem caused by leakage repair works or pipeline connection works

If chemist finds clear causes such as leakage repair works or pipe connection works on upper stream of the distribution pipeline, explains to users about causes and when problem would be stop.

3) If causes are not by leakage repairs or pipeline connection works

If water quality problems are found on both samples taken from house located on upper stream and resident house user complaint, but not find clear causes, please do further investigation for find where it starts to happen. In this case, chemist needs to visit area again and find where problem of water quality starts on distribution line. If cause comes from leakage, broken pipe or some failure of pipeline connection, or valves, arrange for repair or fixes. Report to user why it was happen and explains already fixed.

4) If water quality is happen in in-house area of users and caused by leakage or broken pipes

If water quality problem happens only in-house area of users and not observed in any area including water from residents on upper stream and downstream on same distribution line, cause may obviously from leakage, broken pipe or change of material quality within in-house area of user who complaints. Sometimes careless plumber connects water supply pipe with sewerage pipe and make problem in this category. In this case, recommends to user for further detections of causes, on pipeline in in-house area of user.

5) Serious contamination

If chemist finds serious contamination caused by inaccurate sewerage system or sanitation facilities, damping of solid wastes, or illegal activities such as pumping water from pipeline or illegal connection, please suggest improvement or action should be taken to manager or in-charge of user complaints management system immediately.

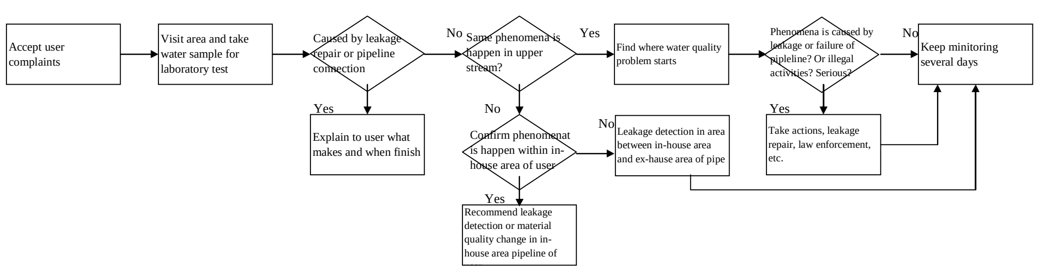



Fig. 3: Sample of water quality related user complain management process

**(4) Others**

If user complaint is not any category of these mentioned above, manage that by ad-hoc and case by case. Please always keep in mind to find what cause the complaint, and fix it. It is commonly happened as phenomena, fist complaint looks meter failure or water quality, but real cause is leakage. Find real cause and fix that cause is principle of user complaints management.

**(5) Job Flow Management**

Manager must supervising and coordinating for operation of user complaints management smoothly. This activities including, log monitoring, trouble shooting, re-assignment of staff for solve the complaint and coordination. For this smoothly operation, closed communication with staff and/or user is very important.

Fig. 4 and 5 show sample format for user complaint management and Fig. 6 shows sample job flow management system. When customer service clerk accepts user complaint by phone or fax, or visit of user, he or she writes complaints on the service request form (Fig. 4). Also when meter reader find some irregularity regarding meter accuracy or water quality, he or she write information on this format. Write name of user, address, date and mark on category of complaints, such as dirty water, no water or high consumption. Then submit to manager or in-charge of user complaints system. He directs his decision based on this service request.

SERVICE REQUEST

| | | |
|---|---|---|
| DATE: | | NO. |
| TIME: | | |
| Name of User: | | |
| Address: | | |
| Zone: | | |

| | | |
|---|---|---|
| ☐ NO WATER | ☐ HIGH CONSUMPTION | ACTION TAKEN: |
| ☐ DIRTY WATER | ☐ TASTE OR ORDER | |
| ☐ HIGH PRESSURE | ☐ LOW PRESSURE | by:<br>NAME OF Meter Reader/Plumber: |
| ☐ METER LEAK | ☐ LEAK CHECK | TO CUSTOMER: Did action taken satisfy your request |
| ☐ REREAD | ☐ OTHERS (Specific) | ☐ YES |
| | | ☐ NO signature |
| REQUEST RECEIVED BY:<br><br>DATE: | APPROVED BY:<br><br>DATE: | COMPLETED ACTION REVIEWED BY:<br><br>DATE: |

Fig 4.: sample format of service request

MAINTENANCE ORDER

| | |
|---|---|
| M.O. NO. | |
| METER NO. | |

| | |
|---|---|
| DATE: | |
| TIME: | |
| Name of User: | |
| Address: | |
| Zone: | |
| USER CODE: | |

☐ READ ☐ TURN OFF ☐ REPAIR BOX

☐ STUCK ☐ METER LEAK ☐ LEAK CHECK

☐ TURN ON ☐ TEST ☐ OTHERS

☐ REMOVE

☐ SET

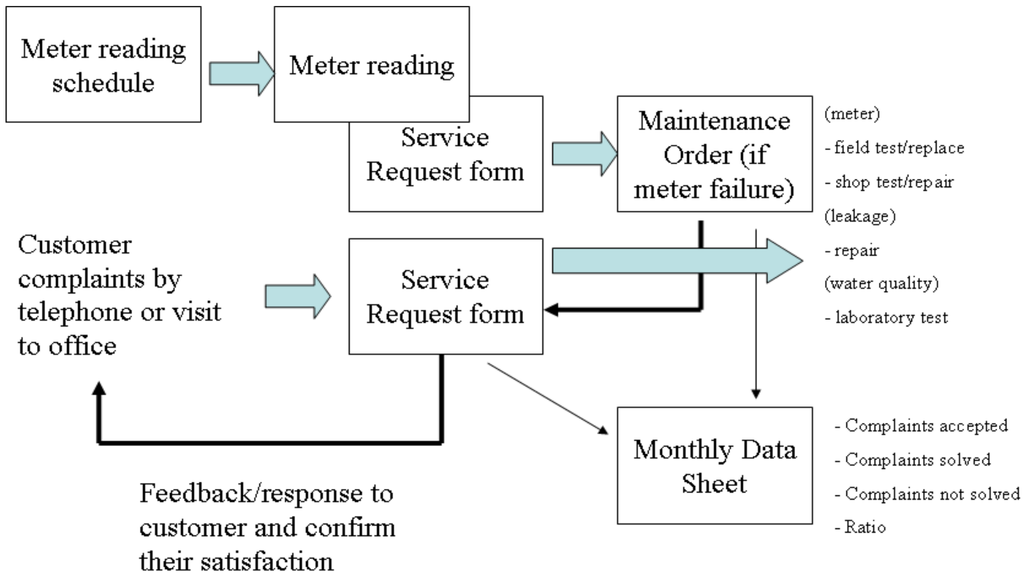
☐ OTHERS

| METER NO. | SIZE | KIND/BRAND | READING |
|---|---|---|---|
| | | | |
| | | | |

REMARKS:

| | | |
|---|---|---|
| TEST RESULTS: | ☐ FIELD | ☐ SHOP |
| | TESTED BY: | DATE: |
| PREPARED BY: | APPROVED BY: | DATE COMPLETED:<br><br>BY:<br>Plumber |

Fig 5.: sample format of maintenance order



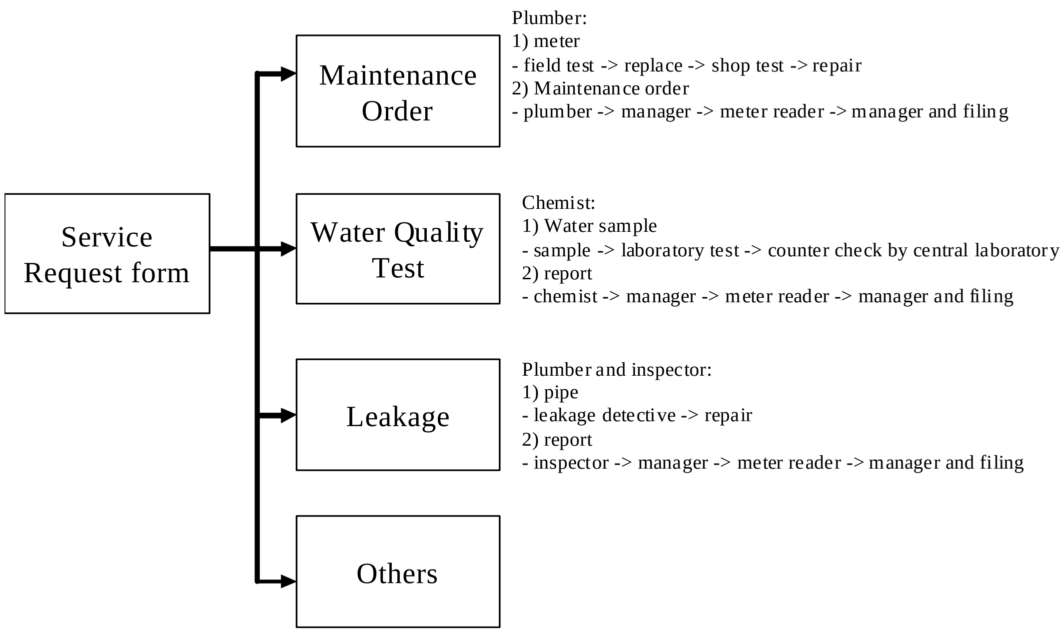




Fig. 6: Sample of user complain management system

If the complaint comes from accuracy of water meter and requires shop test, also write information on the maintenance order. Based on this maintenance order, water meter are replaced with new water meter temporary, and conduct shop test at workshop. Results of test are return to manager or in-charge of user complaints system.

After that works based on maintenance order, manager or in-charge of user complaints management system directs to meter reader for informs results and recommendations, if in that case (such as repair in-house area leakage) based on original service request.

In case of water quality problem, or leakage, use only service request form and directs laboratory test to the chemist, or leakage repair to team of inspector and plumbers.

Service request form and maintenance order form are controlled by serial number and trace history and status of solution by manager or in-charge of user complaints system.

Statistic data of user complaints are also recorded on the monthly data sheet, a kind of monthly report of management and operations. With this monthly data sheet, manager and CEO keeps monitoring performance of customer service.

**4. Analysis of user complaints**

For ensure to maintaining and/or improving quality of customer services, analyzing user complaints and improving complaints management system is very important. Fig. 7 shows sample of log format and Fig. 8 shows sample of statistical analysis report. WUSC can design form and manner of statistical analysis for their objectives. This sample aims improving speed and effectiveness of user complaints management, and change allocation of staff based on the analysis results, such as hire assistant chemist for reduce complaints unsolved on this field.

(1) Record on log to statistic analysis

When WUSC accepts complaints or requirements, write complaints and information on service request form and then transfer to log book. In sample of Fig. 8, complaints categorized into 4 areas, 1) water quality (chemist handles), 2) leakage/pressure (plumber and inspector handles), 3) meter reading and billing, high consumption, (these meter reader handles) and 4) others. Actually mark on category from 1) to 4), and then fulfill other information including serial number (=No. on service request form), date of accept, person and in charge for this complaint. If the complaint requires issuing maintenance order, serial number of the maintenance order is recorded on column of note.

When the complaint is solved, then fulfill the date, and when inform the results to users, fulfill the data. For analysis and management, it is highly recommendable to use computer and EXCEL.

(2) Statistical analysis

Actually, it is so simple, just count by category, number of complaints solved and unsolved within 10 days, those within 20 days and more than 20 days. Then compare performance with last month and previous year. The water supply system using this format concerns efficiency and effectiveness of user complaints management system and they focus to keep monitoring comparison with previous month and previous year, and try to ensure reduction of complaints more than previous as well as solve within maximum 20 days.

Some other water supply system do statistical analysis for complaints solved within 2 days (that is their commitment), and 10 days and more. They concern about achievement of their commitment. Thus they design categorization to 3 groups, complaints solved within 2 days, within 10 days and more. WUSC can design their statistical analysis for purpose.

| | Serial No. | Date of accept | person accept | in-charge | water quality | leakage | meter reading | others | solved date | informed date | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
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| 32 | | | | | | | | | | | |
| 33 | | | | | | | | | | | |
| 34 | | | | | | | | | | | |
| 35 | | | | | | | | | | | |
| 36 | | | | | | | | | | | |
| 37 | | | | | | | | | | | |
| 38 | | | | | | | | | | | |
| 39 | | | | | | | | | | | |
| 40 | | | | | | | | | | | |

Fig. 7: Sample of log form

1) Number

| up to now | Water Quality | Leakage/Pressure | Meter reading | Others | Total |
|---|---|---|---|---|---|
| Unsoved complaints | 5 | 2 | 10 | 3 | 20 |

Accumulatoin to this month Period from 01/01/2009 to 12/31/2009

| | Water Quality | Leakage/Pressure | Meter reading | Others | Total | % |
|---|---|---|---|---|---|---|
| Accepted | 90 | 17 | 240 | 18 | 365 | |
| Solved within 10 days | 40 | 15 | 200 | 10 | 265 | 73% |
| Solved within 20 days | 40 | 0 | 30 | 5 | 75 | 21% |
| Solved more than 21 days | 5 | 0 | 0 | 0 | 5 | 1% |
| Unsolved | 5 | 2 | 10 | 3 | 20 | 5% |
| Ratio | 25% | 5% | 66% | 5% | | |

Accumulation to last Month Period from 01/01/2009 to 11/30/2009

| | Water Quality | Leakage/Pressure | Meter reading | Others | Total | % |
|---|---|---|---|---|---|---|
| Accepted | 81 | 15 | 223 | 12 | 331 | |
| Solved within 10 days | 40 | 12 | 200 | 10 | 262 | 79% |
| Solved within 20 days | 35 | 0 | 20 | 0 | 55 | 17% |
| Solved more than 21 days | 5 | 0 | 0 | 0 | 5 | 2% |
| Unsolved | 1 | 3 | 3 | 2 | 9 | 3% |
| Ratio | 24% | 5% | 67% | 4% | | |

Last year acumulation to same month Period from 01/01/2008 to 12/31/2008

| | Water Quality | Leakage/Pressure | Meter reading | Others | Total | % |
|---|---|---|---|---|---|---|
| Accepted | 85 | 25 | 275 | 22 | 407 | |
| Solved within 10 days | 46 | 23 | 250 | 18 | 337 | 83% |
| Solved within 20 days | 32 | 0 | 20 | 2 | 54 | 13% |
| Solved more than 21 days | 2 | 0 | 0 | 0 | 2 | 0% |
| Unsolved | 5 | 2 | 5 | 2 | 14 | 3% |
| Ratio | 21% | 6% | 68% | 5% | | |

2) Ratio

| | Water Quality | Leakage/Pressure | Meter reading | Others |
|---|---|---|---|---|
| Solved within 10 days | 44% | 88% | 83% | 56% |
| Solved within 20 days | 44% | 0% | 13% | 28% |
| Solved more than 21 days | 6% | 0% | 0% | 0% |
| Unsolved | 6% | 12% | 4% | 17% |

Fig. 8: Sample of statistical analysis

## 5. Feedback for improving management system

As already mentioned, make feedback the result of statistical analysis to management system and improving for high quality service. It is important roles of manager to improving system to achieving objectives and mission of the organization efficiently and effectively. For this purpose, manager should recommend to changing system, staff recruiting or job rotation to the management committee of WUSC.

(1) Organization and staff allocation

Small organization may force for almighty to manager. It may no way but manager control and supervising job flow. However, if possible, it may recommendable to make unit formulated by 4 staffs, meter reader, customer service clerk, plumber or inspector, and chemist under control of manager or in-charge of this unit. Those staff may no necessary for full time assignment. After accept complaints or request from user, manager or in-charge of the unit appoints in-charge for solving the complaint by its nature. If complaint is basically meter accuracy or meter reading, appoint meter reader for in-charge. Appointed meter reader must solve that complaint and reporting to manager or in-charge of unit. Fig. 9 shows sample organizational structure of this unit.

Table 1 shows sample of job allocation, however, job is not fixed but sometimes inter change. For example, complains of high consumption may first appointing meter reader as in-charge for solving this complaint. He visited user and re-reading. Then suppose he found some problem on accuracy of meter and user agrees to do workshop test. Workshop test is done by plumber who works in workshop and reporting result of the test. In such way, job is moves. However, the meter reader is always in-charge of this complaints and he must keep trucking workshop test and get report, or read test results on the maintenance order.

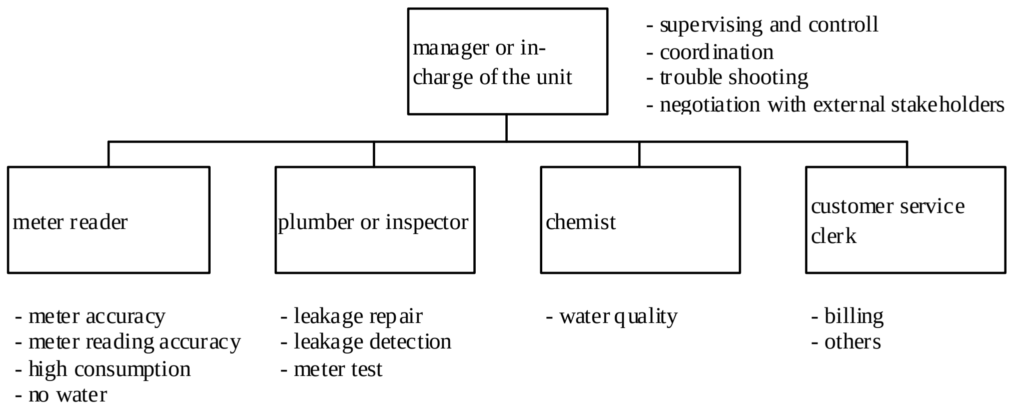


Fig. 8: Sample organizational structure of the unit

Table 1: sample job allocation

| | Staff | Roles |
|---|---|---|
| 1 | Manager or in-charge of the Unit | - supervising user complaints management flow<br>- coordinate and adjusting job allocation between staff<br>- negotiation with external stakeholders when solution requires assistance or supervising from them, such as police for law enforcement to illegal activity |
| 2 | Mater Reader | - handle complaints regarding accuracy of meter reading, water accuracy of water meter, or other consumption related complaints including no water, high pressure, etc. |
| 3 | Plumber or inspector | - handle leakage related complaints including leakage repair, leakage detection as well as workshop or field test of water meter |
| 4 | Chemist | - handle water quality related complaints, such as ordure, smell, taste, color, contamination, etc. |
| 5 | Customer Service Clerk | - handle billing issues and miscellaneous complaints not including above |

(2) Monthly Data Sheet and recommendation

As I already mentioned, solving user complaints are controlled by service request form and monitoring by log. Then statistical analysis is conducted every month at the end of the month and reporting to CEO, in case of WUSC, chairperson. In this monthly data sheet, manager mentions recommendation for improving user complaints management system, if necessary, including re-assignment of staff, recruiting new staff, change organizational structure, change job flow, change protocol, etc.

The result of monthly based statistical analysis are summarized to annual data and mentioned on the annual report as actual performance of customer services.

**6. Bibliography**


- Workshop material, “Workshop of Customer Complaints Management”, April 2010
- Workshop material, “Draft User Complaints Management Manual”, August 2010
- Workshop material, “Business Planning”, August 2010
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(first draft on April 2010)

**PCM: Project Cycle Management**

- Brief Introduction of Problem Solving Techniques Using PCM Method -

## 1. Objectives

This very brief and short introduction aims for make understand knowledge and techniques of problem solving for staff works for WUSC: Water Users and Sanitation Committee. Of course there are so many kinds of problems by nature such as complexity, impacts and cost for solution that makes Problem solving sometimes not so easy. Also there are sometimes several alternatives. Therefore, basically there is no simple way to solve problem. However, author believes understanding this problem solving techniques makes you to have confidence.

PCM: Project Cycle Management is widely acknowledged methodology for find problem, formulate plan for improve the problematic situation, monitoring implementation and lastly evaluate for feedback the lesson learned to next step or next plan. Understanding this methodology and techniques may very useful for solve the problem faced with in the daily operation and management works, specially that is complex and difficult to solve immediately.

I hope reader can understand concept of this methodology and applied for your problem, and that is objective of this short introduction.

## 2. Problem has structure

Except very simple problems, normally problem has structure and understanding the structure is a key for solving. People normally recognizes only surface of the problem but not notice that has structure because structure is hidden under surface.

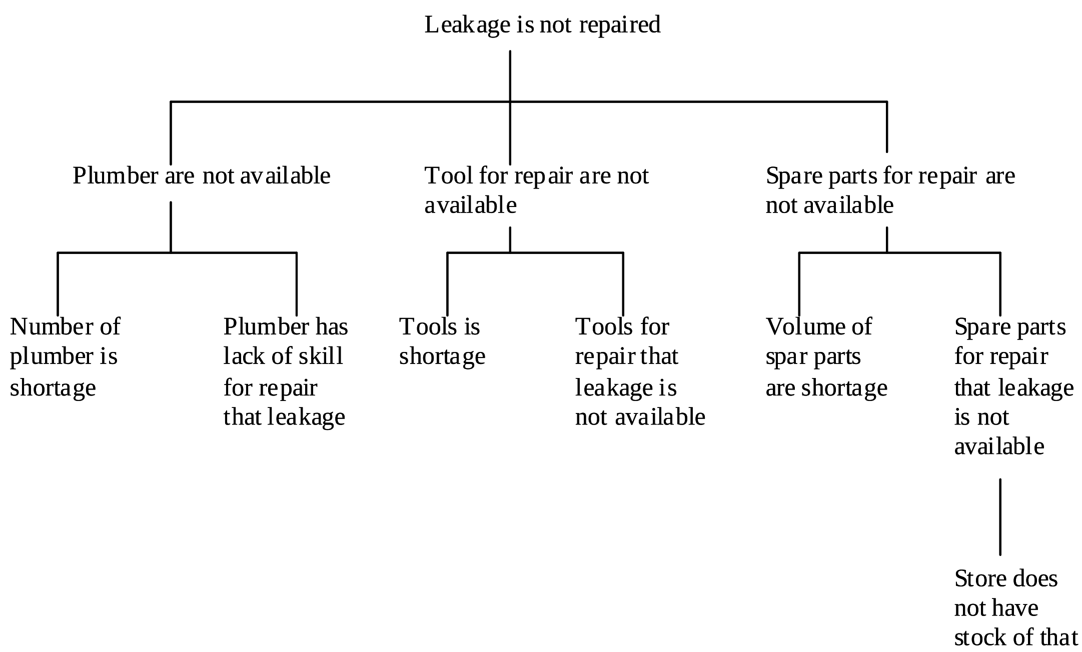



Fig. 1-1: Structure of problem (sample)

Figure 1-1 shows typical problem structure of leakage repair. Leakage is reported to manager. Manager order to repair but repair work is not accomplished. What happen? Simple mind manager may only think there is leakage and simply his staff can repair after his command. But if this manager keeps such attitudes, nobody believes him. Why? He doesn’t direct for repair, but just command without judge the scare, complexity and possibility of repair work. Number of plumber is enough to repair that leakage? Plumber has sufficient skill for repair that leakage? Tool for repair is enough and sufficient? Spare parts for repair are enough and sufficient? Plumber cannot repair leakage of iron pipe with tool for PVC pipe. People can easily understand such problem structure if that is in his familiar area and tackles for solve without recognition of the structure or main factors causes that problem. People can do with his rich experience piled as his in-tacit knowledge. But it is not true for his unfamiliar area. Therefore, it is recommendable to have habit to think or understand structure of problem. It may no need to explain, but experienced manager may direct repair works after inquire several questions for confirmation of situation and conditions:

1) Experienced plumber Mr. Perfect is available for that repair works?
2) Type of available tools able to handle this repair works?
3) Number of that tools are sufficiently enough for repair the leakage?
4) Type of available spare parts is able for repairs and stops the leakage?
5) Volume of that spare part is sufficient enough to accomplish the repair works?

After inquiry of these questions, normal manager may direct to plumber like, first buy such and such spare parts and bring such and such type of tools with such number of assistant workers and rush to leakage point. Also he may direct to his inspector for confirm the repair work and wait his report. Without understanding the structure of problems, he cannot direct this repair works to his staff. Suppose if manager just command to his unskilled plumber for repair and the plumber find leakage is come from old asbestos pipe, but he has only small sized PVC pipe and tools for small sized PVC pipe. Plumber may ask to his manager for next direction, but obviously this manager has not sufficient capability for manage this type of activity.

**3. History of PCM**

PCM is firstly developed by USAID in 1960s for summarized plan cover all necessary factors with logic of input and output and structure for achieve the output. This original concept called logical framework. GTZ, German bilateral assistant agency further improving and added analysis tools and makes it to methodology in 1980s. They call this methodology ZOPP, abbreviation of project cycle management in Germany. Today, PCM is widely adapted to development and management plan. You may have experience to saw same document or report adapted this methodology.

**4. Introduction of PCM**

PCM looks difficult and complicated, but actually concept is so simple and you can do that without using card or official group discussion after some experiences. I have rich experience to work as management consultant and find management consultants use problem analysis similar with PCM commonly for their consultation. However, they call this technique with different terminology, such as structure analysis, logic tree analysis or AS-IS analysis. Whatever they call, analyze problem with structure is basic skill and basic knowledge for management consultant.

PCM normally proceed with following steps, but you can skip or adjust based on your skills and nature of problem.

A) Planning
Step-1: Stakeholder analysis
Step-2: Problem analysis
Step-3: Objective analysis
Step-4: Selection of target area
Step-5: PDM: Project Design Matrix
Step-6: PO: Plan of Operation
B) Monitoring and evaluaiton
Step-7: PDMe
Step-8: Monitoring and evaluation

A) Planning
(1) Stakeholder analysis

First step is stakeholder analysis. For understanding background and nature of problems, check stakeholders and do analysis of their nature, SWOP: strength, weakness, opportunity and threat, opinion, position or your requests to them.

Fig. 2-1 shows typical structure of stakeholder for WUSC.

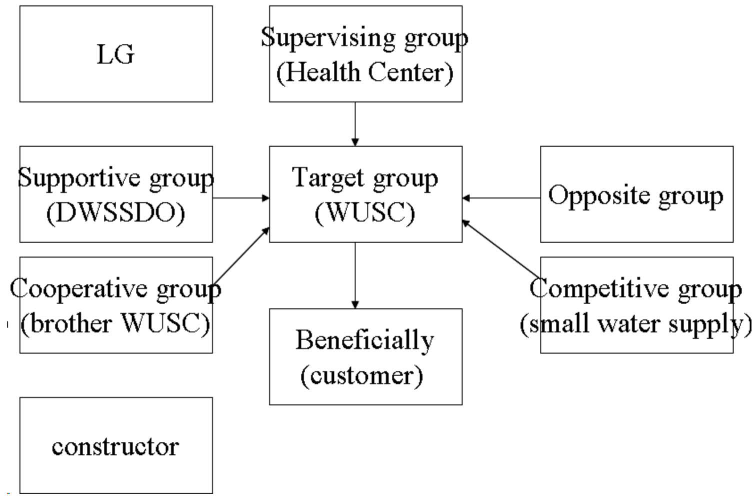



Fig. 2-1: example of stakeholders relation

List up name of stakeholders and write nature of each stakeholder. It may easy to consider their SWOT: strength, weakness, opportunity and threat regarding to you or to problems you may try to solve. If it is difficult, it may useful to write what mostly they said, or their opinion, and your requests to them. Table 2-1 shows sample of such stakeholder analysis. Basically, stakeholder may categorized into supervising, supporting, beneficially, opposite or intervention, but sometimes has several roles, or change the roles by situation.

Table 2-1: sample of stakeholder analysis

| Stakeholders | Characteristics |
|---|---|
| Users | - Beneficially<br>- They want safe water<br>- They want to discount water charge more reasonable level<br>- They want more stable supply<br>- They want more good services<br>- They want more water supply (business member) |
| DWSSDO | - Supporting organization<br>- WUSC want them to do more material supply<br>- WUSC want them to have more training program<br>- WUSC want them to more subsidies facility (and construction)<br>- WUSC want them to have more budget for support to WUSC |
| Health Center | - Supervising water quality (double check water quality)<br>- Provide testing kits and chemicals for water quality test |
| NGO | - A NGO is supportive for awareness campaign by WUSC<br>- B NGO opposites to water charge policy of WUSC and insists for reduce or free charge to poor people |

(2) Problem analysis

As I already mentioned, complex problem has structure and find that structure is key for solve. Without knowing structure, you may not find effective solution. Think causes that makes that problem and relating with cause and effect relation. For example of fig 1-1, problem “leakage is not repaired” is caused by another problem “spare parts for repair is not available”, and this problem caused by out of stock in the shop. In such way, problem has causes and emerged as effect.

For problem structure analysis, following steps with group discussion may effective:

Task-1: write problem on card

Task-2: grouping with similarity, and brush up the description, if necessary
Task-3: find relation of cause and effect with each problem
Task-4: linkage with caused problems and effective problem

1) Write problem on card

Write problem on card. Principles are:

- write one problem on one card, never write several problems on one card
  If necessary, you can use many cards as possible
- better write problem only, not write causes of that problem
- better write problem as passive sentence
- better avoid to use “not” or “no”
- never criticized to description of problem other people write
  Never criticize or deny opinion of others, but try to understand what he or she try to say, even you can not agree with his or her opinion. Problem sometimes looks different for other people and you must remain that. You must try to understand what that problem looks like for other people. But you can suggest to rewriting more clear meaning or more clear description.

2) Grouping

Grouping cards with similarity. If find same problems mentioned with different tone, and if you can make better, you can suggest rewrite and get agreement.

3) Find relation of cause and effect

Find relation of cause and effect among cards. First find one on one relation of cause and effect, and then gradually find another related card, and makes structure of one to many relation.

4) Linkage

Accomplish the linkage and make structure. On this process, you may find some missing problem card. You can add that missing card mentioned problem complete linkage.

Fig 2-2 shows example of problem analysis.

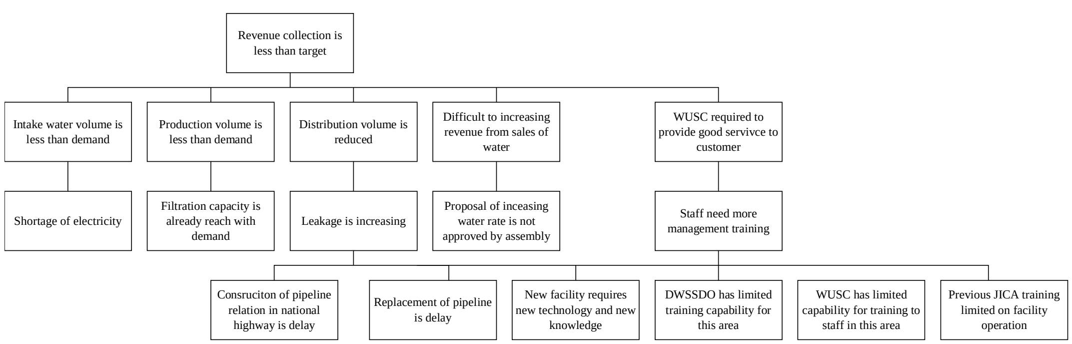



Fig. 2-2: example of problem analysis

After rich experiences, you may do this analysis and find structure easily without using card or group discussion.

Problem set on top of this problem structure called “core problem”. Problem “leakage is not repaired” on Fig. 1-1 is such core problem. Core problem normally be biggest and hardest problem to solve. Or on the other word, although core problem is most problems you want to solve, however, you cannot solve this problem immediately without solving other problems case this core problem. You must solve the problems on bottom first, and step by step, and you can finally solve the core problem. PCM calls this structure as “problem structure” but management consultant calls rather “As-Is” structure because this structure shows whole picture of present problem situation.

(3) Objective analysis

As you may already guess, solution also have structure, or you cannot solve the core problem immediately, but take step by step approach from bottom of problem structure. For find such solution structure, again think relation among situation of problem solved. In this relation, it is more means and objective rather than cause and effect.

For objective structure analysis, following steps with group discussion may effective:

Task-1: pick up the problem and write objective of this problem on card

Task-2: grouping with similarity, and brush up, if necessary

Task-3: find relation of mean for objective

Task-4: linkage with means relations

1) Write objective on card

Pick up one of problem and write status of that problem is solved, so called ideal situation. For example of Fig. 1-1, problem of “leakage is not repaired” becomes “leakage is repaired” as ideal situation or situation when this problem is solved. “Objective” in PCM means such ideal situation when problem solved. Do this activity to all problems on problem structure. However, sometimes there could be several objectives to one problem. No necessary to be one on one relation for such situation. Again, sometimes you cannot find any objective for problem. It may happen sometimes and there is no solution for this type of problem.

2) Grouping

Grouping cards with similarity. If find same meaning but described with different tone, and if you can make it better, you can rewrite after suggestion and get agreement on group discussion.

3) Find relation of mean and objective

Find relation of mean and objective among cards. First find one on one relation of mean and objective, and then gradually find another related card, and makes structure of one objective to many means relation. “Mean’ using in PCM means simply “way to achieve” or “how to realize” that objective.

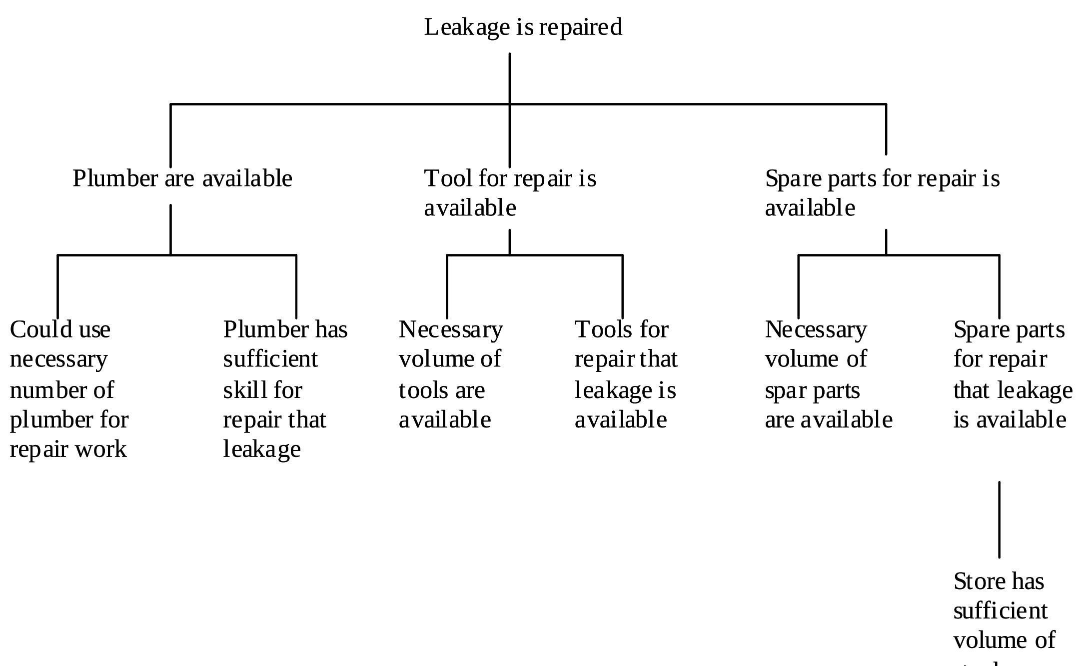



Fig. 2-3: example of such objective structure (to Fig 2-1)

4) Linkage

Accomplish the linkage and make structure. On this process, you may find some missing mean card. You can add that missing mean card and complete linkage. Fig. 2-3 and 2-4 show example of such objective structure.

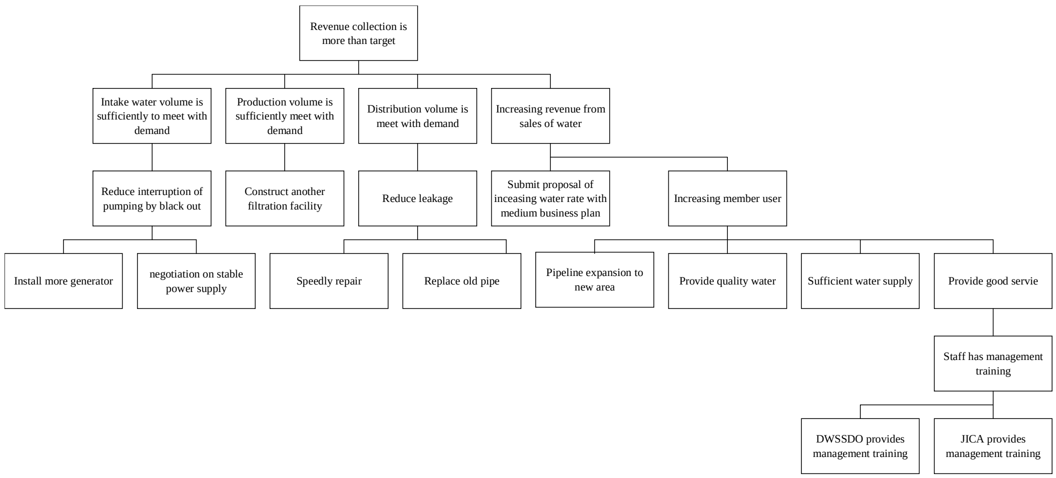



Fig. 2-3: example of such objective structure

After rich experiences, you may do this analysis and find structure easily without using card or group discussion.

Objective set on top of this structure is called "core objective" and this objective normally be biggest and hardest objective for achieve. Or on the other word, although core objective is most one you want to achieve, however, you cannot achieve this situation immediately without realizing other objectives that has means to achieve this core objective. You must achieve the objectives on bottom first, and step by step, you can finally achieve the situation mentioned on core objective. PCM calls this structure as "objective structure" but management consultant calls rather "To-Be" structure because this structure shows whole picture when all problems are solved.

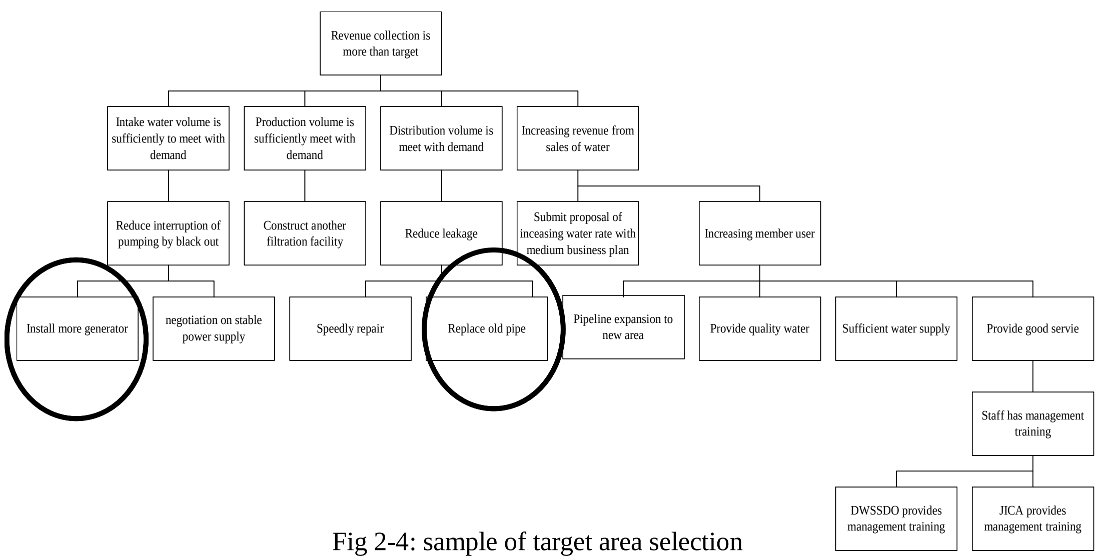



Fig 2-4: sample of target area selection

(4) Selection of target area

If you have affordable resources or problem is simple and not much serious, realizing the ideal situation pictured as objective structure may easy. However, resources are secured and it may not enough to achieve the situation pictured on objective tree. Therefore, you need to select focus area considering availability of resources (budget, human resources and other management resources), efficiency, impact and sustainability. Therefore, considering limit of available resources and select such target area on objective structure. Fig 2-4 shows sample of this selection. In this sample, WUSC select two areas for focus to improving, install new generator and replace old pipe.

(5) PDM

PDM: Project Design Matrix is summary sheet of plan and shows briefly purpose, what are expected outputs, what kind of inputs are considered for achieving outputs, volume of inputs, activity for achieve outputs and sort of targets as validation and means of validation. Also this PDM mentioned about condition for implementing as assumption.

Table 2-2: sample of PDM

| Narrative description | Verification | Mean of verification | assumption |
|---|---|---|---|
| Overall goal:<br>Revenue collection is improved | Revenue from sales of water is increasing from 200 million Yen to 200 million Yen | annual report of 2010, 2011 and 2012 | |
| Project Purpose:<br>Revenue water is increased | NRW: Non Revenue water is improved from 40% to 30% | annual report of 2010, 2011 and 2012 | |
| Outputs:<br>1. Water intake volume becomes stable<br>2. Water distribution volume become stable | 1. Production volume increasing from 2,000 cubic meters per day to 2,500 cubic meters per day in 2012.<br>2. Technical loss is improved from 35% to 25% in 2012. | 1. Monthly performance monitoring report of September 2010 and annual report of 2010<br>2. annual report of 2010, 2011 and 2012 | Source as ground water is stable<br>There is not natural hazard including earthquake |
| Activities:<br>1-1. Project duration and frequency of power supply intervention<br>1-2. Project necessary capacity of new generator<br>1-3. Project sufficient specification of new generator<br>1-4. Estimate cost for purchase new generator<br>1-5. Estimate necessary running cost<br>1-6. Research availability of new generator<br>1-7. Confirm financial possibility to purchase new generator<br>1-8. Purchase new generator<br>1-9. Confirm improvement of intake volume<br><br>2-1. Project necessary pipeline replacement<br>2-2. Estimate necessary cost<br>2-3. Project new running cost<br>2-4. Confirm financial possibility to do this capital investment<br>2-5. Get approval of this capital investment<br>2-6. Bidding<br>2-7. Monitoring construction work<br>2-8. Confirm improvement of NRW | Inputs:<br>Chief engineer: 1 person<br>Chief operator: 1 person<br><br>New generator<br>PVC Pipe, fitting material and valves<br><br>0.5 million Yen for purchase of new generator and installation<br>2 million yen for replacement of old pipeline including civil works | | Assigned persons keep working for this project<br>The Board approves budget for purchase new generator and construction project<br><br>Pre condition: |

PDM is sometimes called as Logical Framework, because this simple summary table has own logic of inputs and outputs. Use inputs and conducts activities. Activities create outputs. Outputs contribute with realization of purpose and purpose contributes achievement of overall goal. With virtual columns of narrative description, there is inputs and outputs relation from bottom to top.

For judgment of realization about outputs and purpose, check the target mentioned as verification column. Or this column be a sort of target to achieve with this plan. Also this PDM mentioned data source for confirmation of achievement. Thus you can check the realization of plan with this summary sheet, as well as so easy to explain about plan. If necessary for explain more detail, you can also using PO: Plan of operation, but briefly, PDM is sufficient enough. It may no necessary to make PDM for simple project, but recommendable to make for complicated problem or huge resources consumption program. Although you may no need to make such PDM for small sort term solution you plan to implementing, however, it is recommendable to have concept of such summary to make clear what is purpose, what is input, what is output, and how to achieve the target. Normally core objective may be super goal or project purpose. If project is small and simple, you may no need to fulfill the column of super goal. Table 2-2 shows sample of PDM.

(6) PO

PO: Plan of Operation is a kind of action plan and determines more detail about activities for who is in charge of each activities, and what is output or result, duration, timing and other necessary information for conducting that activity, or monitoring that activity.

Making PO is very simple. Transfer activities on PDM and set schedule of conducting each activities, responsible person, expected outputs from that activity, budget, necessary management resources and others. You can modify the format for your purpose. This PO may very useful for your work. Table 2-3 shows sample of PO.

Table 2-3: sample of PO

| activities | Implementation schedule | | | | | | In charge | Outputs | Budget | Material | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| 1-1. Project duration and frequency of power supply intervention | | | | | | | Chief Operator | Engineering report | | | |
| 1-2. Project necessary capacity of new generator | | | | | | | Chief Engineer | Engineering report | | | |
| 1-3. Project sufficient specification of new generator | | | | | | | Chief Engineer | Engineering Proposal | | | |
| 1-4. Estimate cost for purchase new generator | | | | | | | Accountant | Vendor quotation | | | |
| 1-5. Estimate necessary running cost | | | | | | | Accountant | Financial analysis report | | | |
| 1-6. Research availability of new generator | | | | | | | Chief Engineer | Proposal with quotation | | | |
| 1-7. Confirm financial possibility to purchase new generator | | | | | | | Accountant | Financial notes | | | |
| 1-8. Purchase new generator | | | | | | | Manager | Purchase order | 0.5 million Yen | | Need to get approval from the board |
| 1-9. Confirm improvement of intake volume | | | | | | | Chief operator | Monthly report | | | |
| 2-1. Project necessary pipeline replacement | | | | | | | Network engineer | Engineering report | | | |
| 2-2. Estimate necessary cost | | | | | | | Accountant | Financial analysis report | | | |
| 2-3. Project new running cost | | | | | | | Accountant | Financial analysis report | | | |
| 2-4. Confirm financial possibility to do this capital investment | | | | | | | Accountant | Vendor quotation | | | |
| 2-5. Get approval of this capital investment | | | | | | | Manager | Proposal | | | Need to get approval from the board |
| 2-6. Bidding | | | | | | | Manager | Bidding document | | | |
| 2-7. Monitoring construction work | | | | | | | Chief engineer | Inspection report | 2 million Yen | | |
| 2-8. Confirm improvement of NRW | | | | | | | Chief operator | Monthly report | | | |

B) Monitoring and evaluation

Normally problem solving in business world requires sort of cycle management of:

- planning
- implementing
- monitoring and evaluating,
- feedback of lessons learned to improve more good planning and implementing

Therefore, time to time monitoring and evaluation may necessary.

Basically, you can monitor progress with PO. However, PO may not sufficient for evaluation. Evaluation is not only means check the accomplishment or realize of outputs as results of activities, but also need to review the meaning of outputs when the problem is solved or on improving. Evaluation of what may sometimes be subjects and also you may change by objective and situation, however, generally speaking, evaluation is done by efficiency, impacts, relevance, effectiveness and sustainability so called 5 evaluation items agreed among DAC in OECD.

Normally, JICA and many other international assisting agencies are conduct evaluation 3 times, pre, medium and post of project period. It may recommendable to do evaluation time to time, at least 3 times when implementation starts, middle of implementation period, and when accomplish the implementation. Pre evaluation means more cool your head and review your plan with different point of view for reconfirmation of effectiveness, sufficiency and sustainability of expected results. Medium term evaluation has more meaning of monitoring and if you find some serious problem on this evaluation, you should take corrective activity immediately. Post evaluation has meaning for get lessons learned and become wise for next time.

For monitoring and evaluation, firstly prepare PDM for evaluation and do evaluation base on this PDM called PDMe: PDM for evaluation.

(7) PDMe

PDMe is basically same with PDM but just adjust for evaluation. For pre evaluation before starts implementation of improvement plan, adjust PDM to PDMe, just change the format shows as Table 2-4, as sample.

Transfer description of super goal, project purpose, outputs and inputs from PDM to PDMe format. Difference is just replace activities with inputs, drop off the column of verification, mean of verification and assumption and replace with column of efficiency, impacts, relevance, effectiveness and sustainability.

(8) Monitoring and evaluation

Conduct evaluation on efficiency, impacts, relevance, effectiveness and sustainability of project. Take necessary action based on your evaluation, if necessary including correction/adjustment of existing plan, make report or memo for feedback, etc.

1) Efficiency

Review outputs were achieved efficiently or not. For judgment of efficiency, consider relation and sufficiency between inputs and outputs. Are inputs sufficient enough to achieve outputs? Is there any shortage? Or should you utilize other kind of inputs? For example, you want to increases intake water volume from 2,000 cubic meters per day to 2,500 cubic meters a day, but suppose capacity of new generator is not meet with increasing such amount. How could you evaluate new generator makes efficiently improving “1. Water intake volume becomes stable”? Or what do you think if achieving this output requires accountant but drop from original plan.

2) Impacts

Review impacts of your planning purpose to core problem of what you really want to do for improving. It may not completely wrong, and also what you can do is sometimes limited, however, you had better review how much your effort gives impacts to core problems. For serious problem, it may useful to insist your contribution and request others for their contribution. Evaluation of impacts may useful for such purpose. Judgment of impacts makes comparison of purpose and outputs as results of your effort you plan to achieved, almost achieved or already achieved.

For example, although increasing revenue water contributes to increase revenue, however, if it may contributing only few percentage and increasing water rate is more has impacts and more required for full cost recovery, how do you think the impact?

Table 2-4: Sample of PDMe

<table>
<tr><th>Narrative Description</th><th>Efficiency</th><th>Impacts</th><th>Relevance</th><th>Effectiveness</th><th>Sustainability</th></tr>
<tr><td>Super goal:<br>Revenue collection is improved</td><td></td><td rowspan="2">Increasing revenue water contributing increases of revenue, however, it is only improves 2% and may more necessary to increasing water rate. Present water rate is not meet to cover necessary operation and maintenance cost.</td><td></td><td></td><td rowspan="4">Sustainability depends on more for negotiation of stable power supply and stable fuel supply with reasonable cost.</td></tr>
<tr><td>Project Purpose:<br>Revenue water is increased</td><td></td><td rowspan="2">Have sufficient relevance for achieving improvement.</td><td rowspan="2">It has effectiveness but also required stable power supply and purchase of fuel that may more effective to maintain stability of intake volume.</td></tr>
<tr><td>Outputs:<br>1. Water intake volume becomes stable<br>2. Water distribution volume become stable</td><td rowspan="2">Capacity of new generator has problem and also fuel supply has problem.<br>Achieving outputs requires involvement of accountant but dropped from original plan.</td><td></td></tr>
<tr><td>Inputs<br>Chief engineer: 1 person<br>Chief operator: 1 person<br><br>New generator<br>PVC Pipe, fitting material and valves<br><br>0.5 million Yen for purchase of new generator and installation<br>2 million yen for replacement of old pipeline including civil works</td><td></td><td></td><td></td></tr>
</table>

3) Relevance

Review relevance of your approach in term of outputs can achieve the purpose. Relevance means sufficiency of your approach (outputs as result of activities) to achieving purpose. Are there any missing elements (output) for achieve purpose? Are there sufficient linkage between outputs and purpose? For judgment of relevance, compare purpose and outputs, and trace linkage to achieve purpose by outputs. If the linkage is weak, relevance is doubtful. Normally, evaluator considers relevance as fitness with higher policy or plan, program, such as national plan, sector plan, business strategy or other improvement plan. If plan follows or support to higher level strategy, plan or programs, or not make any conflict with other plans, evaluator evaluate this plan has sufficient relevance with other plan and polices.

4) Effectiveness

Effectiveness also judge compare with purpose and outputs, and trace how achievement of outputs contributes to project purpose. For example, new generator and pipeline construction may contributes but still if stable power supply and stable purchase of fuel may more effective to maintain stability of intake volume, how do you think effectiveness?

5) Sustainability

Judge of sustainability use all information on super goal, purpose, outputs and inputs. However, for evaluation on sustainability, you may sometimes need to consider other information not mentioned on PDMe. In that case, please look carefully problem structure and objective structure, and which area you select as target and find factors or threat for sustainability of results and achievement by the project.

6) Conclusion

Make conclusion based on evaluation of 5 factors. I introduce 5 factors of evaluation, however, important thing is not evaluate 5 factors, but understand concept of evaluate not only achievement but also outcomes. Project purpose and super goal are called **outcomes** for comparison with outputs. Concept of evaluation is focus to consider these outcomes. But outcomes may not be achieved by your project alone. Achievement of outcome also needs contribution by other projects. Evaluation required consideration of such situation and review your contribution.

**5. Bibliography**

There are so many bibliographies of PCM and ZOPP. Following books may recommendable regarding availability and easy for reading. Many Japanese experts may have experience to learn PCM by these textbooks and some of them may have for reference of his/her assignment. Also you may rather easy to purchase from FASID, publisher of these textbooks by mail order or through your counter Japanese experts.

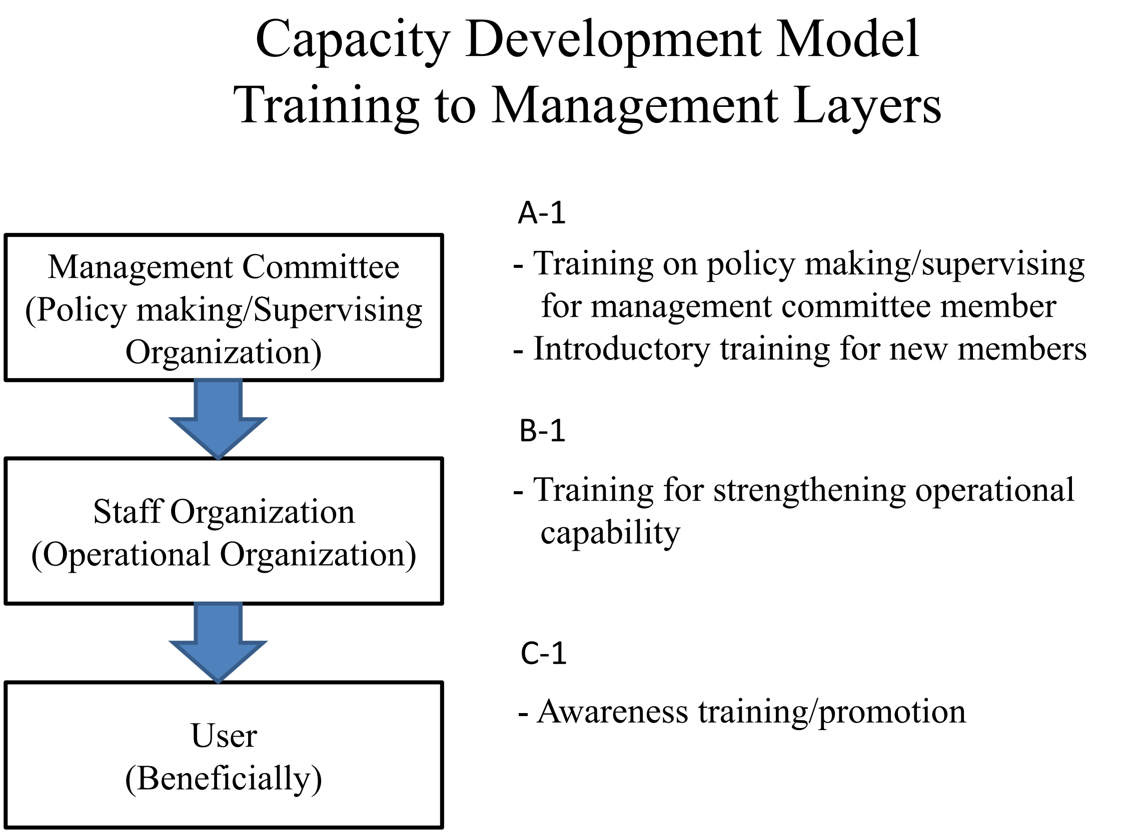
A) Planning
PCM: MANAGEMENT TOOL FOR DEVELOPMENT ASSITANCE：Participatory Planning
B) Monitoring and evaluation
PCM: MANAGEMENT TOOL FOR DEVELOPMENT ASSISTANCE：Monitoring & Evaluation (M&E)

Lastly, I hope you to master concept of this PCM methodology and use for your works efficiently, effectively and practically. That is my objective to write this short introduction about PCM. I repeated again but concept of PCM is very simple and not difficult at all. We Japanese call “Dandori”, for good coordination of problem solving or accomplishment of task. “Dandori” means setup, or process from research, preparation, planning and implementation. Good “Dandori” comes from understanding of problem structure and efficient/effective way to solve the problem by experiences. You could be good manager to do good “Dandori” after you master this problem technique. May PCM with you!

Prepared by T. Suetake
JICA Expert of Management and policy Administration
at Sunday, March Twenty-eighth, 2010
at Kakarbhitta, Nepal bitted by so many mosquito.

**Awareness Program**

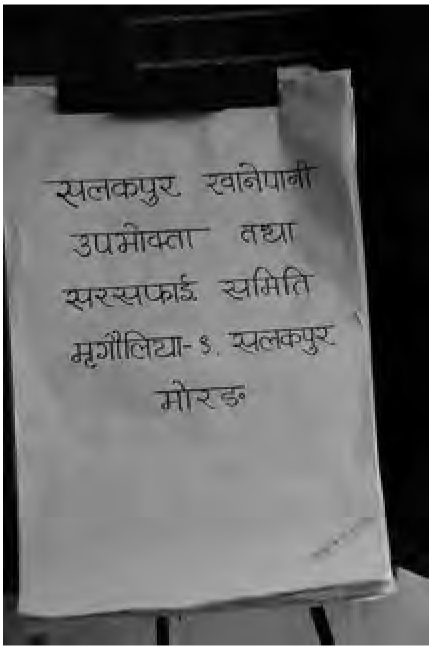
WUSC management model recommends to doing awareness program for get understand and support to activity of WUSC from users. Chart shows three categories of training may necessary, for management committee member to better policy making, capacity strengthening to staff for good business operation and awareness program to user for get their understanding and support to activity of WUSC (C-1).

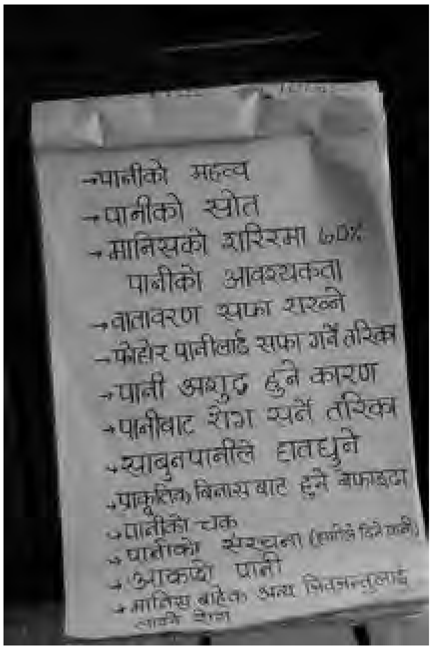



Normally this objective may achieved by marketing or communication. However, since roles of water supply aims to reduce/preventing water born disease and improving life standard of the people, it is very important to promote good hygiene practice and understanding roles of water supply, or importance to using safe water. Approach on the model recommends to preparing awareness program and develop sufficient material for such awareness promoting activity. Here is sample of material developed during awareness program workshop for Salakpur WUSC and Pathari WUSCs, both develop wall hang style story board for 1) school kids and 2) women's group, specially young mother who has infant. However, of course, WUSC can develop other purposes or objectives of awareness such as conservation of water use, protect water pollution, promote payment of water bill, etc.

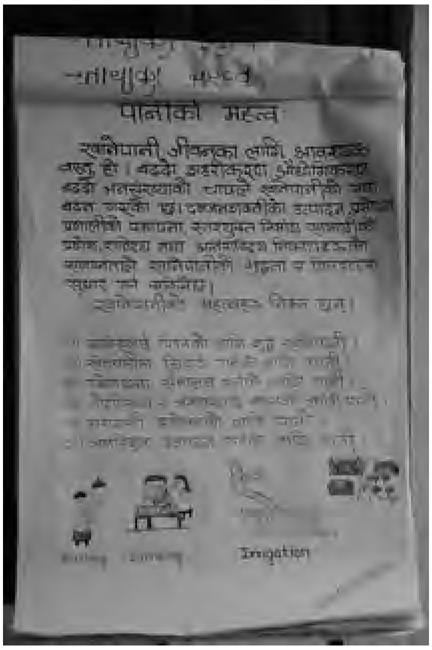
Salakpur WUSC Awareness Program for School Kids

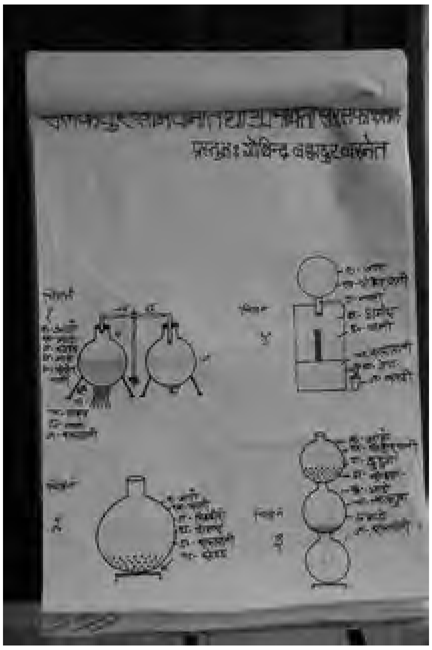
January 2013

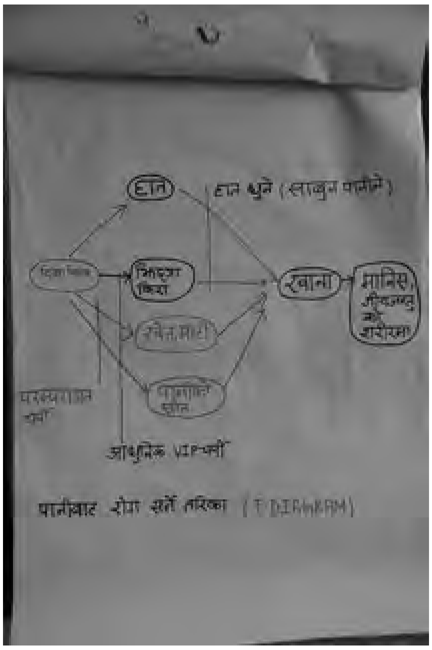


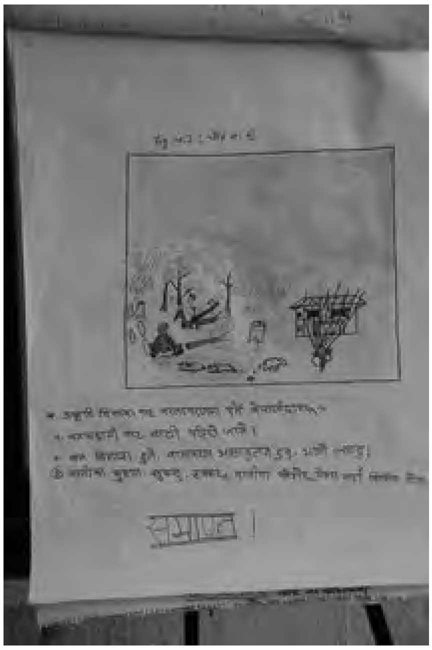



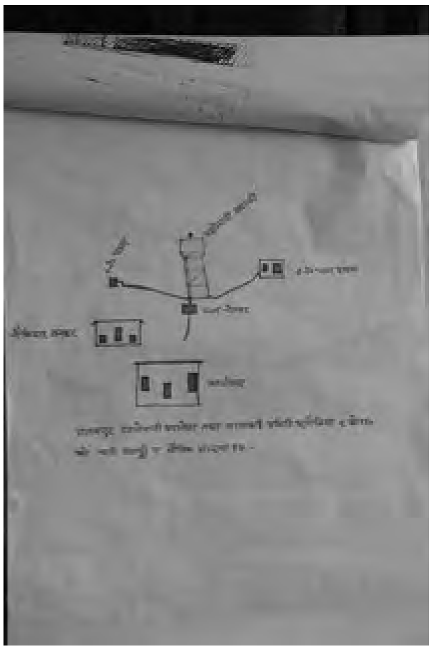

Tap
Rain
Tube wells
River
well
Lake

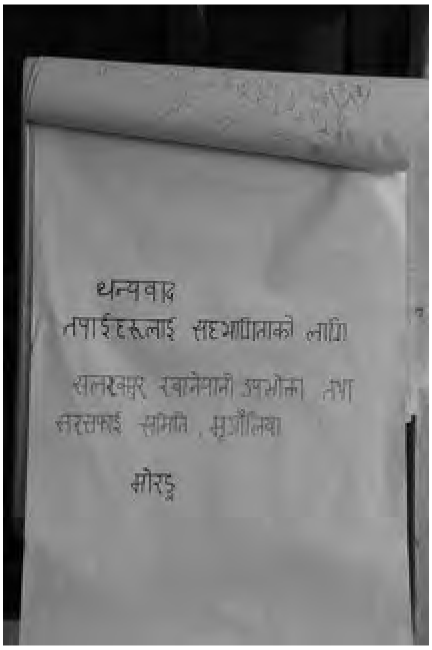

पानीको महत्व
Irrigation




खाना
मानिस


पानीको चक्र प्रणाली
बादल

समाप्त

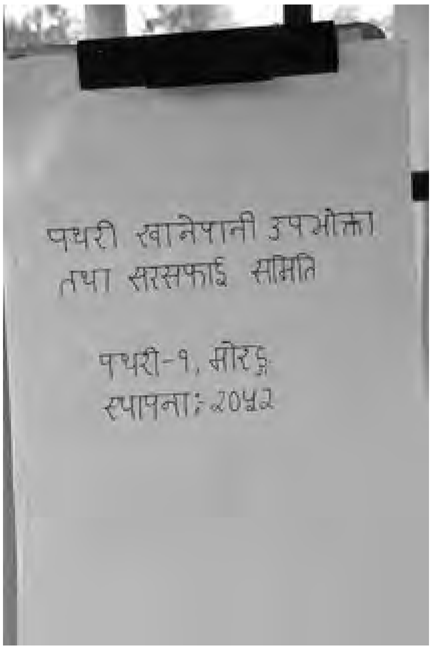


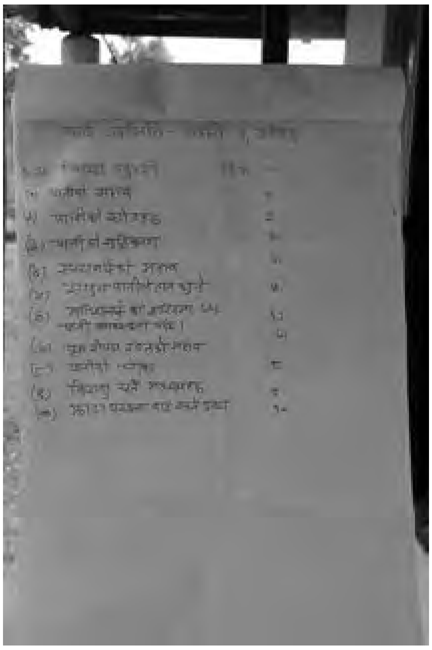


धन्यवाद
तपाईहरूलाई सहभागिताको लागि
सलरखुर खानेपानी उपभोक्ता तथा
सरसफाई समिति, सुर्औलिया
मोरङ

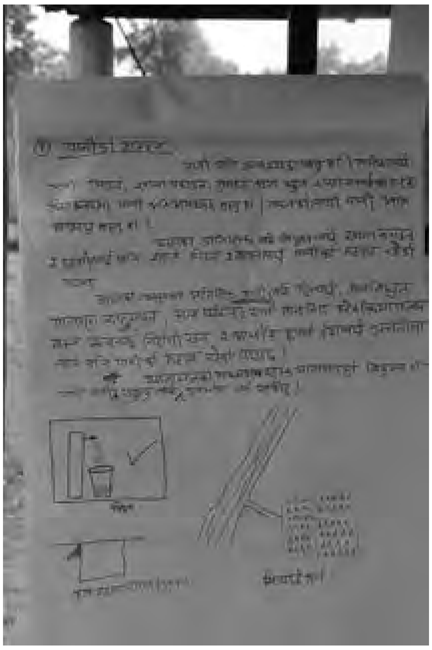
Thank you very much!

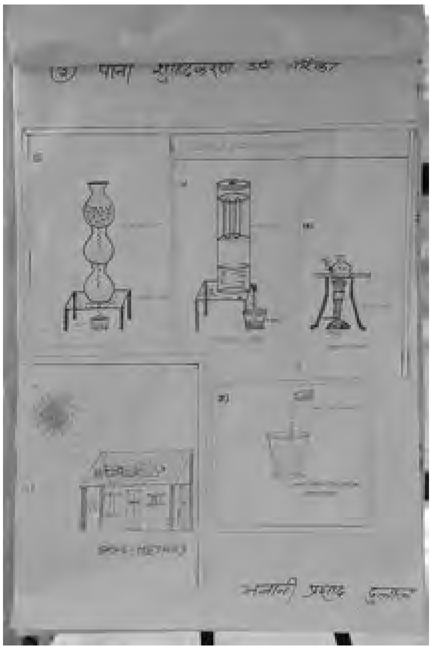
## Pathari WUSC Workshop of Awareness Program, February 2013

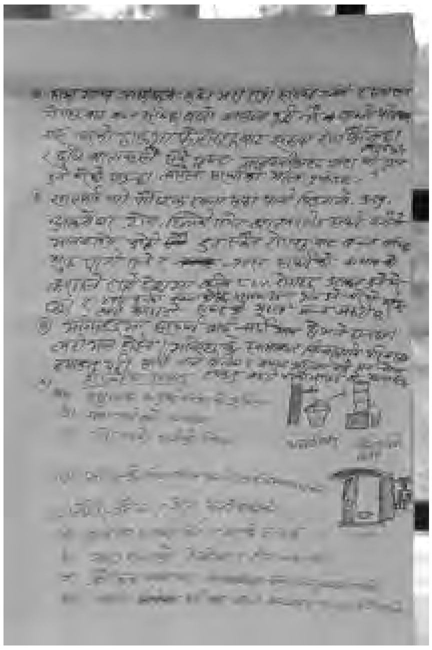


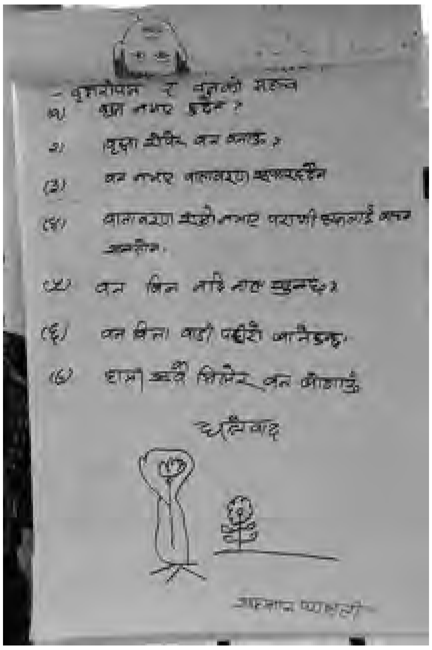
Story board for school kids





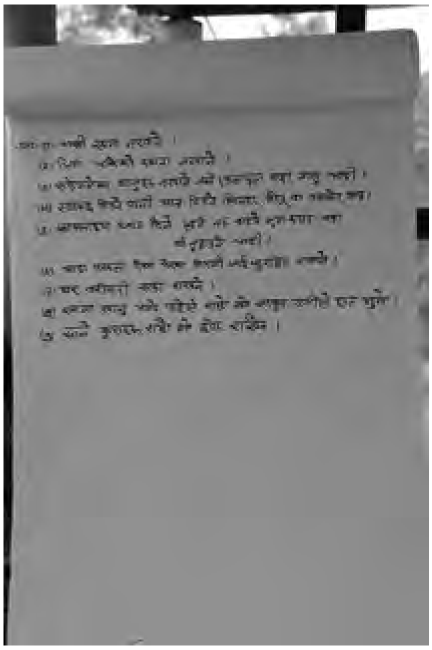


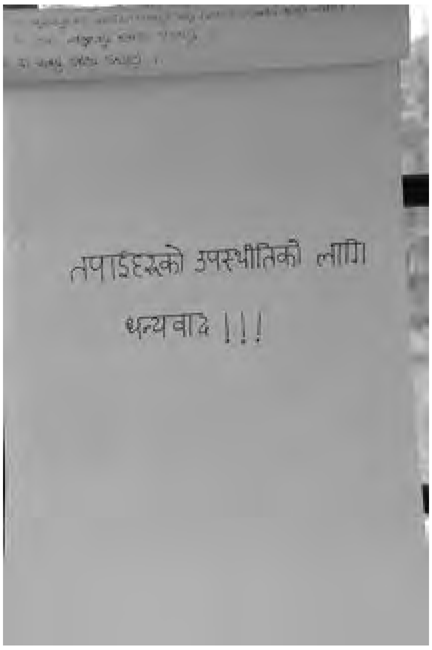

पानीले बनेको हुन्छ ।
मानिस


धन्यवाद


पानीको चक्र
GROUND WATER
Water Table


कीटाणु सर्ने माध्यम
हात धुने

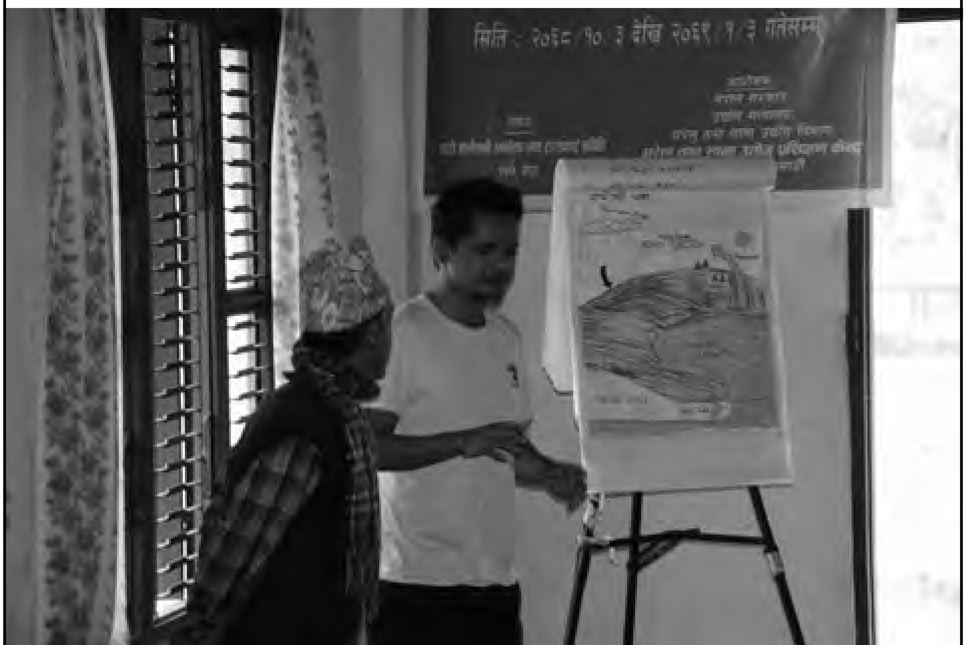



तपाईहरूको उपस्थीतिको लागि
धन्यवाद !!!


३ महिने प्लम्बीङ तालिम कार्यक्रम


मिति : २०६८/१०/३ देखि २०६९/१/३ गतेसम्म


मिति : २०६८/१०/३ देखि २०६९/१/३ गतेसम्म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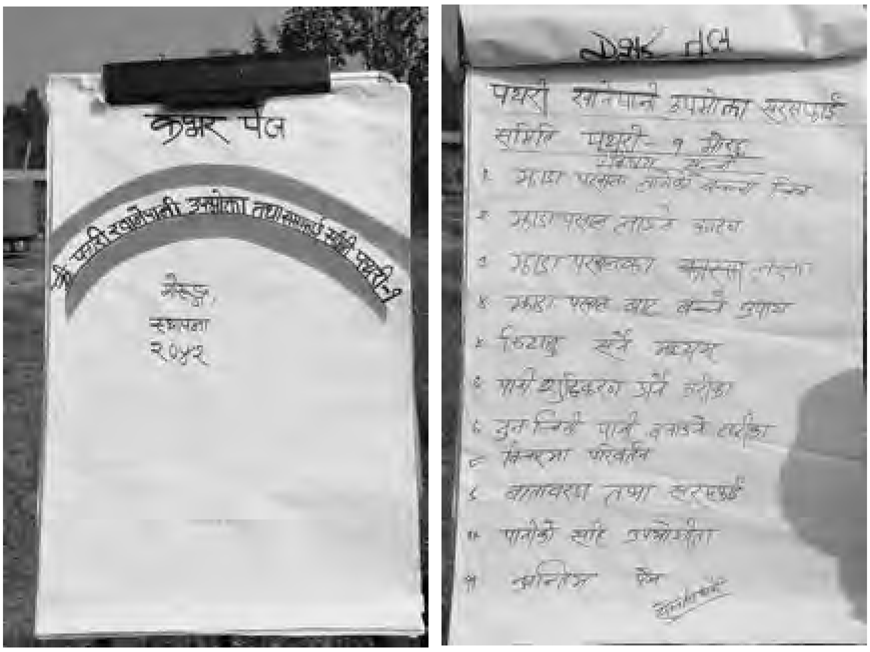
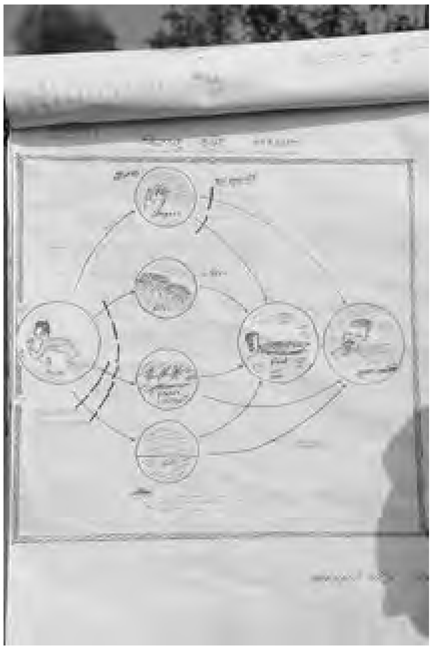
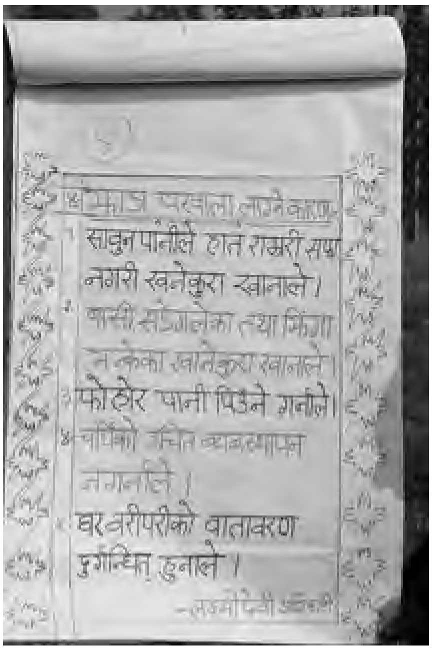
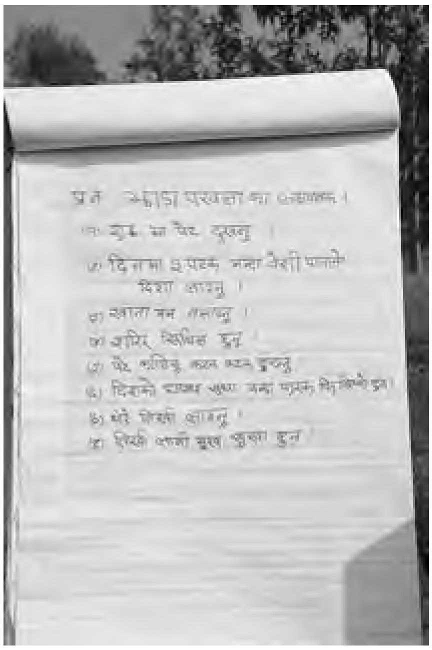
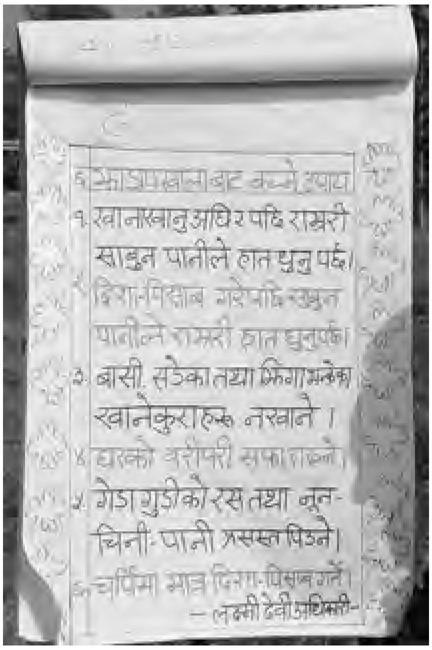
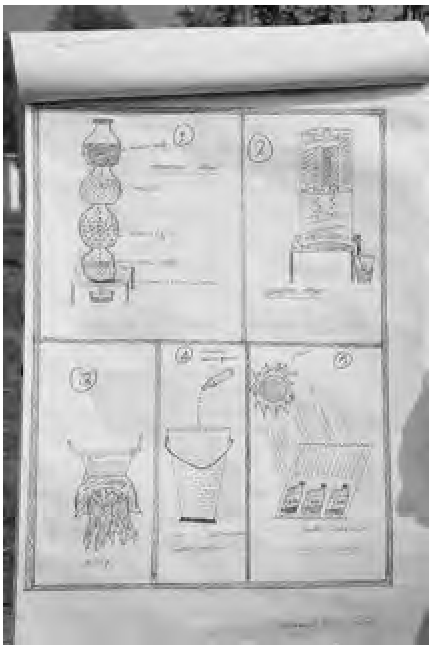
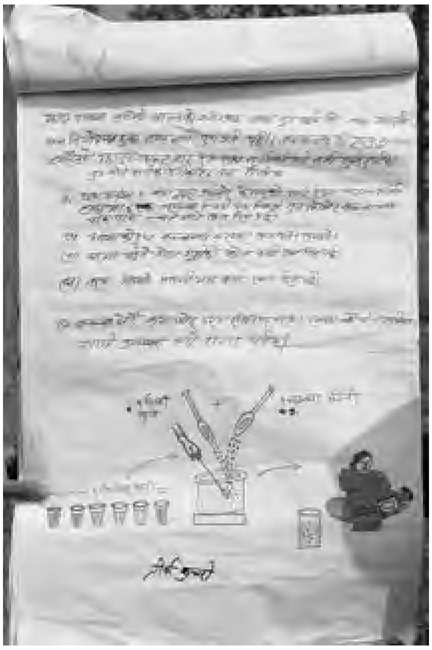


Story board for women's group



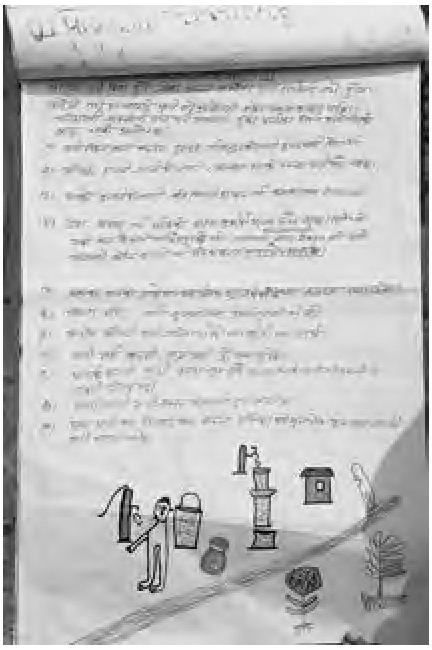

झाडा पखाला लाग्ने कारण
साबुन पानीले हात राम्ररी सफा
नगरी खनेकुरा खानाले।
फोहोर पानी पिउने गर्नाले।
घर वरीपरीको वातावरण
दुर्गन्धित हुनाले।

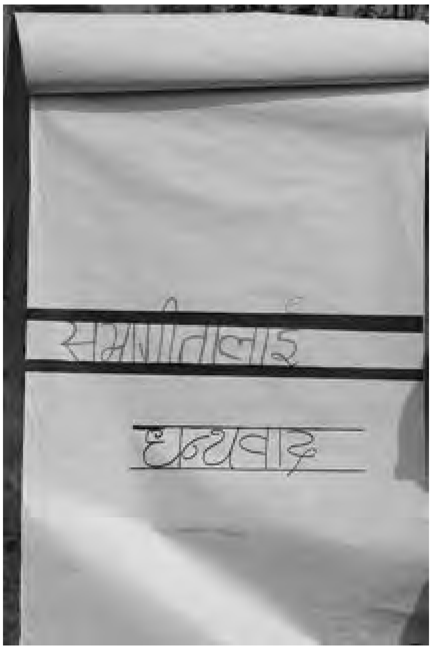



१. खानाखानु अघि र पछि राम्ररी
साबुन पानीले हात धुनु पर्छ।
३. बासी, सडेका तथा
खानेकुराहरू नखाने ।
५. गेडागुडीको रस तथा नून-
चिनी-पानी प्रशस्त पिउने।
चर्पीमा मात्र दिसा-पिसाब गर्ने।
– लक्ष्मी देवी अधिकारी-



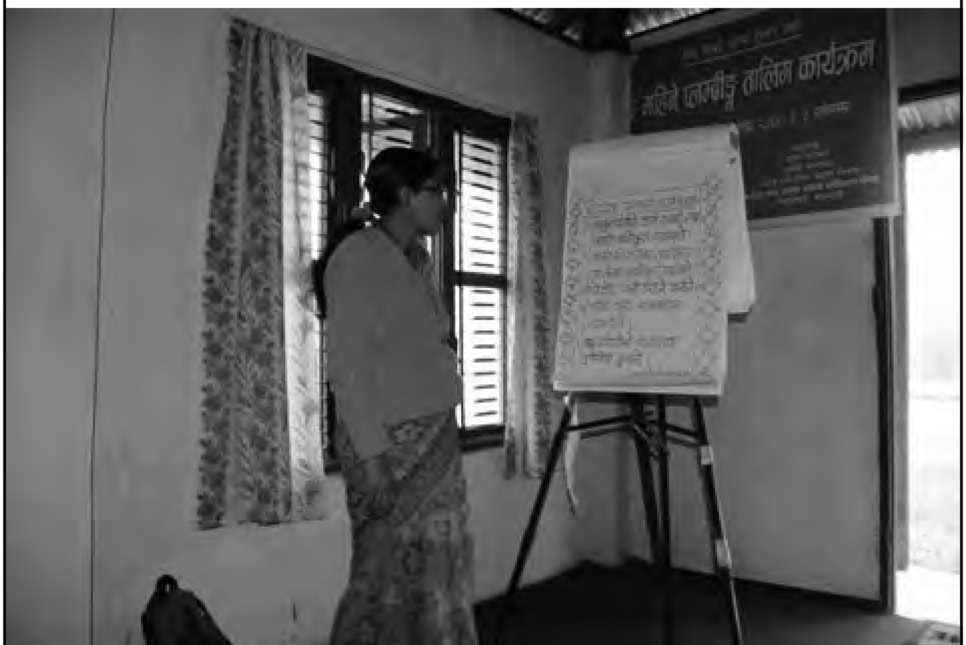


वातावरण सरसफाई




धन्यवाद


३ महिने प्लम्बीङ्ग तालिम कार्यक्रम


महिने प्लम्बीङ्ग तालिम कार्यक्रम

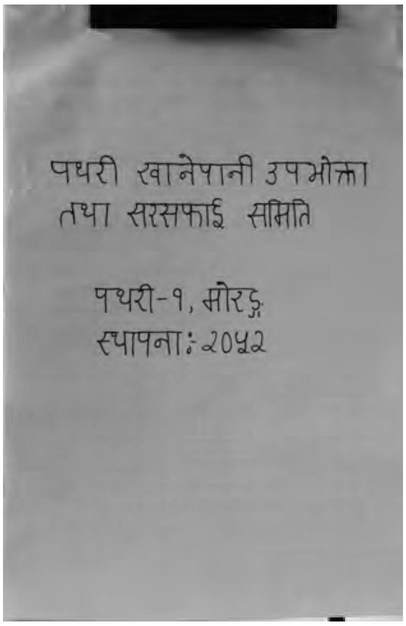

महिने प्लम्बिङ्ग तालिम कार्यक्रम


महिने प्लम्बिङ्ग तालिम कार्यक्रम


प्लम्बीङ्ग तालिम कार्यक्रम

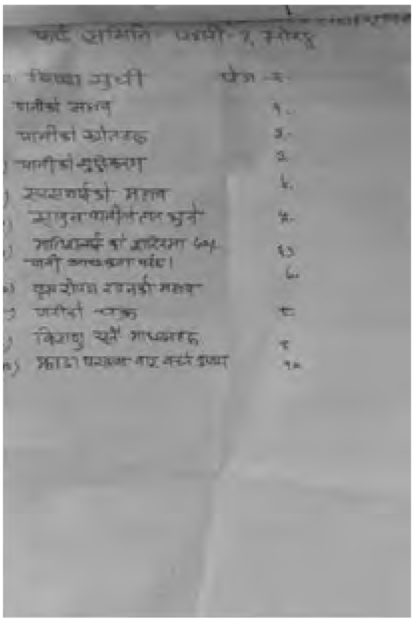
## Pathari Awareness Program Workshop

**February 2013**

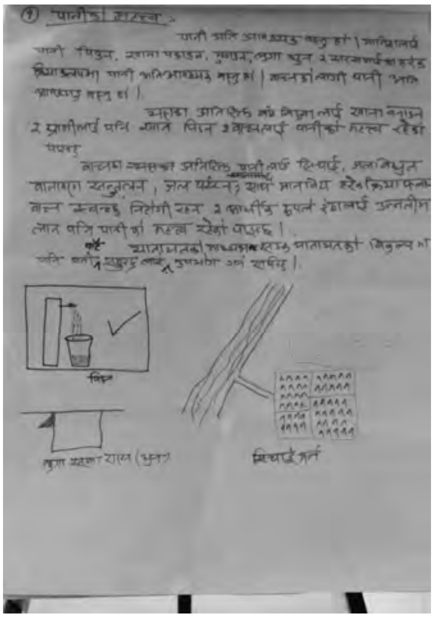


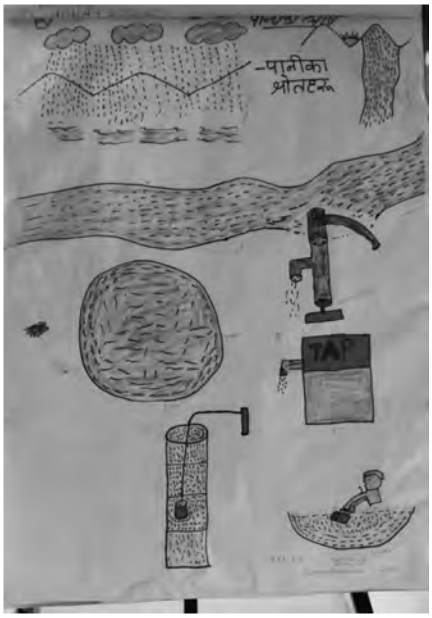
पथरी खानेपानी उपभोक्ता
तथा सरसफाई समिति

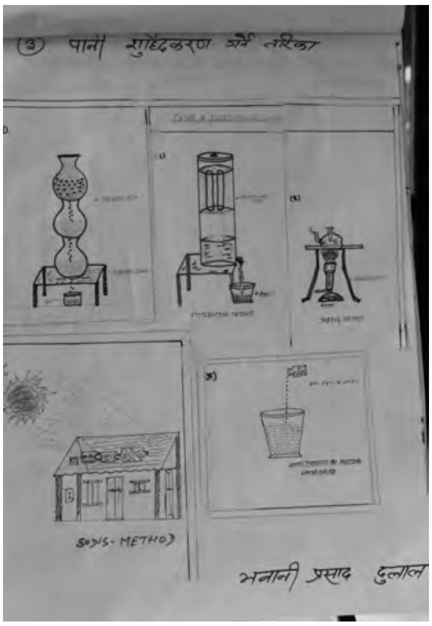
पथरी-१, मोरङ
स्थापना: २०५२

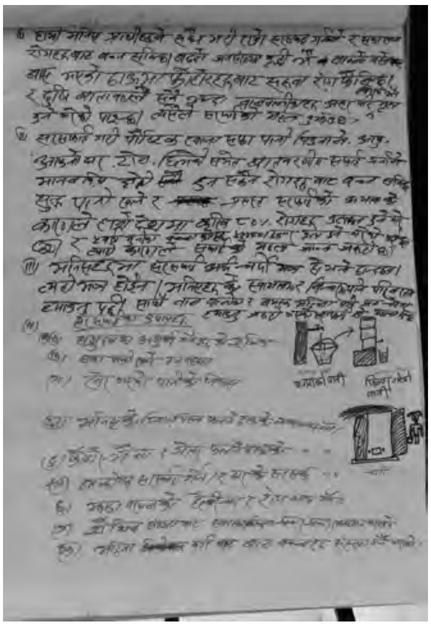


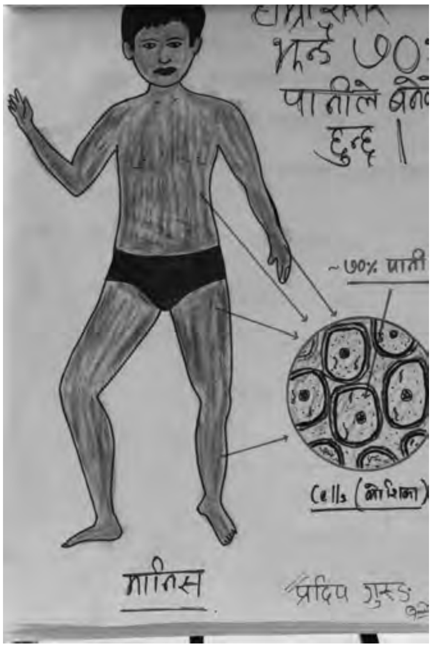
विषय सूची

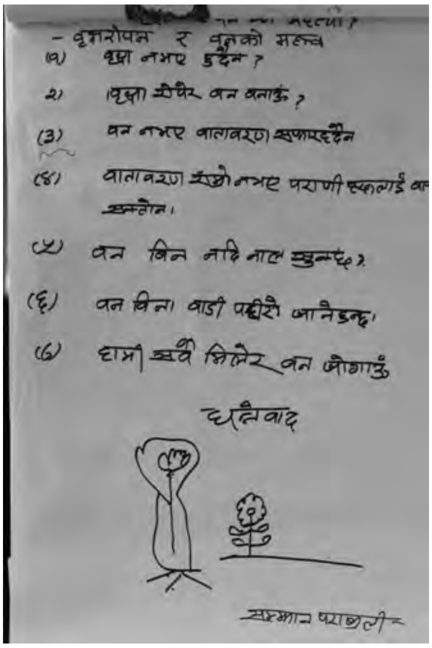



पानीका श्रोतहरू
TAP


पानी शुद्धिकरण गर्ने तरिका
भवानी प्रसाद दुलाल

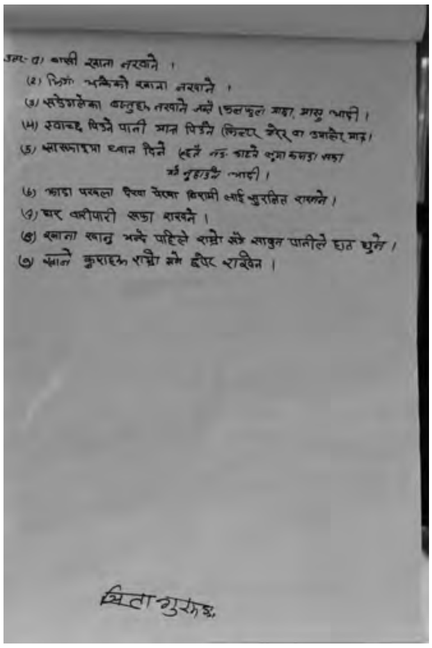



पानीले बने
हुन्छ ।
~70% पानी
Cells (कोषिका)
मानिस
प्रदिप गुरुङ


- वृक्षारोपण र वनको महत्व
(१) वृक्षा नभए हुँदैन ?
२) वृक्षा रोपेर वन बनाऊँ ?
(3) वन नभए वातावरण सफा हुँदैन
(५) वन बिना नदि नाला सुक्छन् ?
(६) वन बिना बाढी पहिरो जानेछन्।
(७) हामी सबै मिलेर वन जोगाऊँ
धन्यवाद


पानीको चक्र
Rain and Snow
Water Vapour
Lakes and Streams
GROUND WATER
Water Table


कीटाणु सर्ने माध्यम
हात धुने
VIP
( आधुनिक
चर्पी)
परम्परागत
चर्पी


(७) घर वरीपरी सफा राख्ने ।
(८) खाना खानु भन्दा पहिले राम्रो संग साबुन पानीले हात धुने ।


तपाईहरूको उपस्थीतिको लागी
धन्यवाद !!!

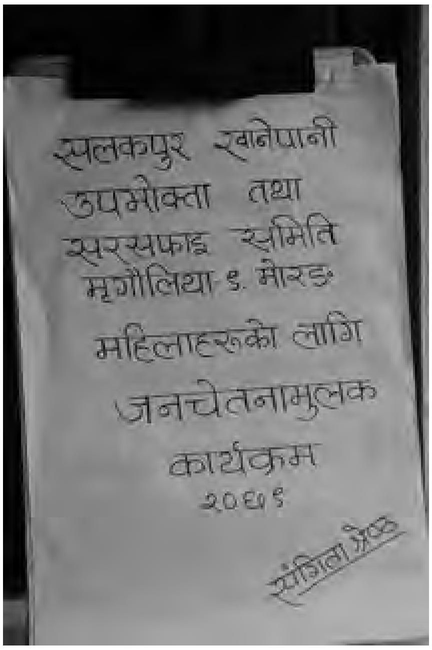

सहकार्य:

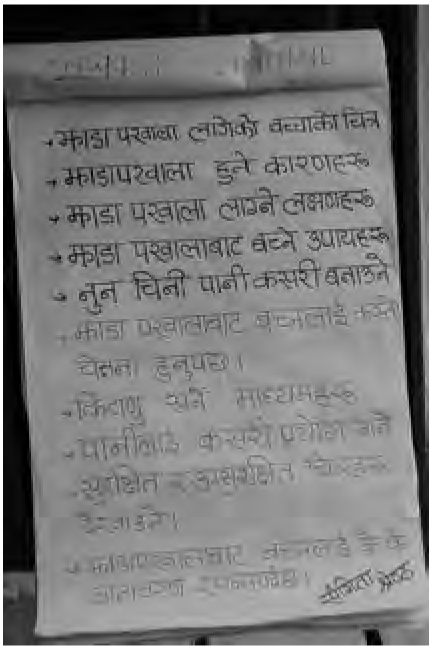

आयोजक:
नेपाल सरकार
उद्योग मन्त्रालय
पानीको चक्र
GROUND WATER

**Thank you**

**Salakpur WUSC Awareness Program for Women's Group**

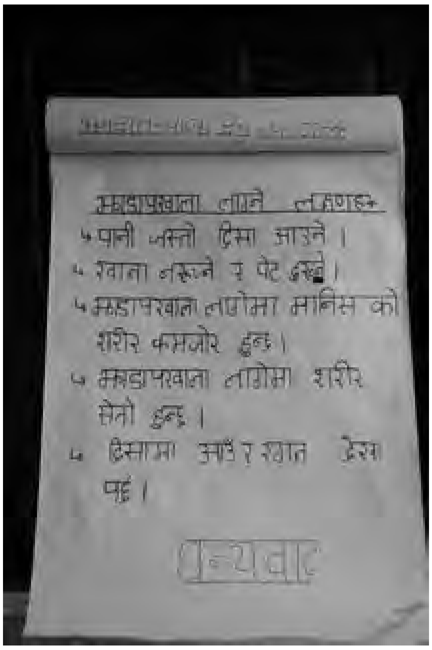
**January 2013**

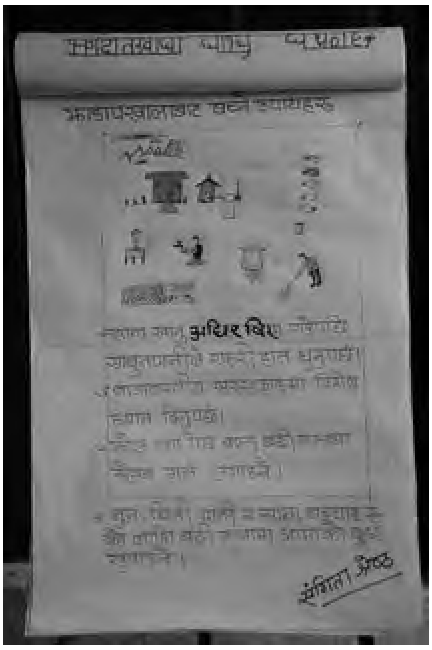


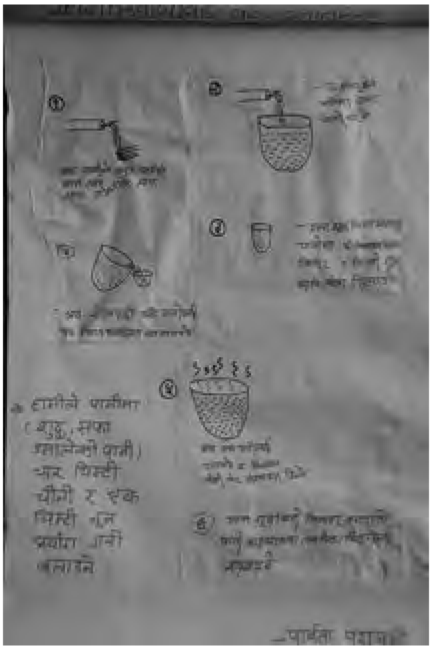



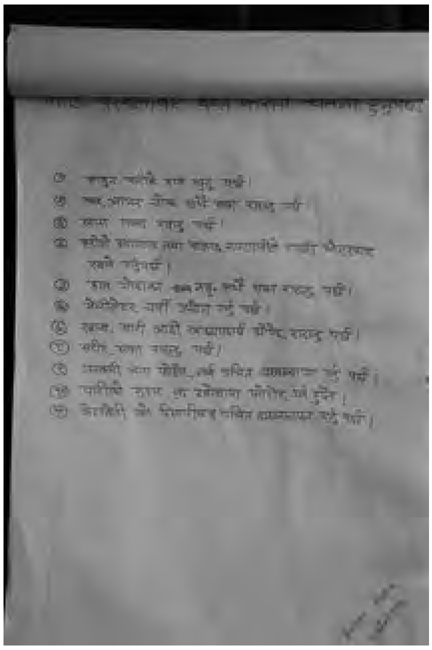

झाडापखाला लागेको बच्चा
बिरामी बच्चा

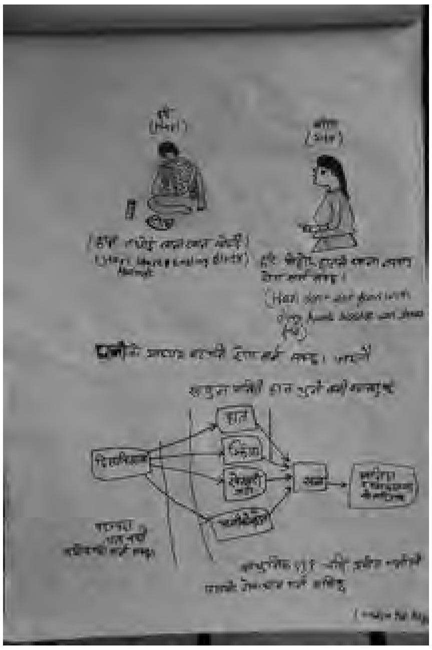

झाडापखाला हुने कारणहरु

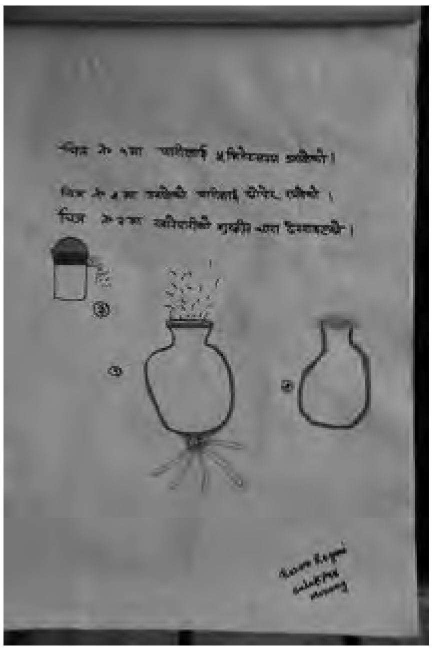

झाडापखाला लाग्ने लक्षणहरु
पानी जस्तो दिसा आउने ।
खाना नरूच्ने र पेट दुख्ने ।
झाडापखाला लागेमा मानिस को शरीर कमजोर हुन्छ ।
झाडापखाला लागेमा शरीर सेतो हुन्छ ।
दिसामा आउँ र रगत देखा पर्छ ।
धन्यवाद

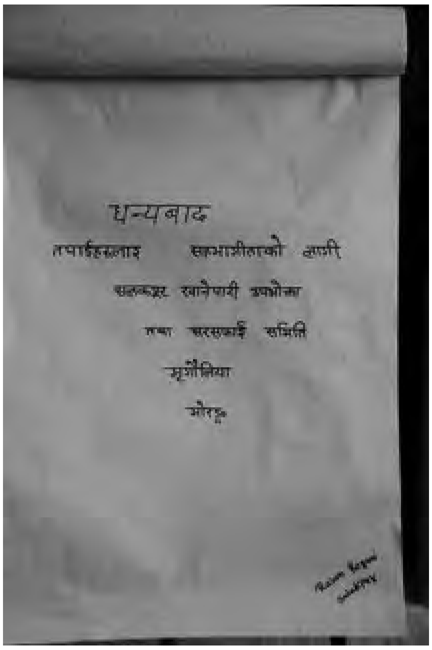

झाडापखालाबाट बच्ने उपायहरु










धन्यबाद
तपाईहरुलाई सहभागीताको लागि
खानेपानी उपभोक्ता
तथा सरसफाई समिति
मोरङ

Thank you very much!

# 7. Awareness Material

Reference materials for Public awareness are as follows;

-Introducing the WASMIP project (Nepali version)
-Good Practice/ Bad Practice (Nepali version)

# Public Awareness Leaflet

Objectives of this Leaflet

- To let residents know about WASMIP
- To ask residents' cooperation: (1) payment of water tariff and (2) saving water attitude

********************************Contents*****************************

(Front side of leaflet: black & white print)

## What is WASMIP?

WASMIP is a project for supporting local WUSCs in improvement of their management and technical skills. For this objective, WASMIP is setting up an operating model called "Water Supply Management Model" , and disseminate this Model to the WUSCs concerned. By introducing this Model in the WUSC's operation, each WUSC can provide quality water in better service.

Targeted WUSCs:

- Morang District; Mangadh, Tanksinuwari, Jhorahhat, Haraicha, Salakpur, Rangeli, Pathari, Urlabari, and Letang.
- Jhapa District: Dhulabari, Kakarbhitta, Budhabare, Sanischare, Birtamode, Chandragadhi, Surunga, Topgachhi, Gauradaha, Damak, and Lakhanpur

## What WASMIP is doing?

Major activities of WASMIP:

- Setting up business/management models
- Setting up systematic maintenance system for Water Supply Facilities, and Water Quality Management
- Trainings and workshops for technical capacity improvement of local technicians
- Dissemination of operating Models for water facilities

## What is your future benefit from WASMIP?

Local residents shall directly be befitted from the improvement of WUSC's abilities pursued by WASMIP

***Major benefits for local residents:***

- Quality of supplied water will be more improved and relibable
- Service of Water Supply will be more efficient… example:
    - Technical problems about water supply (pipe damage, etc.,) will be reduced.
    - When problems happen & claimed, that will be solved rapidly & smoothly

- Interruption and breakdown in the service will be minimized
- Water supply service will be more reliable

(back side of leaflet)

## For quality water, good operation of WUSC, Your Understandings and Cooperation Needed

***Please understand……Future, your water tariff may increase.***

[Why?] WUSC has the responsibility to maintain their facilities upgrade & update their facilities, and their management from the tariff collected from the consumers. If the water tariff being collected is low, it may not cover such maintenance costs as required. These days, population is increasing, and household connection is also increasing also. This means, work of WUSC is increasing and getting complicated and increase of tariff may also be necessary to cope with this situation.

*Do you know how your water payment is utilized for?....Your tariff is applying for..*

- Water quality control
- Maintenance/Repair/Upgrading of water supply facilities
- Smooth running of water supply facilities, such as using Generator
- Enhancement of effective business management such as grievance handling

***Let's save water.***

Your tap water is created though very complicated time-taking process, for example, removing turbidity, iron, etc,. Therefore, please use tap water carefully, and do not waste water leaving water running when not in use. In addition, be careful to **leaks** from tap and/or pipes. If you found any problem, please contact WUSC in your area as soon as possible.

## If you want to know about WASMIP…

- Morang District, Morang WSSDO, Biratnagar, Tel. 021-524821
- Jhapa District, Jhapa WSSDO, Chandragadi, Tel. 023-455976
- Project Office (Kathmandu), Department of Water Supply and Sewerage Works (DWSS), Paniphokari. Tel&Fax 01-4006624, URL http://www.dwss.gov.np/

(Endonote)

WASMIP is funded by Japan International Cooperation Agency

# उपभोक्तालाई गुणस्तरिय र सुरक्षित खानेपानी आपूर्तिको लागि

## वास्मिप भनेको के हो ?

**वास्मिप भनेको स्थानिय खानेपानी तथा सरसफाई उपभोक्ता समितिहरूलाई तिनीहरूको व्यवस्थापकिय र प्राविधिकिय सीपहरूको सुधारका लागि सहयोग गर्ने एउटा आयोजना हो। यस उद्देश्यको लागि, वास्मिपले "खानेपानी व्यवस्थापन मोडल" भन्ने संचालन मोडल बनाउँदै छ र सम्बन्धित खानेपानी समितिहरूमा यस मोडललाई फैलाउने छ। खानेपानी समितिको संचालनमा यस मोडेललाई लागु गराएर, हरेक खानेपानी समितिले अझ राम्रो सेवाका साथ गुणस्तरीय पानी वितरण गर्न सक्नेछ।**

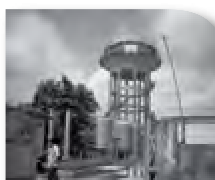
***लक्षित खानेपानी समितिहरू :***

| मोरङ्ग जिल्ला | झापा जिल्ला |
|---|---|
| मानगढ, टंकिसिन्वारी, झोराहट, हरैचा, सलकपूर, रंगेली, पथरी, उर्लाबारी र लेटाङ्ग। | धुलाबारी, काकरभित्ता, बुधबारे, शनिश्चरे, बिर्तामोड, चन्द्रगढी, सुरूङ्गा, टोपगाछि, गौरदह, दमक र लखनपूर। |

## वास्मिपले के गरिरहेको छ ?

***वास्मिपको मुख्य कार्यहरू :***

- व्यवसायिक/व्यवस्थापन मोडेलहरू बनाउने
- खानेपानी वितरण संरचनाहरू तथा पानी गुणस्तर व्यवस्थापनका लागि व्यवस्थित मर्मत संभार प्रणाली बनाउने
- स्थानिय प्राविधिकहरूको प्राविधिक क्षमता सुधारका लागि ट्रेनिङ्गहरू तथा गोष्ठीहरू आयोजना गर्ने
- खानेपानी आयोजनाका लागि संचालन मोडलहरू फैलाउने



## भविष्यमा वास्मिपद्धारा तपाईलाई के फाइदा हुन्छ ?

वास्मिपद्धारा खानेपानी तथा सरसफाई उपभोक्ता समितिहरूमा भएको सुधारबाट स्थानिय बासिन्दाहरूलाई सिधै फाइदा हुनेछ।

***स्थानिय बासिन्दाहरूका लागि मुख्य फाइदाहरू :***

- वितरण गरिएको पानीको गुणस्तरमा सुधार हुनका साथै भरपर्दो हुनेछ।
- खानेपानी वितरणको सेवा अझ धेरै प्रभावकारी हुनेछ जस्तै :
  - खानेपानी वितरण बारे प्राविधिक समस्याहरू (पाइप बिग्रने इत्यादि) घट्नेछ।
  - जब समस्याहरू आउँछ तथा उजुरी पर्छ, त्यसलाई तुरून्तै र सजिलैसँग समाधान गर्न सकिनेछ।
  - सेवामा रूकावट आउने घट्नेछ।
  - खानेपानी वितरण सेवा अझ बढी भरपर्दो हुनेछ।

WASMIP

## गुणस्तरिय खानेपानी, खानेपानी तथा सरसफाई उपभोक्ता समितिको राम्रो संचालनको लागि तपाईको बुझाई तथा तपाईको सहयोगको आवश्यकता

***कृपया बुझ्नु होला...... भविष्यमा, तपाईको पानी महशुलमा बृद्धि हुन सक्छ ।***

[किन ?] खानेपानी तथा सरसफाई उपभोक्ता समितिहरूमा उपभोक्ताहरूबाट संकलित महशुलबाट संरचनाहरूको संभार, सुदृढीकरण र समय सुहाउँदो सुधार गर्ने तथा तिनीहरूको व्यवस्थापनको जिम्मेवारी रहेको हुन्छ । यदि संकलन गरिएको महशुल कम भएमा, आवश्यक मर्मत संभार खर्चहरू समेत्न सकिदैन । आजकल जनसंख्या बृद्धि सँगै घरधुरी धारा जडान पनि बढिरहेको छ । यसको मतलब, खानेपानी तथा सरसफाई उपभोक्ता समितिहरूको कार्य बढ्नुका साथै जटिल भैरहेको छ त्यसकारण यस्तो अवस्थाको सामना गर्नको लागि महशुल बृद्धि गर्न आवश्यक पर्न पनि सक्छ ।

***के तपाईलाई थाहा छ तपाईको पानीको भुक्तानी केका लागि प्रयोग गरिन्छ ?... तपाईको महशुल निम्न कुरामा लगाइन्छ...***

- खानेपानी गुणस्तर नियन्त्रण
- खानेपानी वितरण संरचनाहरूको संभार/मर्मत/सुधार
- खानेपानी वितरण प्रणालीहरूको सुचारू संचालन गर्न जस्तै जेनेरेटर प्रयोग गरेर
- प्रभावकारी व्यवसाय व्यवस्थापनको सुधार जस्तै समस्याका कारकहरूको समाधान

## खानेपानीको सदुपयोग गरौं ।

तपाईको धाराको खानेपानी धेरै जटिल एंव लामो प्रक्रिया जस्तै धमिलोपना, आइरन हटाएर वितरण गरिएको हुन्छ । त्यसैले, कृपया धाराको पानीको सदुपयोग गर्नहोला र जब पानी प्रयोगमा हुदैन, धारा खुल्लै छोडेर पानी खेर जान नदिनु होला । त्यसैगरी धारा र/वा पाइपहरूबाट हुन सक्ने पानीको चुहावट मा ध्यान दिनुहोला । यदि तपाईले केही समस्या देख्नु भएमा, कृपया आफ्नो क्षेत्रमा रहेको खानेपानी तथा सरसफाई उपभोक्ता समितिलाई जति सक्दो चाँदो सम्पर्क गर्नहोला ।

## यदि तपाईलाई वास्मिपको बारेमा थाहा पाउन चाहनु हुन्छ भने....


**मोरङ्ग जिल्ला, मोरङ्ग खानेपानी तथा सरसफाई डिभिजन कार्यालय, बिराटनगर, सम्पर्क नम्बर ०२१-५२४८२१**

**झापा जिल्ला, झापा खानेपानी तथा सरसफाई डिभिजन कार्यालय, चन्द्रगढी, सम्पर्क नम्बर ०२३-४५५९७६**

**प्रोजेक्ट कार्यालय (काठमाडौं), खानेपानी तथा ढल निकास विभाग, पानीपोखरी**

**सम्पर्क नम्बर र फ्याक्स ०१-४००६६२४, URL http://www.dwss.gov.np/**


***वास्मिप जापान अन्तर्राष्ट्रिय सहयोग नियोग (JICA) द्वारा प्रायोजित परियोजना हो ।***

Leaflet (version 2)

The residents' cooperation is an essential key for WUSC to provide safe water for the community. This leaflet explains Good and Bad practices when using the supplied water.

Good Practice

1. Saving water: Please do not let the water run. Please close water taps and save water.
2. Reporting a water leakage: If you find a water leakage outside of your property, please contact WUSC in your area as soon as possible. If the water leakage continues for a long time, the amount of water for distribution will decrease.
3. Feeling safe about Chlorine in your water: Chlorine has bacteria-killing action. Please do not worry if you smell chlorine in your water. Remaining chlorine amount at the user's tap should be more than 0.2 mg per liter. Lack of residual chlorine level causes water-borne diseases such as dysentery, typhoid, cholera, etc.
4. Reporting turbid water: If your drinking water is turbid or looks rust-colored water, please report it to WUSC. The reason might be because of the potential for stagnation and deterioration of water quality at dead ends in water distribution networks.

Bad Practice

5. Damaging water meters: Water meters calculate the volume of your water consumption. Please do not touch your water meter if not necessary, and please do not bang anything against it.
6. Not paying your water bills: Please do not steal water. By paying your water tariff you help WUSC to collect enough fund for providing cleaner water and serving more people. Let's use water in appropriate way and be responsible for our water use.

WASMIP प्रस्तुत गर्दछ

# असल/खराब बानी

## खानेपानी प्रयोग गर्दा

**खानेपानी उपभोक्ता तथा सरसफाइ समितिलाई समुदायमा सुरक्षित खानेपानी उपलब्ध गराउन उपभोक्ताहरूको सहयोग अत्यावश्यक हुन्छ । यो पर्चामा खानेपानी प्रयोग गर्दाको असल र खराब बानी बारे उल्लेख गरिएको छ ।**

## असल बानी

१. **पानीको बचावट गर्ने :** नचाहिने बेलामा धारा खुल्लै छोडेर पानी खेर जान नदिने । धारा बन्द राख्ने र पानी खेर जानबाट बचाउने ।

२. **पानीमा क्लोरिन भएमा सुरक्षित महशुस गर्ने :** क्लोरिनमा ब्याक्टेरिया मार्न सक्ने क्षमता हुन्छ ।खानेपानीमा क्लोरिनको गन्ध आयो भने चिन्ता नलिने । आफ्नो धारामा आउने पानीमा क्लोरिन अवशेषको मात्रा ०.२ मिलिग्राम प्रतिलिटर भन्दा बढि हुनुपर्दछ । पानीमा क्लोरिन अवशेषको मात्रा कम भएको खण्डमा आउँ, टाइफाइड, हैजा जस्ता पानीजन्य रोग लाग्न सक्छ ।

३. **पानी चुहावट भएको खबर गर्ने :** आफ्नो घर कम्पाउण्ड बाहिर पानी चुहावट भइरहेको देख्नु भएमा यथाशक्य छिटो खानेपानी उपभोक्ता तथा सरसफाइ समितिलाई खबर गर्ने । लामो समयसम्म पानी चुहीएर खेर गइरह्यो भने समितिले वितरण गर्ने पानीको परिमाण घट्छ ।

४. **पानी धमिलो आएमा खबर गर्ने :** खानेपानी धमिलो अथवा खिया लागेको रङ्गको देखिएमा खानेपानी उपभोक्ता तथा सरसफाइ समितिलाई खबर गर्ने । खानेपानी वितरण पाइपलाइनहरूको अन्तिम भागमा पानी नबगेर जम्मा भइराख्दा पानीको गुणस्तरमा ह्रास आएर यस्तो रङ्ग देखिएको हुन सक्छ ।

*खानेपानीको प्रयोग गर्नुहुँदा पानी खेर नजाओस् भनि ध्यान पुर्‍याउनुहोस् ।*

*खानेपानी सम्बन्धि केहि समस्या भएमा उपभोक्ता समितिमा गएर भन्नुहोस् ।*

*प्राविधिक आएर तपाईको समस्या जाँच गरी समाधान गरिदिनेछ ।*

# खराब बानी

**१. खानेपानीको मिटर बिगार्ने :** मिटरले तँपाईले उपभोग गर्नुभएको पानीको परिमाण देखाउँछ । आवश्यक नपर्दा पनि खानेपानीको मिटर चलाउनु राम्रो बानी होइन । त्यसैले, अनावश्यक रूपमा खानेपानीको मिटर नचलाउने र कुनै पनि कुरा मिटरमा नठोक्ने ।

*खानेपानीको मिटर*

**२. खानेपानीको महशुल नतिर्ने :** खानेपानी चोर्ने बानी राम्रो होइन । तँपाईले तिरेको खानेपानीको महशुलबाट खानेपानी उपभोक्ता तथा सरसफाइ समितिलाई शुद्ध र सुरक्षित खानेपानी वितरणको लागि चाहिने कोष जुटाउन र धेरै जनतालाई सेवा प्रदान गर्न मद्दत पुग्दछ । त्यसैले खानेपानी उचित तरिकाले र जिम्मेवार भै प्रयोग गर्ने ।


*खानेपानी उपभोक्ता समितिमा जाऔं र पानीको महशुल तिरौं ।*

*थप जानकारीका लागि*

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