Nepal
Ministry of Water Supply
Department of Water Supply and Sewerage Management

THE CAPACITY DEVELOPMENT PROJECT FOR THE IMPROVEMENT OF WATER SUPPLY MANAGEMENT IN SEMI-URBAN AREAS PHASE 2 (WASMIP-II) IN NEPAL

FINAL REPORT
APPENDICES

MARCH 2022

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CO., LTD.
YOKOHAMA WATER CO., LTD.

GE
JR
22-054

<<<APPENDICES>>>

<Chapeter 1>

Appendix 1.1 : PDM
Appendix 1.2 : PO (as of February 28, 2022)

<Chapter 2>

Appendix 2.1 : Kick Off Meetings on Work Plan
Appendix 2.2 : Training Courses Provided NWSSTC in the Past
Appendix 2.3 : Training Needs Assessment to NWSSTC
Appendix 2.4 : NWSSTC Training Activities
Appendix 2.5 : NWSSTC Initial Trainers List
Appendix 2.6 : Equipment List of the NWSSTC Laboratory
Appendix 2.7 : Nepalganji Regional Laboratory
Appendix 2.8 : Data and Information obtained from Baseline Survey of Target A WUSC
Appendix 2.9 : Target A WUSC Site Photos
Appendix 2.10 : Baseline Survey on Local Government, MoPID, WSSDO and FWSSMP
Appendix 2.11 : WaSH Bill (draft)
Appendix 2.12 : DWSSM Job Description (draft)
Appendix 2.13 : FWSSMP Projects and Engineers Number (as of 2019)
Appendix 2.14 : Location Maps on Affiliated Organizations
Appendix 2.15 : SOP Final Version
Appendix 2.16 : SOP Final Version Appendix
Appendix 2.17 : SOP Final Version Record Form
Appendix 2.18 : Simplified SOPs
Appendix 2.19 : Target WUSCs Schematic Flow Diagram
Appendix 2.20 : Cost Breakdown for Target A WUSC
Appendix 2.21 : Design Manual of Rehabilitation Works for WUSC in Semi-Urban Towns
Appendix 2.22 : Flow Diagram indicating the Location of Rehabilitation Works for Target A WUSC
Appendix 2.23 : BOQ of Target A WUSC
Appendix 2.24 : BOQ of Target B WUSC
Appendix 2.25 : Procured Equipment and Installed Status
Appendix 2.26 : Training Materials for ToT of On-site
Appendix 2.27 : Trainer List
Appendix 2.28 : ToT and Basic Training Materials
Appendix 2.29 : 3rd Basic Training Report on December 12, 2020
Appendix 2.30 : 4th Basic Training Report on March 1, 2021
Appendix 2.31 : 5th Basic Training Report on April 11, 2021
Appendix 2.32 : 6th Basic Training Report on January 9, 2022
Appendix 2.33 : On-site Training Reports

Appendix 2.34 : WUSC Rader Charts on Management Check
Appendix 2.35 :Management Check Results
Appendix 2.36 : Training Implementation Guideline
Appendix 2.37 : 1st Training in Japan Training Materials in 2017
Appendix 2.38 : 2nd Training in Japan Training Materials in 2019
Appendix 2.39 : 3rd Training in Japan (Online Training) Training Materials in 2021
Appendix 2.40 : Minutes of Meeting on Amendment of R/D
Appendix 2.41 : 1st JCC Presentation Material in February 2018
Appendix 2.42 : Minutes of Meetings in the 2nd JCC
Appendix 2.43 : 2nd JCC Presentation Material by DWSSM in August 2019
Appendix 2.44 : 2nd JCC Presentation Material by WASMIP Team in August 2019
Appendix 2.45 : 3rd JCC Minutes of Meeting of Terminal Evaluation in October 2021
Appendix 2.46 : 4th Minutes of Meeting in February 2022
Appendix 2.47 : WASMIP-II Deliverables Dissemination Workshop Presentation Material by WASMIP Team in February 2022
Appendix 2.48 : WASMIP-II Deliverables Dissemination Workshop Presentation Material by DWSSM in February 2022
Appendix 2.49 : 1st JPCM Presentation Material in September 2016
Appendix 2.50 : 2nd JPCM Presentation Material in December 2016
Appendix 2.51 : 3rd JPCM Presentation Material by DWSSM in April 2017
Appendix 2.52 : 3rd JPCM Presentation Material by WASMIP Team in April 2017
Appendix 2.53 : 4th JPCM Presentation Material by DWSSM in September 2018
Appendix 2.54 : 4th JPCM Presentation Material by WASMIP Team in September 2018
Appendix 2.55 : 5th JPCM Presentation Material by WASMIP Team in June 2019
Appendix 2.56 : Memorandums of Discussion
Appendix 2.56.1 : Memorandums of Discussion With DWSSM
Appendix 2.56.2 : Memorandums of Discussion With WUSCs
Appendix 2.56.3 : Memorandums of Discussion With NWSSTC
Appendix 2.56.4 : Memorandums of Discussion With Others
Appendix 2.56.5 : Memorandums of Discussion With WSSDO

Appendix 1.1

PDM

Project Design Matrix

Project Title: Capacity Development Project for the Improvement of Water Supply Management in Semi-Urban Areas (WASMIP-II)
Implementing Agencies: Department of Water Supply and Sewerage Management (DWSSM) and National Water Supply and Sanitation Training Centre (NWSSTC)
Target Group: DWSSM, NWSSTC, FWSSMP and Target Water Users and Sanitation Committee (WUSC) (*1)
Period of Project: Five years from initial assignment of JICA expert(s) in Nepal
Project Site: Nagarkot (Location of NWSSTC), Kathmandu, Location of Target WUSC (*2)

Version 4.0
Dated 18 June 2020

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal Continuous support to WUSCs in semi-urban towns is provided by DWSSM and NWSSTC.	1. The trainings are continuously implemented by NWSSTC on the Management Model for WUSCs in semi-urban towns. 2. The contents of the Management Model are utilized for the management of water supply of WUSCs in semi-urban towns.	1. NWSSTC Annual Report, Interview with related persons 2. DWSSM Annual Report, Interview with related persons			
Project Purpose Support to the WUSCs in semi-urban towns is provided and strengthened by DWSSM and NWSSTC using government and non-government organizations' personnel.(*3)	1. The revision process and sections of DWSSM responsible for the Management Model and Technical Support Mechanism for WUSCs in semi-urban towns are identified. 2. The sections of DWSSM responsible for the training on the Management Model for WUSCs in semi-urban towns and revision process of training implementation guideline are identified. 3. More than 15 trainers, who are able to carry out the training on the Management Model for WUSCs in semi-urban towns, are developed. From this trainer batch, at least six must be employees of FWSSMP. 4. Capacity assessment results of trainers on the Management Model for target WUSCs in semi-urban towns are improved compared to the baseline. 5. The final version of the Management Model, training implementation guideline, training plan, and training curriculums for WUSCs in semi-urban towns are officially approved/authorized by DWSSM.	1. Management Model and Training Implementation Guideline, Interview with related persons 2. Training Implementation Guideline, Interview with related persons 3. List of Trainers 4. Result of Capacity Assessment (by Self-evaluation) 5. Approval documentation by DWSSM	1. Budget for NWSSTC is ensured as previous year 2. There is no major changes for involving of the jurisdiction to WUSCs in semi-urban towns by DWSSM and NWSSTC		
Outputs (1) Baseline survey and capacity assessment of DWSSM, NWSSTC, FWSSMP and the target WUSCs are conducted, and project implementation plan is finalized.	1.1 Results of the baseline survey and capacity assessment in DWSSM, NWSSTC, FWSSMP and target WUSCs are shared with counterpart. 1.2 Project Design Matrix (PDM) and Plan of Operation (PO) are finalized.	1. Minutes of Meetings 2. PDM and PO			
(2) Supporting capacity of DWSSM regarding O&M and management for WUSCs in semi-urban towns is strengthened.	2.1 The Management Model / Support Model for WUSCs in semi-urban towns formulated during phase-I project is revised in the context of the actual situation of WUSCs in semi-urban towns. 2.2 Design manual of specifications on rehabilitation works for target WUSCs in semi-urban towns are shared in annual progress review meeting of FWSSMP. (*5) 2.3 Rehabilitation works are carried out in more than 50 target WUSCs in semi-urban towns.(*5)	1. Management model 2. Minutes of review meeting, Interview with related persons 3. DWSSM Annual Report			
(3) Implementing capacity of NWSSTC regarding the training for WUSCs in semi-urban towns is strengthened.	3.1 Training implementation guideline, training plan, training curriculums and training materials for WUSCs in semi-urban towns are formulated. 3.2 The Management Model for WUSCs in semi-urban towns is utilized in trainings in NWSSTC. 3.3 More than 80% of target WUSCs attend the Basic Training on the Management Model. 3.4 Monitoring and Evaluation of more than 80% of target WUSCs are carried out.	1. Training implementation guideline, training plan, training curriculums and training materials 2. NWSSTC Annual Report, Interview with related persons 3. NWSSTC Annual Report 4. NWSSTC Annual Report			

Activities	Inputs		Important Assumption
	The Japanese Side	The Nepalese Side	
1.1 Conduct a baseline survey and technical, financial, management and organizational capacity assessment of DWSSM, FWSSMP, NWSSTC, and the target WUSCs. 1.2 Conduct a situation analysis surrounding water supply sector in semi-urban towns including legislation and development plans. 1.3 Analyze the supporting mechanism for WUSCs by DWSSM, NWSSTC and FWSSMP. 1.4 Coordinate and consult with the Third Small Town Project and Sector Efficiency Improvement Unit (SEIU) on support for WUSCs in semi-urban towns. 1.5 Revise PDM and PO reflecting the result of aforementioned activities.	(1) Japanese Experts/Consultants ・Chief Advisor / Water Supply Management Policy (1) ・Deputy Chief Advisor / Water Supply Management Policy (2) ・Monitoring and Evaluation ・Management (organizational, financial, business planning) ・Water quality control and monitoring ・O&M of water treatment plants and distribution facilities ・O&M of electro-mechanical equipment ・Training Management / Curriculum Development ・Project Coordinator / Assistant for Water Supply Management Policy	(1) Assignment of C/P Unit at DWSSM and officials (2) Running Expenses - Mobilization cost of DWSSM personnel - Cost for facility rehabilitation -Procurement cost for water quality test kit and Electrical equipment (3) Office space - Office space in DWSSM, NWSSTC (4) Other Support - Costs of customs clearance, domestic transportation, storage and installation of equipment provided by JICA as per the Agreement on Technical Cooperation signed on 3 September 2003.	1. No significant change in organizational structure of DWSSM is occurred. **Pre-Conditions**
2.1 Study the monitoring and management evaluation indicators suited on the current condition of WUSCs in semi-urban towns, and revise the Management Model for enhancing the usability of the model for WUSCs in semi-urban towns by DWSSM. 2.2 Plan necessary rehabilitation works for some of target WUSCs in semi-urban towns by DWSSM.(*5) 2.3 Conduct necessary rehabilitation works for some of target WUSCs in semi-urban towns by DWSSM.(*5) 2.4 Prepare a design manual of specifications on rehabilitation works for target WUSCs in semi-urban towns by DWSSM.(*5) 2.5 Identify and document the section of departments responsible for training implementation for WUSCs in semi-urban towns by DWSSM. 2.6 Formulate an outline of the Training of Trainers (ToT) regarding the Basic Training and On-site Training and instruct NWSSTC to implement the training by DWSSM. 2.7 Formulate an outline of the Basic Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM. 2.8 Formulate an outline of the On-site Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM. 2.9 Formulate an outline of the Refresher Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM. 2.10 Evaluate the above-mentioned trainings conducted by NWSSTC, and reflect its results on the training on the Management Model for WUSCs in semi-urban towns in following years by DWSSM. 2.11 Allocate a budget for NWSSTC to implement the above-mentioned trainings by DWSSM. 2.12 Re-update the Management Model for WUSCs in semi-urban towns upon receiving feedbacks from Output 3. 2.13 Conduct the support activities in response to the COVID-19 emergency	(2) Training programs ・Program in Japan (3) Equipment ・Training supporting kits and materials ・Ultra sonic flowmeter ・Electrical equipment		<Issues and countermeasures>
3.1 Evaluate the training implementation mechanism and equipment by NWSSTC. 3.2 Draft a training implementation guideline and a plan for the training on the Management Model for WUSCs in semi-urban towns by NWSSTC. 3.3 Select candidates for ToT regarding the training on the Management Model for WUSCs in semi-urban towns from MoWS, DWSSM, NWSSTC, FWSSMP, WUSCs and other organizations by NWSSTC. 3.4 Plan the ToT regarding Basic Training and On-site Training by NWSSTC. 3.5 Implement the ToT regarding Basic Training and On-site Training by NWSSTC. 3.6 Plan the Basic Training for the WUSCs in semi-urban towns by NWSSTC. (*4) 3.7 Implement the Basic Training by NWSSTC.(*4) 3.8 Plan the On-site Training for the WUSCs in semi-urban towns by NWSSTC. 3.9 Implement the On-site Training for WUSCs in semi-urban towns by NWSSTC. 3.10 Plan the Refresher Training for the WUSCs in semi-urban towns by NWSSTC. 3.11 Implement the Refresher Training for WUSCs in semi-urban towns by NWSSTC. 3.12 Re-update the following: (i) training implementation guideline,(ii) training plan, (iii) training curriculums, and (iv) training materials upon receiving feedbacks from results of aforementioned trainings by NWSSTC.			

(*1) Target WUSC consist of Target A WUSC (for the revision of Management Model formulated in phase I) and Target B WUSC (for the revision of Management Model revised in phase II)
(*2) Target A WUSC: Gulariya, Beljhundi, Pragatinagar, Ramgram, Shankarnagar, Besisahar, Amlekhgunj, Karmaiya, Manthali, Chautara, Dhulabari, Gauradaha, Mangadh (13 WUSC)
Target B WUSC: Rajapur, Gulariya II, Kusumba/Sanoshree, Naulapur, Tripur, Bharatpur, Chaughera, Jhakredhunga, Rajahar, Gaidakot, Agauli, Devdaha, Anandban, Sainamaina, Sauraha-Farsatikar, Sundarbazar, Bhotewodar, Lasunekhola, Nijgadh, Simara, Kolhabi, Jitpur, Dumarbana, Bharatgunj, Dhalkebar, Harivon, Barhathwa, Ishworpur, Ramechhap, Pakarwas, Scheme II, Melamchi, Barahbise, Urlabari, Pathari-Sanichare municipality, Jamunagachi, Rangeli municipality, Tankisinuwari, Itahara, Madhumalla, Pichhra, Sorabhag (Karsiya), Bayerban, Katahari, Jhorahat, Shani-Arjun, Shivasatachhi, Prithvinagar (Gaurisankar), Garamani, Topgachhi-1, Topgachhi-2, Topgachhi-3, Juropani, Chandragadhi-1, Chandragadhi-2 (55 WUSC)
(*3) Government and non-government organizations consist of FWSSMP, NGOs, academic institutions, and so on.
(*4) The contents of Basic Training are a) Water Quality Management, b) Water Treatment Plant O&M, c) Distribution Network O&M, d) Water Meter Management, e) Management Manuals
(*5) Rehabilitation works are to be provided to WUSCs in semi-urban towns for equipment in order to recover the function of water supply facilities.

Appendix 1.2

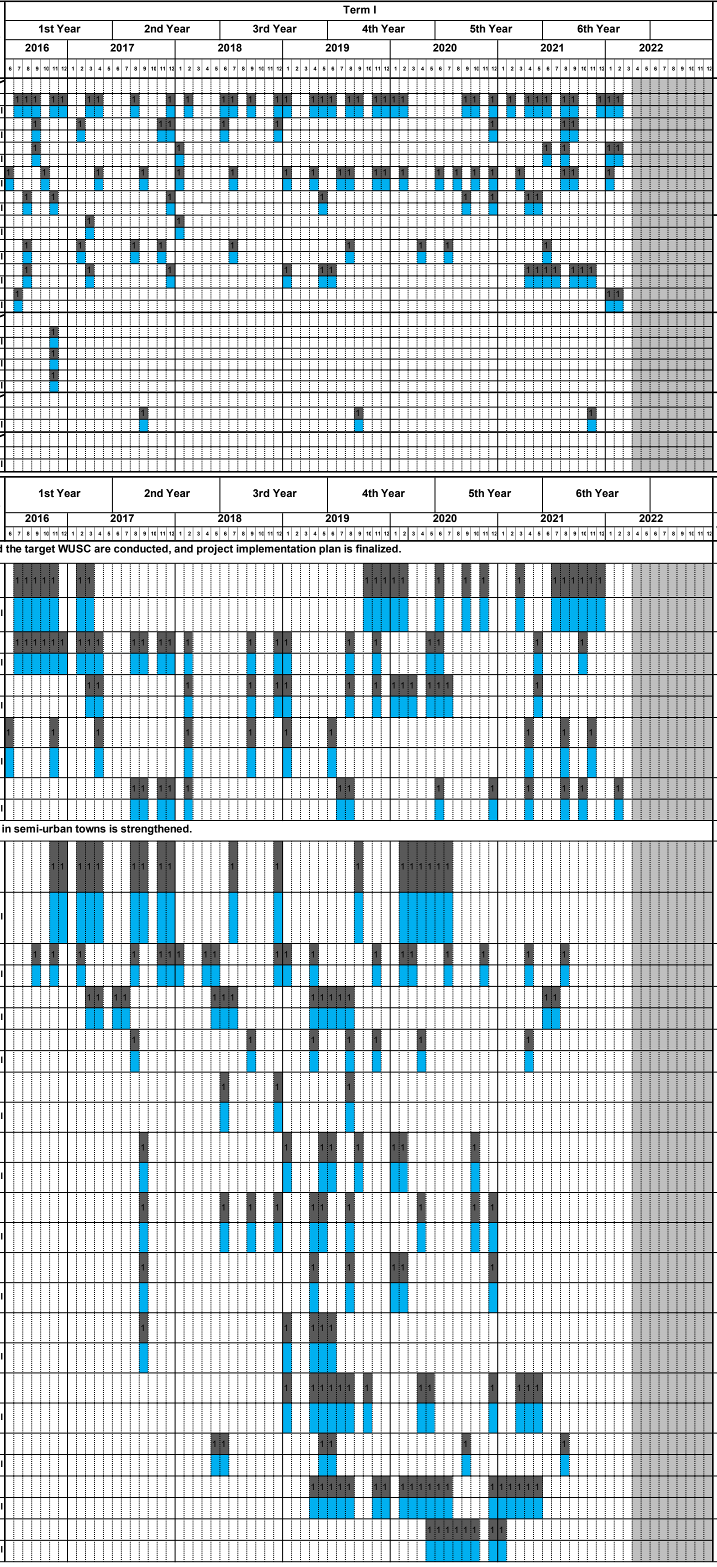
PO (as of February 28, 2022)

Tentative Plan of Operation

Version 11
Dated: 28 February, 2022
Updated:

Project Title: Capacity Development Project for the Improvement of Water Supply Management in Semi-Urban Areas (WASMIP-II)

Project Purpose: Support to the WUSCs in semi-urban towns is provided and strengthened by DWSSM and NWSSTC using government and non-government organizations' personnel.



	Year	Remarks	Monitoring	
			Issue	Solutio

Expert

Expert		Remarks	Issue	Solutio
Chief Advisor / Water Supply Management Policy-1	Plan Actual			
Deputy-Chief Advisor / Water Supply Management Policy-2	Plan Actual			
Monitoring and Evaluation	Plan Actual			
Management (organization, finance, business planning)	Plan Actual			
Water quality control and monitoring	Plan Actual			
O&M of water treatment plants and distribution facilities	Plan Actual			
O&M of electro-mechanical equipment	Plan Actual			
Training Management / Curriculum Development	Plan Actual			
Project Coordinator / Assistant for Water Supply Management Policy	Plan Actual			

Equipment

Equipment	
Training supporting kits and materials	Plan Actual
Ultra sonic flowmeter	Plan Actual
Electrical equipment	Plan Actual

Training in Japan

	Plan Actual

In-country/Third country Training

	Plan Actual

Activities

Sub-Activities	Chief Advisor / Water Supply Management Policy-1	Deputy-Chief Advisor / Water Supply Management Policy-2	Monitoring and Evaluation	Management Organization, Finance, Business planning)	Water Quality Control and Monitoring	O&M of Water Treatment Plants and Distribution	O&M of Electro-Mechanical Equipment	Training Management/Curriculum Development	Project Coordinator/Water Supply Management Policy-3	Year	Responsible Organization Japan	Responsible Organization GON	Achievements	Issue & Countermeasures
Output 1:Baseline survey and capacity assessment of DWSSM, NWSSTC, FWSSMP and the target WUSC are conducted, and project implementation plan is finalized.														
1.1 Conduct a baseline survey and technical, financial, management and organizational capacity assessment of DWSSM, FWSSMP, NWSSTC and the target WUSCs.	■	■		■	■	■	■		■	Plan Actual	JICA	DWSSM		
1.2 Conduct a situation analysis surrounding water supply sector in semi-urban towns including legislation and development plans.	■	■	■	■					■	Plan Actual	JICA	DWSSM		
1.3 Analyze the supporting mechanism for WUSCs by DWSSM, NWSSTC and FWSSMP.	■	■		■	■	■	■			Plan Actual	JICA	DWSSM		
1.4 Coordinate and consult with the Third Small Town Project and Sector Efficiency Improvement Unit (SEIU) on support for WUSCs in semi-urban towns.	■	■		■				■		Plan Actual	JICA	DWSSM		
1.5 Revise PDM and PO reflecting the result of aforementioned activities.	■	■		■						Plan Actual	JICA	DWSSM		
Output 2: Supporting capacity of DWSSM regarding O&M and management for WUSCs in semi-urban towns is strengthened.														
2.1 Study the monitoring and management evaluation indicators suited on the current condition of WUSCs in semi-urban towns, and revise the Management Model for enhancing the usability of the model for WUSCs in semi-urban towns by DWSSM.	■	■		■	■	■	■		■	Plan Actual	JICA	DWSSM		
2.2 Plan necessary rehabilitation works for some of target WUSCs in semi-urban towns by DWSSM.	■	■			■	■	■			Plan Actual	JICA	DWSSM		
2.3 Conduct necessary rehabilitation works for some of target WUSCs in semi-urban towns by DWSSM.	■	■			■	■	■			Plan Actual	JICA	DWSSM		
2.4 Prepare a design manual of specifications on rehabilitation works for target WUSCs in semi-urban towns by DWSSM.	■	■			■	■	■			Plan Actual	JICA	DWSSM		
2.5 Identify and document the section of departments responsible for training implementation for WUSCs in semi-urban towns by DWSSM.	■	■		■						Plan Actual	JICA	DWSSM		
2.6 Formulate an outline of the Training of Trainers (ToT) regarding the Basic Training and On-site Training and instruct NWSSTC to implement the training by DWSSM.	■	■		■	■	■	■	■		Plan Actual	JICA	DWSSM		
2.7 Formulate an outline of the Basic Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM.	■	■		■	■	■	■	■		Plan Actual	JICA	DWSSM		
2.8 Formulate an outline of the On-site Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM.	■	■		■	■	■	■	■		Plan Actual	JICA	DWSSM		
2.9 Formulate an outline of the Refresher Training for the WUSCs in semi-urban towns and instruct NWSSTC to implement the training by DWSSM.	■	■		■	■	■	■	■		Plan Actual	JICA	DWSSM		
2.10 Evaluate the above-mentioned trainings conducted by NWSSTC, and reflect its results on the training on the Management Model for WUSCs in semi-urban towns in following years by DWSSM.	■	■	■	■	■	■	■	■		Plan Actual	JICA	DWSSM		
2.11 Allocate a budget for NWSSTC to implement the above-mentioned trainings by DWSSM.	■	■		■						Plan Actual	JICA	DWSSM		
2.12 Re-update the management model for WUSCs in semi-urban towns upon receiving feedbacks from Output 3.	■	■	■	■	■	■	■		■	Plan Actual	JICA	DWSSM		
2.13 Conduct the support activities in response to the COVID-19 emergency	■	■			■	■	■		■	Plan Actual	JICA	DWSSM		

Output 3: Implementing capacity of NWSSTC regarding the training for WUSCs in semi-urban towns is strengthened.																																																																																											
3.1 Evaluate the training implementation mechanism and equipment by NWSSTC.	■	■		■	■	■	■	■		Plan			1						1	1																					1								1																																							JICA	DWSSM		
										Actual			🟦						🟦	🟦																					🟦								🟦																																										
3.2 Draft a training implementation guideline and plan for the training on the Management Model for WUSCs in semi-urban towns by NWSSTC.	■	■		■	■	■	■	■		Plan																								1	1					1															1												1																						JICA	DWSSM		
										Actual																								🟦	🟦					🟦															🟦												🟦																							
3.3 Select candidates for ToT regarding the training on the Management Model for WUSCs in semi-urban towns from MoWS, DWSSM, NWSSTC, FWSSMP, WUSCs and other organizations by NWSSTC.	■	■	■	■	■	■	■	■		Plan									1								1	1															1							1	1															1																													JICA	DWSSM		
										Actual									🟦								🟦	🟦															🟦							🟦	🟦															🟦																														
3.4 Plan the ToT regarding Basic Training and On-site Training by NWSSTC.	■	■		■	■	■	■	■		Plan									1	1						1																	1						1	1	1						1	1								1																													JICA	DWSSM		
										Actual									🟦	🟦						🟦																	🟦						🟦	🟦	🟦						🟦	🟦								🟦																														
3.5 Implement the ToT regarding Basic Training and On-site Training by NWSSTC.	■	■		■	■	■	■	■		Plan										1								1	1	1											1						1		1						1									1																													JICA	DWSSM		
										Actual										🟦								🟦	🟦	🟦											🟦						🟦		🟦						🟦									🟦																														
3.6 Plan the Basic Training for the WUSCs in semi-urban towns by NWSSTC. (*4)	■	■		■	■	■	■	■		Plan																		1	1	1						1	1				1								1						1									1		1		1									1															JICA	DWSSM		
										Actual																		🟦	🟦	🟦						🟦	🟦				🟦								🟦						🟦									🟦		🟦		🟦									🟦																
3.7 Implement the Basic Training by NWSSTC.(*4)	■	■		■	■	■	■	■		Plan																																1	1								1														1		1		1												1												JICA	DWSSM		
										Actual																																🟦	🟦								🟦														🟦		🟦		🟦												🟦															
3.8 Plan the On-site Training for the WUSCs in semi-urban towns by NWSSTC.	■	■		■	■	■	■	■		Plan																								1	1											1						1	1										1	1			1						1																JICA	DWSSM		
										Actual																								🟦	🟦											🟦						🟦	🟦										🟦	🟦			🟦						🟦																			
3.9 Implement the On-site Training for WUSCs in semi-urban towns by NWSSTC.	■	■		■	■	■	■	■		Plan																																														1										1	1	1						1	1	1	1	1												JICA	DWSSM		
										Actual																																														🟦										🟦	🟦	🟦						🟦	🟦	🟦	🟦	🟦															
3.10 Plan the Refresher Training for the WUSCs in semi-urban towns by NWSSTC.	■	■		■	■	■	■	■		Plan																								1	1							1			1	1	1							1																									1												JICA	DWSSM		
										Actual																								🟦	🟦							🟦			🟦	🟦	🟦							🟦																									🟦															
3.11 Implement the Refresher Training for WUSCs in semi-urban towns by NWSSTC.	■	■		■	■	■	■	■		Plan																																				1	1	1																																													JICA	DWSSM		
										Actual																																				🟦	🟦	🟦																																																
3.12 Re-update the following: (i) training implementation guideline,(ii) training plan, (iii) training curriculums, and (iv) training materials upon receiving feedbacks from results of aforementioned trainings by NWSSTC.	■	■	■	■	■	■	■	■		Plan																																1			1	1	1	1	1			1	1		1										1	1	1	1	1	1																					JICA	DWSSM		
										Actual																																🟦			🟦	🟦	🟦	🟦	🟦			🟦	🟦		🟦										🟦	🟦	🟦	🟦	🟦	🟦																								
Monitoring Plan										Year	1st Year												2nd Year												3rd Year												4th Year												5th Year												6th Year																			Remarks		Issue	Solutio
											2016							2017												2018												2019												2020												2021												2022															
											6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12				
Monitoring																																																																																											
Joint Coordinating Committee										Plan																				1																					1																												1				1															
										Actual																				🟦																					🟦																												🟦				🟦															
Joint Project Coordination Meeting										Plan	1			1			1				1																		1										1																				1							1																			
										Actual	🟦			🟦			🟦				🟦																		🟦										🟦																				🟦							🟦																			
Set-up the Detailed Plan of Operation										Plan													1																																																																					
										Actual																																																																																						
Submission of Monitoring Sheet										Plan							1						1							1						1						1						1								1					1											1																					
										Actual							🟦							🟦						🟦							🟦					🟦							🟦							🟦					🟦											🟦																					
Monitoring Mission from Japan										Plan																																																																																								
										Actual																																																																																						
Joint Monitoring										Plan																																																														1	1	1																
										Actual																																																														🟦	🟦	🟦																
Post Monitoring										Plan																																																																																								
										Actual																																																																																						
Reports/Documents																																																																																											
Progress Report										Plan										1																														1																																										
										Actual										🟦																														🟦																																										
Project Completion Report										Plan																																																																				1												
										Actual																																																																				🟦												
Public Relations																																																																																											
										Plan																																																																																						
										Actual																																																																																						
										Plan																																																																																						
										Actual																																																																																						

Appendix 2.1

Kick Off Meetings on Work Plan

The Capacity Development Project for the Improvement of Water Supply Management in Semi-urban Areas in Nepal
WASMIP-II

June 27, 2016

Chief Advisor

Satoru Oniki

What is WASMIP?

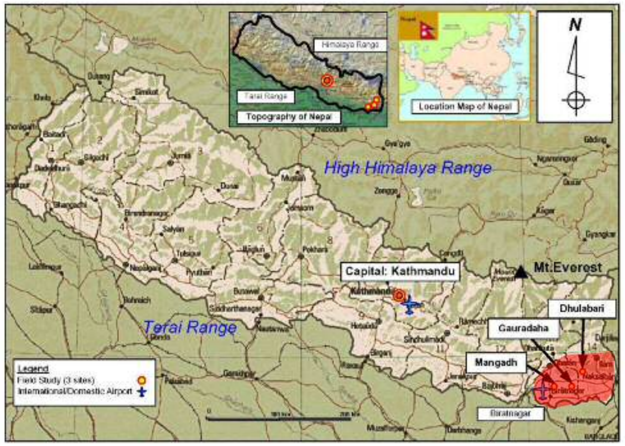
For providing safe and quality drinking water to people

Water Supply Management Improvement Project

Technical Cooperation Project (JICA)

WASMIP-I: January 2010 – September 2013

1.1 Project Sites (WASMIP-I)



1.2 Subjects of the Project

1. WUSCs
   - (1) Fragile management and technical skills
   - (2) Lack of adequate budget and human resource
   - (3) Absence of business plan

2. DWSS and WSSDO
   - (1) Inadequate for regular and proper supervision and guidance to WUSCs
   - (2) Lack of technical and financial capacities

1.3 Project Objective WASMIP-I

1. Project Purpose

DWSS technical support system to WUSCs is improved in Morang and Jhapa districts.

2. Indicators

a) Technical Support and Management Models established by DWSS/WSSDO.

b) The safe drinking water services are improved.

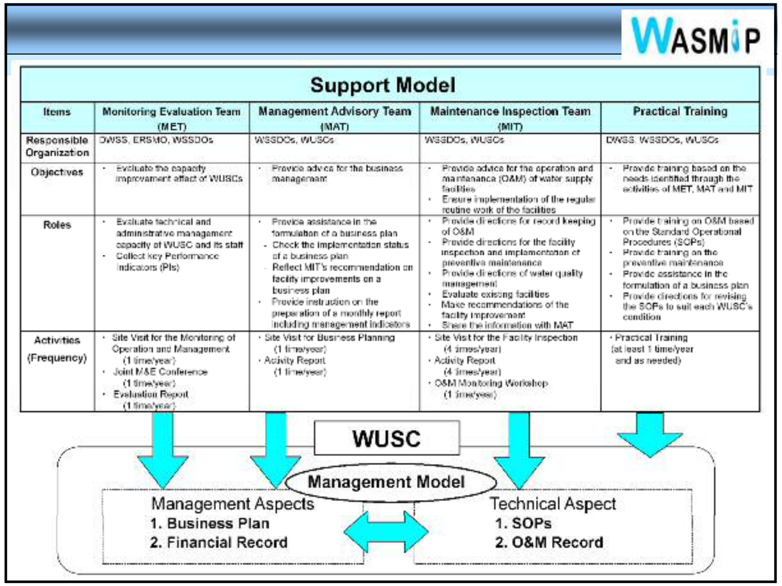
⇩

Development and Dissemination of WASMIP Model

What is the WASMIP Model?

1.4 WASMIP Model

- **Management Model**
  - Business Plan
  - SOP on WTP O&M and Water Quality Management
  - SOP on O&M of Water Distribution Facilities
  - SOP on Water Meter Management
- **Support Model**
  - MET: Monitoring Evaluation Team
  - MAT: Management Advisory Team
  - MIT: Maintenance Inspection Team
  - Practical Training



WASMIP

Support Model

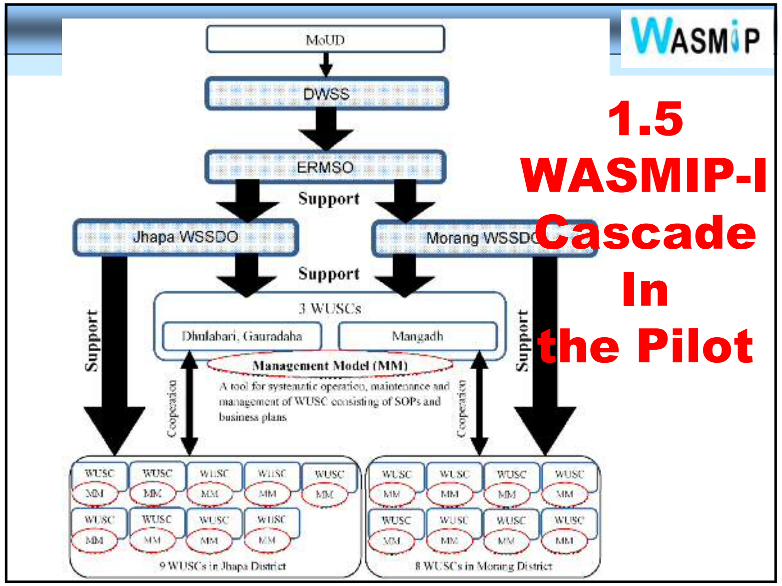
Items	Monitoring Evaluation Team (MET)	Management Advisory Team (MAT)	Maintenance Inspection Team (MIT)	Practical Training
Responsible Organization	DWSS, ERSMO, WSSDOs	WSSDOs, WUSCs	WSSDOs, WUSCs	DWSS, WSSDOs, WUSCs
Objectives	· Evaluate the capacity improvement affect of WUSCs	· Provide advice for the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

WUSC

Management Model

Management Aspects
1. Business Plan
2. Financial Record

Technical Aspect
1. SOPs
2. O&M Record



WASMIP

1.5 WASMIP-I Cascade In the Pilot

MoUD

DWSS

ERMSO

Support

Jhapa WSSDO

Morang WSSDO

Support

3 WUSCs

Dhulabari, Gauradaha

Mangadh

Management Model (MM)

A tool for systematic operation, maintenance and management of WUSC consisting of SOPs and business plans

Support

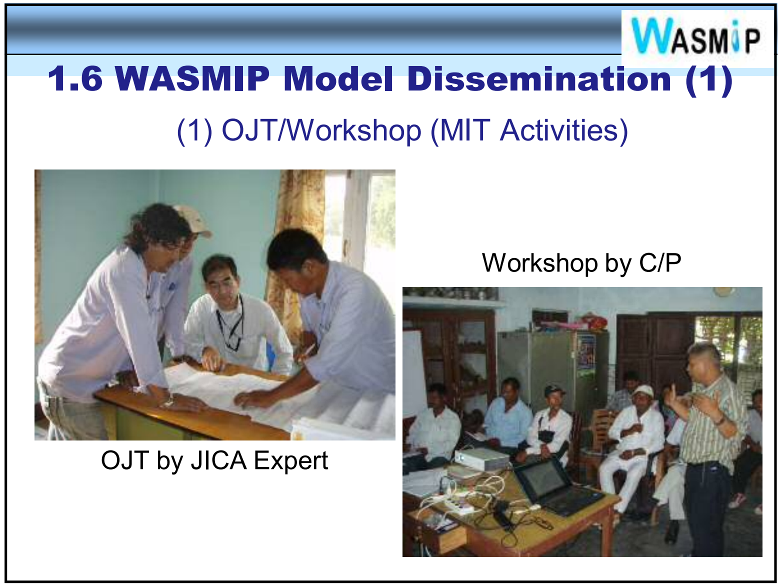
Cooperation

Cooperation

Support

9 WUSCs in Jhapa District

8 WUSCs in Morang District



WASMIP

1.6 WASMIP Model Dissemination (1)

(1) OJT/Workshop (MIT Activities)

OJT by JICA Expert

Workshop by C/P

WASMIP

1.6 WASMIP Model Dissemination (2)

(2) Joint Workshop (MET Activities)

Monitoring and Evaluation by C/P

Liaison Conference

1.7 Project Outcome

MIT Achievement

- Long life span
- Sustainable water supply service

O&M and Records

- Daily operation record
- Preventive Maintenance

Why WASMIP-II ?

2.1 DWSS Duties

(M/M in 6th JCC in 2013)

- DWSS shall revise the management model and support model (WASMIP model)
- WSSDOs instruct and conduct the training to WUSC based on continually implemented OJT/workshops with WASMIP model.
- DWSS shall conduct the follow-up for E&M in order to apply the two models to other sites.
- CHRDU plans to conduct workshop for formulating business plan and it is targeted for WUSC.

2.2 Issues & Challenges

DWSS

•Human Resources

•Budget for WASMIP Model Implementation

•Incentives

WASMIP Model

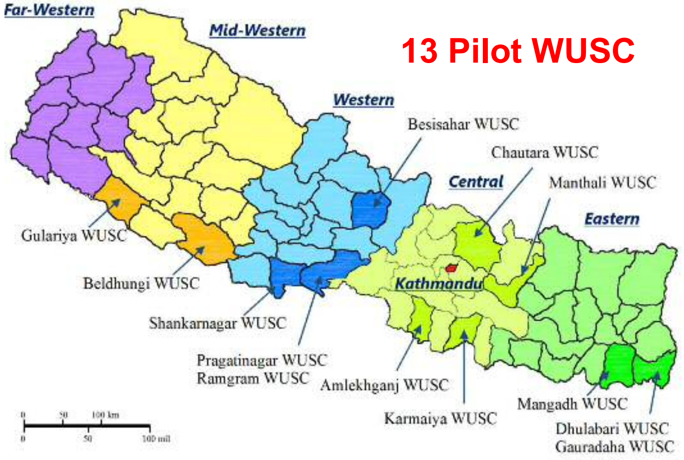
•Suitable Model

•Proper Cascade System (Support System)

3 Outline of the WASMIP-II

3.1 Proiect Sites

13 Pilot WUSC



3.2 Counterparts

Ministry of Drinking Water and Sanitation (MWSS)

Department of Water Supply and Sewerage (DWSS)

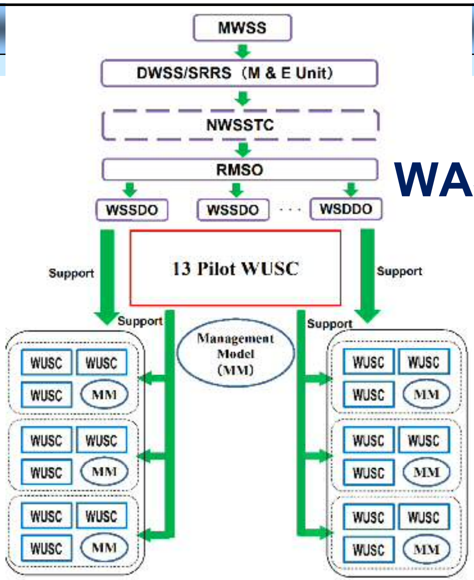
National Water Supply and Sanitation Training Center (NWSSTC)

Regional Monitoring and Supervision Offices(RMSO)

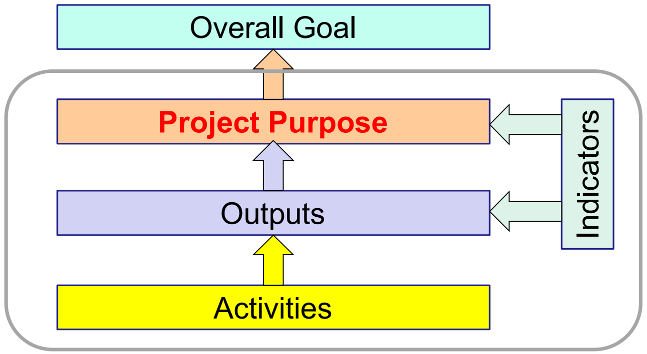
Water Supply and Sanitation Division Office (WSSDO)

Whole Country: 40,000 WUSCs
Overall Goal: 159 WUSCs
Project Purpose: Target 67 WUSCs
Pilot Project: 13 WUSCs

3.3 WASMIP-II


MWSS
DWSS/SRRS (M & E Unit)
NWSSTC
RMSO
WSSDO
WSSDO
WSDDO
13 Pilot WUSC
Support
Support
Support
Support
Management Model (MM)

3.4 PDM Structure



WASMIP-II

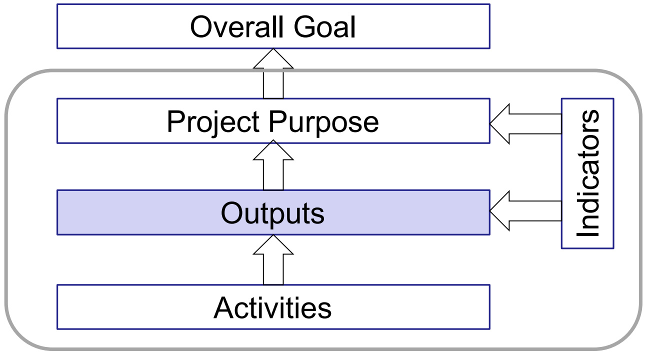
3.5 Project Purpose

Supporting mechanism for target WUSCs to be set up by DWSS /NWSSTC /RMSOs /WSSDOs will be established.

1. Project Purpose in the WASMIP-I

DWSS technical support system to WUSCs is improved in Morang and Jhapa districts.

3.6 Outputs



WASMIP-2

3.7 Outputs of WASMIP-II (1)

Output-1

Support & Management Model (WASMIP Models) established in WASMIP-1 will be reviewed/updated and its implementation modality will be established, contributing in finalization of suitable PDMs/POs.

Output-2

The Training Capacity of the National Water Supply and Sanitation Training Center (NWSSTC) will be strengthened.

3.7 Outputs of WASMIP-II (2)

Output-3

Human resource development and capacity enhancement systems for target RMSOs /WSSDOs will be established.

Output-4

Training system for target WUSCs by the DWSS /the NWSSTC /RMSOs /WSSDOs will be established.

Output-5

Monitoring system based on Performance Indicators (PIs) of target WUSCs will be established in the DWSS.

---

4. Basic Policy of the WASMIP-II

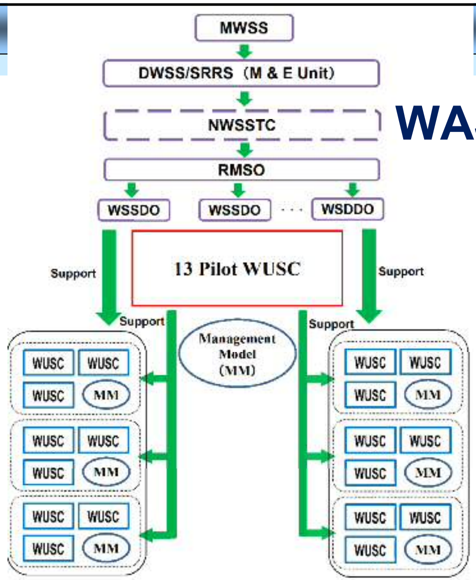
4.1 Revised and Updated WASMIP Model (1)

1. Study for the implementation of the WASMIP Model
   →Baseline Survey（Check lists, Performance Indicators）
2. Review and Revision of the WASMIP Model
   →Revising SOPs based on the pilot project (13 WUSCs)
3. Finalization of the PDM and PO
4. How to approach organization and legal system
   →Annual monitoring, Review of training contents

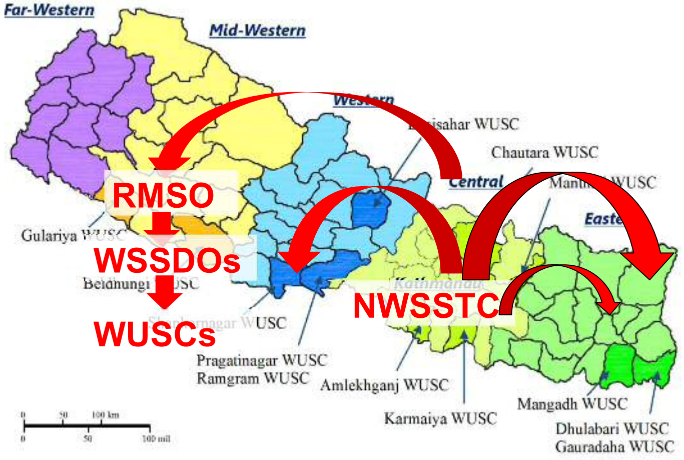
4.1 Revised and Updated WASMIP Model (2)

6. How to accelerate the broad use of the WASMIP Model and relevant legislation
   →Screening Criteria, initiative to encourage to Model
7. Confirmation of the organization system in the DWSS
8. Implementation of Capacity Assessment
9. How to implement the cascade method for the WASMIP Model dissemination

WASMIP-II



4.2 Cascade System



4.3 Activities & Achievements

1. **Technology Transfer**
   - **Work with Experts**, CA, BS, Monitoring (check lists, PIs), ToT, OJT
2. **Visualization of Achievements**
   - Documents, Records, Reports, PIs, Organization
3. **Information sharing**
   - Workshop, Liaison conference, Recognition to WUSC

5. Duration of the WASMIP

June 2016 – May 2021

The 1st Year

June 2016 – December 2017

The 2nd Year

January 2018 –September 2019

The 3rd Year

October 2019 – May 2021

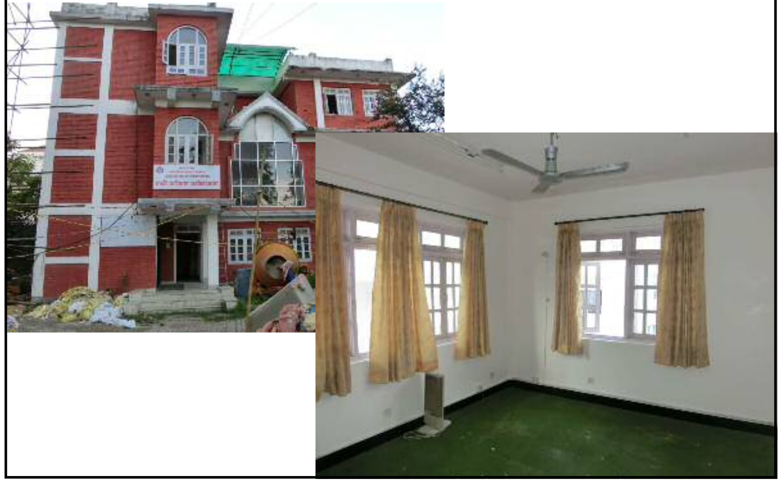
6. JICA Expert Team

No.	Position and/or Assigned Tasks	Name	
1	Chief Advisor/Water Supply Management Policy	Satoru Oniki	
2	Deputy Chief Advisor/ Water Supply Management Policy-2	Kazuhiko Nakamura	
3	Monitoring and Evaluation Advisor	Yasumi Tsutsui	
4	Management (Organizational, Financial, Business Planning)	Yoshio Chikamatsu	
5	Water Quality Control and Monitoring/O&M of Water Treatment Plant-2	Yusaku Numajiri	
6	Water Treatment Plant-1	Diasuke Yashiro	
7	O&M of Electro-Mechanical Equipment	Akira Hasebe	
8	Training Management/Curriculum Development	Kozo Hayashishita	
9	Water Supply Management Policy-3/Project Coordinator	Mikita Amano	

7.Counterparts

Position	Position and Organaization	Name
Project Director	Dupty Director General	
Project Manager	Chief, NWSSTC	
Staff	Chief, Sector Efficiency Improvement Unit, MOUD	
Staff	Engineer, Sector Efficiency Improvement Unit, MOUD	
Staff	Chief, Planning and Foreign Aid Coordination Section, DWSS	
Staff	Engineer, Planning and Foreign Aid Coordination Section, DWSS	
Staff	Chief, NWSSTC	
Staff	Engineer, NWSSTC	
Staff	Chief, Water Quality Section, DWSS	
Staff	Engineer, Water Quality Section, DWSS	
Staff	Chief, Service Regulation and Rehabilitation Section, DWSS	
Staff	Engineer, Service Regulation and Rehabilitation Section, DWSS	
Staff	Chief, Electro-Mechanical Section, DWSS	
Staff	Engineer, Electro-Mechanical Section, DWSS	
Staff	Chief, Program Monitoring and Evaluation Section, DWSS	
Staff	Engineer, Program Monitoring and Evaluation Section, DWSS	

8. WSMIP-II Office



9. Weekly Meeting

- Once a week
- Information Suring
- WASMIP-II Progress
- JICA Expert Team Activities
- C/P Achievements
- Issues, Subjects and Challenges
- Schedule

10. Public Relations

Final Beneficiaries
→Residents / Users

Tools;
Poster, Pamphlet,
DWSS Homepage, etc.

Thank you very much for your attention

Enjoy WASMIP-II

Appendix 2.2

Training Courses Provided NWSSTC in the Past

Appendix B1: Training Courses Provided by NWSSTC in the Past

- ✓ Trainers’ training for WASH program
- ✓ Personality traits
- ✓ Social graces, communication and presentation
- ✓ Proposal, scientific paper report writing, documentation and publication
- ✓ Leadership in WASH sanitation, health and livelihood
- ✓ Total sanitation and related issues
- ✓ Triggering for sanitation as social movement
- ✓ Planning, programming, implementation and monitoring in WASH
- ✓ Fund raising and financial management in WASH
- ✓ Information management and social networking for WASH
- ✓ Business plan
- ✓ Community dynamics, management and mobilization for WASH
- ✓ Safety in work place for WASH facility construction
- ✓ Gender equality and social inclusion in WASH approaches
- ✓ Modalities and tools in sanitation
- ✓ Administrative, store and financial management
- ✓ Construction and contract management and administration
- ✓ Water quality monitoring, surveillances and water safety plan
- ✓ Treatment plant operation and maintenance
- ✓ Solid waste management, wastewater treatment and water treatment plant design
- ✓ Well drilling technology
- ✓ Water supply gravity flow system design
- ✓ Water supply lifting system design and solar powered system
- ✓ Pipe network and hydraulic design WASH in emergencies
- ✓ WASH and climate change
- ✓ Eco-san promotion
- ✓ Rain water harvesting
- ✓ Construction supervision and quality assurance for WASH project
- ✓ Water supply system calibration
- ✓ Meter reading, maintenance and calibration pipe and material testing
- ✓ NRW management
- ✓ Environmental simulation and IEE/EIA
- ✓ operation and maintenance of WASH facilities
- ✓ Plumbing and masons
- ✓ Ferro cement construction

Appendix 2.3

Training Needs Assessment to NWSSTC

Visit Log

Destination	National Water Supply and Sanitation Training Center（NWSSTC)
Date	2016.06.29(Thu),11:00-14:30
Venue	NWSSTC (Nagarkot)
C/P	Mr. Rajeeb Ghimirei (NWSSTC Director), Mr. Kamal Adhkari (NWSSTC Sociologist/Trainer) NWSSTC staff
WASMIP	Mr. Oniki, Mr. Amano、Mr. Chikamatsu, Deepak
Purpose	NWSSTC Capacity Assessment

○NWSSTC Profiling

・Originated from the Manpower Development Project by DWSS in 1983, reorganized as the Central Human Resource Development Unit (CHRDU) in 1987.

・When it was first established, its purpose was to develop human resources for DWSS staff. Since then, the scope of human resource development has been gradually expanded to include all waterworks-related personnel.

・Reorganized as NWSSTC in 2014.

・Obtained ISO 9001:2008 certification in 2014.

・Received an award from WaterLinks (an international non-profit organization based in the Philippines that supports water utilities) in 2015.

→URL : http://www.waterlinks.org/what-we-do/waterlinks-awards

・Web site http://www.nwsstc.gov.np/

・NWSSTC features: 43 years of experience, not-for-profit operation, grassroots support, extensive training facilities, continuous revision of training content, training needs assessment（TNA: Training Needs Assessment)

・Major business partners (including those in the past) : UNDP、UNICEF、WHO、JICA、Maynilad Water Services（Water utility companies in the Philippines）、WSSCC（Water Supply and Sanitation Collaborative Council）（International and overseas organizations）、DOLIDAR(Department of Local Development and Agricultural Road)、MOFALD（Ministry of Federal Affairs and Local Government）、STWSSSP (Small Town and Water Supply Sanitation Sector Project) and so on.（Domestic organizations)

○Projects of NWSSTC

・Projects can be categorized into the following: (1) Workshops, (2) Seminars, (3) WASH Expo, (4) Training (group training/OJT), (5) Orientation, (6) Site visits

・The first Expo, WASH Expo 2015 (*WASH: Water, Sanitation and Hygiene) was held in Nagarkot in March 2015. Attracted about 1500 people.

○Training Program

・The training will focus on (1) technology, (2) management, and (3) society and culture.

・About 90% of the total training programs are management-related training. Only a small percentage is technical training.

・The themes of the training program are: 1) Technology and knowledge of global standards, etc., 2) Joint sector review（JSR : Joint Sector Review）、3) NMIP: National Management Information Project、4) Urgent matters such as disasters, 5) Information from WSSDO and WASH-CC, 6) Consideration based on TNA, etc.

・In accordance with the internal regulations determined by the ISO process, the company has stipulated that four new training programs will be introduced per year.

・There was no follow-up survey after the training, but there was news that the former trainees were active after the training was implemented.

○Budget allowance and service methods for training

・Mostly government-funded group training. Some training is commissioned by the students' organizations.

・Multi-day group training at a training facility in Nagarkot is standard. In some cases, only the training facilities are provided, and in other cases, instructors are dispatched.

・Online training is being planned.

○Objectives of the training

・Policy makers, political leaders, water sector experts, and WASH-CC(WASH Coordination Committee、WUSC、DWSS、NGO、CBO（Community Based Organization）、General public, media, etc.

・For government-funded group training: NSHCC (National Sanitation and Hygiene Coordination Committee) recommendation、Decisions will be made based on selection criteria such as gender balance in training (33% or more female), WASH-CC/WUSC membership, educational background, and requests from WSSDO/WASH-CC (special cases such as disasters).

・The WASH-CC plays a major role in training planning and selection of trainers. Each RMSO has a Training Cell, but their activities vary by region. RMSOs in the Midwest region are doing well.

○Training facility

・The building consists of a training building, two trainee accommodation buildings, a staff residence building, a director's residence building, a private power generation building, a museum building, and a cafeteria building.

・The training building has three floors and consists of an auditorium, lecture rooms, director's office, staff room, library, computer room, IT management room, copy room, etc.

・Computer lab provides training in Autocad, financial management, etc. Stand-alone PCs are installed.

・The museum building is three stories high and consists of a workshop, recreation room, various training facilities, and laboratories. It was completed last month.

・The laboratory is equipped with a muffle furnace, PH meter, colorimeter, turbidimeter, and centrifuge.

○Training related to the WASMIP model

・Conducted training on WASMIP model business plans. About 60 people in total. The training period was three days.

・We feel that it is difficult to apply in small scale WUSC. In addition, there are cases where students lack the basic knowledge necessary as a prerequisite for creating a business plan, such as finance. (Comment by Mr. Ghimirei)

・For technical staff, only training on meter reading SOPs was provided.

○Training being conducted during the visit

・Training course "Water Supply and Sanitation" is being conducted from June 28 to July 1 (4 days).

・36 students, selected by Water Users and Sanitation Committee (WUSC).

・At the time of the visit, the second day of lectures was underway. On the third day, the next day, a site visit to the water purification facility was conducted.

・Government-funded group training tends to be conducted intensively at the end of each fiscal year. For example, the first training on "Water Supply and Sanitation" for the current fiscal year (2015/6 (Nepali calendar year 2072/3)) was conducted in February 2016. The training underway is the last batch for this year.

○NWSSTC's issues and items needed in the future (self-analysis by NWSSTC side presentation)

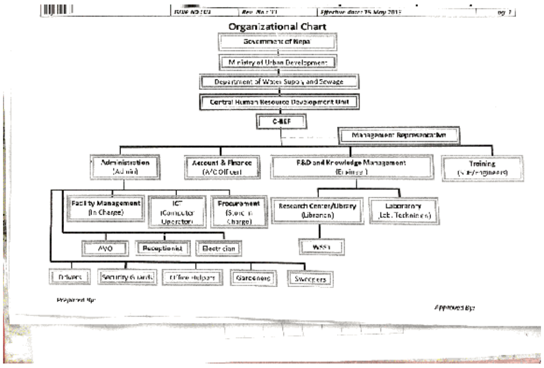
・Current issues include: 1) Lack of instructors. Training of instructors to meet changing training needs. (2) Ambiguity in the key direction of business strategy. (3) Lack of research function.
・Items that need to be addressed in the future include (1) developing a Capacity Development Master Plan, (2) developing Training Management Information Systems, (3) increasing the number of instructors and resource persons, and (4) improving training resource materials.

BMTRADA

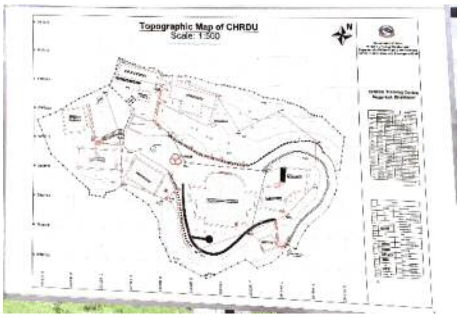
CERTIFICATE OF REGISTRATION

Department of Water Supply and Sewerage
National Water Supply and Sanitation Training Centre
Bhaktapur
Nepal

【Photo1】ISO9001:2008



【Photo 2】NWSSTC Origanization



【Photo 3】NWSTTC 敷地全体図

【Photo 4】 Training Center

【Photo 5】Museum building

【Photo 6】Staff (left) and Director (right) in the residential building

【Photo７】 Accommodation building A

【Photo８】 Accommodation building B

【Photo ９】 Private power generation building (front) and cafeteria building (back)

【Photo１０】 Reception (Training Building)

【Photo 11】 Auditorium (Training Building)

【Photo 12】 Computer room (training building)

【Photo 13】 Lecture Room (Training Building)

【Photo 14】 Library (Training Building)

【Photo 15】 Recreation Room (Museum Building)

【Photo 16】 Workplace (Museum Building)

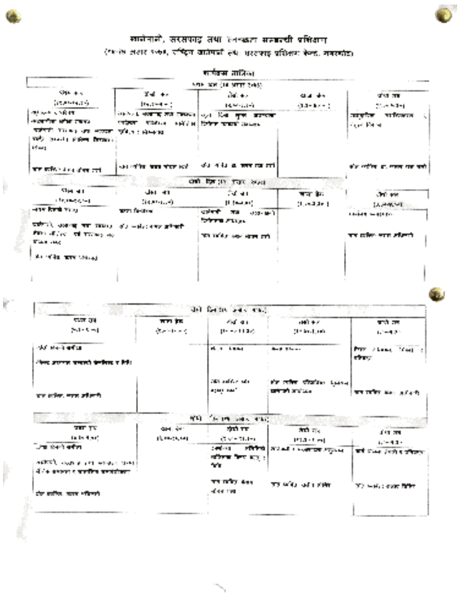
【Photo 17】 Practical meter reading (Museum building)

【Photo 18】 Laboratory (Museum Building)

【Photo 19】 Trainees' accommodation room (accommodation building)

【Photo 20】 Cafeteria (Cafeteria Building)

【Photo 21】 Printed materials produced by NWSSTC



【Photo 22】 Schedule of ongoing lectures (in Nepali)

【Photo 23】 Participants in the ongoing lecture

National Water ... Training Centre

Certificate of Completion

This is to certify that

Office Copy

【 Photo 24 】 Sample certificates for ongoing lectures

Water Supply and Sanitation Training for User Committee
16-19 Jesth 2073

S.N	Name	District/ Dept.	Phone
1	Bir Bahadur Manni	Masuriy WSUC, Kailali	9749006682
2	Nam Sara Nepali	Masuriy WSUC, Kailali	9868456688
3	Bhoj Raj Bhatt	Geta WSUC, Kailali	9849473384
4	Khem Lal Chaudhary	Geta WSUC, Kailali	9811620879
5	Surendra Acharya	Pahalmanpur WSUC, Kailali	9868548659
6	Karuna Bam (Batala)	Pahalmanpur WSUC, Kailali	9868477158
7	Man Bahadur Rawal	Godabari WSUC, Kailali	9868530711
8	Surja Devi Kadayat	Godabari WSUC, Kailali	9825620779
9	Sita Chaudhary	Shripur WSUC, Kailali	9848485143
10	Chandra Bhul	Shripur WSUC, Kailali	9812647500
11	Shanker Bahadur Thapa	Koiral Bojhiaya WSUC, Kanchanpur	9868794525
12	Khagendra Bahadur Adhikari	Koiral Bojhiaya WSUC, Kanchanpur	9848476140
13	Ishwori Dutt Bhatt	Malubela WSUC, Kanchanpur	9749510327
14	Indra Bahadur Deuba	Malubela WSUC, Kanchanpur	9848844734
15	Nar Bahadur Oli	Malubela WSUC, Kanchanpur	9749515734
16	Kamala Ter	Brahamdevmandi WSUC, Kanchanpur	9806410103
17	Dev Dutt Joshi	Brahamdevmandi WSUC, Kanchanpur	9809429332
18	Prakash Raj Absthi	Rautela WSUC, Kanchanpur	9848722328
19	Prema Chaudhary	Kalkata WSUC, Kanchanpur	9812708362
20	Anokha Rana	Kalkata WSUC, Kanchanpur	9809430524
21	Dipendra Bahadur Dhami	Faldugri WSUC, Achham	9865670745
22	Gyan Bahadur Saud	Dhanapani WSUC, Achham	9848550244
23	Jayasara Kumari Batala Bogati	Magalsen WSUC, Achham	
24	Dipa B.C.	Bhairabsthan WSUC, Achham	9848691931
25	Karna Bahadur Budha	Basundhara WSUC, Achham	9868414469
26	Harka Bahadur Budha	Ramaroshan WSUC, Achham	9860931978
27	Kripa Ram Regmi	Shrikot Jalpadevi WSUC, Achham	98485655
28	Dhan Bahadur Khati	Lungra WSUC, Achham	9812636427
29	Chakra Bahadur Damai	Khagarkot WSUC, Dadeldhura	9809489542
30	Rajendra Bahadur Bist	Manilek WSUC, Dadeldhura	9844135532
31	Keshav Bhatt	Bhatkanda WSUC, Dadeldhura	9868566684
32	Yagya Raj Ojha	Khalanga WSUC, Dadeldhura	9848889944
33	Basanti Bhandari	Bhandari Gaun WSUC, Dadeldhura	9848731539
34	Kalu Devi Kami	Lekhunga Pantura WSUC, Dadeldhura	9868571745
35	Gyanu Bhandari	Bhandari Gaun WSUC, Dadeldhura	9840018168
36	Sobita Rawal	WSUC, Achham	9847275371

【Photo 25】 List of students in the current lecture

WASMIP-II Questionnaire for Training Program

1. To NWSSTC

1-1 Training facilities		
Q1	The number of lecture rooms and capacity	Room-I (Room No-7):25 persons Room-II (Room Name-Kanchanghanga): 60 persons Room-III (Room Name-Sagarmatha):80 persons Room-IV (Room No-22):25 persons
Q2	Are lecture rooms available whenever you want to use?	Yes (for NWSSTC use)
Q3	If not, what are some of the reasons	If it is already occupied by any external agencies
Q4	Are lecture rooms and/or equipments satisfactory to you?	Partially satisfactory
Q5	If not, what are some of the reasons	-Installation of new computers/laptops and equipments -Well furnishing of rooms
Q5	Number of training courses and the theme of the curricula ever provided	• Trainer's Training for WASH program • Personality traits • Social graces, communication and presentation • Proposal, scientific paper, report writing, documentation and publication • Leadership in WASH Sanitation, health and livelihood • Total sanitation and related issues • Triggering for sanitation as social movement • Planning, programming, implementation and monitoring in WASH • Fund raising and financial management in WASH • Information management and social networking for WASH • Business plan • Community dynamics, management and mobilization for WASH • Safety in work place for WASH facility construction • Gender equality and social inclusion in WASH Approaches, • Modalities and tools in sanitation • Administrative, store and financial management • Construction and contract management and administration • Water quality monitoring, surveillances and water safety plan • Treatment plant operation and maintenance • Solid waste management, waste water treatment and water treatment plant design • Well drilling technology • Water supply gravity flow system design • Water supply lifting system design including solar

		powered systems • Pipe network and hydraulic design WASH in emergencies • WASH and climate change • Eco-san promotion • Rain water harvesting • Construction supervision and quality assurance for WASH project • Water supply system calibration • Meter reading, maintenance and calibration Pipe and material testing • NRW management • Environmental Simulation and IEE/EIA • Operation and maintenance of WASH facilities • Plumbing and masons • Ferro cement construction
1-2 Qualification for the position of the trainers		
Q1	The number of trainers and their areas of expertise	Number of trainers at NWSSTC: 2 Areas of expertise: a) Water supply and sanitation (engineer) b) Social and cultural aspects (sociologist)
Q2	Trainers affiliation including outsourcing	-Government staff -University teachers -WASH sector professionals -Experts from private sector agencies
Q3	Did you sit an examination to be qualified as a trainer?	No
Q4	If not, are there any criteria to be qualified as a trainer?	Not specific and mandatory
Q5	If not, the reason why you were selected as a trainer?	As a WASH sector practitioner having experience, involvement and expertise in policy, planning and implementation level
Q6	When you assumed a position as trainer, did you smoothly take over the task from the predecessors?	Yes
Q7	If not, what kind of problem(s) did you experience?	Felt the shortcoming of standard training manual
Q8	Do you have a manual for a training method?	There are some training manuals and guidelines used in the WASH sector
Q9	If so, is it useful for your task as a trainer	Yes but need some update and modification
Q10	If not, how are knowledge and procedure passed over to the successor?	Mainly through training schedules used in the past and existing guidelines and policy documents
1-3 Training materials		
Q1	The form of materials (PPT slides or textbooks?)	-PPT -Flex -Booklets -Manuals

		-Research documents and reports -Guidelines -Policy and plan documents
Q2	Is the quality of materials satisfactory to you?	Partially satisfactory
Q3	If not, what are some of the reasons	Timely update and proper application of modern technology is lacking
Q4	When you implement trainings, do you prepare the training materials by yourself?	Yes
Q5	If not, who are supposed to prepare them?	In some cases materials used by other resource persons are also considered as a reference material
1-4 Achievements of the training		
Q1	Do you judge that the training have been beneficial to trainees as a whole?	Yes we collect trainees' feedback (through verbal and written process) regarding methodology, contents and effectiveness of the training at the end day of the training
Q2	Why do you judge that?	We judge the training for two reasons: a) to assess the appropriateness of training and b) to improve training contents and quality

Appendix 2.4

NWSSTC Training Activities

National Water Supply and Sanitation Training Center
Training Activities

Year (2072/073)

S.No.	Description of Training	Date	Estimated Participant No.	Actual Participant No.
1	Operation and maintenance and meter Readers Training	2072/08/24 to 08/28	23	23
2	Water Sanitation and Hygiene for WW	2072/09/01 to 09/03	22	22
3	Gravity Flow System Design for Er.	2072/09/05 to 09/09	17	17
4	Water Supply Pumping System Design Training for Engineers	2072/09/13 to 09/17	16	21
5	Pipe Testing Training for Engineers	2072/09/27 to 09/29	20	20
6	Training on Standard Bidding Document Preparation and E bidding	2072/10/04 to 10/08	24	24
7	Operation and maintenance and meter Readers Training	2072/10/07 to 10/11	20	19
8	Ground Water Development Training for Engineers	2072/10/10 to 10/13	20	18
9	Water Supply System Maintenance and Plumbing	2072/10/18 to10/24	20	20
10	Water Supply and Sanitation Training for Users Committee	2072/10/25 to10/27	25	25
11	Water Supply and Sanitation Training for Users Committee	2072/11/02 to11/04	25	24
12	Sanitation and Health Training for Stakeholder	2072/11/05 to11/07	40	35
13	Sewerage Network Design Training for Engineers	2072/11/12 to11/14	16	15
14	Advance Level Eplanet Training for SDE and Engineers (WOP)	2072/11/16 to11/19	16	16
15	Total Sanitation Training for Muucipality Staff	2072/12/14 to12/16	30	28
16	Total Sanitation Training for	2072/12/17 to12/19	42	42

Appendix 2.5

NWSSTC Initial Trainers List

Appendix B2 Trainers List of NWSSTC

Name	Organization	Position	Field of Specialization	Remarks
Ministry of water Supply and Sanitation (MoWSS)				
Mr. Rajan Raj Pandey	MoWSS	Joint Secretary	WaSH Policies, WaSH Sector Development Plan, EIA/IEE, Disaster and Climate Change	
Mr. Ram Chandra Devkota	MoWSS	Joint Secretary	WaSH Sector Policies and Water Safety Plan	
Mr. Hari Prasad Timilseena	MoWSS	SDE	WaSH Sector Development Plan and Water Supply System Design	
Department of Water Supply and Sewerage (DWSS)				
Mr. Tej Raj Bhatt	DWSS	DG	Project Management	
Mr. Sunil Kumar Das	DWSS	DDG	Water Safety Plan	
Mr. Manoj Ghimire	DWSS	DDG	Disaster Management	
Mr. Kabindra Bikraam Karki	DWSS	Chief/ NWSSTC	WaSH Policies, WaSH Sector Development Plan, Disaster, Climate Change and Monitoring	
Mr. Kiran Darnal	DWSS	SDE	Water Quality, Water Safety Plan, Disaster and Climate Change	
Mr. Narayan Prasad Khanal	DWSS	SDE	Water Quality and Water Safety Plan	
Mr. Prem Krishna Shrestha	DWSS	SDE	ODF, Urban Sanitation and Ecological Sanitation	
Mr. Kamal Adhikari	DWSS	Sociologist/ NWSSTC	Sanitation and Hygiene Master Plan, Strategic Plan, ODF, total Sanitation, GESI and Sector Triggering	
Mr. Bhojendra Aryal	DWSS	Sociologist	Sanitation and Hygiene Master Plan, ODF, GESI and Total Sanitation	
Dr. Kamal Raj Sharma	DWSS	Sociologist	ODF, Research on WASH and Community Empowerment	
Ministry of Federal Affair and Local Development (MoFALD)				
Mr. Chakra Pani Sharma	MoFALD	Under Secretary	Environment Friendly Local Governance	
Rural Water Supply and Sanitation Fund Development Board (RWSSFDB)				
Ms. Deepa Shakya	RWSSFDB	GESI Expert	GESI in WASH	
UNICEF Nepal				
Ms. Arinita Maskey	UNICEF Nepal	Disaster and Climate Change	Disaster Management	
CARE Nepal				

Name	Organization	Position	Field of Specialization	Remarks
Mr. Guna Raj Shrestha	CARE Nepal	Consortium Manager	WASH Policies , Sanitation Marketing and Menstrual Hygiene Management	
SEBAC Nepal				
Mr. B.B. Thapa	USAID/SEBAC Nepal	Chief of Party	ODF, Training, GESI and linkage of WASH and Health	
FEDWASUN				
Ms. Rita Katuwal	FEDWASUN	GESI Expert	GESI in WASH	
Freelancer				
Mr. Nawal Kishor Mishra	Freelancer	WASH Expert	WASH Policies, Training and Ecological Sanitation	
Mr. Rajeeb Ghimire	Freelancer	WASH expert	WaSH Sector Development Plan, Business Plan, Water Supply System Design, Monitoring and Evaluation	
Mr. Ramesh Kumar Adhikari	Freelancer	Governance Expert	Governance in WASH and Motivation	
Mr. Nam Raj Khatri	Freelancer	WASH Expert	Water Supply System Design, Water Safety Plan and IEE/EIA	
Mr. Namaste Lal Shrestha	Freelancer	Sanitation and Hygiene Expert	ODF, WASH in School, Hygiene, Training and Life Skills Based Hygiene Education	
Mr. Prem Nidhi K.C	Freelancer	GESI Expert	GESI, Training and WASH in School	
Mr. Mukti Pokhrel	Freelancer	Disaster, Sanitation and Hygiene Expert	Disaster, ODF, WASH in School, Hygiene, Training and Life Skills Based Hygiene Education	
Mr. Bal Krishna Pokhrel	Freelancer	WASH Governance	WASH Governance and Water	
Mr. Keshab Lochan Sharma	Freelancer	Training Expert	ODF and Training	
Mr. Bishwa Nath Paudyal	Freelancer	Governance and Research Expert	Governance and Research on WaSH	
Mr. Rabin Bastola	Freelancer	IEE/EIA Expert	IEE/EIA and Knowledge Management	
Mr. RaJendra Shakya	Freelancer	Disaster Management Expert	Disaster Management and Contingency Plan	

Appendix 2.6

Equipment List of the NWSSTC Laboratory

Equipment List of NWSSTC Laboratory

29/11/2016, JICA WASMIP Team

No.	Name	Specification	Manufacturer	Parameter	Q'ty	Photo	Operating Situation
1	Centrifugal Machine	Model: R8C	REMI	---	1		Not available
2	Serological Water Bath	---		---	1		Not available
3	pH Meter	Model: pH 526	WTW	pH	1		Available
4	Colori Meter	Model: CL 157	ELICO	Chemical parameter	1		Not available
5	Turbidity Meter	Model: CL 52D Range / Accuracy: 0-200 NTU / 3% of range, 200-1,000 NTU / Non linear	ELICO	Turbidity	1		Available
6	Muffle Furnace	---	TOSHIBHA	---	1		Available
7	Jar Tester	---	---	(Jar Test)	1		Available
8	Heating Plate	---	---	---	1		Available
9	Magnetic Stirrer	---	---	---	1		Available
10	Water Testing Kit -1	---	DelAqua	E.Coli, Total Coliform, Turbidity, Residual Chlorine, pH	1		Available
11	Water Testing Kit -2	POTATEST	Wagtech	E.Coli, Total Coliform, Turbidity, Residual Chlorine, pH	1		Available

No.	Name	Specification	Manufacturer	Parameter	Q'ty	Photo	Operating Situation
12	Microscope	---	---	(Microorganism)	1		Not available
13	Arsenic Test Kit	Cat. No.2800000	HACH	Arsenic	1		Available

* Parameter shall be confirmed.

Appendix 2.7

Nepalganji Regional Laboratory

Summary of Site Survey Result

Facility Name	Nepalganj Regional Laboratory	Date	28/07/2016

< Result >

1. **Lack of manpower**; Only one assistant chemist is working. (Chemist is studying in USA now)

2. **Lack of skill** ; Assistant Chemist seems not to have enough skill and experience of water quality analysis.

Assisntant Chemist has been instructed by only one week training at DWSS Labo.

Therefore, the analytical accuracy is supposed to be doubtful.

3. **Lack of equipment and materials** ; Total 12 parameters can be measured.

5 physical parameters; TDS, Turbidity, EC, Color, pH

5 chemical parameters; Total Hardness, Calcium Hardness, Ammonia, Iron, Arsenic

2 biological parameters; Total Coliforms, E.Coli.

4. **Maintenance of instruments are not enough** ; as shown in Photo 3 and 4.

< Photos>

Photo 1: Full view of building

Photo 2: Spectrophotometer

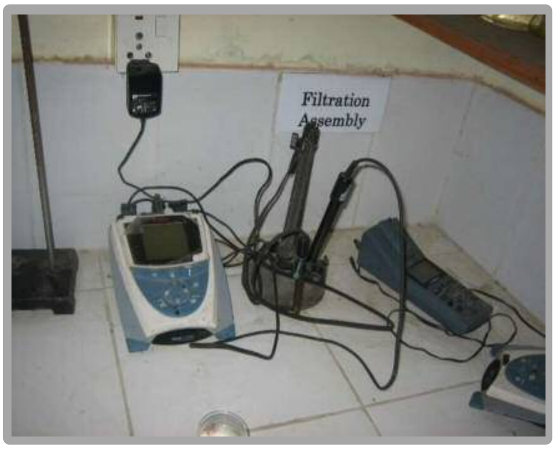


Photo 3: EC meter

Photo 4: Test Kit

Appendix 2.8

Data and Information obtained from Baseline Survey of Target A WUSC

Appendix B3 The data and information obtained from baseline survey of Target-A WUSC

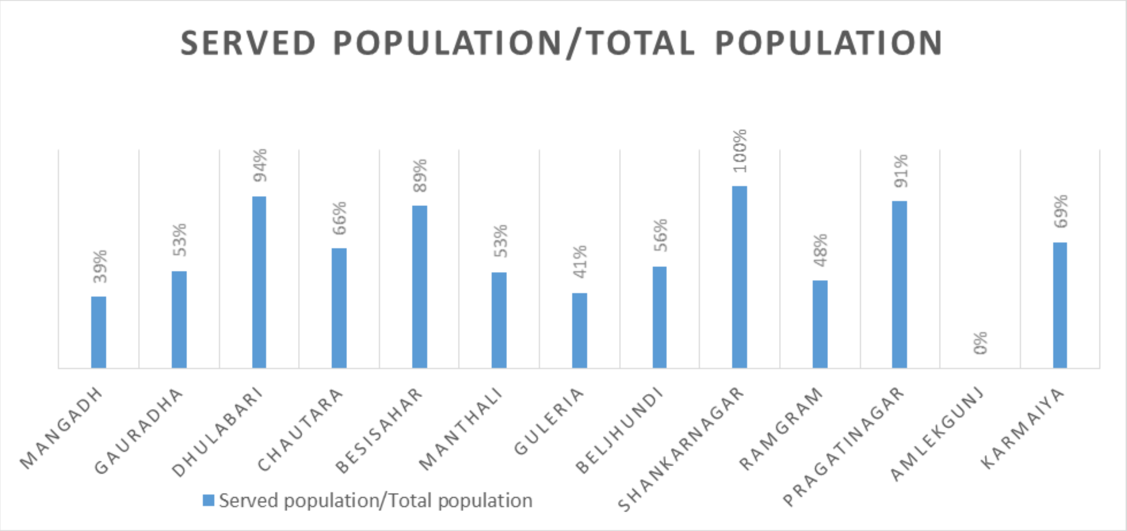


Figure 1 Served population/Total population in 13 Plot WUSCs

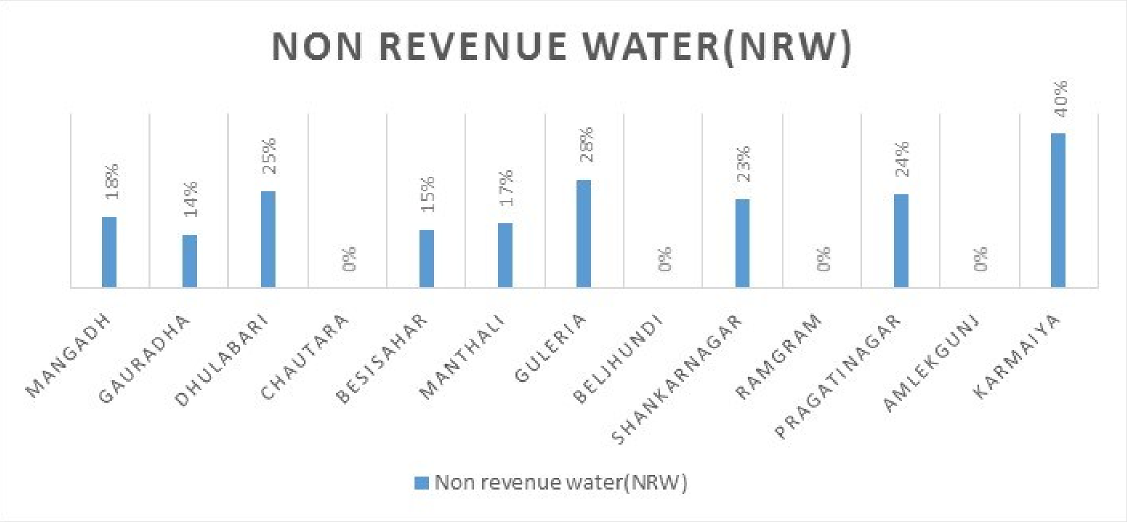


Figure 2 Non revenue water ratio in 13 Pilot WUSCs

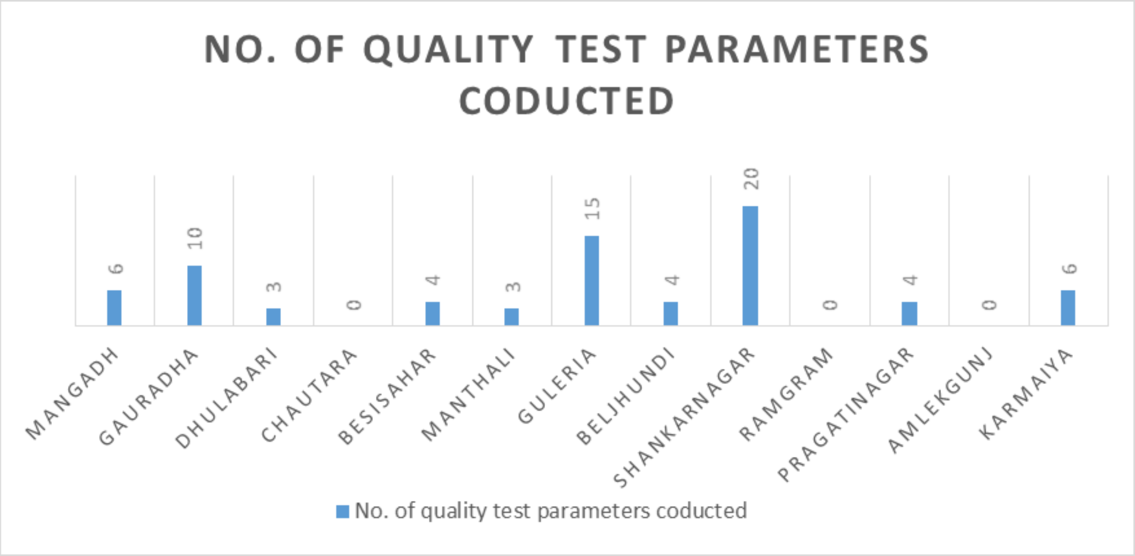


Figure 3 The number of water quality test parameters in 13 Pilot WUSCs

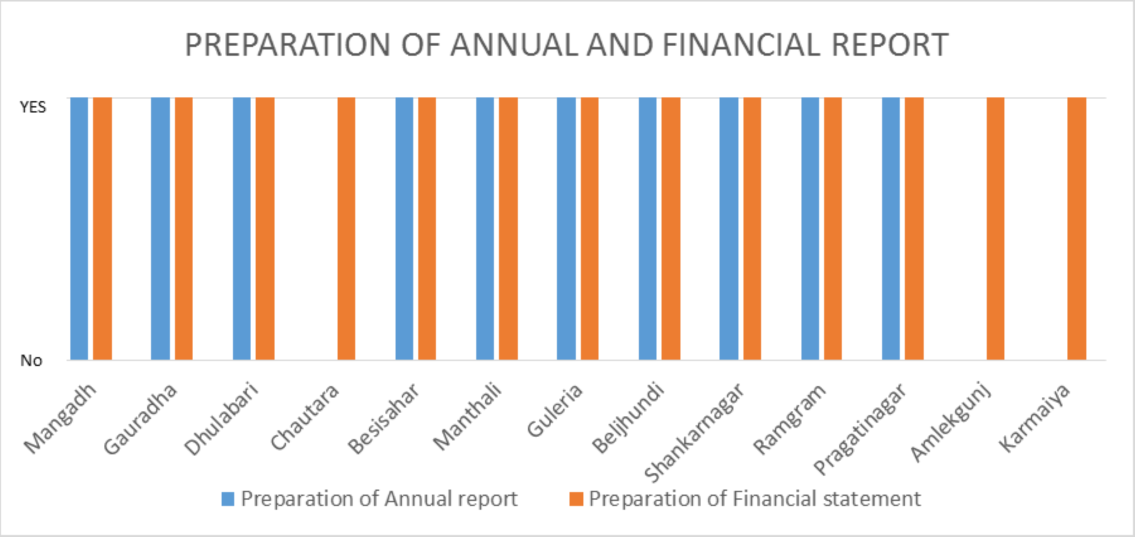


Figure 4 Preparation of annual and financial report in 13 Pilot WUSCs

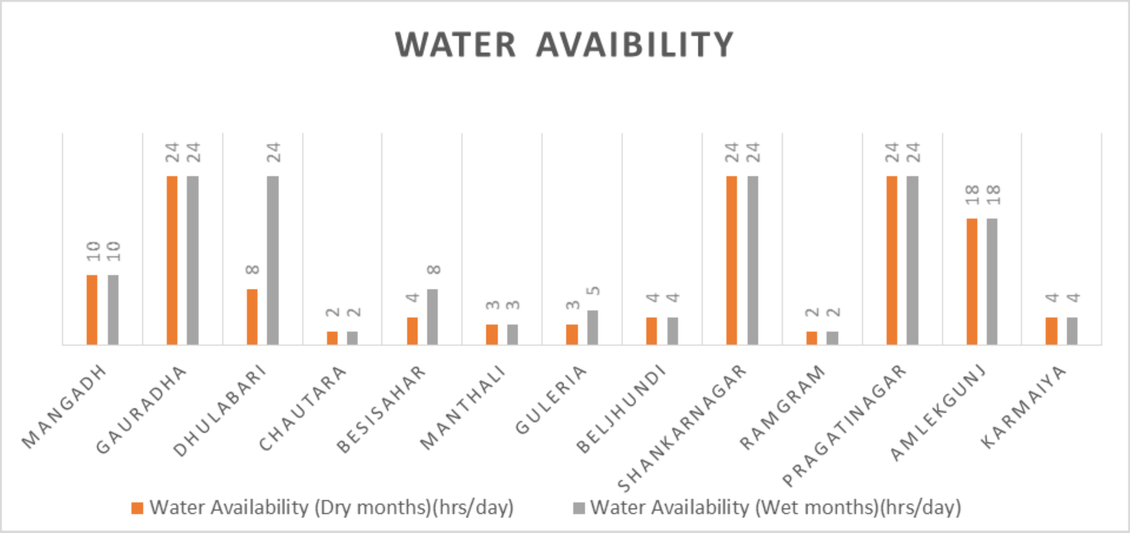


Figure 5 Water availability in 13 Pilot WUSCs

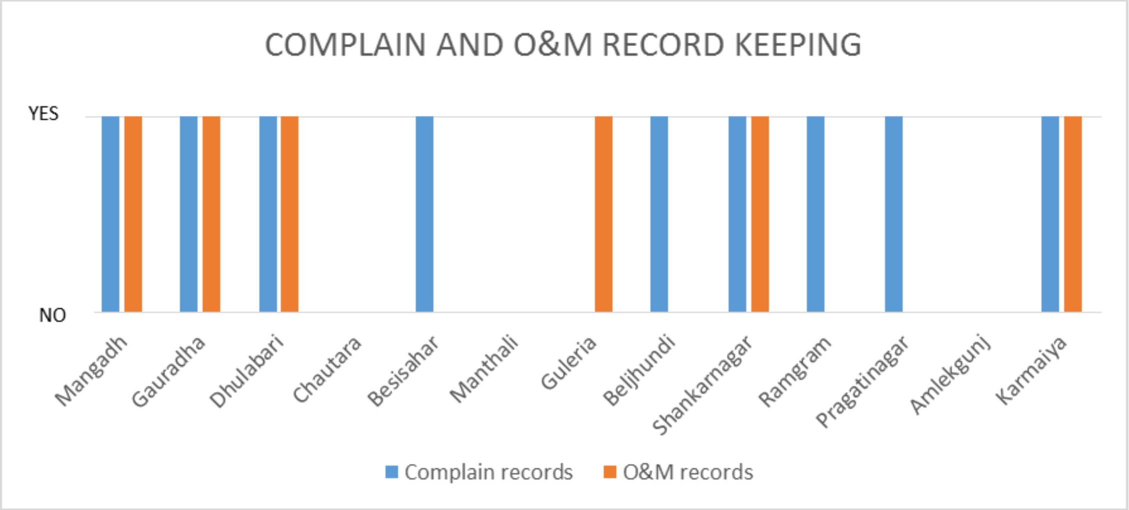


Figure 6 Complain and O&M record Keeping on 13 Pilot WUSCs

Appendix 2.9

Target A WUSC Site Photos

Photo-1 Mangadh WUSC on July 4 2016

Population: 69,436 persons
Served Population: 27,144 persons
Served Population percentage: 39%
No. of Connections: 3,500
Staff Number: 15 persons

Treatment Process
Groundwater → Well pump → Aeration Tank → Pressure Sand filter → Clear Water Reservoir → Booster pump → Elevated

Photo-2 Mangadh WUSC on July 4 2016

Malfunction of the Inlet Flow meter
(Japanese product)

Photo-3 Mangadh WUSC on July 4 2016

Malfunction of the Outlet Flow meter
(Japanese product)

Photo-4 Mangadh WUSC on July 4 2016

Chlorination dosing equipment
Dosing controller is out of order

Photo-5	Mangadh WUSC on July 4 2016

Supports are covered with rust
WUSC maintains the supports with rustproof

Photo-6	Mangadh WUSC on July 4 2016

Water quality test results on the Windows
WUSC informs the results of consumers

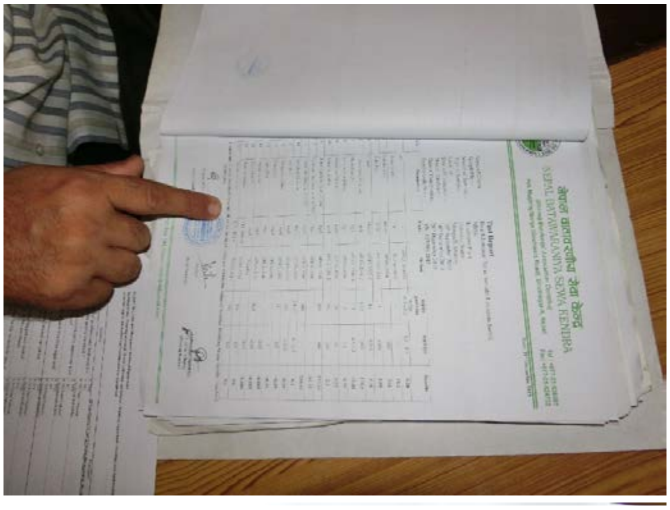


Photo-7	Mangadh WUSC on July 4 2016

Water quality test results

Photo-8 Gauradaha WUSC on July 5 2016

Population: 20,155 persons
Served Population: 10,740 persons
Served Population percentage: 53%
No. of Connections: 1,790
Staff Number: 7 persons

Treatment Process
Groundwater → Well pump → Aeration Tank → Pressure Sand filter → Clear Water Reservoir → Booster pump → Elevated

Photo-9 Gauradaha WUSC on July 5 2016

Media for the aeration tank

Photo-10 Gauradaha WUSC on July 5 2016

Sand for the pressure tank

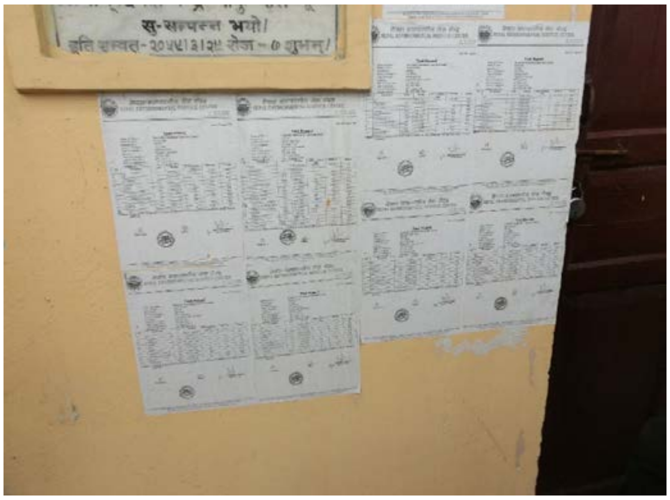


Photo-11 Gauradaha WUSC on July 5 2016

Water quality test results in the tariff window

Photo-12　Gauradaha WUSC on July 5 201

Cylinder of the Compressor pump

Photo-13　Gauradaha WUSC on July 5 201

Compressor pump

Photo-14　Gauradaha WUSC on July 5 201

Chlorine Tank

Photo-15　Gauradaha WUSC on July 5 201

Feeding pipe for chlorine is set temporary (NO flange)

Photo-16 Gauradaha WUSC on July 5 2016

Proper connection with the flanges

Photo-17 Gauradaha WUSC on July 5 2016

Power generator

Photo-18　Dhulabari WUSC

Population: 25,200 persons
Served Population: 23,800 persons
Served Population percentage: 94%
No. of Connections: 3,500
Staff Number: 24 persons

Treatment Process
Surface water/Groundwater → Receiving Basin → Sedimentation Basin → Roughing Filter → Slow Sand Filter → Reservoir → Distribution

Photo-19　Dhulabari WUSC on July 6 2016
In the existing elevated tank site (Magurmari
Electrical panel for the power generator
In 2012, the panel burned, probably, an overcurrent by a lightning was caused

Photo-20　Dhulabari WUSC on July 6 2016

In the existing elevated tank site (Magurmari

Chlorination equipment dose not work now because groundwater dried up in the existing deep tube well .

Photo-21　Dhulabari WUSC on July 6 2016
In the existing elevated tank site (Magurmari
Treatment Process
Groundwater → Well pump → Elevated Tank → Distribution

The existing deep tube well transmission pip

The groundwater is depletion. Now, stop the operation.

Photo-22 Dhulabari WUSC on July 6 2016

In the existing elevated tank site (Magurmari

Recommendation; the dosing chlorine point reconnects to new deep tube well.

Photo-23 Dhulabari WUSC on July 6 2016

WTP site

Chlorination tank
Dosing control is out of order

Photo-24 Dhulabari WUSC on July 6 2016

WTP site

Chlorine mixer motor is out of order

Photo-25 Dhulabari WUSC on July 6 2016

WTP site

Chlorination equipment Supports are rusted

Photo-26 Dhulabari WUSC on July 6 2016

Intake site

Gabions are set to protect the intake facility from a landslide

Photo-1 Sindhupalchok WSSDO on July 10, 2016

Office is under construction

Photo-2 Sindhupalchok WSSDO on July 10, 2016

Submersible pumps for WUSC's projects
But Not for Chautara WUSC

Photo-3 Chautara WUSC on July 10, 2016

Receiving pit from intakes

Population: 32,000 persons
Served Population: 3,000 persons
Served Population percentage: 9%
No. of Connections: 875
Staff Number: 21 persons

Raw water transmission: 24 km from the Intake sites

Photo-3-1 Chautara WUSC on September 11, 2016

Receiving pit from Intakes
Transmitted water coming from 4 intakes by 2 pipes flows into the receiving pit.
Water goes to the roogh sand filter throgh the channel.
By-pass line is used when the WTP shuts down for clean-up each tank.

Photo-4 Chautara WUSC on July 10, 2016

Roughing Filter

Treatment Process
No.1: Surface water → Receiving Basin → Sedimentation Basin → Roughing Filter → Slow Sand Filter → Reservoir → Distribution

No.2: Surface water → Reservoir → Distribution (temporary)

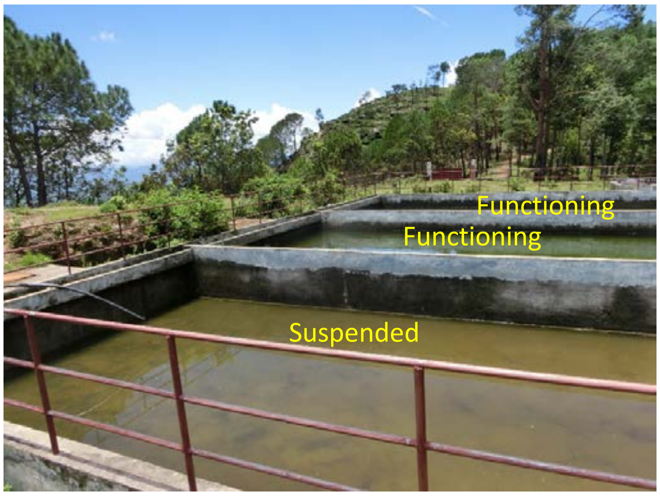


Photo-5 Chautara WUSC on July 10, 2016

Slow Sand Filter

Due to the earthquake, the slow sand filter was damaged and caused leakage. Two basins of three are

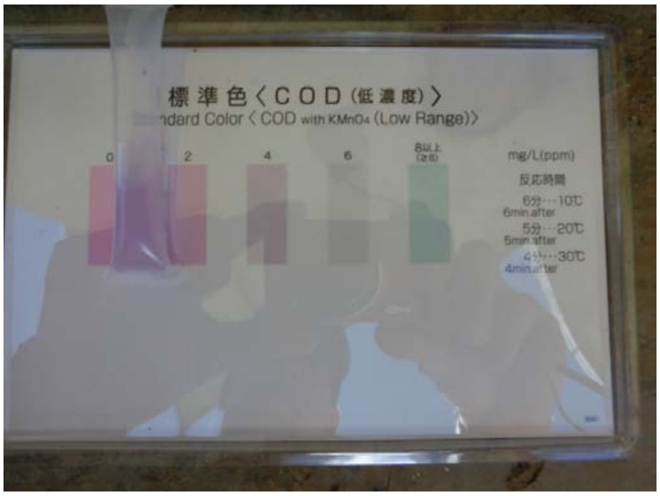


Photo-6 Chautara WUSC on July 10, 2016

Raw water quality test
COD: 1-2 mg/L

Photo-7 Chautara WUSC on July 10, 2016

Ground Service Reservoir: 24 m3 at WTP

The water from the slow sand filter and bleaching tank enters the reservoir.

Photo-8 Chautara WUSC on July 10, 2016

The water is transferred to the other reservoir located in Laxman Dada.

Laxman Dada Reservoir: 100 m3

Photo-9 Chautara WUSC on July 10, 2016

JICA Expert and National staff conducts the questionnaire survey to Chautara WUSC chair person.

Photo-10 Chautara WUSC on July 10, 2016

Outlet chamber of the reservoir at WTP

There is NO flow meter.

Photo-11 Chautara WUSC on July 10, 2016

Bleaching Powder Solution Tank

No regular dosing chlorine. The dosing is done by every 3 days in rainy season but it is not frequent in

This tank is used temporaly when the slow sand silter basins are maintained.

Photo-12 Chautara WUSC on September 11, 2016
Chlorine is injected on the top of the chamber.(red arrow)
It conducted once in a week.
Existing chrolination facility is abondoned because of mechanical miulfunction.

Photo-13 Chautara WUSC on September 11, 2016

Each basin has outlet pipe, overflow pipe and wash-out pipe.
Outlet pipe in each basin meets in the chamber shown on photo 12.

Photo-14 Chautara WUSC on September 11, 2016

Chrolinated water is devided to two lines.
One goes to a reservior in the WTP and the other goes t
a reservoir near WSSDO office.
Wash out pipe lays parallel to outlet line that goes to the reservior in the WTP.

Photo-15 Chautara WUSC on September 11, 2016

Treated water from the WTP comes in the reservior near WSSDO office.
Some of treated water from the WTP is distributed to 5 areas before it flows into the reservior.
Water meter is installed in each household except millitary camp.

Photo-16 Chautara WUSC on September 11, 2016

Stored water in the reservior is distributed to 7 distribution water lines.

Photo-1 Besisahar WUSC on July 13, 2016

Deep Tube Well at the WUSC office
There is NO Flow meter

Photo-2 Besisahar WUSC on July 13, 2016

Receiving Pit in Water Treatment Plant
There is NO Flow meter

Photo-3 Besisahar WUSC on July 13, 2016
Receiving Pit inside & 2 Raw water Transmission Pipes
There are NO Flow meters

Photo-4 Besisahar WUSC on July 13, 2016

Sedimentation Tank

Photo-5 Besisahar WUSC on July 13, 2016

Rough Filter

Photo-6 Besisahar WUSC on July 13, 2016

Slow Sand Filter separated from the sedimentation tank & rough filter site

Photo-7 Besisahar WUSC on July 13, 2016

4 Reservoirs next the slow sand filter

2 Reservoirs from the slow sand filter
1 Reservoir from Deep Tube Well
1 Reservoir from different intake

Photo-8 Besisahar WUSC on July 13, 2016

Chlorine dosing equipment at the reservoir site
The delivery pipe is clogging
Currently, breaching powder is dosed by manual

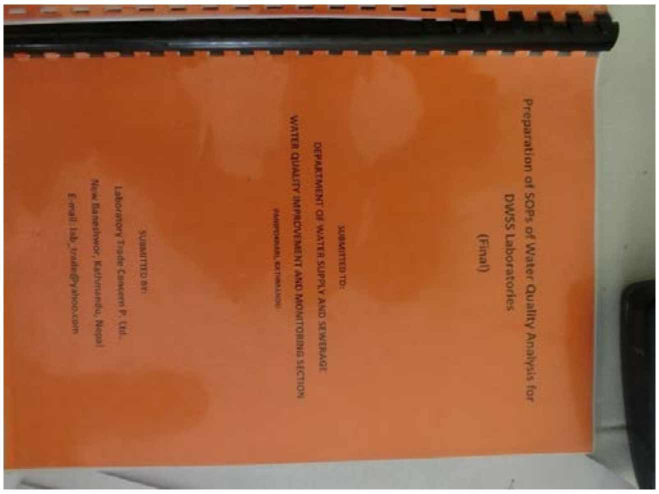
Photo-9 Besisahar WUSC on July 13, 2016

Reservoir outlet pipes
5 transmission pipes per reservoir, the pipes have different service areas

Photo-10 Western RMSO on July 14, 2016

Water Quality Laboratory funded by DWSS

16 parameters have been tested in the Laboratory



Preparation of SOPs of Water Quality Analysis for
DWSS Laboratories
(Final)

SUBMITTED TO:
DEPARTMENT OF WATER SUPPLY AND SEWERAGE
WATER QUALITY IMPROVEMENT AND MONITORING SECTION

SUBMITTED BY:
Laboratory Trade Concern P. Ltd.
New Baneshwor, Kathmandu, Nepal
E-mail: lab_trade@yahoo.com

Photo-11 Western RMSO on July 14, 2016

SOPs of the Water Quality Test by "Laboratory Trade Concern P. Ltd."

Photo-12 Western RMSO on July 14, 2016

Mobile Type Water Quality Test Kit provided by WHO
Every year 10-20 sets to WUSC

Photo-1 Manthali WUSC on July 22, 2016

Water Distribution Map

Population: 20,000 persons
Served Population: 2,864 persons
Served Population percentage: 14%
No. of Connections: 716
Staff Number: 7 persons

Photo-2 Manthali WUSC on July 22, 2016

Receiving Pit & Sedimentation Tank

Treatment Process
No.1 Surface water → Receiving Basin → Sedimentation Basin → Roughing Filter → Slow Sand Filter → Reservoir → Distribution

Water from Bhalua khola (spring) and lampate khola (stream) is conveyed to the slow sand filter

Photo-3 Manthali WUSC on July 22, 2016

Receiving Basin

There is NO flow meter in inlet and outlet pipes.

Photo-4 Manthali WUSC on July 22, 2016

Sedimentation Tank

Photo-5 Manthali WUSC on July 22, 2016

Slow Sand Filter basin

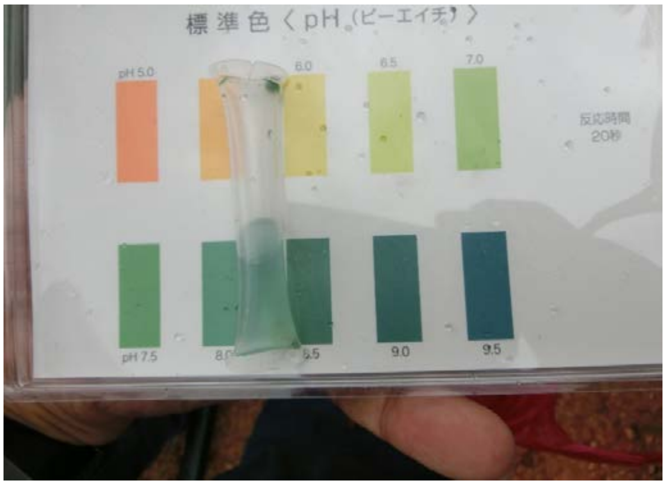


Photo-6 Manthali WUSC on July 22, 2016

pH: 8.0 -8.5 in raw water

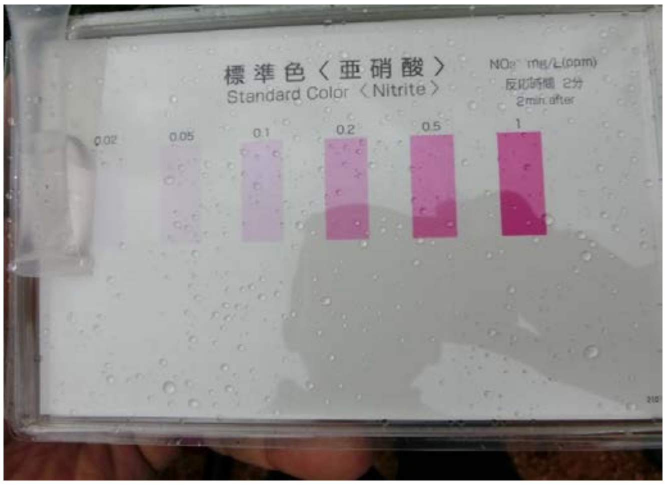


Photo-7 Manthali WUSC on July 22, 2016

NO2-N: below 0.02 mg/L in raw water

Photo-8 Manthali WUSC on July 22, 2016

COD: 0-2 mg/L in raw water

Photo-9 Manthali WUSC on July 22, 2016

Outlet chamber of the slow sand filter

Photo-10 Manthali WUSC on July 22, 2016

Distribution pipelines from the reservoir

Photo-11 Manthali WUSC on July 22, 2016

Outlet chamber in the reservoir

There are 4 distribution pipes and connected another reservoir.

Photo-12 Manthali WUSC on July 22, 2016

The reservoir at WTP site is under construction due to earthquake.

Reservoir Capacity: 200 m3

Photo-13　Manthali WUSC on July 22, 2016

Reservoir outside WTP

Photo-14　Manthali WUSC on July 22, 2016

Outlet chamber at the reservoir

Photo-15　Manthali WUSC on July 22, 2016

Another reservoir outsdide WTP

Distribution networks are very complicated.

See Network Diagram

Photo-16　Manthali WUSC on July 22, 2016

4 outlet pipes from another reservoir

In order to measure supplied water, at least 7 flow meters shall be installed in different inlet and outlet

Photo-17 Manthali WUSC on July 22, 2016

There are presently 3 type of water sources which are spring, stream and shallow wells.

Photo-18 Manthali WUSC on July 22, 2016

Battichaur-1 Well with 110mm GI

Photo-19 Manthali WUSC on July 22, 2016

Battichaur-2 Well with 50mm HDPE

Photo-20 Manthali WUSC on July 22, 2016

New shallow well under construction (Not connected to the supply system)

Photo-21 Manthali WUSC on July 22, 2016

Electric panel for Battichaur well pumps

Fan is needed to cool inside.

Photo-22 Manthali WUSC on July 22, 2016

The transsmission pipe will be connected to the new well.
Pipe dia. 110 mm GI

Photo-23 Manthali WUSC on July 22, 2016

Akase shallow well was constructed 10 years ago.

Photo-24 Manthali WUSC on July 22, 2016

Inside Akase well

Photo-25 Manthali WUSC on July 22, 2016

Reservoir outside TWP

Photo-26 Manthali WUSC on July 22, 2016

Outlet pipes in the chmber

Photo-27 Manthali WUSC on July 22, 2016

Flow meters in WUSC's store

These meters are NOT installed in the transmission/distribution pipes.

WSSDO has NOT conducted the needs assesment to WUSC.
Some flow meters should be installed to measure distributed water.

Photo-1 Beljhundi WUSC on July 27, 2016

Population: 29,991 persons
Served Population: 16,783 persons
Served Population percentage: 56%
No. of Connections: 1,000
Staff Number: 8 persons

WTP construction year: 1977 (A.D.)

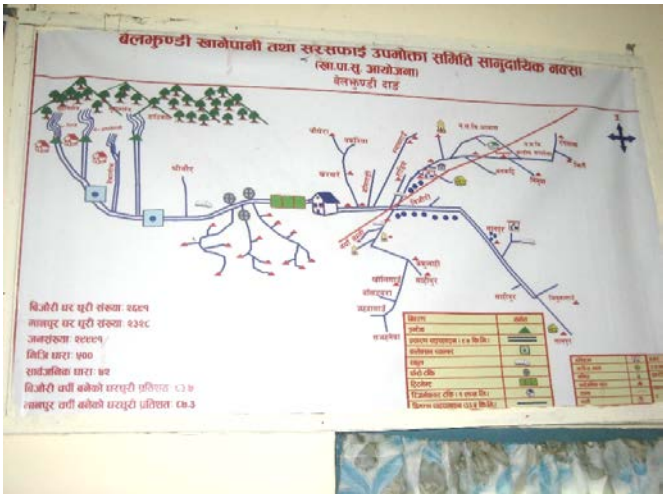


Photo-2 Beljhundi WUSC on July 27, 2016

Water resources: 2 stream water, 1 spring water
Raw water Transmission pipeline (from Intake to Reservoir): approx. 12.6 km

Distribution pipeline: approx. 44.8 km

Handover from GoN: in September 1999

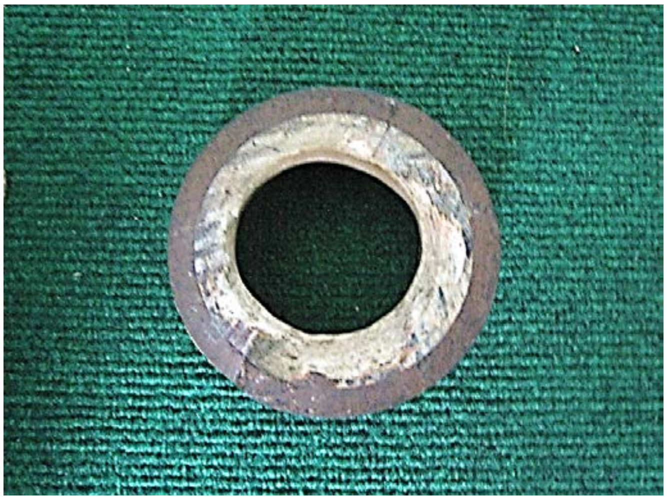


Photo-3 Beljhundi WUSC on July 27, 2016

Lime and Calcium in the raw water

Adhesion of lime and calcium inside pipe (section of pipe)

Photo-4 Beljhundi WUSC on July 27, 2016

Receiving and Sedimentation Basin

Treatment Process

Surface water → Receiving Basin → Sedimentation Basin → Roughing Filter → Slow Sand Filter → Reservoir →

Photo-5 Beljhundi WUSC on July 27, 2016

Roughing Filter

Photo-6 Beljhundi WUSC on July 27, 2016

Currently, after roughing filter, water bypasses slow sand filter

Within 10 NTU in water, slow sand filter can be used. (Recommendation)

Photo-7 Beljhundi WUSC on July 27, 2016

Slow Sand Filter
2 basins

Photo-8 Beljhundi WUSC on July 27, 2016

Outlet chamber after slow sand filter

Two overflow pipes and an outlet pipe

No Chlorination in WTP
No Flow meter in WTP

Photo-9 Beljhundi WUSC on July 27, 2016

Sand wash tanks

Photo-10 Beljhundi WUSC on July 27, 2016

7 reservoirs in the service area

After WTP, 200 m3 Reservoir

No Chlorination in Reservoir
No Flow meter in Reservoir

Photo-11 Beljhundi WUSC on July 27, 2016

After WTP, 200 m3 Reservoir
Currently Not operation

No Chlorination in Reservoir
No Flow meter in Reservoir

Photo-12 Beljhundi WUSC on July 27, 2016

After WTP, 14 m3 Reservoir

Ferro cement Tank (Reservoir): 14 m3

No Chlorination in Reservoir

Photo-13 Beljhundi WUSC on July 27, 2016

No Flow meter in Reservoir

Photo-14 Beljhundi WUSC on July 27, 2016

Spare parts in WUSC
WUSC mages the inventory of spare parts

Photo-15 Beljhundi WUSC on July 27, 2016

Water quality tests are conducted in their laboratory by the staff. The staff has received a training to use the wagtech kit provided by the WHO.

Beljhundi Khanepani
Dang
Lab Test

S.N.	Name	Turbidity	P.H.	F.R.C.	E-Coil	Date
(i)	Manpur Public	5 N T.u	7.36	0.2	6 CFU per 100 ml/-	2072-08-07
(ii)	Kholigaun Public	5 N T.u	7.32	0.2	2 CFU per 100 ml /-	2072-08-07
(iii)	Pakriya Public	5 N T.u	7.34	0.1	2 CFU per 100 ml /-	2072-08-07
(iv)	Bijauri Public	5 N T.u	7.33	0.1	4 CFU per 100 ml /-	2072-08-07
(v)	Bankatti Public	5 N T.u	7.29	0.1	7 CFU per 100 ml /-	2072-08-07
(vi)	Hemantapur Public	5 N T.u	7.35	0.1	2 CFU per 100 ml /-	2072-08-07

Pradeep Gautam
Chairman

Madan
Madan Mani Pokhrel
Chief of office

Photo-16 Beljhundi WUSC on July 27, 2016

Water Quality Test results records

Photo-1 Gulariya WUSC on July 28, 2016

Service area

Population: 55,747 persons
Served Population: 23,081 persons
Served Population percentage: 41%
No. of Connections: 1,150
Staff Number: 7 persons

Elevated Tank construction year: 1981 (A.D.)

Photo-2 Gulariya WUSC on July 28, 2016

No.1 deep tube well
125m depth

Groundwater → Well pump → Elevated Tank → Distribution

Photo-3 Gulariya WUSC on July 28, 2016

No.2 deep tube well
125m depth

Photo-4 Gulariya WUSC on July 28, 2016

Presence of sand in the raw water in main problem.

Photo-5 Gulariya WUSC on July 28, 2016

Abandoned well pump
The pump suctions sand from groundwater.

Photo-6 Gulariya WUSC on July 28, 2016

Elevated Tank: 225m3, 21m height

Water supply: 5 hours/day

No chlorination
Distribution pipeline: approx. 42 km
No washout facility in the distribution pipeli

Photo-7 Gulariya WUSC on July 28, 2016

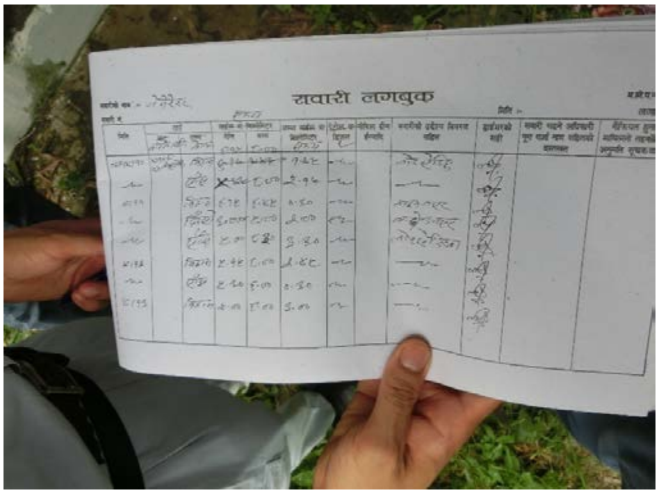
Outlet flow meter was additionally installed in the main distribution pipeline.

Distributed volume has been recorded for once a month only.

Photo-8 Gulariya WUSC on July 28, 2016

Generator

WUSC has the invoice of procurement of spare parts for the generator.



सवारी लगबुक

Photo-9 Gulariya WUSC on July 28, 2016

Record of daily operation hours and fuel consumption

Photo-10 Gulariya WUSC on July 28, 2016

WASMIP Team instructed how to solve dead ends in the distribution pipelines with WASMIP Model.

Photo-1 Shankarnagar WUSC on August 8, 2016

Population: 50,000 persons
Served Population: 50,000 persons
Served Population percentage: 100%
No. of Connections: 4,650
Staff Number: 15 persons

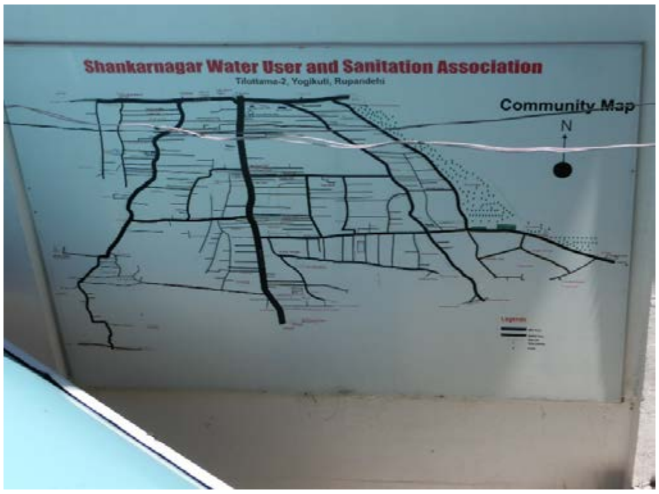


Photo-2 Shankarnagar WUSC on August 8, 2016

Distribution Map

Area: 50km2
Pipeline length: approx. 200km

Groundwater → Well pump → Elevated Tank → Distribution

Photo-3 Shankarnagar WUSC on August 8, 2016

Service area

There are 4 deep tube wells. No.1, 3, 5 are in office premise, No.4 is in nearby school premise. No.2 is out of order.

Another new deep tube well is under construction with co-financing project

Photo-4 Shankarnagar WUSC on August 8, 2016

No.1 DTW: 20 L/sec, 100m depth, 12.5 HP

Photo-5 Shankarnagar WUSC on August 8, 2016

No.2 DTW: Out of order

Photo-6 Shankarnagar WUSC on August 8, 2016

No.3 DTW: 35 L/sec, 96m depth, 35 HP

The flow meter is leaning at an angle of approximately 20 degrees.
It is a cause of malfunction due to plastic abrasion in gears/impeller

Photo-7 Shankarnagar WUSC on August 8, 2016

No.4 DTW: 40 L/sec, 95m depth, 33 HP

Photo-8 Shankarnagar WUSC on August 8, 2016

No.5 DTW: 35 L/sec, 105m depth, 33 HP

Photo-9 Shankarnagar WUSC on August 8, 2016

Elevated Tank: 450m3

Photo-10 Shankarnagar WUSC on August 8, 2016

Chlorine has been dosed to the inlet pipe
Mixing of the solution is done manually and dosed by automatic dosing pump.

Photo-11 Shankarnagar WUSC on August 8, 2016

New elevated tank: 450m3 with a flow meter in the design phase

Photo-12 Shankarnagar WUSC on August 8, 2016

Shankarnagar WUSC has their own laboratory.

Tests on 20 parameters

Photo-13 Shankarnagar WUSC on August 8, 2016

In the service area, 5 samples are taken every 15 days.

Water quality lab has no SOP to follow but they have employed a lab technician to carry out regular tests.

शंकरनगर खानेपानी उपभोक्ता तथा सरसफाई संस्था

पानी सुरक्षा योजना (WSP)

Water Quality Test Record

Analysis Date:

Sampling Location:

S.No क.सं	Parameters पारामिटरहरु	Units इकाई	NDWQS	[illegible]
1.	Turbidity धमिलोपना	NTU	5(10)	Clear
2.	Residual Chlorine क्लोरिन अवशेष	mg/l मि.ग्रा./लि.	0.1-0.2	0.2
3.	P^H हाइड्रोजन आयान	% प्रतिशत	6.5-8.5	7.5
	Total Coliforms कुल कोलिफर्म	P/A उपस्थित/अनुपस्थित	NIL	Nill

Photo-14 Shankarnagar WUSC on August 8, 2016

WUSC informs consumers of the water quality through the display board at the windows in the WUSC.

Photo-1 Ramgram WUSC on August 9, 2016

Service area

Population: 20,500 persons
Served Population: 9,808 persons
Served Population percentage: 48%
No. of Connections: 1,400
Staff Number: 6 persons

Photo-2 Ramgram WUSC on August 9, 2016

Groundwater → Well pump → Elevated Tank → Distribution

Photo-3 Ramgram WUSC on August 9, 2016

Elevated Tank : 225 m3

Photo-4 Ramgram WUSC on August 9, 2016

1 Deep tube well only (previously, there were 2 tube wells, the other is abandoned)

210m depth

Photo-5 Ramgram WUSC on August 9, 2016

Mixing of the solution is done manually
Dosing chlorine is done by automatic dosing pump

Photo-6 Ramgram WUSC on August 9, 2016

No flow meter

Photo-7 Ramgram WUSC on August 9, 2016

New Elevated Tank : 450 m3
Under construction

Co-finance project (70%: DWSS, 30%: WUSC)

Photo-8 Ramgram WUSC on August 9, 2016

New deep tube well
Under construction

Photo-1 Pragatinagar WUSC on August 10, 2016

Distribution Map

Population: 17,500 persons
Served Population: 16,000 persons
Served Population percentage: 91%
No. of Connections: 3,128
Staff Number: 12 persons

Photo-2 Pragatinagar WUSC on August 10, 2016

Intake site
Receiving basin
High turbidity in the rainy season

Treatment Process
No.1: Surface water → Receiving Basin → Sedimentation Basin → Roughing Filter → Slow Sand Filter → Reservoir → Distribution

No.2: Groundwater → Well pump → Reservoir → Distribution
No.3: Groundwater → Distribution

Photo-3 Pragatinagar WUSC on August 10, 2016

Cannel to Raw water transmission pipes
There is a net to remove rubbish (to avoid clogging of the pipes)

Photo-4 Pragatinagar WUSC on August 10, 2016

Sedimentation Basin

Surface water → Receiving basin → Sedimentation basin → Roughing filter → Slow sand filter → Reservoir → Distribution

Photo-5 Pragatinagar WUSC on August 10, 2016

Sedimentation Basin

Photo-6 Pragatinagar WUSC on August 10, 2016

Roughing filter

Photo-7 Pragatinagar WUSC on August 10, 2016

Roughing filter

Photo-8 Pragatinagar WUSC on August 10, 2016

Slow sand filter

Photo-9 Pragatinagar WUSC on August 10, 2016

Operator check turbidity in water by visual inspection without equipment.

In case that water is high turbidity, the operator in the intake inform another operator in the WTP and stop conveying water to the WTP. The operator in the WTP stars to operate the tube well pump in the WTP.

Photo-10 Pragatinagar WUSC on August 10, 2016

No water from the intake site

Photo-11 Pragatinagar WUSC on August 10, 2016

Slow sand filter

Photo-12 Pragatinagar WUSC on August 10, 2016

Reservoir A: 500m3

Photo-13 Pragatinagar WUSC on August 10, 2016

Installed Flow meter from the Reservoir A (500m3)

Difficult to access the meter for reading due to no ladder

Photo-14 Pragatinagar WUSC on August 10, 2016

Reservoir B: 100m3

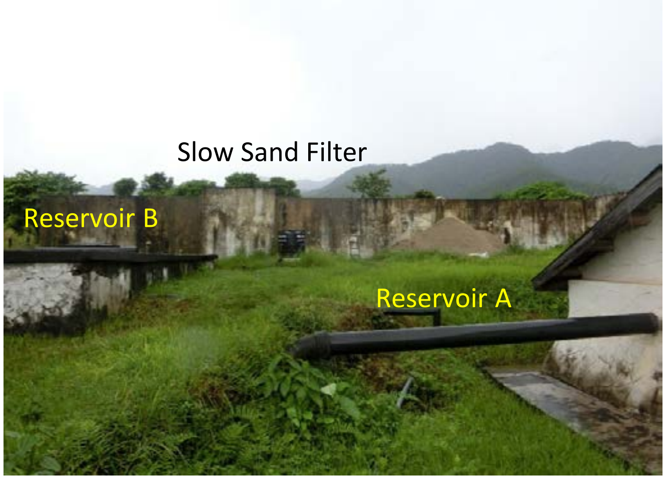


Photo-15 Pragatinagar WUSC on August 10, 2016

Reservoirs

Photo-16 Pragatinagar WUSC on August 10, 2016

Installed Flow meter from the Reservoir B (100m3)

Difficult to access the meter for reading due to no ladder

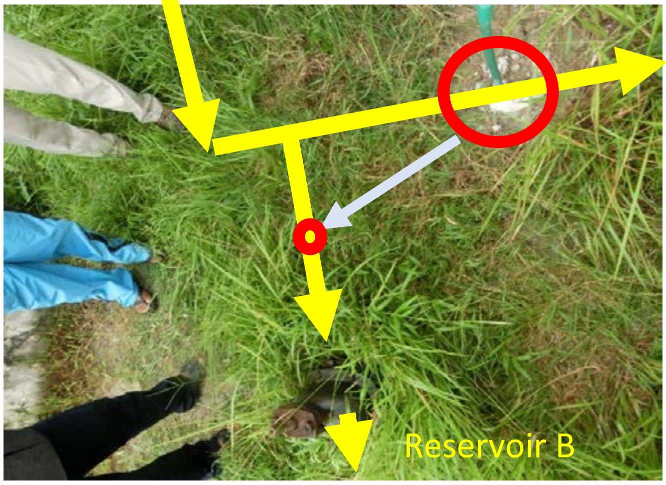


Photo-17　Pragatinagar WUSC on August 10, 2016

Chlorine dosing point

WASMIP advised WUSC to change the point

Photo-18　Pragatinagar WUSC on August 10, 2016

Quality test for residual chlorine at the Reservoir B

Photo-19　Pragatinagar WUSC on August 10, 2016

No residual chlorine at the Reservoir B

Photo-20　Pragatinagar WUSC on August 10, 2016

Residual chlorine is 0.8 mg/L at the Reservoir A

Photo-21　Pragatinagar WUSC on August 10, 2016

Deep tube well at the WTP
77m depth

Groundwater → Well pump → Reservoir

Photo-22　Pragatinagar WUSC on August 10, 2016

Overflow from the reservoir B
The operator closes the valve manually.

Photo-23　Pragatinagar WUSC on August 10, 2016

Deep tube well
WUSC does not connect the distribution pipelines
because raw water has high turbidity

Photo-1 Amlekhganj WUSC on August 29, 2016

Population: Approx. 4,400 persons
Served Population: 2,280 persons
Served Population percentage: 52%
No. of Connections: 570
Staff Number: 4 persons

Surface water → Reservoir → Distribution

Photo-2 Amlekhganj WUSC on August 29, 2016

Intake site
There are 4 spring sources.

Photo-3 Amlekhganj WUSC on August 29, 2016

Intake site access

There is no an access road to the intake sites.

Photo-4 Amlekhganj WUSC on August 29, 2016

Intake site

Photo-5 Amlekhganj WUSC on August 29, 2016

Intake site: spring source

Photo-6 Amlekhganj WUSC on August 29, 2016

Suspended raw water transmission pipes crossing the river.
It is unstable and fragile for floods and strong winds.

Photo-7 Amlekhganj WUSC on August 29, 2016

Ground Service Reservoir in the WUSC area

The reservoir was built approximately 120 years ago.

Capacity : 2,400 m3

Photo-8 Amlekhganj WUSC on August 29, 2016

Ground Service Reservoir

There are 4 inlet pipes (two 100mm, 75mm and 50mm, all HDPE) from transmission pipelines

Photo-9 Amlekhganj WUSC on August 29, 2016

Dosing is done manually by making a bleaching powder solution.

Photo-10 Amlekhganj WUSC on August 29, 2016

Bleaching powder

The dosing is done once a month and when high turbidity is observed.

Photo-11 Amlekhganj WUSC on August 29, 2016

Outlet chamber

Photo-12 Amlekhganj WUSC on August 29, 2016

There is no flow meter installed in inlet and outlet pipes.

Photo-13 Amlekhganj WUSC on August 29, 2016

There are 9 valves on the distribution pipe from the reservoir.

Photo-14 Amlekhganj WUSC on August 29, 2016

Distribution Pipe: 100mm HDPE needs to be installed a flow meter

Issues in Amlekhguni WUSC

1. No Flow meter
2. No water quality record
3. No Operation and Maintenance record

Photo-1 Karmaiya WUSC on August 29, 2016

Population: Approx. 9,700 persons
Served Population: 6,700 persons
Served Population percentage: 52%
No. of Connections: 1,487
Staff Number: 5 persons

Photo-2 Karmaiya WUSC on August 29, 2016

Elevated Tank: 450m3

Photo-3 Karmaiya WUSC on August 29, 2016

Service area

Issues:
1. High non-revenue water ratio
2. Need the public cooperation to find leakage water in the distribution pipes
3. The WUSC has asked the GoN to reimburse electric bills for pumping. No action has been taken.

Photo-4 Karmaiya WUSC on August 29, 2016

There are two deep tube wells under operation and 1 new tube well under construction

No.1 DTW: 4 L/sec, 110m depth, 35HP

Groundwater → Well pumps → Elevated Tank → Distribution

Photo-5 Karmaiya WUSC on August 29, 2016

No.2 DTW: 4 L/sec, 110m depth, 25HP

Photo-6 Karmaiya WUSC on August 29, 2016

No.1 DTW: 4 L/sec, 110m depth, 35HP

Photo-7 Karmaiya WUSC on August 29, 2016

No.2 DTW: 4 L/sec, 110m depth, 25HP

Photo-8 Karmaiya WUSC on August 29, 2016

No.3 DTW: 3 L/sec, 110m depth, 35HP (under construction)

Photo-9 Karmaiya WUSC on August 29, 2016

Chlorination equipment

Chlorine is fed by the pump to the elevated tank

The chlorine solution is prepared 2 times every day and dosed before supplying water to consumers because of 2 hours supplying x 2 times per day

Photo-10 Karmaiya WUSC on August 29, 2016

Feeding pipe from chlorination room to elevated tank

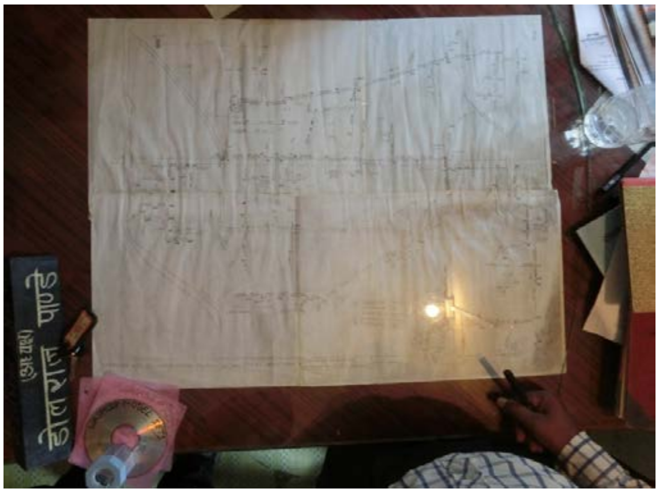


Photo-11 Karmaiya WUSC on August 29, 2016

Water distribution map

No indication of valves and washouts

Photo-12 Karmaiya WUSC on August 29, 2016

Water quality test kit

Tests on 4 parameters (pH, turbidity, color and residual chlorine)

Photo-13 Karmaiya WUSC on August 29, 2016

Flow meter recorded once a month

Recommendations;
1. Record of flow daily base
2. Removed water from the meter chamber
3. Control chlorine solution concentration
4. Clear the piping network in the WUSC
   4.1 Mark allow "→"
   4.2 Development of the network illustration
5. Repair the valves occurred leakage water
6. Rotating operation of the DTW pumps due to close

Appendix 2.10

Baseline Survey on Local Government, MoPID, WSSDO and FWSSMP

WASMIP Projects and Related Authorities.

S.N	Target WUSCs	District	Municipality/ Rural Municipality	Province No	MoPID	WSSDO	FWSSMP
1	Dhulabari	Jhapa	Mechi NP	1	Biratnagar	Jhapa	Biratnagar
2	Juropani		Gauradaha NP				
3	Gauradaha						
4	Shani-Arjun		Arjundhara NP				
5	Shivasatachhi		Shivasatachhi NP				
6	Garamani		Birtamod NP				
7	Topgachi -I		Kamal GP				
8	Topgachi -II						
9	Topgachi -III						
10	Chandragadhi-I		Bhadrapur NP				
11	Chandragadhi-II						
12	Prithvinagar(Gaurisankar)						
13	Mangadh	Morang	Biratnagar NP				
14	Jamuna Gachi						
	Pichhra						
15	Urlabari municipality		Urlabari NP				
16	Pathari- Sanichare municipality		Pathari Sanischare NP				
17	Rangeli municipality		Rangeli NP				
18	Tankisnuwari		Budiganga GP				
19	Ithara		Ratuwamai NP				
20	Madhumalla		Miklajung GP				
22	Bayerban		kanepokhari GP				
23	Sorabhag (Karsiya)		Dhanpalthan GP				
24	Katahari		Katahari GP				
25	Jhorahat		Gramthan GP				
26	Amlekhgunj	Bara	Jitpur Simara UMNP	2	Janakpur	Bara	Birgunj
27	Simara						
28	Dumarbana						
29	Nijgadh		Nijgadh NP				
30	Bharatgunj						
31	Kolhabi		Kolhabi NP				
32	Jitpur Gadimai		Mahagadimai NP				
33	Dhalkebar	Dhanusa	Mithila NP			Mahottari	Janakpur
34	Karmaiya	Sarlahi	Bagmati NP			Sarlahi	
35	Hariyon		Harion NP				
36	Barhathwa		Barathawa NP				
37	Ishworpur		Ishworpur NP				
38	Chautara	Sindhupalchok	Chautara Sangachowkgadhi NP	Bagmati	Hetauda	Sindhupalchok	Bhaktapur
39	Melamchi		Melamchi NP				
40	Barahbise		Barahbise NP				
41	Manthali	Ramechaap	Manthali NP			Ramechhap	Ramechhap
42	Pakarwas-I		Khandadevi GP				
43	Pakarwas-II						
44	Ramechhap		Ramechhap NP				
45	Besishahar	Lamjung	Besisahar NP	Gandaki	Pokhara	Gorkha	Lamjung
46	Sundarbazar		Sundarbazar NP				
47	Bhotewodar						
48	Lasunekhola						
49	Rajahar	Nawalparasi East	Devchuli NP			Tanahu	Pokhara
50	Pragatinagar						
51	Gaidakot		Gaidakot NP				
52	Agauli		Kawasoti NP				
53	Gulariya	Bardiya	Gulariya NP	5	Butwal	Dang	Nepalgunj
54	Gulariya II						
55	Rajapur		Rajapur NP				
56	Kusumba		Madhuban NP				
57	Naulapur		Thakurbaba NP				
58	Beljhundi	Dang	Tulsipur UMNP				
59	Jhakredhunga						
60	Tripur		Ghorahi UMNP				
61	Bharatpur						
62	Chaughera						
63	Ramgram	Nawalparasi West	Ramgram NP			Rupandehi	Butwal
64	Shankarnagar	Rupandehi	Tilottama NP				
65	Anandban						
66	Devdaha		Devdaha NP				
67	Sainamaina		Sainamaina NP				
68	Sauraha-Farsatikar		Suddhodhan GP				
		13	49		5	10	9

Appendix-2.1 Baseline Survey on MoPID/FWSSMP/WSSDO/NP/GP in Jhapa district in Province No.1

		MoPID	**WSSDO**	**FWSSMP**
S.N.		**Province 1, Biratnagar**	**Jhapa**	**Biratnagar**
	Name of Information Officer	**Mr.Dharmendra Kesari (S.D.E.)**	**Mr. Sayan Kumar Shrestha (S.D.E.) Mr. Babukaji Shrestha (Engineer) Mr. Kari Mahato (Engineer)**	**Mr. Sujit Mahato (Engineer)**
1	Organization with Chart (as of October,2019)	Water Supply and Sanitation Section Existed	Not Available (Existing). Requested to send through email. (WSSDO Engineer will email to WASMIP)	Not Available (Existing). Requested to send through email.
2	Job Description for each division/section (as of October,2019)	Not Available. Not existing.	Not Available for each section. WSSDO Chief allocates Job description for each engineer.	Not Available (Existing). Requested to send through email.
3	Number of staffs for each division/section (as of October,2019)	As per existing organization chart	As per organization chart.	As per organization chart
4	Number of engineers/technicians for each division/section (as of October,2019)			
4.1	Engineers	1 Engineers- 2 (Water Supply and Sanitation Section)	3	Chief-1 5 Contract-1
4.2	Technicians	0	4	1 Contract- 5
4.3	is there a specific unit to look after WaSH functions?	Not Available. Not existing.	Not Available. Not existing.	Not Available. Not existing.
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of October,2019)	5 WSSDOs in 14 districts. according to budget book of FY 2076/77 of Province No. 1	237 (according to red book of MoWS and Province 1). Collected	120 (according to budget book published by MoWS.
6	Budget head and Budget to support WUSCs (O&M , Management) in FY 2076/77 in NPR	Co-Finance Project, Water Quality Impovement Project, Deep Tubewell Project, Terai, Madesh Water Supply Improvement Project, Climate Resilliant Water Supply Project.	Water Quality Impovement Project, Deep Tubewell Project, Terai, Madesh Water Supply Improvement Project, Climate Resilliant Water Supply Project.	Water Quality Improvement Project,Drinking Water co- Finance Project,Urban Water Supply and Sanitation Project, Rural Water Supply and Sanitation Fund Development Committee, Water Supply Service Expansion and Rehabilitation Program, Terai Madesh Water Supply Improvement Project, Climate resilient Water Supply Project.
6.1	Total Budget for FY 2076/77	NPR 19,859,981,000 (100%)	NPR 500,000,000 (100%)	NPR 5,397,474,000 (100%)
7	Budget for construction in FY 2076/77		NPR 499,000,000 (99.8%)	NPR 2,657,898,000 (49%)
7.1	Road; NPR	NPR 7,158,014,000 (36.05%)	N/A	Not Applicable. (FWSSMP does not work for road constrution so no budgetfor road)
7.2	Water Supply; NPR	2 NPR 2,150,000,000 (11%)	NPR 499,000,000 (99.8%)	2,657,898,000 (49%)
7.3	Other sources; Donor Information, Donor name, period (from….to….), project contents	No Donor	No Donor	No donor .
7.4	Others; NPR	N/A	N/A	N/A
8	Budget for maintenance/repair of infrastructures in FY 2076/77			
8.1	Road; NPR	N/A	N/A	Not Applicable.(FWSSMP does not work for road constrution so no budget for road)
8.2	Water Supply; NPR	3 N/A	NPR 1,000,000 (0.2%)	0%
8.3	Others; NPR	N/A	N/A	N/A
9	Other activities for WUSCs			
9.1	Support on O&M (advisory/ consultation)	MoPID supports through WSSDOs.	Provides request based support to WUSCs	Provides request based support to WUSCs especially WUSCs that has Co-finance projects.
9.2	Supervision of construction	MoPID supports through WSSDOs.	Regularly Monitor and Supervise construction of new projects	Regularly Monitor and Supervise construction of new projects
9.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	WSSDOs attend WUSC's events.	Attends when requested.	Attends when requested.
9.4	Others			
10	Communication with MoPID/ WSSDOs			
10.1	Frequency	Very Frequently.	Very Frequently	Direct communication is difficult because of Federal and Provincial Government.
10.2	Method	Telephone, Email, official letters and visit.	Telephone, Email, official letters and visit.	
10.3	Contents	Progress of project works .	Progress of project works.	
10.4	Others	Inviting WSSDOs in workshop and seminars		
11	Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:	4		
11.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	WSSTs are highly experienced in a field works. Need a refresher training on O&M.	O&M of water supply sytem	WSSTs are experienced in field works.
11.2	Sub-engineer	O&M of WTP and Water Supply components (Intake to Distribution)	No staffs in this position	O&M of Water Supply Systems
11.3	Engineer	Pumping system design and O&M and an abroad Training is needed for MoPID Engineers.	Training on new technologies of of water supply system such as SCADA. Abroad Training for Engineers. (*Jhapa WSSDO has no SCADA system in its service area.)	Design of Water Supply Systems with Groundwater Source.
12	Issues/ Challenges (if any)	5 Large number of projects comapred to existing staffs.	Large Number of Projects compared to existing staffs.	Large number of projects compared to staffs.

Appendix-2.1 Baseline Survey on MoPID/FWSSMP/WSSDO/NP/GP in Jhapa district in Province No.1

		Mechi NP	Urlabari NP	Bhadrapur NP
S.N.				
	Name of Information Officer	**Ms. Mina Pokharel Upreti (Vice Mayor) Mr. Mahendra Khamyahang (CEO)**	**Mr. Sambhu Bhattarai (CEO) Mr. Roshan Udash (Engineer)**	**Mr. Jivan Shrestha (Mayor) Mr. Pramod Pradhan (A. CEO)**
1	Organization with Chart (as of October,2019)	6 Water Supply and Sanitation Section Not -Existed	Water Supply and Sanitation Section Not -Existed	Water Supply and Sanitation Section Not -Existed
2	Job Description for each division/section (as of October,2019)	Not Available. Mechi NP will prepare organization chart and job description after organization and survey result.	Not Available. Urlabari NP has conducted organization and Management Survey. New Job description will be prepared after the survey result.	Not Available. After Organization and management survey
3	Number of staffs for each division/section (as of October,2019)	After new organization chart is prepared.	As per organization chart.	Not Available. After Organization and management survey
4	Number of engineers/technicians for each division/section (as of October,2019)			
4.1	Engineers	7 2	Contract-2	1 Contract- 1
4.2	Technicians	2	8	2 Contract-3
4.3	is there a specific unit to look after WaSH functions?	No WaSH Unit	No WaSH unit.	No WaSH Unit.
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of October,2019)	Semi-urban- 3 (Dhulabari, Kakarvitta, Charali) Rural WUSCs - 20	Semi- urban - 1 (Urlabari) Rural - 1 (Manglabare)	NWSC-1 (Bhadrapur) semi urban- 3 (Chandragadi I, Chandragadi II, Prithvinagar)
6	Budget head and Budget to support WUSCs (O&M , Management) in FY 2076/77 in NPR	Administration, Financial Development,Infrastructure Development,Good Governace and It's interrelated area, Social developmentr	Financial Development, Social Development, Infrastructure Developmwent, Environment/ disaster management.	Financial Development, Social Development, Infrastructure Development, Environmental Development, Administrative Expenses, Miscellaneous.
6.1	Total Budget for FY 2076/77	NPR 1,428,860,000 (100%)	NPR 617,458,000 (100%)	NPR 714,195,000 (100%)
7	Budget for construction in FY 2076/77	8 NPR 63,495,000 (4.4%)	NPR 83,750,000 (13.6%)	NPR 19,700,000 (2.8%)
7.1	Road; NPR	NPR 63,495,000 (4.4%)	NPR 80,700,000 (13.05%)	NPR 17,300,000 (2.4%)
7.2	Water Supply; NPR	9 0	NPR 3,050,000 (0.5%)	NPR 2,400,000 (0.3%) for providing pipe materials
7.3	Other sources; Donor Information, Donor name, period (from….to….), project contents	No Donor	NPR 150 million by World Bank for road construction.	No donor.
7.4	Others; NPR	N/A	N/A	N/A
8	Budget for maintenance/repair of infrastructures in FY 2076/77			
8.1	Road; NPR	NPR 25,425,000 (1.78%)	NPR 15,800,000 (2.6%)	NPR 9,100,000 (1.3%)
8.2	Water Supply; NPR	10 0	0	0
8.3	Others; NPR	N/A	N/A	N/A
9	Other activities for WUSCs			
9.1	Support on O&M (advisory/ consultation)	No such support so far.	So far no such support is provided by NP.	So far no such support is provided by NP.
9.2	Supervision of construction	No such support so far.	So far no such support is provided by NP.	So far no such support is provided by NP.
9.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Elected members attend general assembly. Mechi Np staffs conducts election of WUSCs.	Mayor , Vice Mayor and other elected member particiapates in WUSC's events.	Mayor , Vice Mayor and other elected member particiapates in WUSC's events.
9.4	Others			Supported Open Defecation Free campaign
10	Communication with MoPID/ WSSDOs			
10.1	Frequency	As per necessary.	As necessary	As necessary.
10.2	Method	Telephone, letters, email.	Phone , letters, visit.	Telephone, letters, visit.
10.3	Contents	Progress of projects inside NP's area, budget and project requests.	Demand of new projects .	Requests for funds and projects.
10.4	Others	Frequent communication with MoPID.	No offcial communication with WSSDO but commnicates with MoPID	Communicates with MoPID. Less communication with WSSDO.
11	Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:			
11.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	11 Plumbing Works, Repair Works (Field Works)	O&M , Water Quality Test , Plumbing	Water Quality Test.
11.2	Sub-engineer	Survey and Training for Water Supply Systems	Survey and Design	Pipeline design and specifications.
11.3	Engineer	Training is necessary on water supply systems. Engineers have not received any trainings on O&M of water supply systems.	Design of WTP and overall O&M of Water Supply Sytem.	Training for engineer is necessary. New engineers will be appointed by February 2020.
12	Issues/ Challenges (if any)	12 NP has limited resource to support WUSCs. There are more that 20 WUSCs in NP's service area.	Water supply is less prioritized while preapring budget. Elected members should be oriented about importance of safe water.	2 WUSCs (not target) in Bhadrapur NP are not functioning due to poor management and lack of O&M skill. It is necessary to rehabilitate WUSCs to supply safe water. People are using shallow tubewells where piped water is not accessible.

Appendix-2.1 Baseline Survey on MoPID/FWSSMP/WSSDO/NP/GP in Jhapa district in Province No.1		**Gramthan GP**	**Katahari GP**	**Kamal GP**	**Dhanpalthan GP**
S.N.					
	Name of Information Officer	**Mr. Chandra Kattel (CEO)**	**Mr. Ganesh Karki (CEO)**	**Mr. Benu Prasad Sivakoti (Vice Mayor)** **Mr. Suwash Shrestha (CEO)**	**Mr. Ranjit Shah (CEO)**
1	Organization with Chart (as of October,2019)	13 Water Supply and Sanitation Section, Not -Existed	Water Supply and Sanitation Section Not -Existed	Water Supply and Sanitation Section Not -Existed	Water Supply and Sanitation Section Not -Existed
2	Job Description for each division/section (as of October,2019)	Not Available	Not Available	Not Available.	Not Available. WUSC will prepare after Organization and Management Survey.
3	Number of staffs for each division/section (as of October,2019)	Not Available	As per organization chart	As per organization chart	As per organization chart
4	Number of engineers/technicians for each division/section (as of October,2019)				
4.1	Engineers	14 0	0 (No Engineer)	1 Contract - 1	Contract- 1
4.2	Technicians	Contract- 1	1	1 (WSST) Contract - 3	1
4.3	is there a specific unit to look after WaSH functions?	No WaSH unit.	No WaSH Unit	No WaSH Unit.	No WaSH Unit.
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of October,2019)	Semi urban- 1 (Jhorahat)	Semi Urban - 1 (Katahari)	Semi-uraban - 4 (Topgachi I, Topgachi II, TopgachiIII, and Lakhanpur)	Semi- Urban - 1 (Karsiya)
6	Budget head and Budget to support WUSCs (O&M , Management) in FY 2076/77 in NPR	Budget Book has not been disclosed to public	Administration, Financial Development, Animals and Birds, Social Develpoment, Infrastructure Development.	Agricultural Development, Animal Husbandary, Education, Womena and Children, Health, Infrastrure Development, Target Group Plan.	Budget Book has not been disclosed to public
6.1	Total Budget for FY 2076/77		NPR 346,515,000 (100%)	NPR 625,492,000 (100%)	
7	Budget for construction in FY 2076/77		NPR 15,750,000 (4.5%)	NPR 51,950,000 (8.3%)	Budget book is not published yet due to internal reason of GP.
7.1	Road; NPR		NPR 15,750,000 (4.5%)	NPR 51,750,000 (8.27%)	
7.2	Water Supply; NPR	15	NRP 0 (0%)	NPR 200,000 (0.03%)	
7.3	Other sources; Donor Information, Donor name, period (from….to….), project contents	No donor	No any donor.	No donor.	
7.4	Others; NPR	N/A	N/A	N/A	
8	Budget for maintenance/repair of infrastructures in FY 2076/77				
8.1	Road; NPR		NPR 900,000 (0.26%)	NPR 37,260,000 (5.95%)	
8.2	Water Supply; NPR	16 NPR 500,000	NPR 100,000 (0.03%)	NPR 4,50,000 (0.07%)	NPR 300,000 for maintainence and Repair
8.3	Others; NPR	N/A	N/A	N/A	
9	Other activities for WUSCs				
9.1	Support on O&M (advisory/ consultation)	No such support has been provided	No such support has been provided	Support (Financial and Technical) in distribution pipeline replacement of Topgachi III WUSC.	No such support has been provided by GP to WUSCs.
9.2	Supervision of construction	No such support has been provided	No such support has been provided	Yes. If requested,	No such support has been provided by GP to WUSCs.
9.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	GP's representatives attend general assembly.	GP's representatives attend general assembly.	Attends General Assembly and other events.	GP's representatives attend general assembly of WUSC.
9.4	Others			Invites WUSCs in budget discussion meetings.	
10	Communication with MoPID/ WSSDOs				
10.1	Frequency	As necessary.	Frequently	Atleast once a month and if necessary.	As per necessary
10.2	Method	Telephone, letters.	Mostly visit as MoPID is near.	Telephone, letters.	Telephone, letters.
10.3	Contents	Progress of MoPID's projects in GP's area.	Project progress, seminar and workshop.	Project demand, budget request.	Road projects, budget requests.
10.4	Others	Less communication with MoPID. No communication with WSSDO so far.		Mostly communicates with MoPID.	Communication only with MoPID.
11	Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:	17			
11.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	Repair works, Valve operation for distribution	Solar power O&M, Repair	WSST is experinced in a water supply system.	leakage repair, use of proper fittings
11.2	Sub-engineer	Facility Expansion such as distribution network	ToT on O&M of water supply	Need Trainings on water supply systems.	ToT on O&M of water supply system
11.3	Engineer	Overall Water supply system	Pumping system water supply	Need Trainings on water supply systems.	Design of water supply sytems with WTP
12	Issues/ Challenges (if any)	18 Only 1 technical staff and no capacity to support WUSCs.	Low budget for support to WUSCs. Priority is road. Since local representatives are responsible for preapring budget, it is necessary to educate them about water supply systems.	Kamal GP has a low population coverage of piped water. Constructions of more water supply projects are necessary .	Lack of staffs. High priority on road construction. Lack of understanding of safe water in a Gaupalika.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		Biratnagar MNP	Rangeli NP	Pathari Sanischare NP	Budhiganga GP	Ratuwamai NP
S.N.	Province/District	Province No. 1, Morang	Province No. 1, Morang	Province No. 1, Morang	Province No. 1, Morang	Province No. 1, Morang
	Name of Information Officer	Mr. Ekdev Adhikari (CEO) Ms.Archana Karn (Engineer) Ms. Anita Neupane (Environment Section Chief)	Mr. Tom Prasad Subedi (CEO) Mr. Deepak Timsina (Engineer)	Mr. Ambika Prasad Dhamala (CEO) Mr. Krishna Koirala (Engineer)	Mr. Balchandra Majhi (Chairman) Mr. Kharanand Ishar (Engineer)	Mr. Rajendra Bhattarai (CEO) Mr. Krishna Dhakal (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	7	1 Contract-2	Contract-1	2	Contract-1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	19	Contract-8	1 Contract-6	3 Contract-1	1 Contract-3
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban- 3 (Mangadh, Pichhra and Jamungachi WUSC)	Semi urban-1 (Rangeli WUSC)	Semi urban-1 (Pathri Sanischare WUSC) Rural- 1	Semi urban-1 (Tankisinuwari WUSC)	Semi urban-1 (Itahara WUSC)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**					
6.1	Total Budget for FY 2076/77 (NPR)	5,907,447,750	636,741,345	725,264,000	221,444,000	860,059,130
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	42,541,460	1,950,000	1,150,000	7,500,000	No breakdown of budget is available.
6.3	Percentage of Total Budget (%)	0.7%	0.3%	0.2%	3.4%	-
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	5,314,300,750	272,689,163	608,737,000	145,444,000	717,917,130
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	Preparing cost cost estimate sheet for WUSCs. WUSCs submit cost estimate sheet to related WSSDO/FWSSMP.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Elected members of MNP attend WUSCs events (General assembly, PR events).	Elected members of NP attend WUSCs events (General assembly, PR events).	Elected members of NP attend WUSCs events (General assembly, PR events).	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Local representatives (Chief and elected members) attend WUSC's General Assembly.
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary with MoPID	As necessary	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID
8.2	Method	Telephone, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit
8.3	Contents	Budget and annual programs	Budget and annual programs. Workshops and training sometimes	Budget and annual programs	Budget and reporting of progress of programs. MoPID provides budget to GP. GP has to report the activities and the use of budget to MoPID.	Budget and annual programs
8.4	Others	Communication mostly with MoPID	Communication only with MoPID	Communication only with MoPID	Communication only with MoPID	Communication only with MoPID
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	No staff existed	No staff existed	No staff existed	O&M of groundwater supply system	No staff existed
9.2	Sub-Engineer (Assistant Engineer)	O&M of groundwater supply system	O&M of groundwater supply system. (pump operation, electrical panel board maintenance)	O&M of groundwater supply system	O&M of groundwater water supply system	Overall trainings on water supply system
9.3	Engineer	Water modelling software for designing water supply system, GIS and other technologies related to water supply system. (Design and cost estimate for large projects are outsourced to private consultants.) Design and cost estimation are also required. MNP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Overall trainings on all components of water supply system including design and cost estimation work. (Design and cost estimate are outsourced to private consultants.)	Overall trainings from intake to distribution including water treatment plant and water quality management. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	All components of water supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. GP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Overall trainings on water supply system included in water quality management. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.
10	Issues/ Challenges (if any)	Lack of communication from WUSC's side is a major issue. (MNP expects WUSCs need to come to MNP.) MNP (Environmental sanitation section) is preparing WaSH plan to address water supply issues in its area.	Lack of human resources (engineers, technicians) compared to the number of projects (road, water supply, sanitation, irrigation, building construction etc.).	Rapidly growing population has caused high water demand but water production capacity is limited. Lack of skilled manpower in NP to support WUSC for expansion of water supply system.	So far, GP has not visited WUSCs and WUSCs have not shared any information with GP. GP does not recognaize the WUSCs' situstions.	Groundwater is a major water source in Ratuwamai area. Proper knowledge and training regarding water quality are very essential for NP's staffs to monitor quality of water and provide advice and instruction to WUSCs.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		**Kanepokhari GP**	**Urlabari NP**	**Bhadrapur NP**	**Gramthan GP**	**Katahari GP**
S.N.	**Province/District**	**Province No. 1, Morang**	**Province No. 1, Morang**	**Province No. 1, Morang**	**Province No. 1, Morang**	**Province No. 1, Morang**
	Name of Information Officer	Mr. Purushottam Ghimire (CEO) Mr. Chandra Rai (WSST)	Mr. Sambhu Bhattarai (CEO) Mr. Roshan Udash (Engineer)	Mr. Jivan Shrestha (Mayor) Mr. Pramod Pradhan (A. CEO)	Mr. Chandra Kattel (CEO)	Mr. Ganesh Karki (CEO)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section	Not Existing in water supply and sanitation section	Not Existing in water supply and sanitation section	Not Existing in water supply and sanitation section
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Available. Urlabari NP has conducted organization and Management Survey. New Job description will be prepared after the survey result.	Not Available. After Organization and management survey	Not Available	Not Available
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned	Not Available. After Organization and management survey	Not Available	Not Mentioned
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	1	Contract-2	1 Contract- 1	0	0 (No Engineer)
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	1 Contract-4	8	2 Contract-3	Contract- 1	1
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WaSH unit	No WaSH Unit	No WaSH unit	No WaSH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban-1 (Bayerban WUSC)	Semi urban - 1 (Urlabari WUSC) Rural - 1 (Manglabare WUSC)	NWSC-1 (Bhadrapur) Semi urban- 3 (Chandragadi I, Chandragadi II, Prithvinagar WUSC)	Semi urban- 1 (Jhorahat WUSC)	Semi urban - 1 (Katahari WUSC)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**		Data Source: Financial Development, Social Development, Infrastructure Development, Environment/ disaster management.	Data Source: Financial Development, Social Development, Infrastructure Development, Environmental Development, Administrative Expenses, Miscellaneous.	Budget Book has not been disclosed to public	Data Source: Administration, Financial Development, Animals and Birds, Social Development, Infrastructure Development.
6.1	Total Budget for FY 2076/77 (NPR)	Not mentioned in budget book	617,458,000	714,195,000		346,515,000
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	1,000,000	3,050,000	2,400,000		
6.3	Percentage of Total Budget (%)	-	0.5%	0.3%	-	-
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	Not mentioned in budget book	86,599,960	594,473,000		341,000,000
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Local representatives (Chief and elected members) attend WUSC's General Assembly. Staffs are not invited by WUSC.	Mayor , Vice Mayor and other elected member participate in WUSC's events.	Mayor , Vice Mayor and other elected member participate in WUSC's events.	GP's representatives attend general assembly.	GP's representatives attend general assembly.
7.4	Others	-	-	Supported Open Defecation Free campaign	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary with MoPID	As necessary	As necessary	As necessary	Frequently
8.2	Method	Telephone, letters, email, visit	Phone , letters, visit	Telephone, letters, visit	Telephone, letters	Mostly visit as MoPID is near
8.3	Contents	Request of Budget and programs	Demand of new projects	Requests for funds and projects	Progress of MoPID's projects in GP's area	Project progress, seminar and workshop
8.4	Others	Communication only with MoPID	No official communication with WSSDO, but communicates with MoPID	Communicates with MoPID Less communication with WSSDO	Less communication with MoPID No communication with WSSDO so far	-
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of facilities. Installation of equipment such as valves. Repair works of pump and its components.	O&M of water supply system, Water Quality Test, Plumbing	Water Quality Test	Repair works, valve operation for distribution	Solar power O&M, Repair
9.2	Sub-Engineer (Assistant Engineer)	Overall trainings on all components of water supply system	Survey and Design of water supply system	Pipeline design and specifications	Facility expansion such as distribution network	ToT on O&M of water supply
9.3	Engineer	Overall trainings on all components of water supply system included in the latest technological development (such as SCADA system) in water business. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. GP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design of WTP and overall O&M of Water Supply System.	Training for engineer on overall water supply system is necessary. New engineers will be appointed by February 2020.	Overall water supply system	Pumping system water supply
10	Issues/ Challenges (if any)	Least priority is given to water supply during preparation of budget by elected members. Political members should be oriented on importance of safe water.	Least priority is given to water supply during preparation of budget by elected members. Political members should be oriented on importance of safe water.	2 WUSCs in Bhadrapur NP are not functioning due to poor management and lack of O&M skill. It is necessary to rehabilitate WUSCs' facilities to supply safe water to people. People are using shallow tubewells where piped water is not accessible.	Only 1 technical staff and no capacity to support WUSCs.	Low budget allocation for support to WUSCs. Priority is road construction. Since local representatives are responsible for preparing budget, it is necessary to educate them about water supply systems to be higher priority.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		**Kamal GP**	**Dhanpalthan GP**	**Miklajung GP**	**Mechi NP**	**Birtamode NP**
S.N.	**Province/District**	**Province No. 1, Morang**	**Province No. 1, Morang**	**Province No. 1, Morang**	**Province No. 1, Jhapa**	**Province No. 1, Jhapa**
	Name of Information Officer	Mr. Benu Prasad Sivakoti (Vice Mayor) Mr. Suwash Shrestha (CEO)	Mr. Ranjit Shah (CEO)	Mr. Rajkumar Khatiwada (Admin. Chief) Mr. Sangit Rai (Technician)	Ms. Mina Pokharel Upreti (Vice Mayor) Mr. Mahendra Khamyahang (CEO)	Mr. Pashupati Khatiwada (CEO Mr. Dilli Gautam (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section	Not Existing in water supply and sanitation section	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Available.	Not Available. WUSC will prepare after Organization and Management Survey.	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned	Not Mentioned	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	1 Contract - 1	Contract- 1	0	2	1 Contract-2
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	1 (WSST) Contract - 3	1	1 Contract-3	2	1 Contract-4
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WaSH Unit.	No WaSH Unit.	No WASH Unit	No WaSH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi uraban - 4 (Topgachi I, Topgachi II, TopgachiIII, and Lakhanpur WUSC)	Semi urban - 1 (Karsiya WUSC)	Semi urban-1 (Madhumalla WUSC) Rural - 10	Semi-urban- 3 (Dhulabari, Kakarvitta, Charali WUSC) Rural - 20	Semi urban-2 (Birtamod WUSC and Garamani WUSC). Garamani WUSC is not in operation as distribution pipeline laying work is remaining. (Distribution pipes construction is WUSC's responsibility, not DWSSM. Schedule has not been fixed as of January 2020.
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**	Data Source: Agricultural Development, Animal Husbandary, Education, Women and Children, Health, Infrastrure Development, Target Group Plan.	Budget Book has not been disclosed to public			
6.1	Total Budget for FY 2076/77 (NPR)	625,492,000	-	392,200,000	1,428,860,000	1,123,246,000
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	200,000	-	2,000,000	-	2,650,000
6.3	Percentage of Total Budget (%)	0.03%	-	0.5%	-	0.2%
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	577,092,000	-	332,200,000	1,110,060,000	662,714,000
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	GP's representatives attend general assembly.	GP's representatives attend general assembly of WUSC.	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Elected members attend general assembly. Mechi NP staffs conduct election of WUSCs.	Local representatives (Chief and elected members) attend WUSC's General Assembly.
7.4	Others	GP invites WUSCs in budget discussion meetings.	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	At least once a month and if necessary	As necessary	As necessary with MoPID	As necessary	As necessary with MoPID
8.2	Method	Telephone, letters	Telephone, letters	Telephone, letters, email, visit	Telephone, letters, email	Telephone, letters, email, visit
8.3	Contents	Project demand, budget request	Road projects, budget requests	Budget and reporting of progress of programs. MoPID provides budget to GP. GP has to report the activities and use of budget to MoPID.	Progress of projects inside NP's area, budget and project requests	Request of Budget
8.4	Others	Mostly communicates with MoPID	Communication only with MoPID	Communication only with MoPID	Frequent communication with MoPID	Communication only with MoPID
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	WSST is experienced in a water supply system	Leakage repair, use of proper fittings	No staff in GP. WSST is working in Ward levels	Plumbing Works, Repair Works (Field Works)	No staff existed
9.2	Sub-Engineer (Assistant Engineer)	Need trainings on water supply systems	ToT on O&M of water supply system	All trainings related to groundwater supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. GP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Survey and Training for Water Supply Systems	All trainings related to groundwater supply system
9.3	Engineer	Need trainings on water supply systems	Design of water supply systems included in WTP. So far, GP has not constructed any water supply project. However, GP requeste the design training for their engineers.	No staff existed	Training is necessary on water supply systems. Engineers have not received any trainings on O&M of water supply systems.	All trainings related to groundwater supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.
10	Issues/ Challenges (if any)	Kamal GP has a low population coverage of piped water. Constructions of more water supply projects are necessary .	Lack of staffs. High priority on road construction. Lack of understanding of safe water in a Gaupalika. Both sides (consumers and local representative) lacks knowledge and understanding about importance of water quality.	Lack of staffs (engineers, technicians) and insufficient budget to support WUSCs.	NP has limited human resource to support WUSCs. There are more than 20 WUSCs in NP's service area.	Rapidly growing population in the city. Proper planning and coordination with road and other stakeholders for expansion of pipelines are the major challenge.

	Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas	**Arjundhara NP**	**Gauradaha NP**	**Shivasatakchi NP**	**Mithila NP**	**Ishworpur NP**
S.N.	**Province/District**	**Province No. 1, Jhapa**	**Province No. 1, Jhapa**	**Province No. 1, Jhapa**	**Province No. 2, Dhanusa**	**Province No. 2, Sarlahi**
	Name of Information Officer	Mr. Pankaj Bhurtel (CEO) Mr. Niraj Adhikari (Engineer)	Mr. Khemraj Ojha (CEO) Mr. Gopal Bhandari (Engineer)	Mr. Surendra Dahal (CEO) Mr. Mahesh Bhandari (Engineer)	Ram Kumar Karki (CEO) Jay Ganesh Singh (Engineer)	Mr.Ramesh Kumar Shah (Engineer) Mr.Shyam Prasad Yadav (Account Officer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	Contract-1	Contract-1	Contract-2	1 Contract-1	1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	4	1 Contract-2	1 Contract-2	1 Contract-2	3
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban- 1 (Shani Arjun WUSC)	Semi urban -2 (Gauradaha WUSC and Juropani WUSC) Rural -1	Semi urban- 1 (Shivasatakchi WUSC)	Semi urban - 2 (included in Dhalkebar WUSC) Rural - 20	Semi urban -1 (Ishworpur WUSC)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**	Not approved yet by the Municipal council				
6.1	Total Budget for FY 2076/77 (NPR)	1,059,039,000	855,275,000	875,405,000	628,797,001	810,484,767
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	3,500,000	2,100,000	50,000	49,075,000	4,000,000
6.3	Percentage of Total Budget (%)	0.3%	0.2%	0.0%	7.8%	0.5%
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	983,803,464	80,275,000	747,505,000	529,097,001	698,589,767
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	Preparing cost estimate for WUSCs whenever WUSC request.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	Sometimes WUSC requests to supervise their construction works.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Local representatives (Chief and elected members) attend WUSC's General Assembly and other events.	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Elected member participates in WUSC's events (General Assembly).	NP's representatives attend general assembly.
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID	As necessary	As necessary
8.2	Method	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, emails
8.3	Contents	Budget and annual programs	Budget and annual programs	Budget and Reporting of progress of programs MoPID provides budget to NP. NP has to report the activities and the use of budget to MoPID.	Requests for funds and projects. Progress of projects.	Quarterly report of progress of MoPID granted projects
8.4	Others	Communication only with MoPID	Communication only with MoPID	Communication only with MoPID	Communicates with MoPID No communication with WSSDO	Communication with Ministry of Economic Affairs -Province No. 2
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of Water supply facilities and equipment	No staff existed	No staff existed	Maintenance of pipelines and deepwell pumps	No staff existed
9.2	Sub-Engineer (Assistant Engineer)	All trainings related to groundwater supply system	O&M of water supply systems included in electrical components	All trainings related to groundwater supply system	O&M of groundwater water supply system	O&M of groundwater and surface water supply systems.
9.3	Engineer	All trainings related to groundwater supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	All trainings related to groundwater supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	All trainings related to groundwater supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design of groundwater water supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. GP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	All trainings related to groundwater and surface water supply systems in Nepal. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.
10	Issues/ Challenges (if any)	Lack of understanding on O&M of water supply in NP's staffs. Staffs need extensive training to support WUSCs.	Water supply project is low priority in NP when preparing budget. Elected members should be provided training to enhance their knowledge on importance of water supply.	Heavy workload (water supply, irrigation, road, building construction etc.) for limited technical staffs. Local representatives (mayor, vice-mayor) have less knowledge about importance of water supply.	Scarcity of water is a major problem. Municipality constructs borewell and handover it to the community. However, municipality has no capacity to support on O&M after handover of such water supply systems.	People prefer to use shallow tubewell instead of WUSC's water because they do not want to pay tariff. Staffs have lack of technical manpower on water supply systems.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		**Hariyon NP**	**Barahathawa NP**	**Bagmati NP**	**Nijgadh NP**	**Kolhavi NP**
S.N.	**Province/District**	**Province No. 2, Sarlahi**	**Province No. 2, Sarlahi**	**Province No. 2, Sarlahi**	**Province No. 2, Bara**	**Province No. 2, Bara**
	Name of Information Officer	Mr.Tikaram Dahal (CEO) Mr. Jakir Ahmad (Engineer)	Mr. Hom Bahadur Thapa (CEO) Mr. Roshan Chaudhary (Engineer)	Mr. Niranjan Lamichhane (Engineer)	Mr. Bishaksen Dhakal (CEO) Thaneshwor Sapkota (Secretary of Mayor)	Mr. Basu Chaudhary (Ward Chairman) Mr. Bharat Yadav (CEO)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	Contract- 1	Contract- 1	Contract- 1	Contract- 1	Contract-1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	0	0	WSST-1 Contract-1	1	1 Contract-3
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban- 2 (Hariyon WUSC)	Semi urban - 1 (Barahathawa WUSC)	Semi urban - 1 (Karmaiya WUSC) Rural-2	Semi urban - 2 (included in Nijgadh WUSC) Rural- 6	All 3 WUSCs (included in Kolhabi WUSC) Not in operation. Distribution pipeline laying works are remaining.
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**			Budget Book has not been disclosed because of internal issues.		Budget is not finalized due to internal reasons of the Municipality
6.1	Total Budget for FY 2076/77 (NPR)	491,014,000	817,481,990	No data available.	621,433,000	No data available.
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	14,672,000	15,500,000	No data available.	25,535,000	No data available.
6.3	Percentage of Total Budget (%)	3.0%	1.9%	-	4.1%	-
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	286,691,000	703,281,990		300,201,000	
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	Yes. If requested,	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	NP's representatives attend general assembly.	WUSC has not invited in such events.	NP attends General Assembly and other events.	NP's representatives attend general assembly of WUSC.	WUSCs are not in operation.
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary	Frequently (as necessity)	At least once a month and if necessary	As necessary	As necessary with MoPID
8.2	Method	Telephone, letters, email, visit	Telephone, email, letters, visit	Telephone, letters, email, visit	Telephone, letters, email, visit	Telephone, letters, email, visit
8.3	Contents	Progress of MoPID's projects in NP's area	Project progress, seminar and workshop	Project demand, budget request	Road projects, budget requests	Budget and programs of MoPID ongoing in NP's area
8.4	Others	-	-	Mostly communicates with MoPID	Communication only with MoPID	Communication only with MoPID
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	No staff existed	No staff existed	WSST is experienced in a water supply system	No staff existed	No staff existed
9.2	Sub-Engineer (Assistant Engineer)	No staff existed	No staff existed	O&M of groundwater supply systems	O&M of groundwater supply system	Design of distribution pipeline network
9.3	Engineer	Overall groundwater supply systems including design and cost estimate skills. (Design and cost estimate are outsourced to private consultants.)	Groundwater pumping system and water quality management. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Need overall trainings including design and cost estimate on groundwater supply systems. (Design and cost estimate are outsourced to private consultants.)	Design of groundwater supply systems with WTP. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design and O&M of groundwater supply system and water quality control. (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	No technical capacity and manpower to support WUSCs.	Arsenic and iron contaminations in shallow tube well (The values are higher than NDWQS standard). Lack of knowledge on water quality management.	Scarcity of water in some area. NP has a mobile water tanker to supply water during scarcity.	Lack of manpower (engineers, technicians) to support WUSCs and manage construction/rehabilitation works under NP. High demand of distribution pipeline expansion.	Lack of awareness of safe water among consumers. People demand for shallow tube well to NP due to lack of awareness on water quality and they don't like to pay the tariff.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		**Maha gadhimai NP**	**Jeetpur Simara UMNP**	**Melamchi NP**	**Chautara NP**	**Barhabise NP**
S.N.	**Province/District**	**Province No. 2, Bara**	**Province No. 2, Bara**	**Province No. 3, Sindhupalchowk**	**Province No. 3, Sindhupalchowk**	**Province No. 3, Sindhupalchowk**
	Name of Information Officer	Mr. Ram Prasad Chaurasiya (CEO)	Mr. Shivasaj Sedhain (CEO) Mr. Sanjib Rupakheti (Engineer)	Mr. Ganesh Prasad Dhakal (WSST)	Mr. Badri Narayan Bhujel (Engineer)	Mr. Surendra Nepal (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	Contract-3	1 Contract-2	2	1	1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	Contract-3	Contract-3	4	5	2
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	All 3 WUSCs (included in Gadimai WUSC) Not in operation. Distribution pipeline laying works are remaining.	Semi urban-5 (included in Simara WUSC and Amlekhgunj WUSC)	Semi urban-2 (included in Melamchi WUSC) Melamchi WUSC is not in operation as distribution pipes were destroyed due to pipe burstied because of poor pipe laying work. The completion schedule is not fixed as of January 2020)	Semi urban-1 (Jugal Thalkharka WUSC) Rural-13	Semi urban-1 (Barahbise WUSC)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**					
6.1	Total Budget for FY 2076/77 (NPR)	543,070,000	Not mentioned	1,527,382,682	1,358,904,000	Budget not finalized due to internal reason
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	3,500,000	12,430,000	22,398,182	19,550,000	
6.3	Percentage of Total Budget (%)	0.6%	-	1.5%	1.4%	-
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	232,383,000		1,402,382,682	1,249,869,000	
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	No such support so far.	Yes, ongoing water supply construction and rehabilitation works under NP Red book. Red book is the summary of estimated or intended expenditures for a given period of time.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	WUSCs are not in operation.	Elected members of NP attend WUSCs events (General assembly, PR events).	Elected members of NP attend WUSCs event (General assembly).	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Elected members of NP attend WUSCs event (General assembly).
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary with MoPID	As necessary with MoPID	No	Yes with WSSDO, as needed	No
8.2	Method	Telephone, letters, email, visit	Telephone, letters, email, visit	No	Phone calls, meeting	No
8.3	Contents	It is an obligation to prepare Quarterly report of progress of MoPID's projects in NP's area.	Budget and ongoing projects funded by MoPID	No	Budget and Programs granted by MoPID and Federal government	No
8.4	Others	Communication only with MoPID	Communication only with MoPID	-	Communication only with MoPID	-
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	No staff existed	No staff existed	Survey, O&M of surface water and groundwater supply systems	Survey, O&M of surface water and groundwater supply systems	Survey, O&M of surface water and groundwater supply systems
9.2	Sub-Engineer (Assistant Engineer)	O&M of groundwater supply system	Design and construction of distribution pipe network extension and laying. O&M of groundwater supply system.	Survey, cost estimate, O&M of groundwater supply system. Engineer explained sub-engineers are capable of conducting surveys and cost estimation for simple surface water systems but they require training for survey and cost estimation of water treatment plant.	Survey, cost estimate, O&M of groundwater supply system. Engineer explained sub-engineers are capable of conducting surveys and cost estimation for simple surface water systems but they require training for survey and cost estimation of water treatment plant.	Survey, cost estimate and supervision of surface and lifting water supply systems
9.3	Engineer	Design and O&M of groundwater supply system and water quality control. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design and construction of groundwater system. GIS for water supply system. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of surface water and groundwater supply systems. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of surface water and groundwater supply systems. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of surface and lifting water supply systems. (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	Completion of ongoing 3 water supply project is very necessary to provide safe water to people. (Refer to No.5)	Few number of technical staffs compared to the number of projects. High demand of water supply. NP has no capacity to construct water supply facilities. NP distributes shallow tube wells for water supply to people as they don't have adequate knowledge on designing deep tube well system.	Lack of proper knowledge of design and cost estimate of pumping systems. Less manpower as project.	There are many projects (water supply, irrigation and road), but less manpower as projects.	There are many projects (water supply, irrigation and road), but less manpower as projects. The actual number of WUSCs in NP is unknown.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		**Manthali NP**	**Khandadevi GP**	**Ramechaap NP**	**Devchuli NP**	**Gaindakot NP**
S.N.	**Province/District**	**Province No. 3, Ramechaap**	**Province No. 3, Ramechaap**	**Province No. 3, Ramechaap**	**Gandaki Province, Nawalparasi-East**	**Gandaki Province, Nawalparasi-East**
	Name of Information Officer	Mr. Dilli Adhikari (Engineer)	Mr. Saroj Adhikari (Engineer)	Mr. Dipendra Poudel (Chief)	Mr. Bishnu Prasad Bhusal (CEO)	Mr. Ram Prasad Acharya (CEO) Mr. Laxmi Prasad Soti (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	1	2	2	2	1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	2 Contract- 9	2	7	3	1 Contract- 1
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban-1 (Manthali WUSC)	Semi urban-2 (Pakarbas-I and Pakarbas-II WUSCs)	Semi urban-1 (Ramechaap WUSC)	Semi urban-2 (Pragatinagar , Rajahar WUSCs) Rural-21	Semi urban - 5 (including Gaidakot WUSC) Rural - 14
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**					
6.1	Total Budget for FY 2076/77 (NPR)	914,923,560	618,952,948	670,423,000	497,810,000	646,873,399
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	32,780,000	28,843,342	26,870,909	7,728,000	3,847,538
6.3	Percentage of Total Budget (%)	3.6%	4.7%	4.0%	1.6%	0.6%
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	772,623,560	568,952,948	584,383,000	414,583,000	234,376,399
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	WUSC has not invited in such events.	Elected members of NP attend WUSCs event (General assembly).	Elected members of NP attend WUSCs event (General assembly).	Elected members attend general assembly. Devchuli NP staffs support election of WUSCs.	Mayor, Vice Mayor and other elected members are invited in WUSC's event (General Assembly).
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	Yes with WSSDO, as needed	No	Yes with WSSDO, as needed	As necessary	As necessary
8.2	Method	Phone calls, meeting	No	Phone calls, meeting	Telephone, letters, email	Phone , letters, email, visit
8.3	Contents	Budget and Programs granted by MoPID and Federal government	No	Budget and Programs granted by MoPID and Federal government	Progress of projects inside NP's area, budget and project requests	Demand of new projects . Reporting progress of MoPID grant projects
8.4	Others	Communication only with MoPID	-	Communication only with MoPID	Frequent communication with MoPID	Communicates with MoPID No communication with WSSDO
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	Survey, O&M of surface water and groundwater supply systems	Supervision of construction work of surface water and groundwater supply systems (structural construction works and electrical/mechanical devices)	Supervision of construction work of surface water and groundwater supply systems (structural construction works and electrical/mechanical devices)	Plumbing Works, Repair Works (Field Works)	No WSST, and VMW exists
9.2	Sub-Engineer (Assistant Engineer)	Survey, cost estimate and supervision of surface and lifting water supply systems	Survey, cost estimate and supervision of surface and lifting water supply systems	Survey, cost estimate and supervision of surface and lifting pump water supply systems	Survey and training for water supply systems	O&M , Water Quality Test, Plumbing
9.3	Engineer	Survey, design, cost estimate of surface and lifting water supply systems. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of surface and lifting water supply systems. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of surface and lifting water supply systems. (Design and cost estimate are outsourced to private consultants.)	Training on water supply system is necessary. Engineers have not received any training on O&M of water supply systems. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design of WTP and overall O&M of water supply system. (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	Lack of proper knowledge of design, cost estimate of pumping systems, less manpower as projects. The actual number of WUSCs in NP is unknown.	Less manpower and lack of skilled manpower in water supply sector. The actual number of WUSCs in GP is unknown.	Less manpower and lack of skilled manpower in water supply sector. The actual number of WUSCs in NP is unknown.	NP has limited resource (manpower) to support WUSCs. There are 21 WUSCs in NP's service area.	Lack of technical staffs in comparison to the number of projects.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		Kawasoti NP	Besisahar NP	Sundarbazar NP	Devdaha NP	Tilottama NP
S.N.	**Province/District**	**Gandaki Province, Nawalparasi-East**	**Gandaki Province, Lamjung**	**Gandaki Province, Lamjung**	**Province No. 5, Rupandehi**	**Province No. 5, Rupandehi**
	Name of Information Officer	Mr. Roshan Gyawali (CEO) Mr. Niraj Dahal (Engineer)	Mr. Milan Kamali (Engineer)	Mr. Thakur ji Tiwari(Secretary)	Mr. Ganesh Pandey (Engineer)	Mr. Giriraj Dumre (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	2	2	1	2	2 Contract: 1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	1 Contract-2	4 Contract- 2	2	5	4
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban- 2 (Kawasoti, Agyauli WUSCs)	Semi urban- 1 (Besisahar WUSC)	Semi urban- 3(Sundarbazar, Lasunekhola, Bhoteodar WUSC)	Semi urban- 1 (Devdaha WUSC) Rural-11	Semi urban-2 (Shankarnagar , Anandaban WUSCs)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**					
6.1	Total Budget for FY 2076/77 (NPR)	882,670,000	323,912,190	543,121,000	789,600,000	1,543,910,000
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	1,500,000	11,452,000	6,775,000	5,240,000.00	8,200,000
6.3	Percentage of Total Budget (%)	0.2%	3.5%	1.2%	0.7%	0.5%
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	725,276,000	71,309,190	467,621,000	699,123,000	1,213,030,000
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	No such support so far.	Yes, ongoing works under NP Red book. Red book is the summary of estimated or intended expenditures for a given period of time.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Mayor, Vice Mayor and other elected members are invited in WUSC's event (General Assembly).	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Local representatives (Chief and elected members) attend WUSC's General Assembly.	Local representatives (Chief and elected members) attend WUSC's General Assembly.	WUSC has not invited in such events.
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID
8.2	Method	Telephone, letters, email, visit	Phone	Phone, meeting	Phone, meeting	Phone, meeting
8.3	Contents	Requests for funds and projects. Progress of projects to MoPID.	Technical issues	Technical issues	Technical issues	Technical issues
8.4	Others	Communicates with MoPID Less communication with WSSDO	Communication only with MoPID	Communication only with MoPID	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	No WSST, and VMW exists	O&M of WTP	O&M of surface water supply system	O&M of water supply system	O&M of water supply system
9.2	Sub-Engineer (Assistant Engineer)	O&M of water supply systems	Retrofitting (repair of cracked walls and columns) of water tank	Water quality, cost estimate, survey of surface water supply system	Survey and cost estimate of groundwater system	Survey and cost estimate of groundwater system
9.3	Engineer	GIS and other latest technologies on water supply system. (Design and cost estimate are outsourced to private consultants.) Design and cost estimation are also required. NP's engineers have no previous experience on water supply system. Therefore, engineers request all kind of trainings related to water supply system.	Design of groundwater tank. (Design and cost estimate are outsourced to private consultants.)	Design of surface water supply system. (Design and cost estimate are outsourced to private consultants.)	Design and cost estimate of groundwater system. (Design and cost estimate are outsourced to private consultants.)	Design and cost estimate of groundwater system. (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	Population is growing rapidly. Need of new water supply projects to meet the water demand of people.	Insufficient budget for rehabilitation works required by many WUSCs.	Insufficient budget for rehabilitation works required by many WUSCs.	Budget for water supply is insufficient, and engineers have lack of knowledge of water supply system.	There are many projects (water supply, road, irrigation, building constructions), but few/insufficient engineers and technicians. Engineers and technicians don't have adequate knowledge of water supply system.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		Sainamaina NP	Sudhodhan GP	Ramgram NP	Tulsipur UMNP	Ghorahi UMNP
S.N.	**Province/District**	**Province No. 5, Rupandehi**	**Province No. 5, Rupandehi**	**Province No. 5, Nawalparasi west**	**Province No. 5, Dang**	**Province No. 5, Dang**
	Name of Information Officer	Mr. Surj Neupane (Sub-Engineer)	Mr. Kesav Raj Bhattarai (WSST)	Mr. Satis Kumar Gupta (Engineer)	Mr. Pawan Kumar (Engineer)	Mr. Ram Dhan Shrestha (Engineer)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	1	1	1	1	4
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	7	4	4	8	6
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban-1 (Sainamaina WUSC)	Semi urban-1 (Sauraha farsatikar WUSC)	Semi urban-2 (included in Parasi WUSC) Rural-2	Semi urban-3 (Tulsipur, Jhakredhunga, Beljhundi WUSCs), Rural-3	Semi urban-3 (Tripur, Bharatpur, Chaughera WUSCs)
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**					
6.1	Total Budget for FY 2076/77 (NPR)	908,551,000	468,985,400	690,628,400	1,010,106,000	1,576,852,000
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	19,050,000	450,000	31,625,000	25,158,162	29,535,000
6.3	Percentage of Total Budget (%)	2.1%	0.1%	4.6%	2.5%	1.9%
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	781,818,000	444,335,400	551,949,000	784,000,000	601,927,000
6.4	Total Budget for FY 2076/77 Road construction (NPR)					
7	**Other activities for WUSCs**					
7.1	Support on O&M for water supply (advisory/ consultation)	No such support so far.	No such support so far.	No such support so far.	No such support so far.	Yes as requested
7.2	Supervision of construction for water supply	Yes, ongoing water supply construction and rehabilitation works under NP Red book. Red book is the summary of estimated or intended expenditures for a given period of time.	Yes, ongoing water supply (construction and rehabilitation works) under GP Red book. Red book is book with summary of estimated or intended expenditures for a given period of time.	Yes, ongoing water supply construction and rehabilitation works under NP Red book.Red book is the summary of estimated or intended expenditures for a given period of time.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Elected members of NP attend WUSCs event (General assembly).	Elected members of GP attend WUSCs events (General assembly).	Elected members of NP attend WUSCs event (General assembly).	Elected members of NP attend WUSCs event (General assembly).	Elected members of NP attend WUSCs event (General assembly).
7.4	Others	-	-	-	-	-
8	**Communication with MoPID/ WSSDOs**					
8.1	Frequency	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID
8.2	Method	Phone calls	Phone calls	Phone calls, meeting	Phone calls, meeting	Phone calls, meeting
8.3	Contents	Budget and Programs granted by MoPID and Federal government	Budget and Programs granted by MoPID and Federal government	WASH plan	WASH plan	WASH plan
8.4	Others	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**					
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	O&M of water supply system, water quality	O&M of water supply system	O&M of water supply system	O&M of surface water and groundwater supply systems
9.2	Sub-Engineer (Assistant Engineer)	Design related to pipe network and over head tank	Survey and cost estimate of groundwater supply system	Survey and cost estimate of groundwater supply system	Survey and cost estimate of surface water and groundwater supply systems	Survey and cost estimate of groundwater supply system, Engineer explained sub-engineers are capable of conducting surveys and cost estimation for simple surface water systems but they require training for survey and cost estimation of water treatment plant.
9.3	Engineer	Design related to pipe network and over head tank. (Design and cost estimate are outsourced to private consultants.)	Design of groundwater supply system (O&M, distribution system and over head tank) (Design and cost estimate are outsourced to private consultants.)	Design of groundwater supply system (O&M, distribution system and over head tank) (Design and cost estimate are outsourced to private consultants.)	Design of groundwater and surface water supply systems (O&M, distribution system, treatment plants and over head tank) (Design and cost estimate are outsourced to private consultants.)	Design of groundwater and surface water supply systems (O&M, distribution system, treatment plants and over head tank) (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	There are many projects (water supply, road, irrigation, building constructions), but few/insufficient engineers and technicians. Budget is not enough. General Public (consumers) lacks awareness on importance of clean and safe water.	Insufficient budget and lack of skilled technicians in water supply sector. General Public (consumers) lacks awareness on importance of clean and safe water, and prefer to use shallow wells (to avoid paying tariff).	Insufficient budget and lack of skilled engineers and technicians (sub-engineers) in water supply sector	Insufficient budget and lack of skilled engineers and technicians (sub-engineers) in water supply sector	Insufficient budget is the main issue. Engineers and technicians also require trainings on overall water supply system.

Appendix 2.2 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP in Target Areas		Gulariya NP	Thakurbaba NP	Rajapur NP	Madhuban NP
S.N.	**Province/District**	**Province No. 5, Bardiya**	**Province No. 5, Bardiya**	**Province No. 5, Bardiya**	**Province No. 5, Bardiya**
	Name of Information Officer	Mr. Ram Chandra Poudel (Chief)	Mr. Hikmat B.C (Engineer)	Mr. Hikmat B.C (Engineer)	Mr. Khimraj Pokhrel (Chief)
1	Organization with Chart (as of January, 2020) (Refer to No.3)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)	Not Existing in water supply and sanitation section (All Engineers belong to Planning section)
2	Job Description for each division/section (as of January, 2020)	Not Existing	Not Existing	Not Existing	Not Existing
3	Number of staffs for each division/section (as of January, 2020)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)	As per organization chart prepared by Ministry of Foreign Affairs and General Administration.	Not Mentioned (As per organization chart prepared by Ministry of Foreign Affairs and General Administration. Following the organization chart, but revising the chart)
4	**Number of engineers/technicians for each division/section (as of January, 2020)**				
4.1	Engineers	1	1	1	1
4.2	Technicians (Sub-Engineer, Assistant sub engineer)	4	4	4	Contract-4
4.3	Is there a specific unit to look after WASH functions? (Initial LG had the unit, V-WaSH-CC, but now, it is NOT obligation for LG)	No WASH Unit	No WASH Unit	No WASH Unit	No WASH Unit
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020) Parentheses show the Target WUSC in WASMIP-II	Semi urban-2 (Gulariya-I and Gulariya-II WUSCs)	Semi urban-2 (included in Bhurigau WUSC) Rural-5	Semi urban-1 (Rajapur WUSC)	Semi urban-1 (Kusumba WUSC) Rural-2
6	**Budget head and Budget to support WUSCs (O&M, Management) in FY 2076/77 in NPR**				
6.1	Total Budget for FY 2076/77 (NPR)	843,970,358	712,049,106	445,338,000	Budget not finalized due to internal reason
6.2	Water Supply; NPR (O&M, rehabilitation and construction) (NPR)	2,400,000	5,685,000	350000	-
6.3	Percentage of Total Budget (%)	0.3%	0.8%	0.1%	-
	Total Budget for FY 2076/77 excluding NP/GP operating cost (NPR)	654,820,358	328,891,000	426,473,000	-
6.4	Total Budget for FY 2076/77 Road construction (NPR)				
7	**Other activities for WUSCs**				
7.1	Support on O&M for water supply (advisory/ consultation)	Yes as requested	No such support so far.	No such support so far.	No such support so far.
7.2	Supervision of construction for water supply	Yes, ongoing water supply construction and rehabilitation works under NP Red book. Red book is the summary of estimated or intended expenditures for a given period of time.	No such support so far.	No such support so far.	No such support so far.
7.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Elected members of NP attend WUSCs event (General assembly).	Local representatives (Chief and elected members) attend WUSC's General Assembly.	WUSC has not invited in such events.	WUSC has not invited in such events.
7.4	Others	-	-	-	-
8	**Communication with MoPID/ WSSDOs**				
8.1	Frequency	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID	As necessary with MoPID
8.2	Method	Phone calls, meeting	Phone calls, meeting	Phone calls, meeting	Phone calls, meeting
8.3	Contents	Budget and Programs granted by MoPID and Federal government	Budget and Programs granted by MoPID and Federal government	Budget and Programs granted by MoPID and Federal government	Budget and Programs granted by MoPID and Federal government
8.4	Others	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan	Communication with MoPID on preparation of WASH plan
9	**Training needs for survey, design, construction and operational aspects of Water Supply System:**				
9.1	Water supply & San Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of groundwater supply system	O&M of groundwater supply system	O&M of groundwater supply system	Survey, O&M of groundwater supply system
9.2	Sub-Engineer (Assistant Engineer)	Survey and cost estimate of groundwater supply system	Survey and cost estimate of groundwater supply system	Survey and cost estimate of groundwater supply system	Survey, cost estimate, O&M of groundwater supply system
9.3	Engineer	Design of groundwater supply system (O&M, distribution system and over head tank) (Design and cost estimate are outsourced to private consultants.)	Design of groundwater supply system (O&M, distribution system and over head tank) (Design and cost estimate are outsourced to private consultants.)	Design of water supply system (pumping system), troubleshooting. (Design and cost estimate are outsourced to private consultants.)	Survey, design, cost estimate of groundwater supply system. (Design and cost estimate are outsourced to private consultants.)
10	Issues/ Challenges (if any)	Insufficient budget for water supply is the main issue. Number of Engineers and technicians is limited.	Insufficient budget for water supply is the main issue. Number of Engineers and technicians is limited.	Number of Engineers and technicians is limited. Budget for water supply is lacking.	Lack of proper knowledge of design and cost estimate of pumping systems. Less manpower as project.

Appendix 2.3 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP:		**Jhapa WSSDO**	**Sarlahi WSSDO**	**Bara WSSDO**
S.N.		**Province No. 1**	**Province No. 2**	**Province No. 2**
	Name of Information Officer	Mr. Dharmendra Kesari (Senior Division Engineer)	Mr. Janaki Sharan Bhagat (Engineer)	Mr. Zakir Ansari (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	3	3	3
4.2	Technicians (including sub-engineer)	4	2	6
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	234 WUSCs	Sarlahi, Rautahat Districts (The number of WUSCs is unknown.)	Bara, Parsa Districts (The number of WUSCs is unknown.)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	500,000,000	240,846,074	151,439,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	499,000,000	219,010,000	151,439,000
7.2	Percentage against Total Budget	99.8%	91%	100%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	Pre construction and post construction training are conducted for WUSCs.	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email,visit	Telephone, letters, email,visit	Phone, meeting
9.3	Contents	Budget, programs	Budget, programs	Budget, programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	Pump operator and pumping system O&M	Water Quality testing training
10.2	Sub-engineer	No staffs in this position	Survey, cost estimate of ground water supply system	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP	Pipeline design and training on electromechanical components of deep tubewell system	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Large no. of projects compared to availble staffs.	Lack of manpower, budget	Lack of manpower, budget

Appendix 2.3 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP:		Mahottari WSSDO	Sindhupalchowk WSSDO	Ramechaap WSSDO
S.N.		**Province No. 2**	**Province No. 3 (Bagmati Province)**	**Province No. 3 (Bagmati Province)**
	Name of Information Officer	Mr. Madan Mohan Sah (Engineer)	Mr. Lok Bahadur Chaulagain (SDE)	Mr. Navraj Satyal (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	3	3	4
4.2	Technicians (including sub-engineer)	3	4	Contract-2
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Dhanusa, Mahottari Districts (The number of WUSCs is unknown.)	Sindhupalchowk district (19 WUSCs) and Kavre district (63 WUSCs)	Dolakha district (13 WUSCs), Sindhuli district(28 WUSCs) and Ramchaap district (10 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	185,095,000	233,365,000	242,998,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	185,095,000	230,550,000	242,998,000
7.2	Percentage against Total Budget	100%	99%	100%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	-	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Phone, meeting	Telephone, letters, email, visit	Telephone, letters, email, visit
9.3	Contents	Budget, programs	Budget	Budget, Programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	O&M of water supply system	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system	Survey and design of water supply system	Survey and design of water supply system
10.3	Engineer	GIS survey, design and cost estimate of water supply sytems with WTP	Survey and design of water supply sytems with WTP	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower, budget, awareness for water quality in consumers	Lack of manpower, budget	Lack of manpower, budget

Appendix 2.3 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP:		**Tanahu WSSDO**	**Gorkha WSSDO**	**Dang WSSDO**
S.N.		**Province No. 4 (Gandaki Province)**	**Province No. 4 (Gandaki Province)**	**Province No. 5**
	Name of Information Officer	Mr. Bamdev Poudel (Engineer)	Mr. Dev Bahadur Lama (Engineer)	Mr. Guna nidhi Pokhrel (SDE)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	4	3, Contract-1	5
4.2	Technicians (including sub-engineer)	11	1, Contract-6	4
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Tanahu, Nawalparasi-east district (The number of WUSCs is unknown.)	Gorkha (77 WUSCs), Lamjung (40 WUSCs), Manag (13 WUSCs), Kaski districts (39 WUSCs)	Dang district (65 WUSCs), Banke district (40 WUSCs) and Bardiya district (40 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	222,000,000	500,800,000	410,563,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	222,000,000	500,800,000	403,863,000
7.2	Percentage against Total Budget	100%	100%	98%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	-	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email, visit	Phone, meeting	Telephone, letters, email, visit
9.3	Contents	Budget, programs	Budget, programs	Budget
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	O&M of water supply system	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system	Survey and design of water supply system	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP	Design and cost estimate of water supply sytems with WTP	Survey and design of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower, budget	Lack of manpower and large number of projects	Lack of manpower, budget

Appendix 2.3 Baseline Survey on MoPID/ FWSSMP/WSSDO/NP/GP:		**Rupandehi WSSDO**
S.N.		**Province No. 5**
	Name of Information Officer	Mr. Khagendra Khatri (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**	
4.1	Engineers	4
4.2	Technicians (including sub-engineer)	3, Contract-1
4.3	is there a specific unit to look after WaSH functions?	
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Nawalparasi-west district (25 WUSCs), rupandehi (17 WUSCs), kapilbastu district (36 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**	
6.1	Total Budget for FY 2076/77	628,649,000
7	**Budget for construction in FY 2076/77**	
7.1	Water Supply; NPR	608,899,000
7.2	Percentage against Total Budget	97%
8	**Other activities for WUSCs**	
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request
8.4	Others	-
9	**Communication with MoPID/ WSSDOs**	
9.1	Frequency	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email, visit
9.3	Contents	Budget, programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**	
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower compared to large no. of projects

Appendix-2.4 Baseline Survey on WSSDO in the Target Areas		Jhapa WSSDO	Sarlahi WSSDO	Bara WSSDO
S.N.		**Province No. 1**	**Province No. 2**	**Province No. 2**
	Name of Information Officer	Mr. Dharmendra Kesari (Senior Division Engineer)	Mr. Janaki Sharan Bhagat (Engineer)	Mr. Zakir Ansari (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	3	3	3
4.2	Technicians (including sub-engineer)	4	2	6
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	234 WUSCs	Sarlahi, Rautahat Districts (The number of WUSCs is unknown.)	Bara, Parsa Districts (The number of WUSCs is unknown.)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	500,000,000	240,846,074	151,439,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	499,000,000	219,010,000	151,439,000
7.2	Percentage against Total Budget	99.8%	91%	100%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	Pre construction and post construction training are conducted for WUSCs.	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email,visit	Telephone, letters, email,visit	Phone, meeting
9.3	Contents	Budget, programs	Budget, programs	Budget, programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	Pump operator and pumping system O&M	Water Quality testing training
10.2	Sub-engineer	No staffs in this position	Survey, cost estimate of ground water supply system	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP	Pipeline design and training on electromechanical components of deep tubewell system	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Large no. of projects compared to availble staffs.	Lack of manpower, budget	Lack of manpower, budget

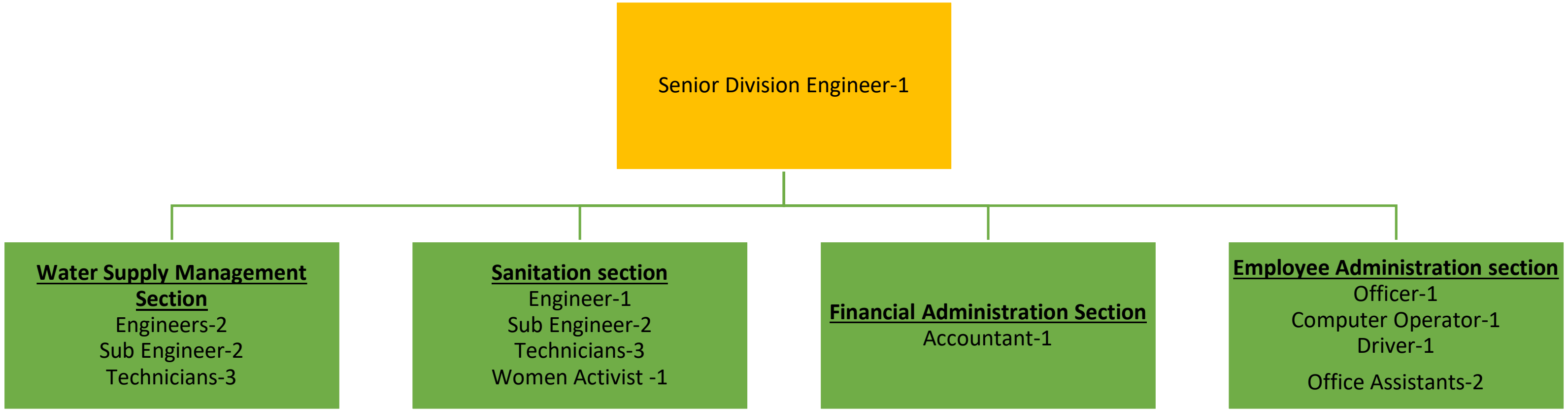
Appendix-2.4 Baseline Survey on WSSDO in the Target Areas		**Mahottari WSSDO**	**Sindhupalchowk WSSDO**	**Ramechaap WSSDO**
S.N.		**Province No. 2**	**Province No. 3 (Bagmati Province)**	**Province No. 3 (Bagmati Province)**
	Name of Information Officer	Mr. Madan Mohan Sah (Engineer)	Mr. Lok Bahadur Chaulagain (SDE)	Mr. Navraj Satyal (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	3	3	4
4.2	Technicians (including sub-engineer)	3	4	Contract-2
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Dhanusa, Mahottari Districts (The number of WUSCs is unknown.)	Sindhupalchowk district (19 WUSCs) and Kavre district (63 WUSCs)	Dolakha district (13 WUSCs), Sindhuli district(28 WUSCs) and Ramchaap district (10 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	185,095,000	233,365,000	242,998,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	185,095,000	230,550,000	242,998,000
7.2	Percentage against Total Budget	100%	99%	100%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	-	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Phone, meeting	Telephone, letters, email, visit	Telephone, letters, email, visit
9.3	Contents	Budget, programs	Budget	Budget, Programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	O&M of water supply system	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system	Survey and design of water supply system	Survey and design of water supply system
10.3	Engineer	GIS survey, design and cost estimate of water supply sytems with WTP	Survey and design of water supply sytems with WTP	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower, budget, awareness for water quality in consumers	Lack of manpower, budget	Lack of manpower, budget

Appendix-2.4 Baseline Survey on WSSDO in the Target Areas		**Tanahu WSSDO**	**Gorkha WSSDO**	**Dang WSSDO**
S.N.		**Province No. 4 (Gandaki Province)**	**Province No. 4 (Gandaki Province)**	**Province No. 5**
	Name of Information Officer	Mr. Bamdev Poudel (Engineer)	Mr. Dev Bahadur Lama (Engineer)	Mr. Guna nidhi Pokhrel (SDE)
1	Organization with Chart (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2	See ANNEX-2	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**			
4.1	Engineers	4	3, Contract-1	5
4.2	Technicians (including sub-engineer)	11	1, Contract-6	4
4.3	is there a specific unit to look after WaSH functions?			
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Tanahu, Nawalparasi-east district (The number of WUSCs is unknown.)	Gorkha (77 WUSCs), Lamjung (40 WUSCs), Manag (13 WUSCs), Kaski districts (39 WUSCs)	Dang district (65 WUSCs), Banke district (40 WUSCs) and Bardiya district (40 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**			
6.1	Total Budget for FY 2076/77	222,000,000	500,800,000	410,563,000
7	**Budget for construction in FY 2076/77**			
7.1	Water Supply; NPR	222,000,000	500,800,000	403,863,000
7.2	Percentage against Total Budget	100%	100%	98%
8	**Other activities for WUSCs**			
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request	On the basis of WUSC's request	On the basis of WUSC's request
8.4	Others	-	-	-
9	**Communication with MoPID/ WSSDOs**			
9.1	Frequency	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email, visit	Phone, meeting	Telephone, letters, email, visit
9.3	Contents	Budget, programs	Budget, programs	Budget
9.4	Others	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**			
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system	O&M of water supply system	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system	Survey and design of water supply system	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP	Design and cost estimate of water supply sytems with WTP	Survey and design of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower, budget	Lack of manpower and large number of projects	Lack of manpower, budget

Appendix-2.4 Baseline Survey on WSSDO in the Target Areas		Rupandehi WSSDO
S.N.		**Province No. 5**
	Name of Information Officer	Mr. Khagendra Khatri (Engineer)
1	Organization with Chart (as of January, 2020)	See ANNEX-2
2	Job Description for each division/section (as of January, 2020)	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-2
4	**Number of engineers/technicians for each division/section (as of January, 2020)**	
4.1	Engineers	4
4.2	Technicians (including sub-engineer)	3, Contract-1
4.3	is there a specific unit to look after WaSH functions?	
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Nawalparasi-west district (25 WUSCs), rupandehi (17 WUSCs), kapilbastu district (36 WUSCs)
6	**Budget head and Budget to support WUSCs (O &M , Management) in FY 2076/77 in NPR**	
6.1	Total Budget for FY 2076/77	628,649,000
7	**Budget for construction in FY 2076/77**	
7.1	Water Supply; NPR	608,899,000
7.2	Percentage against Total Budget	97%
8	**Other activities for WUSCs**	
8.1	Support on O&M (advisory/ consultation)	On the basis of WUSC's request
8.2	Supervision of construction	Frequent monitoring of ongoing construction and rehabilitaion works
8.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	On the basis of WUSC's request
8.4	Others	-
9	**Communication with MoPID/ WSSDOs**	
9.1	Frequency	On the basis of request from MoPID as well as WSSDO
9.2	Method	Telephone, letters, email, visit
9.3	Contents	Budget, programs
9.4	Others	Communication with MoPID and frequent communication with WUSCs
10	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**	
10.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers (VMWs)	O&M of water supply system
10.2	Sub-engineer	Survey and design of water supply system
10.3	Engineer	Survey, design and cost estimate of water supply sytems with WTP
11	Issues/ Challenges (if any)	Lack of manpower compared to large no. of projects

ANNEX-2 WSSDO organization chart

*All WSSDOs have same organization chart



Senior Division Engineer-1

Water Supply Management Section
Engineers-2
Sub Engineer-2
Technicians-3

Sanitation section
Engineer-1
Sub Engineer-2
Technicians-3
Women Activist -1

Financial Administration Section
Accountant-1

Employee Administration section
Officer-1
Computer Operator-1
Driver-1

Office Assistants-2

	Appendix-2.3 Baseline Survey on FWSSMP in the Target Areas	FWSSMP	FWSSMP	FWSSMP	FWSSMP	FWSSMP
S.N.		**Hetauda**	**Lamjung**	**Pokhara**	**Butwal**	**Janakpur**
	Name of Information Officer	**Mr. Atulesh Kumar Karn (Engineer)**	**Mr. Maheshi Mahato (Engineer)**	**Ms. Sunam Thapa (Engineer)**	**Mr. Binod Kumar Bhujel (SDE)**	**Mr. Ganga Prasad Mahato (Engineer)**
1	Organization with Chart (as of January, 2020)	See ANNEX-1	See ANNEX-1	See ANNEX-1	See ANNEX-1	See ANNEX-1
2	Job Description for each division/section (as of January, 2020)	Not existing	Not existing	Not existing	Not existing	Not existing
3	Number of staffs for each division/section (as of January, 2020)	See ANNEX-1	See ANNEX-1	See ANNEX-1	See ANNEX-1	See ANNEX-1
4	**Number of engineers/technicians for each division/section (as of January, 2020)**					
4.1	Engineers	Chief-1 SDE (senior division engineer)-1 Engineer-5	Chief-1 Engineers-2	Chief-1 Engineers-3 Contact-1	Chief-1 Engineers-2	Chief-1 Engineers-2, Contract-6
4.2	Technicians (including sub-engineer)	2	1	Contract- 7	Contract- 4	Contract- 1
4.3	is there a specific unit to look after WaSH functions?	Not existing	Not existing.	Not existing.	Not existing.	Not existing.
5	Number of WUSCs and size within a MoPID/FWSSMP/WSSDO/local body (as of January, 2020)	Not available (FWSSMP doesn't have actual information on number of WUSCs.)	Not available (FWSSMP doesn't have actual information on number of WUSCs.)	Not available (FWSSMP doesn't have actual information on number of WUSCs.)	Not available (FWSSMP doesn't have actual information on number of WUSCs.)	Not available (FWSSMP doesn't have actual information on number of WUSCs.)
6	**Budget head and Budget to support WUSCs (O&M , Management) in FY 2076/77 in NPR**	The following budget heads are mentioned in budget book; Water Quality Improvement Project, Drinking Water co- Finance Project, Urban Water Supply and Sanitation Project, Rural Water Supply and Sanitation Fund Development Committee, Water Supply Service Expansion and Rehabilitation Program, Terai Madesh Water Supply Improvement Project, Climate resilient Water Supply Project.				
6.1	Total Budget for FY 2076/77	1,397,788,000	1,244,975,000	1,415,861,000	1,105,070,000	417,128,000
7	**Budget for construction in FY 2076/77**					
7.1	Water Supply; NPR	1,369,985,000	1,207,375,000	1,366,361,000	1,071,272,000	417,128,000
7.2	Percentage against Total Budget	98%	97%	97%	97%	100%
9						
9.1	Support on O&M (advisory/ consultation)	Provides support to WUSCs on the basis of the request, in case WUSCs has Co-finance projects.	Provides support to WUSCs on the basis of the request.	Provides support to WUSCs on the basis of the request.	Provides support to WUSCs on the basis of the request.	Provides support to WUSCs during site visit and on the basis of WUSC's request
9.2	Supervision of construction	Regular monitoring and supervising construction of new projects	Regular monitoring and supervising construction of new projects	Regular monitoring and supervising construction of new projects	Regular monitoring and supervising construction of new projects	Regular monitoring and supervising construction of new projects
9.3	Meeting (General Assembly, Board Meeting, PR events, and so on.)	Attends on the basis of the request.	Attends on the basis of the request.	Attends on the basis of the request.	Attends on the basis of the request.	Attends on the basis of the request.
9.4	Others	-	-	-	-	-
10	**Communication with MoPID/ WSSDOs**					
10.1	Frequency	Direct communication is difficult because Federal Government and Provincial Government are independent authorities and they do not have any obligations to communicate with each other.	Direct communication is difficult because Federal Government and Provincial Government are independent authorities and they do not have any obligations to communicate with each other.	Seldom communication with MoPID.	Seldom communication with MoPID.	Seldom communication with MoPID.
10.2	Method	-	-	Letters, meetings, phone calls	Letters, meetings, phone calls	Letters, meetings, phone calls
10.3	Contents	-	-	About the projects that has to be transferred to federal government from provincial government. (Based on the population criteria, some projects are taken over by federal government from provincial government.)	About the projects that has to be transferred to federal government from provincial government. (Based on the population criteria, some projects are taken over by federal government from provincial government.)	About budget and projects
10.4	Others	-	-			
11	**Training needs for survey, design, construction and operational aspects of Water & Sanitation systems:**					
11.1	Water supply & Sanitation Technicians (WSSTs) / Village maintenance workers	No staff existed.	O&M of water supply systems	O&M of water supply systems	O&M of water supply systems	No staff existed
11.2	Sub-engineer	O&M of water supply systems	Survey and cost estimate of water supply systems	Survey and cost estimate of water supply systems	Survey and cost estimate of water supply systems	Need refresher training on survey and O&M of water supply system
11.3	Engineer	Smart water management system.	Design of water supply systems	Design of water supply systems (new technologies)	Design of water supply systems (new technologies)	Design, cost estimate of water supply system and water quality management (Since FWSSMP is newly established organization, FWSSMP staffs need trainings on water quality management.)
12	Issues/ Challenges (if any)	Large number of projects compared to number of staffs.	Large number of projects compared to number of staffs.	Large number of projects compared to number of staffs and duplication of some projects with provincial government (due to lack of communication and coordination, both federal and provincial government sometimes select the same area for the new project).	Large number of projects compared to number of staffs and duplication of some projects with provincial government (due to lack of communication and coordination, both federal and provincial government sometimes select the same area for the new project).	Large number of projects compared to number of staffs and duplication of some projects with provincial government (due to lack of communication and coordination, both federal and provincial government sometimes select the same area for the new project).

ANNEX-1

FWSSMP Butwal/FWSSMP Pokhara/FWSSMP Biratnagar

S.N	Designation	No.
1	Superitendent Engineer	1
2	Senior Division Enigeer	1
3	Account Officer	1
4	Engineer	8
5	Chemist	1
6	Admin Assistant	1
7	Sub-Engineer	8
8	Assistant Chemist	1
9	Driver	2
10	Office Assistants	1
	Total:	**25**

FWSSMP Hetauda

S.N	Designation	No.
1	Superitendent Engineer	1
2	Senior Division Enigeer	1
3	Account Officer	1
4	Engineer	6
5	Chemist	1
6	Admin Assistant	1
7	Sub-Engineer	6
8	Assistant Chemist	1
9	Driver	2
10	Office Assistants	1
	Total:	**21**

FWSSMP Lamjung, Ramechaap

S.N	Designation	No.
1	Senior Division Enigeer	1
2	Engineer	3
3	Account Officer	1
4	Computer Operator	1
5	Sub-Engineer	3
6	Driver	1
7	Office Assistants	1
	Total:	**11**

FWSSMP Janakpur

S.N	Designation	No.
1	Superitendent Engineer	1
2	Senior Division Enigeer	2
3	Account Officer	1
4	Engineer	8
5	Chemist	1
6	Admin Assistant	1
7	Sub-Engineer	8
8	Computer Operator	1
9	Assistant Chemist	1
10	Driver	3
11	Office Assistants	3
	Total:	**30**

Appendix 2.11

WaSH Bill (draft)

Clause-3

Obligations and Responsibilities Relating to Water Supply and Sanitation

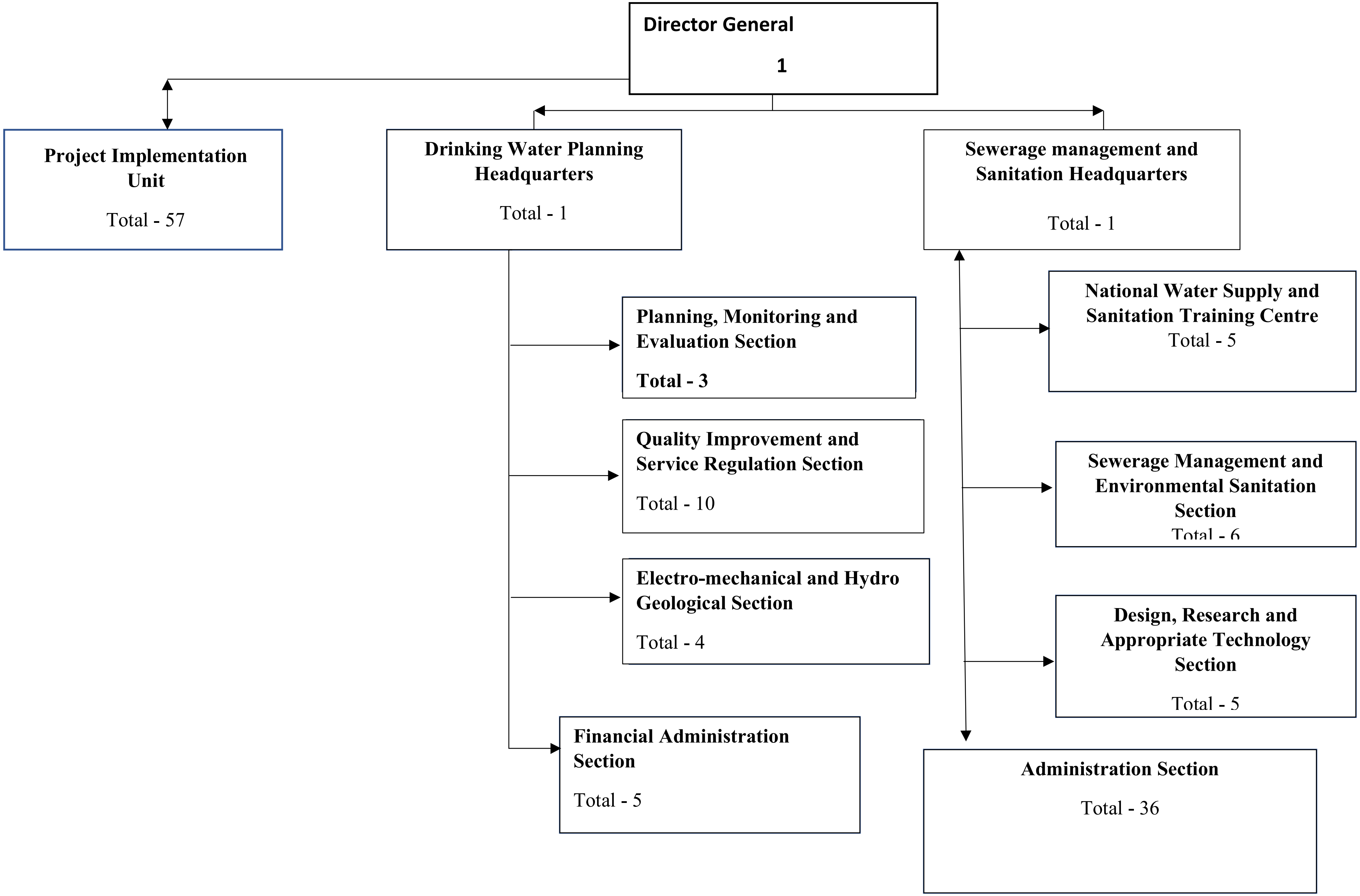
1. **Obligations and responsibilities relating to water supply and sanitation:**
    a. The responsibility and obligation to provide drinking water service, sanitation service, and issuance of license, construction, operation, and management of a project shall lie with Government of Nepal, provincial governments, and local authorities.
    b. For activities specified in sub-section (a), the responsibilities and obligations of the Government of Nepal, provincial governments, and local authorities shall be as follows: -
        i. Responsibilities and Obligations of Government of Nepal: -
            1. National-scale projects relating to drinking water and sanitation services,
            2. Projects supported by multilateral investments or foreign aid,
            3. Project to provide drinking water and sanitation services for specified area and population,
            4. Projects associated with more than one province,
            5. As specified, waste water treatment and management works requiring large-scale investment,
            6. Projects requiring transfer of water from natural source of one catchment area to another,
            7. Projects specified by the Government of Nepal,
            8. Monitor water supply and sanitation projects.
        ii. Responsibilities and obligations of provincial governments: -
            1. Project to provide drinking water and sanitation services for specified area and population,
            2. Relating to wastewater treatment and management,
            3. Projects affecting more than one local administrative division.
        iii. Responsibilities and obligations of local authorities: -
            1. Distribution and monitoring of drink water services at local level,
            2. Enhancement of public awareness regarding sanitation,
            3. Operation of wastewater management system,
            4. Project providing drinking water and sanitation services for specified area and population,
            5. Repair, maintenance, and rehabilitation of water supply and sanitation projects operated at local level.
    c. In subjects relating to responsibilities and obligations specified in articles (ii) and (iii) of sub-section (b), provision of license and construction, operation, and management of projects and service systems shall be in accordance with provincial and local laws.
    d. Notwithstanding sub-section (c), Government of Nepal may operate in accordance with this act until the provincial and local laws are promulgated.

e. Notwithstanding other sub-sections of this section, in case a provincial government or local authority is unable to accomplish a drinking water or sanitation project on its own due to geographic complexity or requirement of high capital specialised manpower, provincial governments, and local authorities, upon request, may coordinate with Government of Nepal for implementation of the project.
f. In accordance with sub-section (e), the projects requested by local government will be implemented by the provincial government and the projects requested by provincial government will be implemented by the Government of Nepal.
g. In accordance with sub-section (b) the right to regulate water supply and sanitation within its respective jurisdiction shall lie with Government of Nepal, provincial governments, and local authorities.

Appendix 2.12

DWSSM Job Description (draft)

Appendix 1 (B) Organizational Structure of Department of Water Supply and Sewerage
(Proposed for organization and management survey)



Appendix 3: Proposed Job Description of Organization, Division and Section

Work Area of Department of Water Supply and Sewerage Management:

1. Prepare long term legal plan, policy, law, strategy, directory, criteria, and manage necessary legal arrangements for drinking water sector.
2. Conduct tasks related to Annual Program and Budget preparation of the Department and subordinate bodies.
3. Prepare a proposal for the projects that should be operated with foreign assistance and coordinate accordingly.
4. Prepare and update standard norms, codes, criteria, manuals, feasibility plan studies, design, and construction and operation management for Water Supply and Sanitation Project.
5. Put together all the work related to the preparation of action plan, budget management, and implementation of quality drinking water service as per the national drinking water quality standards.
6. Establish a leadership role by maintaining coordination and communication between regional bodies of DWSSM.
7. Update the national statistics record of regional planning and program.
8. Conduct activities such as benchmarking and record statistics of water supply system and service level.
9. Operate, update and regulate the appropriate management information system (MIS) for the development and management of drinking water and sanitation sector.
10. Manage the monitoring, inspection, and evaluation of projects and programs.
11. Prepare necessary action plan for the maintenance and sustainability of drinking water and sanitation system.
12. Provide required technical assistance and feedback to different water supply systems including pumping and deep tube well facilities.
13. Emphasize study, research, and development of the latest, effective technology, climate change and adaptation on drinking water and sanitation systems.
14. Continuously implement high-tech drinking water management and smart water management system.
15. Prepare and manage long term master plan, policy, law, rule, strategy, directory, standard as well as ensure the necessary legal obligations for sewage management and environmental sanitation.
16. Allocate budget for an annual program related to sewerage, sludges, environmental sanitation and disaster management.
17. Provide coordinating goal to achieve total sanitation.
18. Conduct or organize environmental impact assessment of the programs and projects.
19. Organize technical audit of the projects.

1. Drinking Water and Planning Headquarters

1. Prepare long-term master plan, policy, law, rule, strategy, directory, criteria, and necessary legal management for water supply sector.
2. Play a leading role and establish coordination and communication between regional entities of DWSSM.
3. Allocate budget for an annual program for DWSSM and subordinate bodies.
4. Keep national statistics on the project and programs up to date.
5. Operate, update, and regulate an appropriate management information system (MIS) for the development and management of drinking water and sanitation sector.
6. Prepare and update standard norms, codes, criteria, manuals, etc. regarding the planning, design, construction, operation and management of drinking water and sanitation project.
7. Prepare necessary action plan and manage the budget for the supply of quality drinking water services as mandated by National Drinking water quality standards.
8. Manage the monitoring, inspection, and evaluation of projects and programs.
9. Conduct activities such as benchmarking and record statistics of water supply system and service level.
10. Conduct necessary support for the maintenance and sustainability of drinking water and sanitation system.
11. Implement high-tech drinking water management and smart water management system.
12. Manage the Federal Water Testing Laboratory. Facilitate establishing water testing laboratories on provincial and local level.
13. Manage programs to reduce the arsenic level.
14. Manage required directory and other policies for Water Safety Plan.
15. Formulate the project and programs based on national policy guidelines.
16. Coordinate with Ministry of Finance to prepare annual program and budget and complete the related work.
17. Prepare proposals for the projects that are to be operated through foreign assistance.
18. Update the national statistics on the project and programs.
19. Manage the monitoring, inspection, and evaluation of projects and programs.
20. Organize technical audit of the projects.

21. Provide required technical assistance and feedback to different water supply systems including pumping and deep tube well facilities.
22. Prepare specification of mechanical tools and prepare action plan for its management.
23. Manage the installation and operation of mechanical workshops.

2. Sewerage Management and Sanitation Headquarters

1. Prepare and manage long-term master plan, policy, law, rule, strategy, directory, criteria and necessary legal management for sewerage management and environmental sanitation.
2. Play a leading role and establish coordination and communication between regional entities of DWSSM.
3. Update information and statistics on sewerage system management and keep records.
4. Develop technological studies and research on sewage system management and environmental sanitation.
5. Allocate budget for an annual program related to sewerage, sludges, environmental sanitation, and disaster management.
6. Play a coordinating role to support the campaign for open defecation free area and achieve total sanitation.
7. Manage the monitoring, inspection, and evaluation of projects and programs.
8. Conduct or organize environmental impact assessment of the programs and projects.
9. Study, research, and develop the latest technology on climate change and drinking water and sanitation systems.
10. Prepare and update standards, norms, codes, standards, manuals etc. related to feasibility study, design, construction and operation management of sanitation projects such as sewage and sludge management.
11. Formulate the project and programs on the basis of national policy guidelines.
12. Work for the capacity development of the stakeholders of Drinking Water and Sanitation Sector.
13. Operate and manage federal level laboratory for testing construction materials.

Planning Monitoring and Evaluation Section

1. Plan and coordinate to prepare proposals for the projects that should be operated with foreign assistance, based on national policy guidelines.
2. Keep an updated statistics to mobilize internal and external resources and to coordinate foreign assistance in the drinking water and sanitation sector.
3. Prepare and coordinate annual development programs of the department and the subordinate bodies and present the final authorization.
4. Manage regional information on drinking water and sanitation.
5. Monitor and prepare report of project implementation and achievements.
6. Prepare a periodical (monthly, quarterly, annually, etc.) progress Report of Central level projects and present it to the concerned bodies.
7. Make arrangements for technical audit of the projects.
8. Provide necessary technical assistance to concerned parties or bodies to collect and update data related to drinking water and sanitation.
9. Conduct benchmarking to update statistics and manage the information to identify the differences in the level of drinking water and sanitation services provided by provincial and local level.
10. Design and operate proper Management Information System (MIS) for the development and management of drinking water and sanitation sector.

Quality Improvement and Service Regulation Section

1. Prepare Drinking Water Quality Standard.
2. Prepare necessary action plan to provide qualitative drinking water as stated by National Drinking Water Quality Standards.
3. Coordinate for the implementation of high-tech water treatment systems.
4. Maintain, monitor and evaluate the water supply operated by service providers and the service provided at personal level to regulate the quality of service.
5. Coordinate for the operation of water test laboratory in all seven states. Properly use and manage the central laboratory.

6. Identify various programs that will enhance quality of drinking water and increase the capacity.
7. Monitor and supervise ongoing drinking water quality improvement projects.
8. Manage the quality of drinking water and service level statistics.
9. Make necessary action plans for maintenance and improvement in the service of completed drinking water projects.
10. Study and research topics related to institutional empowerment and drinking water service regulation.
11. Improve drinking water and sanitation sector through community empowerment and facilitate effective service through water user and sanitation committee and non-governmental organizations.
12. Develop policy, strategy, directory and guidelines for Community empowerment and operational policy, include the issues of gender equality and social inclusion in the projects and campaigns pertaining to drinking water, sanitation and hygiene.

Electro-mechanical and Hydro Geological Section

1. Provide technical assistance to drinking water projects based on the pumping system.
2. Keep up to date information and records of pumping system projects.
3. Prepare and coordinate the essential norms related to electro-mechanical and hydro-geology.
4. Develop and supervise Deep Tube Well Development Project.
5. Develop and propose the design criteria and directories of Deep tube well and Pumping Stations.
6. Prepare an action plan for the management of vehicles and other mechanical equipment.
7. Develop specification for purchasing vehicles and other mechanical equipment.
8. Provide training to related human resource from time to time for efficient operations of mechanical equipment.
9. Mobilize vehicles used in the department and plan within the department to operate and manage vehicles by coordinating with offices.

Financial Administration Section

1. Manage current budget and allocate authority to Department and Sections.
2. Control overall accounting of the Department and Sections.

3. Prepare and formulate the budget of the Department and Sections.
4. Manage all kinds of records related to financial administration.
5. Provide an opinion and suggestions on Financial Act, Rules and Policy.
6. Work on the release of budget, transfer of budget and transfer of resource.
7. Prepare financial statement of the Central Department.
8. Update financial records of foreign aid projects.
9. Conduct daily tasks related to the financial administration of the department.
10. Provide financial feedback and advice as per requirement to the sections of the department.
11. Work on clearance of irregularities of internal and final audit.
12. Instruct the projects operated by foreign assistance to prepare and submit the required details and certificates of audit report to the donor organizations, and monitor.
13. Delegation of authority regarding the budget in the department and related organizations.

National Water Supply and Sanitation Training Center

1. Work for the capacity development, promotion of innovation, and technological development of stakeholders and service providers of water supply and sanitation sector.
2. Develop necessary manuals, online courses and information management system for training.
3. Identify and analyze the work related to course development as per the need for training in different subjects.
4. Prepare training norms.
5. Prepare and update the business work plan of the training center.
6. Operate high, low, and minimum cost technical training.
7. Conduct necessary training for the operation of drinking water and sewage management projects that use automated technology.
8. Operate and manage Federal level laboratory for testing construction materials.
9. Formulate necessary action plans and procedures to increase the efficiency in the operation of Drinking Water and Sanitation projects.

Sewerage Management and Environmental Sanitation Section

1. Prepare a long-term master plan for Sewage management.
2. Develop design guidelines and norms for the construction and management of sewerage system.
3. Conduct study, research and information on sewerage system management.
4. Prepare annual development programs and budget for implementation and coordination for Sewerage system.
5. Prepare and update criteria on sewerage management.
6. Conduct inspection, supervision, monitoring, and evaluation on sewerage management.
7. Help build environmental sanitation policy, strategy, and more.
8. Prepare annual sanitation budget related to environmental sanitation.
9. Organize environmental sanitation studies, research, and information management.
10. Conduct IEE or EIA to evaluate the environmental effects of projects.
11. Record and update environmental sanitation information and statistics.
12. Prepare, manage, and implement necessary action plans to maintain the river health, water body’s health and the water quality of rivers, lakes and stream that are affected by urbanization.
13. Prepare action plan for Disaster management, reduction, and reinforcement.
14. Prepare progress reports on monitoring, inspection and evaluation of environmental and sanitation programs.
15. The Branch Head shall act as the Member Secretary of the National Sanitation and Hygiene Coordinating Committee.

Design, Research and Appropriate Technology Section

1. Prepare, publish and update the study, design, construction criteria, directories, norms, manual etc. of the project.
2. Check the design report of the projects.
3. Study, research and develop high, minimal and low-cost technologies.
4. Develop drinking water and sewerage management sample project based on high, minimum and low-cost technology.
5. Develop and promote technologies to operate drinking water and sewage management projects with smart water management techniques.
6. Operate climate-friendly projects. Conduct study on conservation of drinking water, ground water recharge, rainwater collection technology.

7. Implement action plan for strengthening the institutional capacity necessary for the service providers.
8. Prepare business action plan of the department and help in preparing business action plan of the projects run by the service providers.
9. Prepare Federal, State and Local level Plan (WaSH Plan) and co-ordinate the implementation.

Administration Section

1. Confirm the required number of employees and create the job description for the post.
2. Conduct necessary work regarding the transfer, promotion, appointment, courtesy, punishment, incentive, award, medal, discipline, leave and appointment, departure and posting etc. of the employee.
3. Update the records of all the employees of the department and sections.
4. Work on the organizational structure for credit review, post creation, rank, appointment, promotion, departmental proceedings, penalties, rewards, medals, discipline and leisure activities.
5. Award, recognition and punishment.
6. Conduct workshop for employees’ growth and development.

Appendix 2.13

FWSSMP Projects and Engineers Number (as of 2019)

Federal Water Supply and Sewerage Management Project

Data Source ;
*** Red Book for FY 2076/77 published by MoWS**
**** Interview survey by phone**

Province	**Federal Water and Sewerage Management Project**	**Chief person**	**Work Area**	**WASMIP Target WUSCs**	**Number of Project ***	**ocated Enginee**	**tual Engineers**	**Name of Engineers**
1	1. Biratnagar	Chakrapadi Sharma	Sankhuwasabha		21	2	4	
			Terathum		12			Rajiv Poddar
			Dhankuta		12			Jyotish Kumar Mishra
			Sunsari		17			Bedkant Chaudhary
			Morang	13	27			Sujit Mahato
			Jhapa	12	31			
			Udaypur		26			
			Bhojpur		34			
			Total	**25**	**180**	**2**	**4**	
2	2. Janakpur	Arun Kumar Simkhada	Saptari		20	4	3	Mr. Pushparaj Singh
			Dhanusha	1	31			Mr. Ganga Prasad Mahato
			Mahottari		33			Mr. Umesh Jha
			Sarlahi	4	32			
			Rautahat		35			
			Bara	7	36			
			Parsa		25			
			Total	**12**	**212**	**4**	**3**	
3	3. Hetauda	Nanadalal Banjade	Makwanpur		31	6	6	Mr. Uttam Simkhada
			Sindupalchowk	3	88			Mr. Atulesh Karn
			Kathmandu		82			Mr. Suresh Satyal
			Lalitpur		32			Mr. Annapurna Baral
			Bhaktapur		35			Mr. Biswajit Kayastha
			Kavrepalanchowk		42			Mr. Diluram Shrestha
			Total	**3**	**310**	**6**	**6**	
	4. Ramechaap	Jagarnath Purbe	Ramechap	4	72	4	3	Mr. Sitaram Shah
			Dolakha		42			Mr. Ramudgar Yadav
			Sindhuli		40			Mr. Sanjay Sigdel
			Total	**4**	**154**	**4**	**3**	
4	5. Pokhara	Shivendra Jha	Kaski		45	2	3	
			Tanahu		22			Ms. Sunam Thapa
			Syangja		22			Mr. Naresh Regmi
			Parbat		13			Mr. Kul Prasad Poudel
			Baglung		23			
			Nawalparasi East	4	11			
			Myagdi		11			
			Mustang		4			
			Total	**4**	**151**	**2**	**3**	
	6. Lamjung	Ram Chandra kafle	Gorkha		83	3	2	Mr. Maheshi Mahato
			Manang		12			Mr. Krishna bastola
			Lamjung	4	15			
			Total	**4**	**110**	**3**	**2**	
5	7. Butwal	Shalikram Paudel	Nawalparasi	1	10	3	**3**	
			Rupandehi	5	11			
			Kapilvastu		3			
			Rukum East		27			
			Rolpa		29			
			Dang	5	41			
			Banke		14			
			Bardiya	5	14			
			Total	**16**	**149**	**3**	**3**	
			WASMIP Target WUSC Total	**68**				
			Total Projects		**1,266**			
			Total Engineers				**24**	

Appendix 2.14

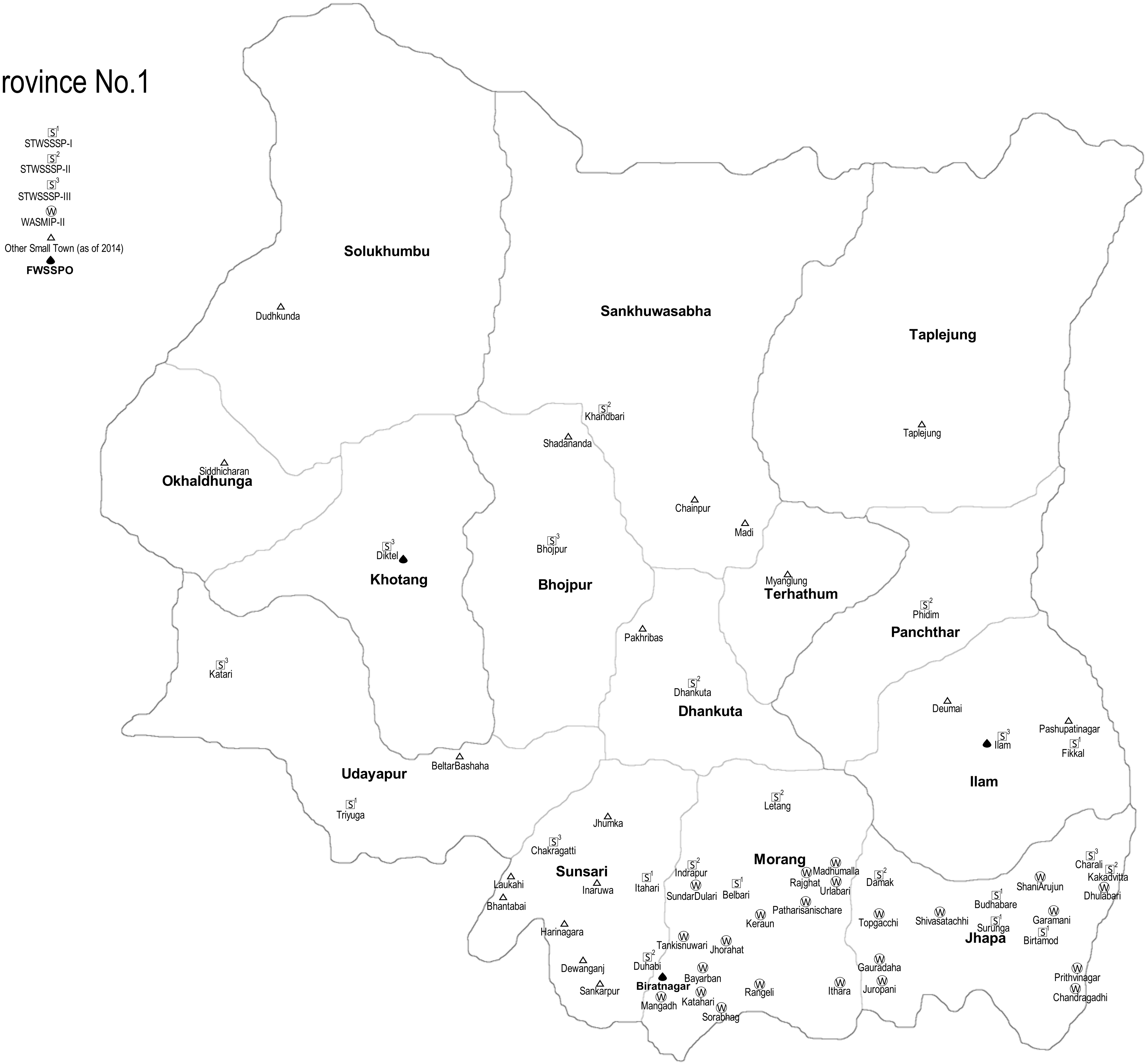
Location Maps on Affiliated Organizations

Geographical Location of DWSSM and its afflilicate organizations (Federal Government)

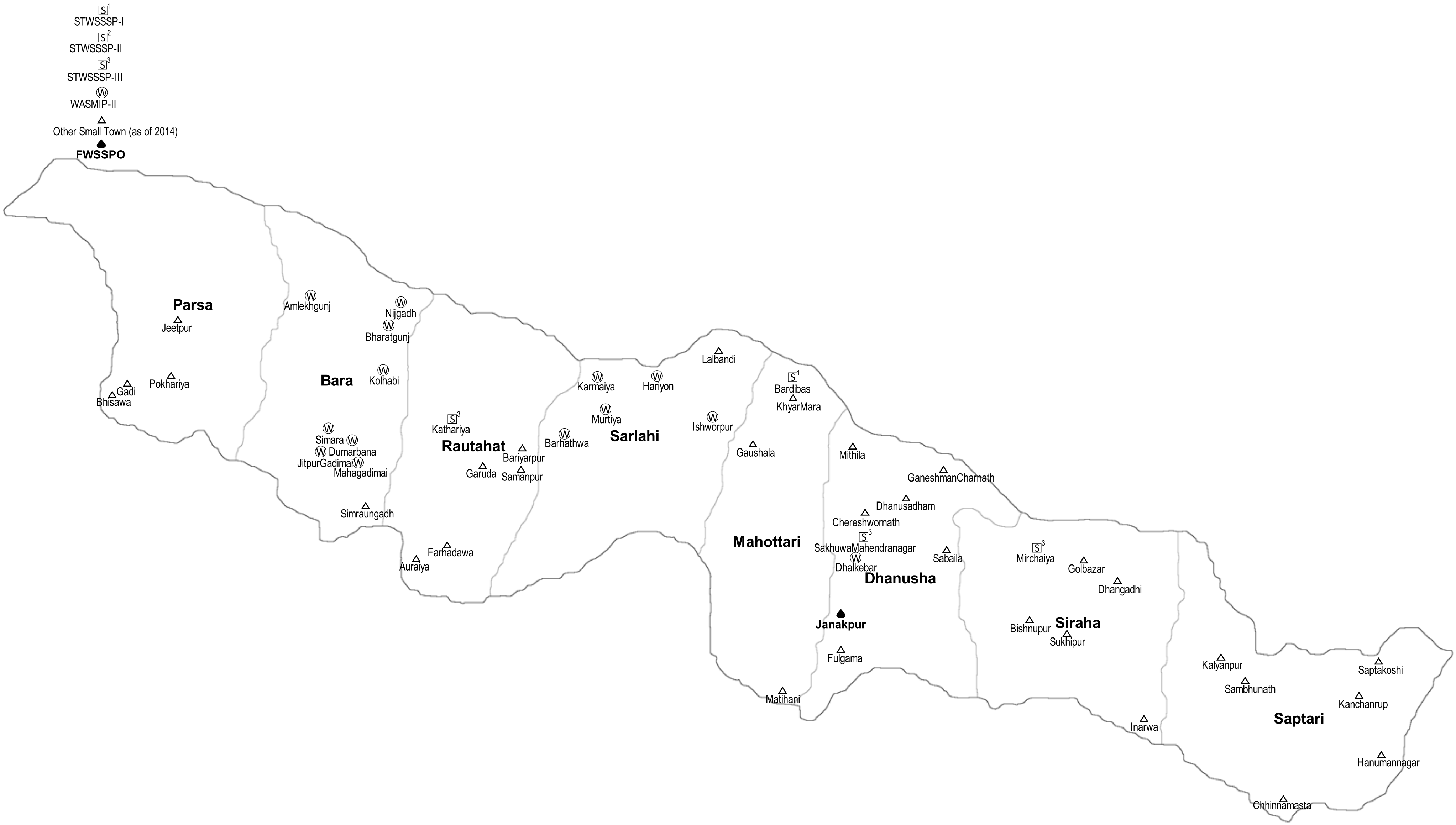
Geographical Location of MoPID and Division Office (Provincial Government)


Humla
Karnali
Darchula
Bajhang
Baitadi
Bajura
Mugu
Dadeldhura
Doti
Achham
Kalikot
Jumla
Dolpa
Kanchanpur
Kailali
Dailekh
Jajarkot
Mustang
Gandaki
WRukum
ERukum
Surkhet
Salyan
Myagdi
Nawang
Sudurpashchim
Bardia
Rolpa
Baglung
Parbat
Kaski
Lamjung
Gorkha
No.3
Banke
Pyuthan
Gulmi
Syangja
Tanahun
Rasuwa
Dang
Arghakhandi
Palpa
Nawalpur
Nawakot
Sindhupalchok
Dolakha
No.1
Dhading
Bhaktapur
KTM
Solukhumbu
Sankhuwasabha
Taplejung
No.5
Kapilbastu
Rupandehi
Parasi
Chitwan
Makwanpur
Lalitpur
Kavrepalanchok
Ramechhap
Okhaldhunga
Khotang
Bhojpur
Tehrathum
Panchthar
Sindhuli
Parsa
Bara
Rautahat
Sarlahi
Mahottari
Dhanusa
Udayapur
Dhankuta
Ilam
Siraha
Saptari
Sunsari
Morang
Jhapa
No.2

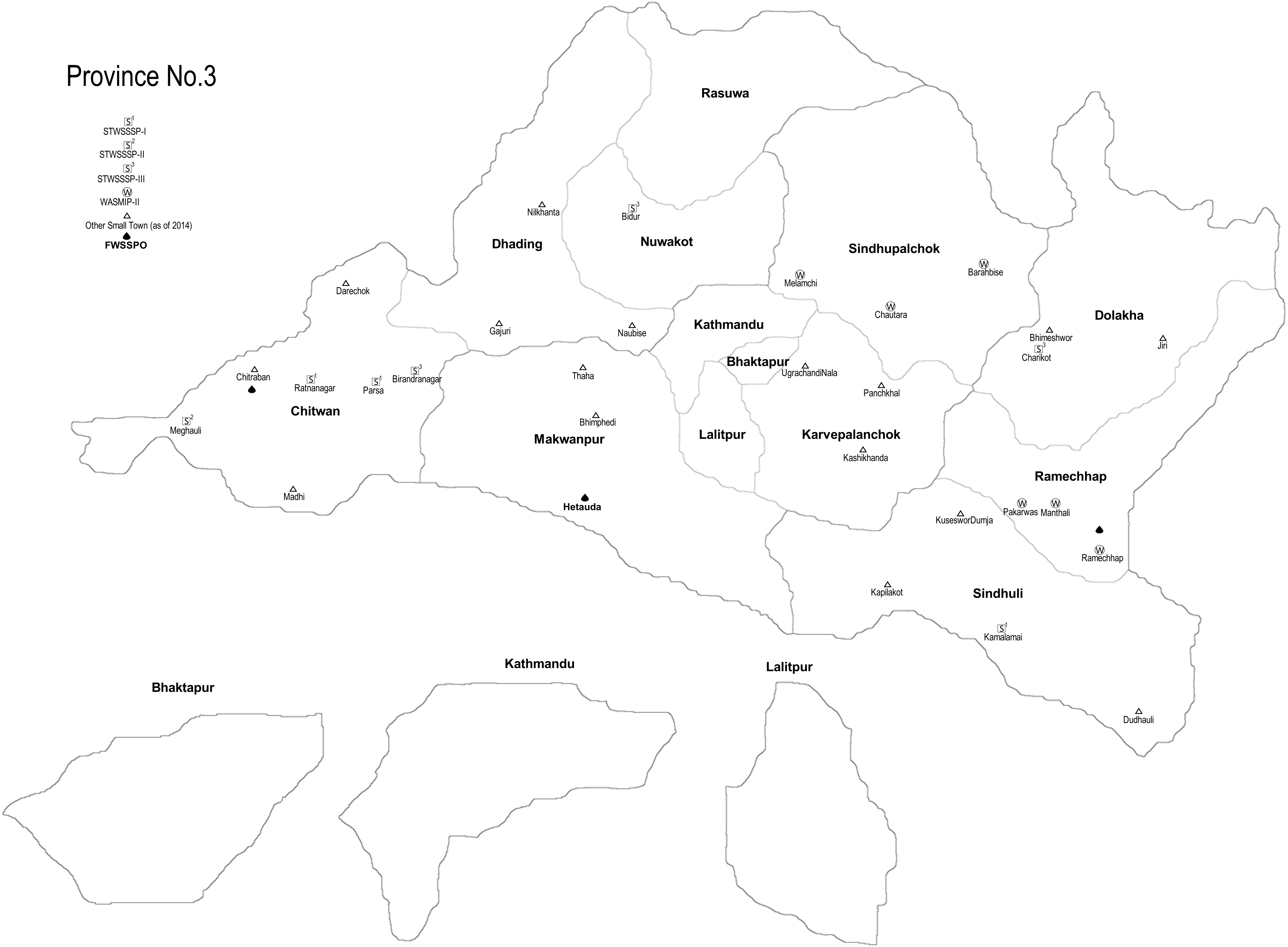
Province No.1



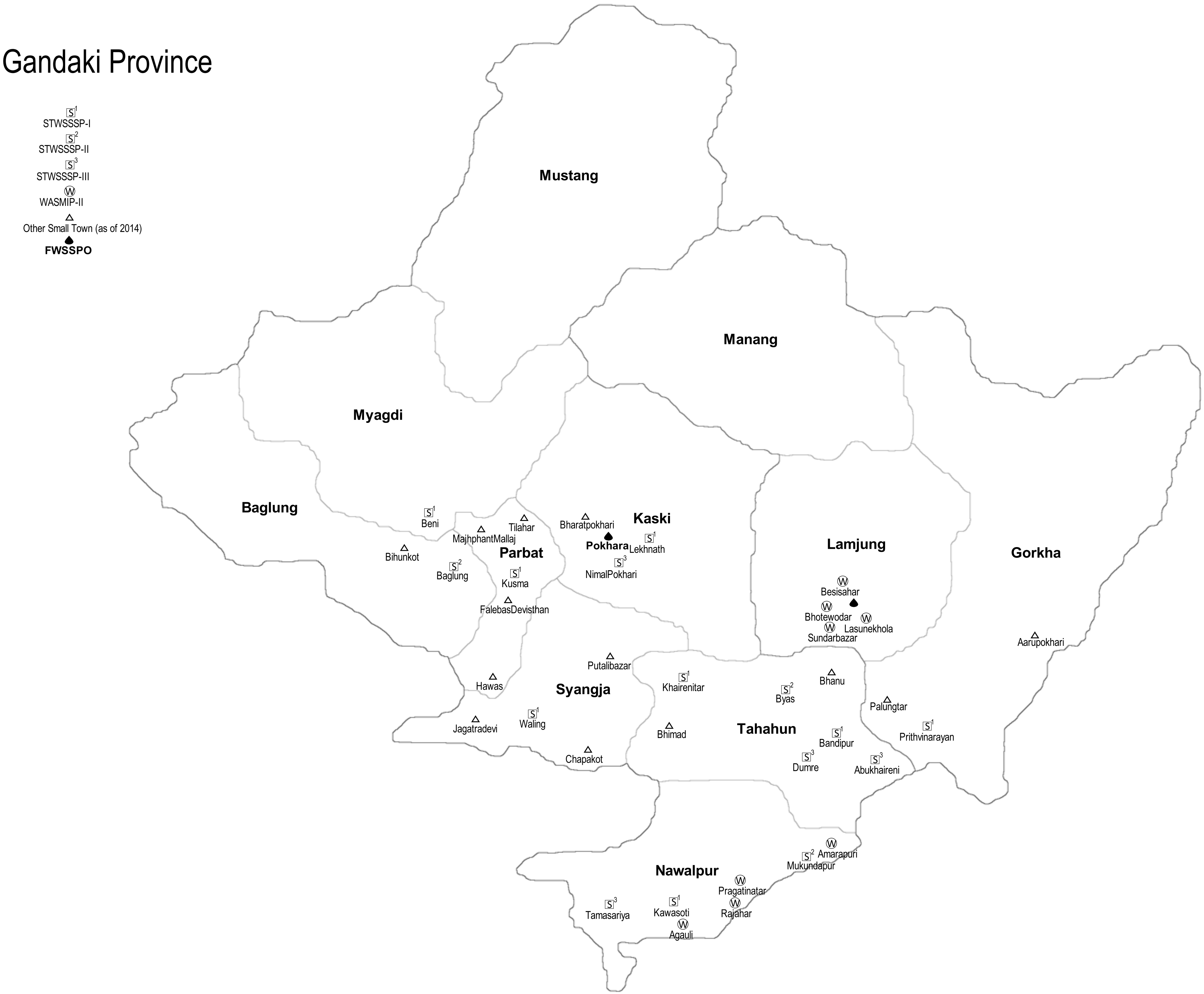
Province No.2



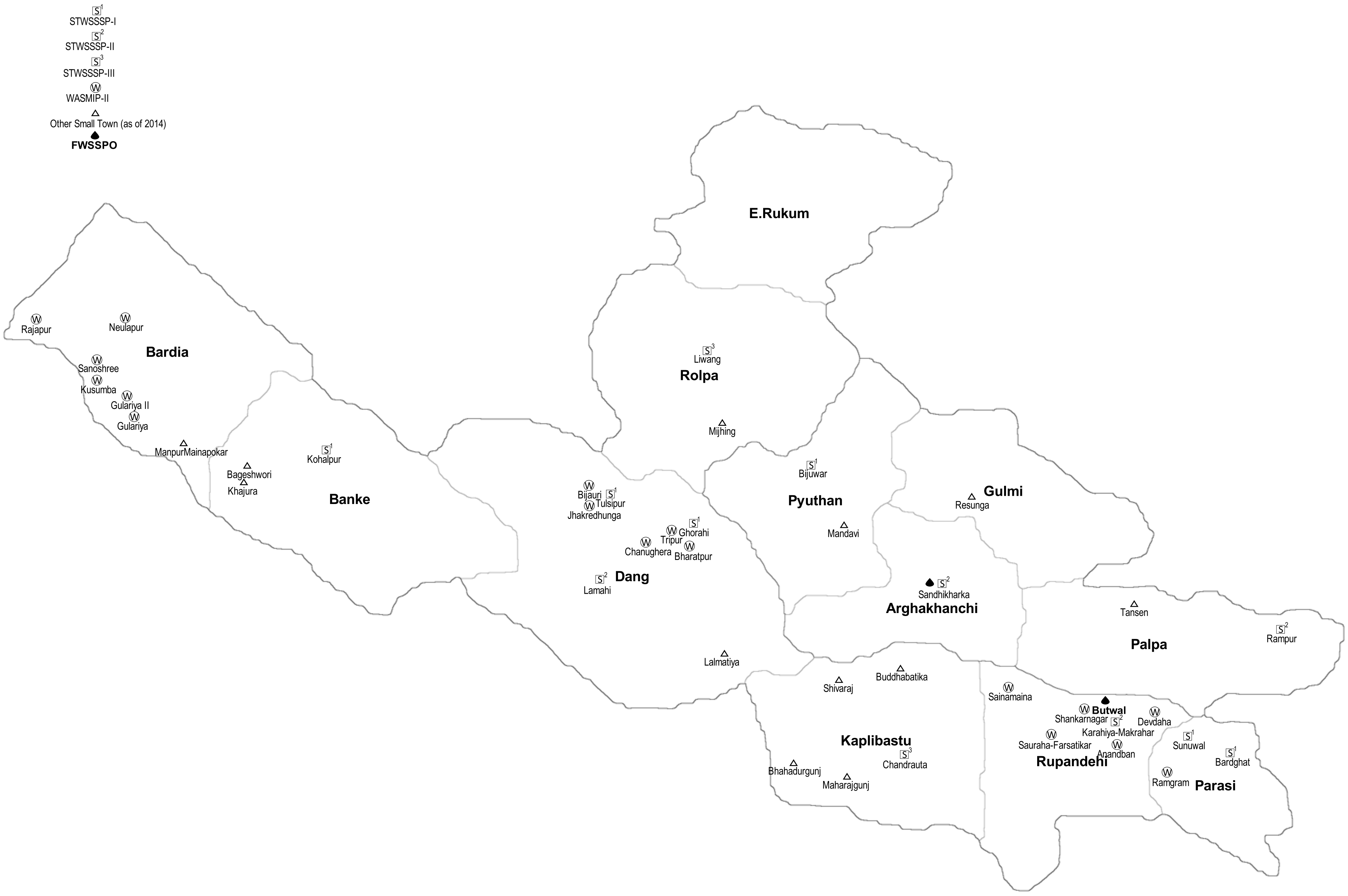
Province No.3



Gandaki Province

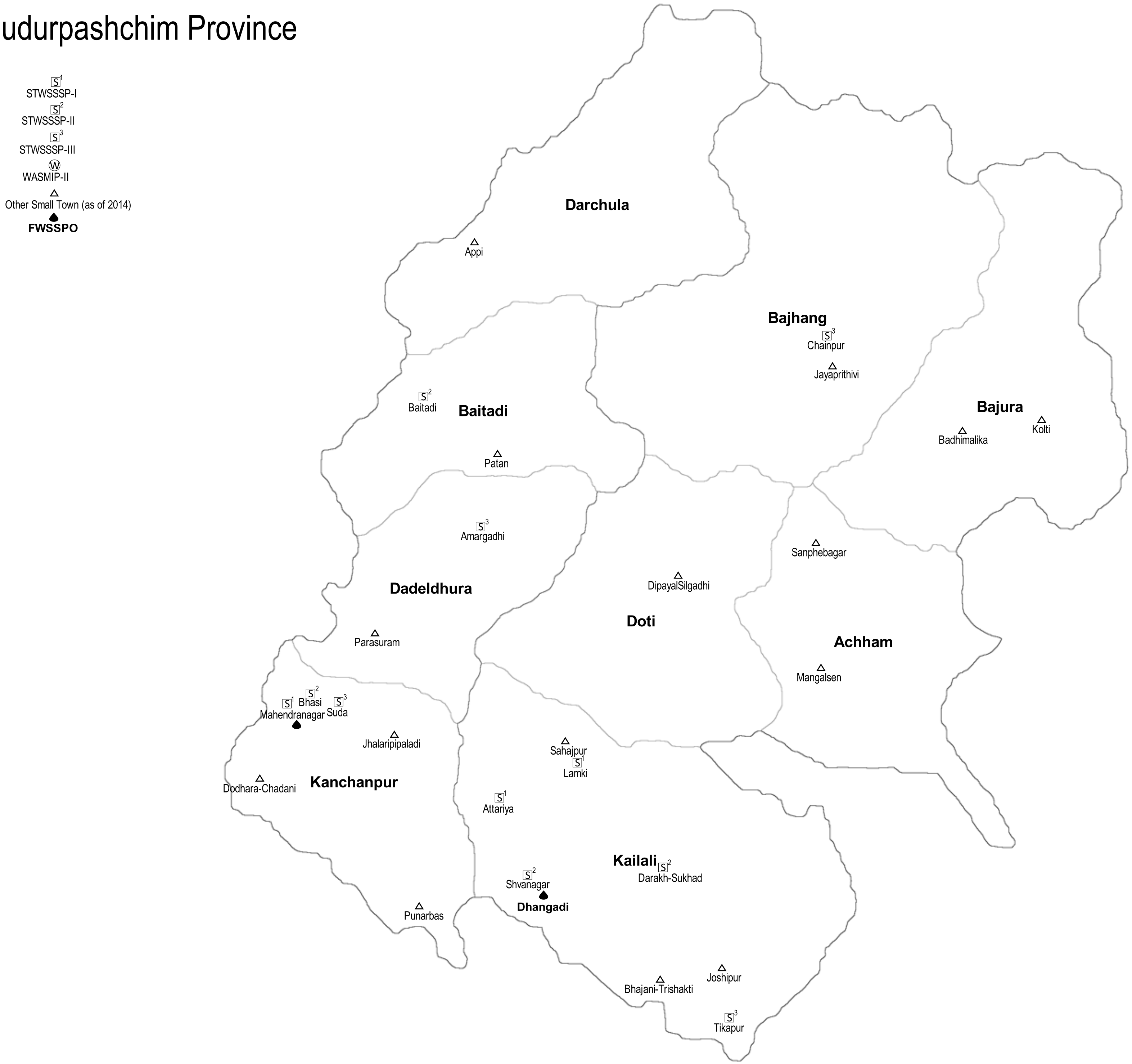


Province No.5

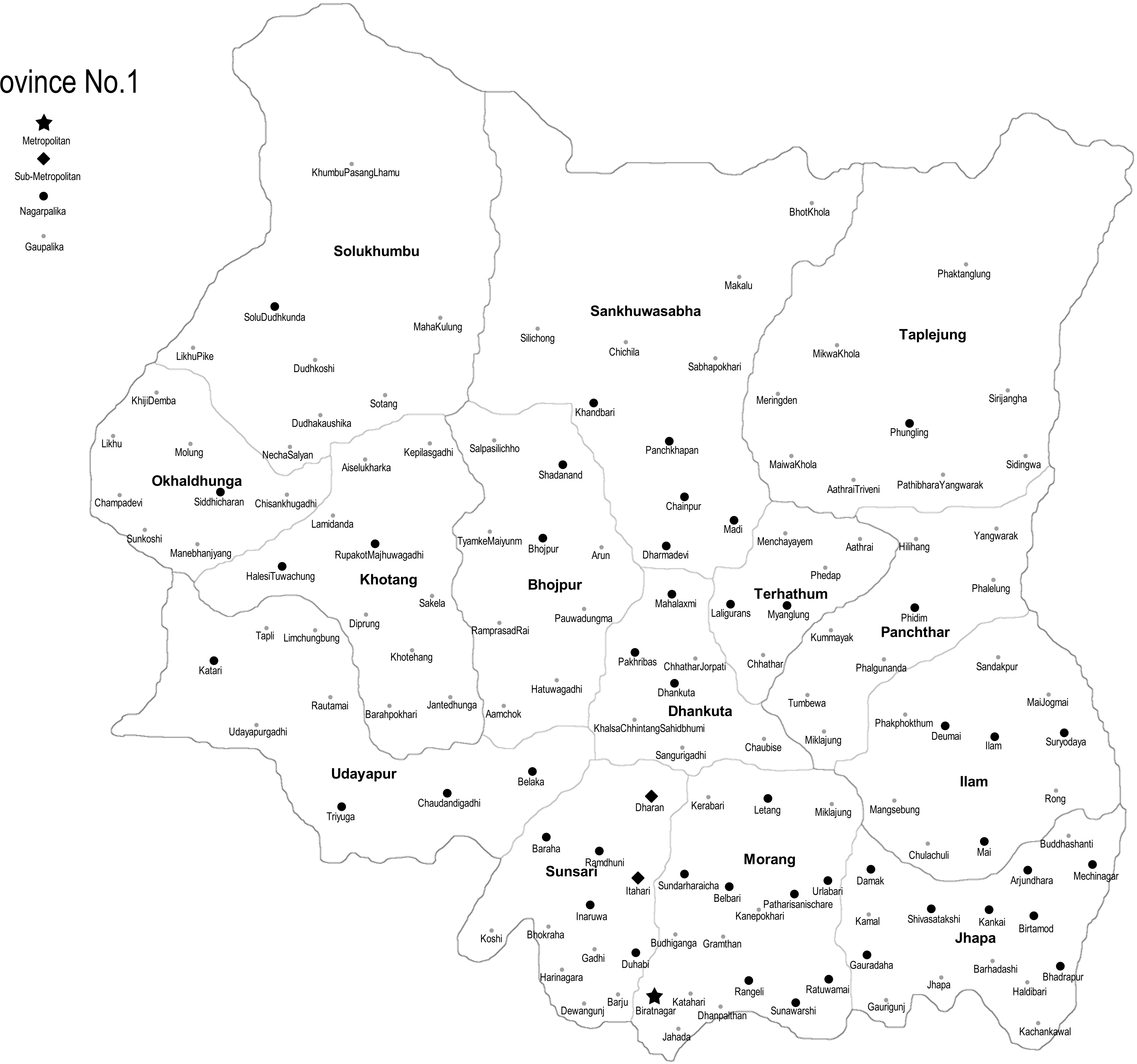


Karnali Province

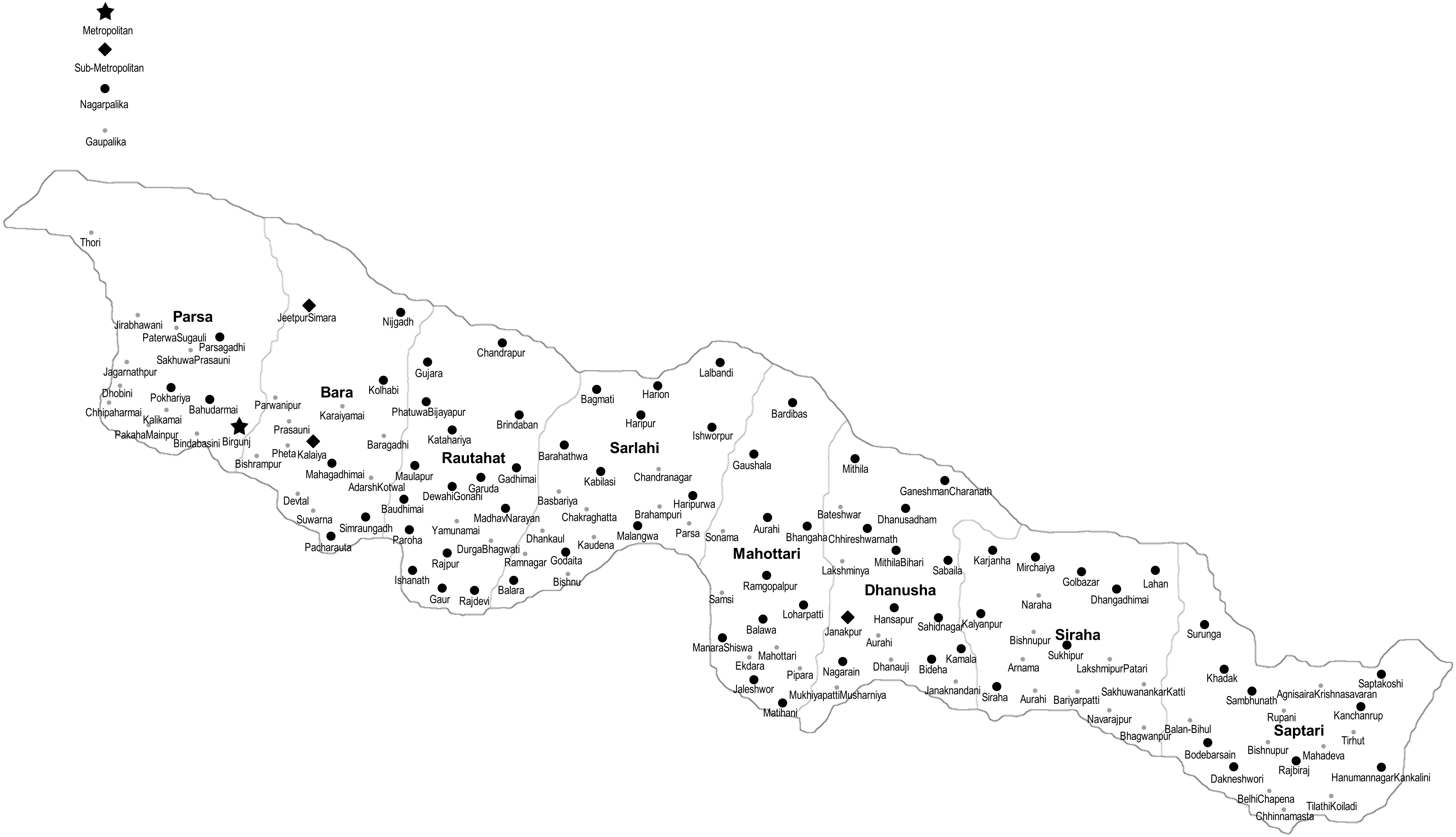
Sudurpashchim Province

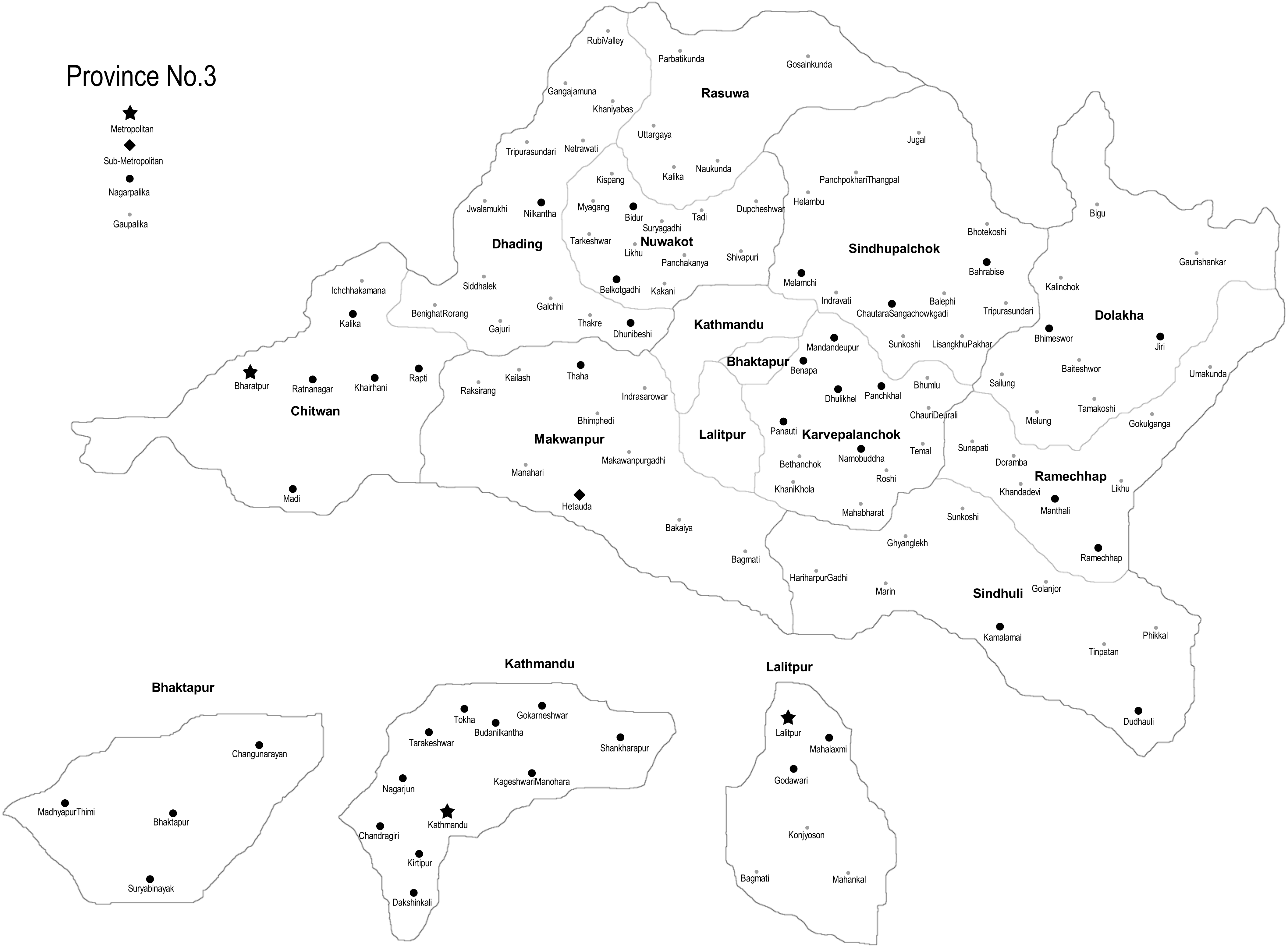


Province No.1



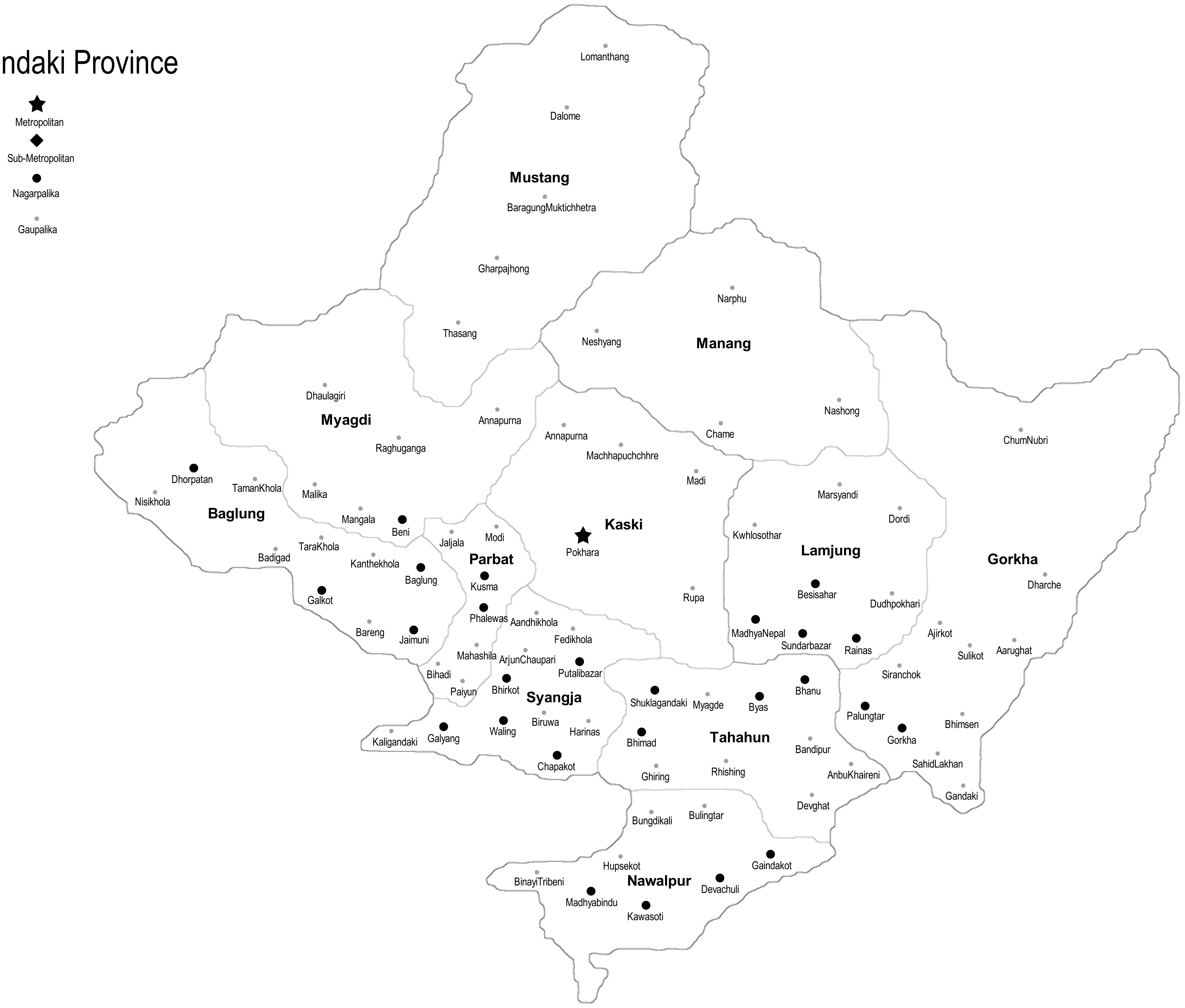
Province No.2



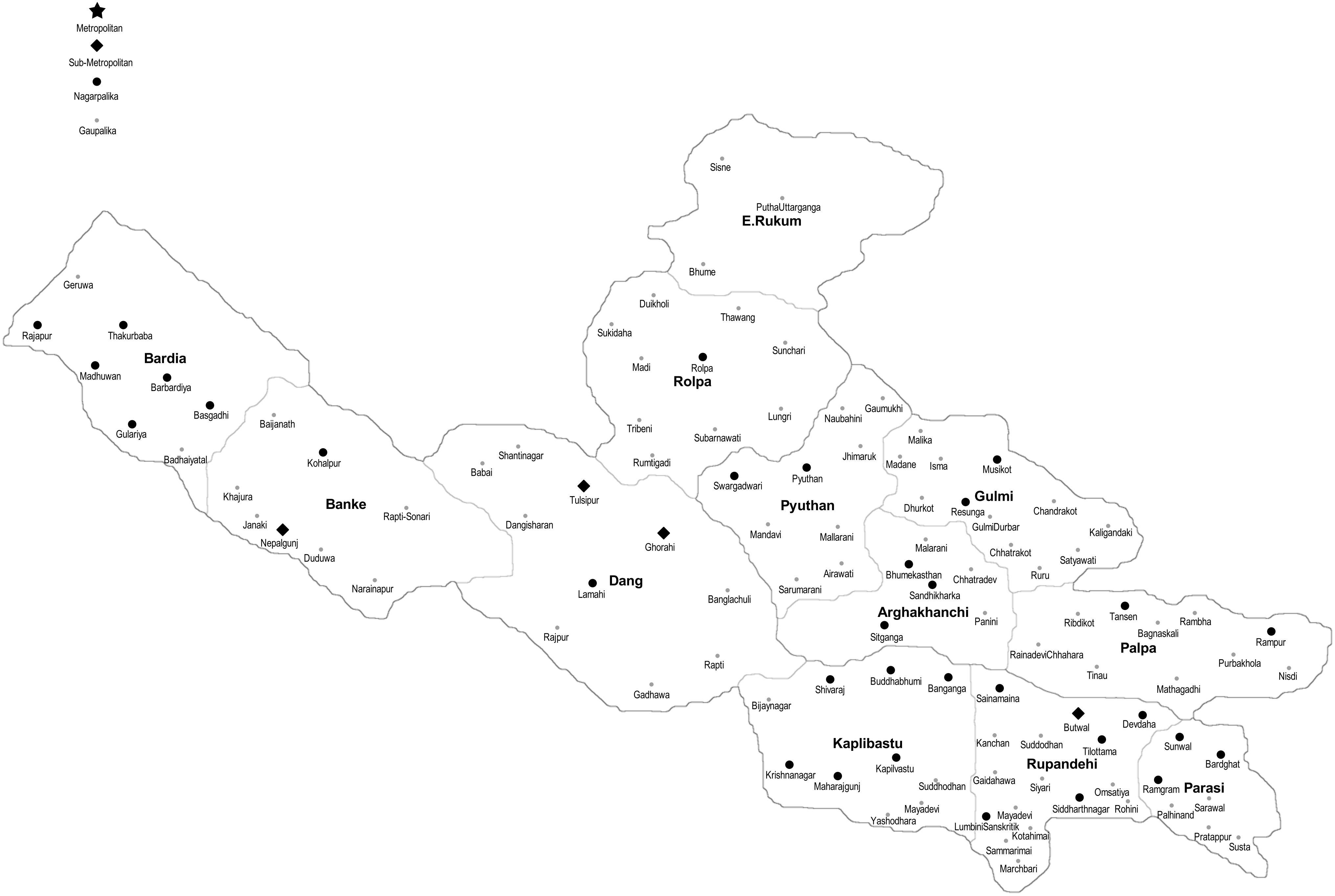


Province No.3

Gandaki Province

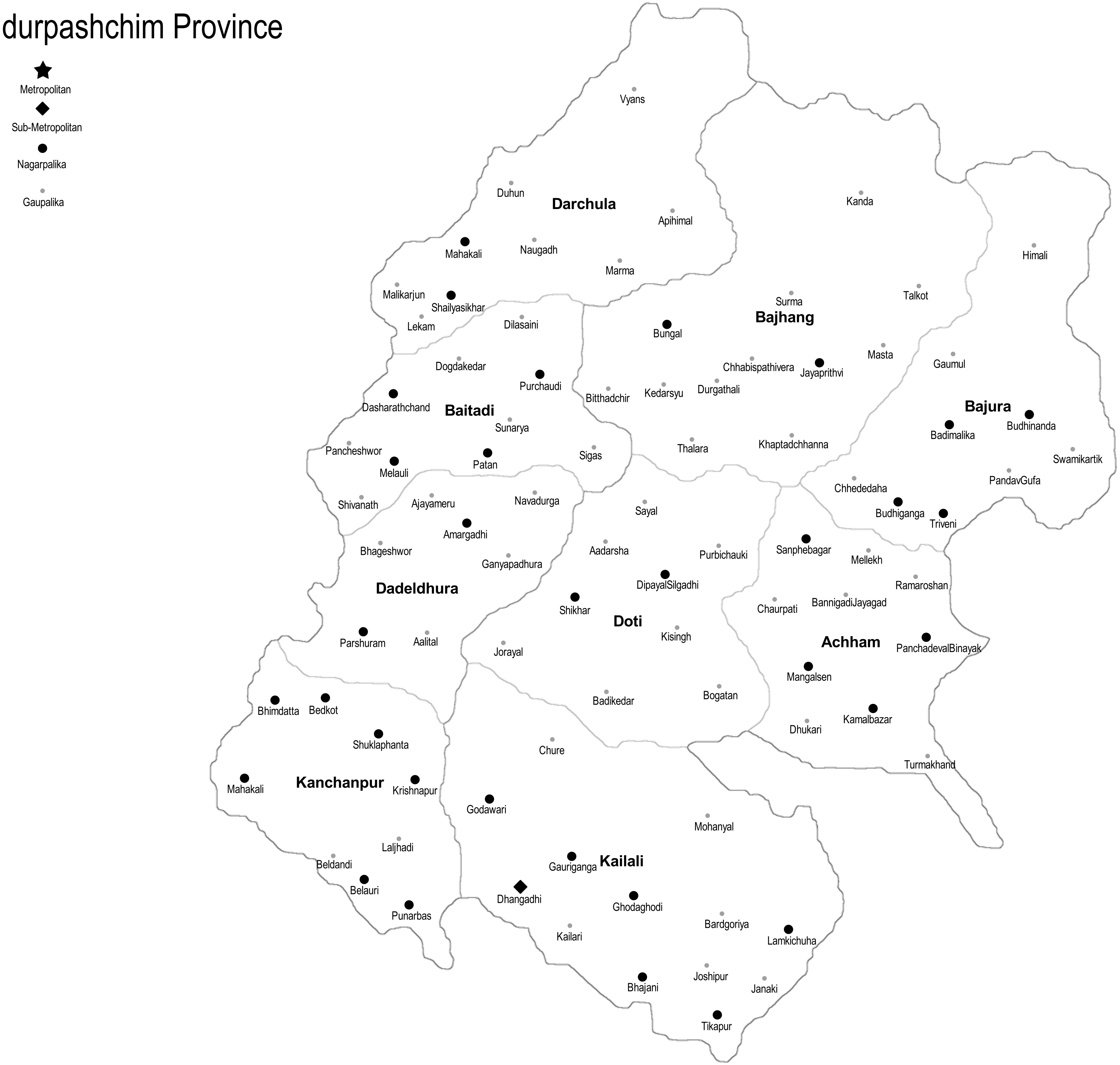


Province No.5

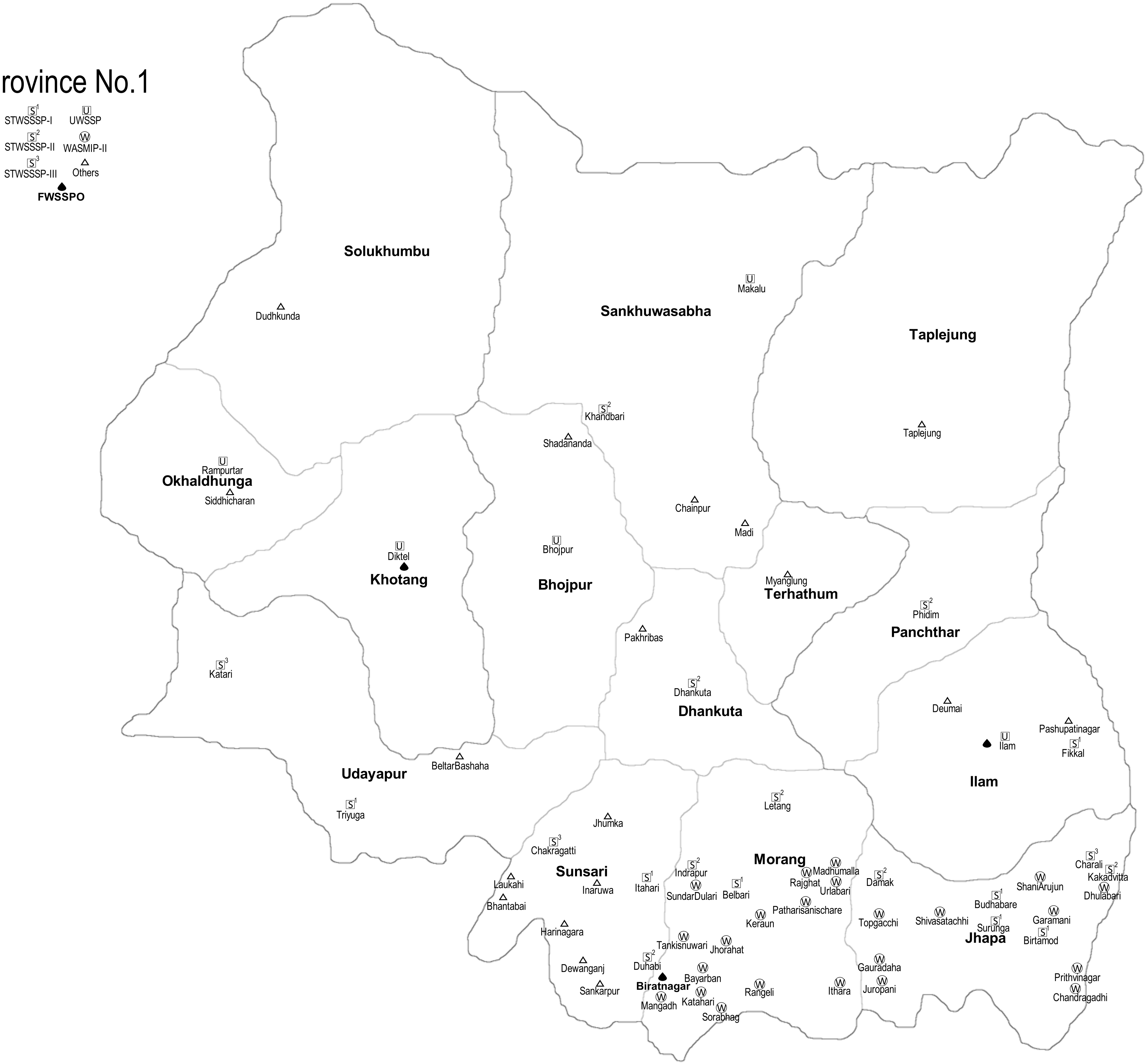


Karnali Province

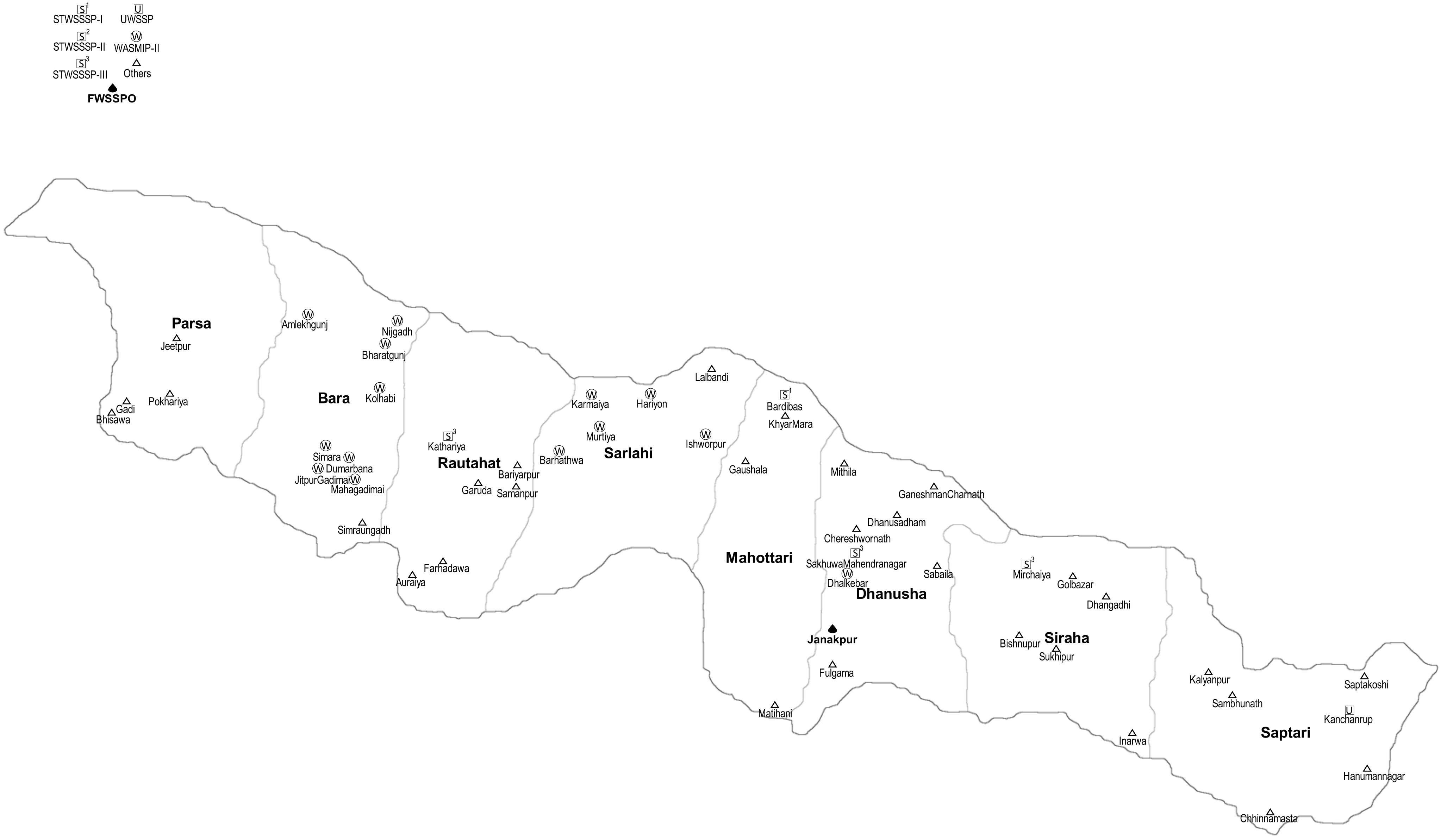
Sudurpashchim Province

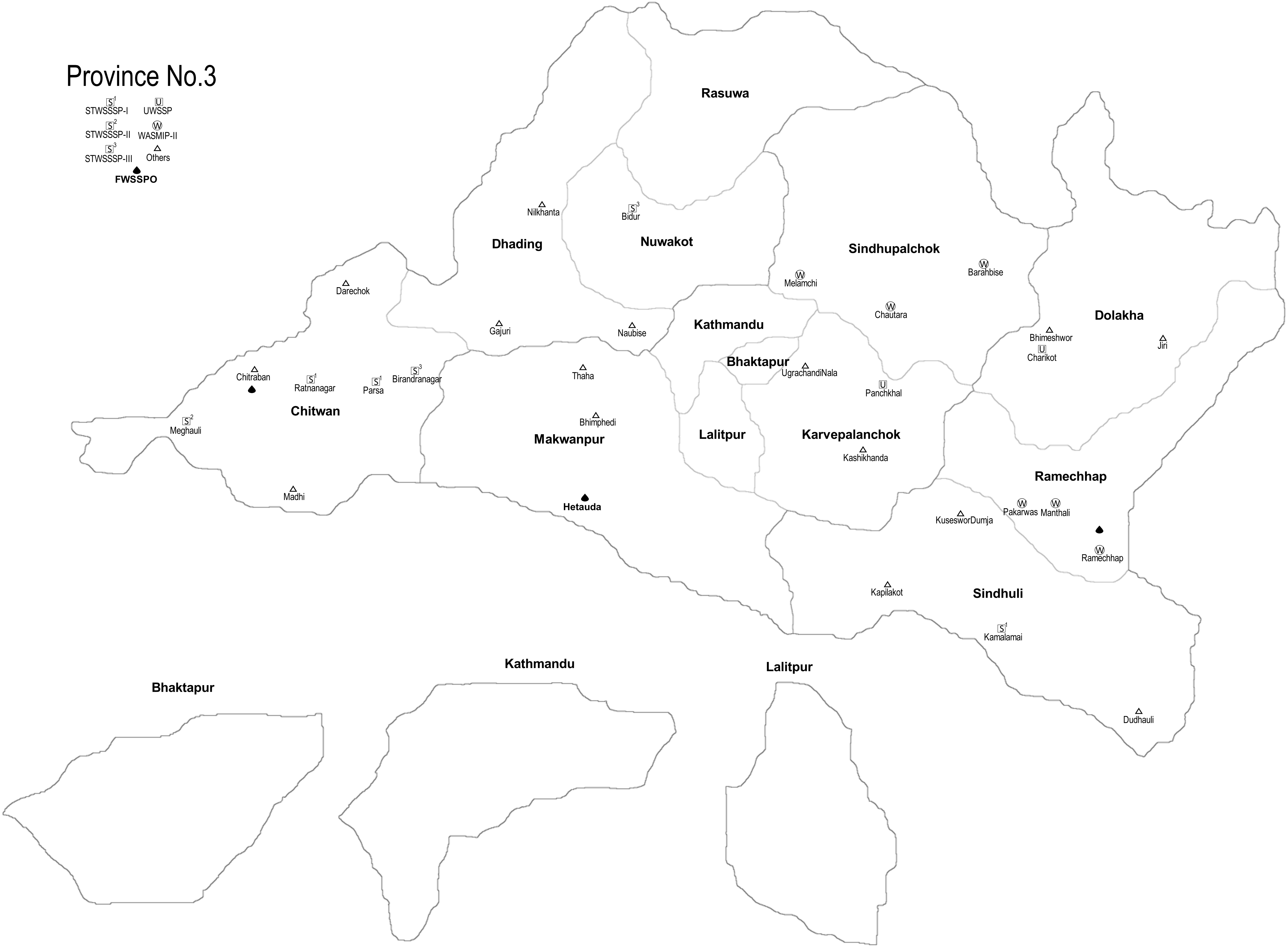


Province No.1



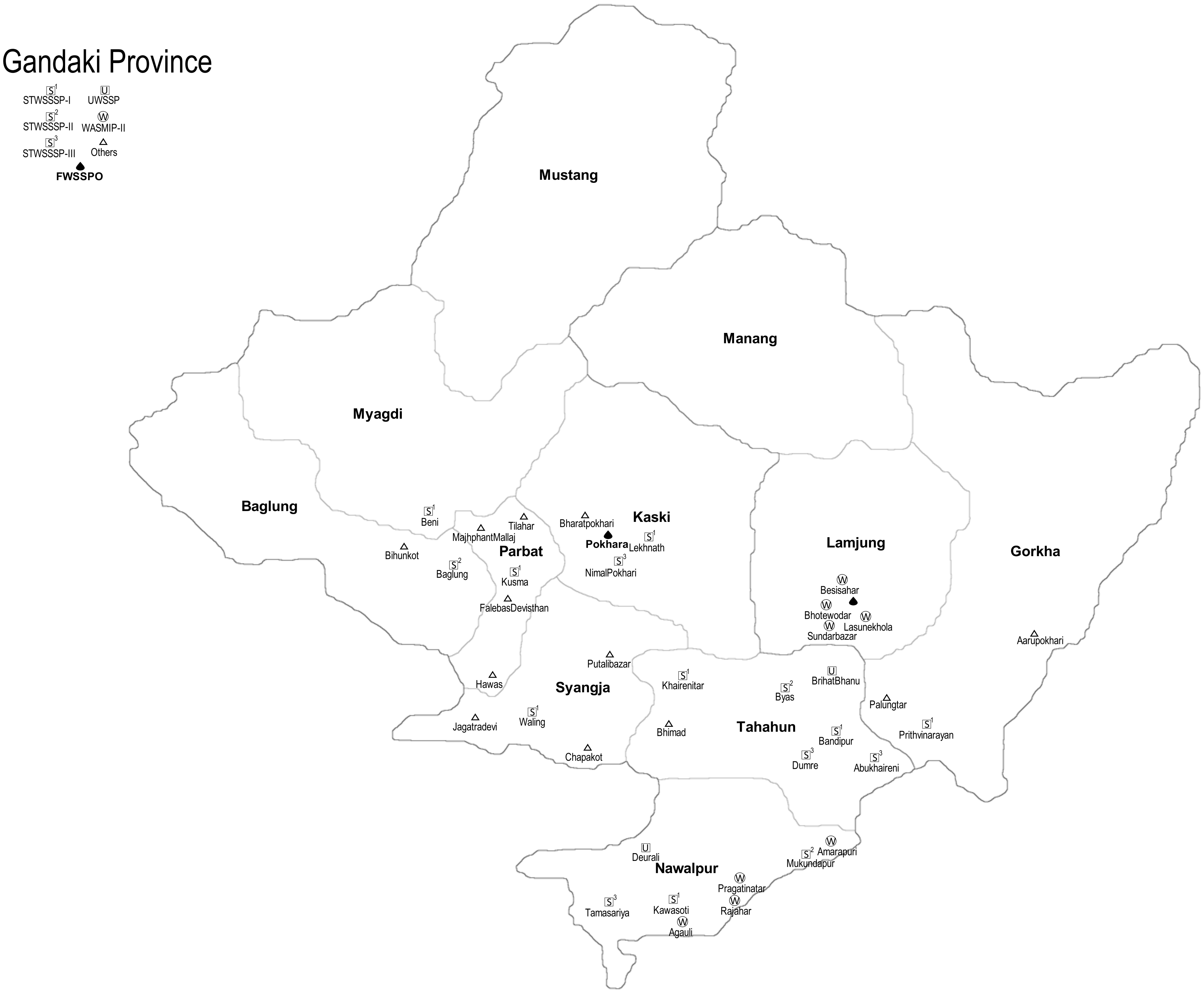
Province No.2



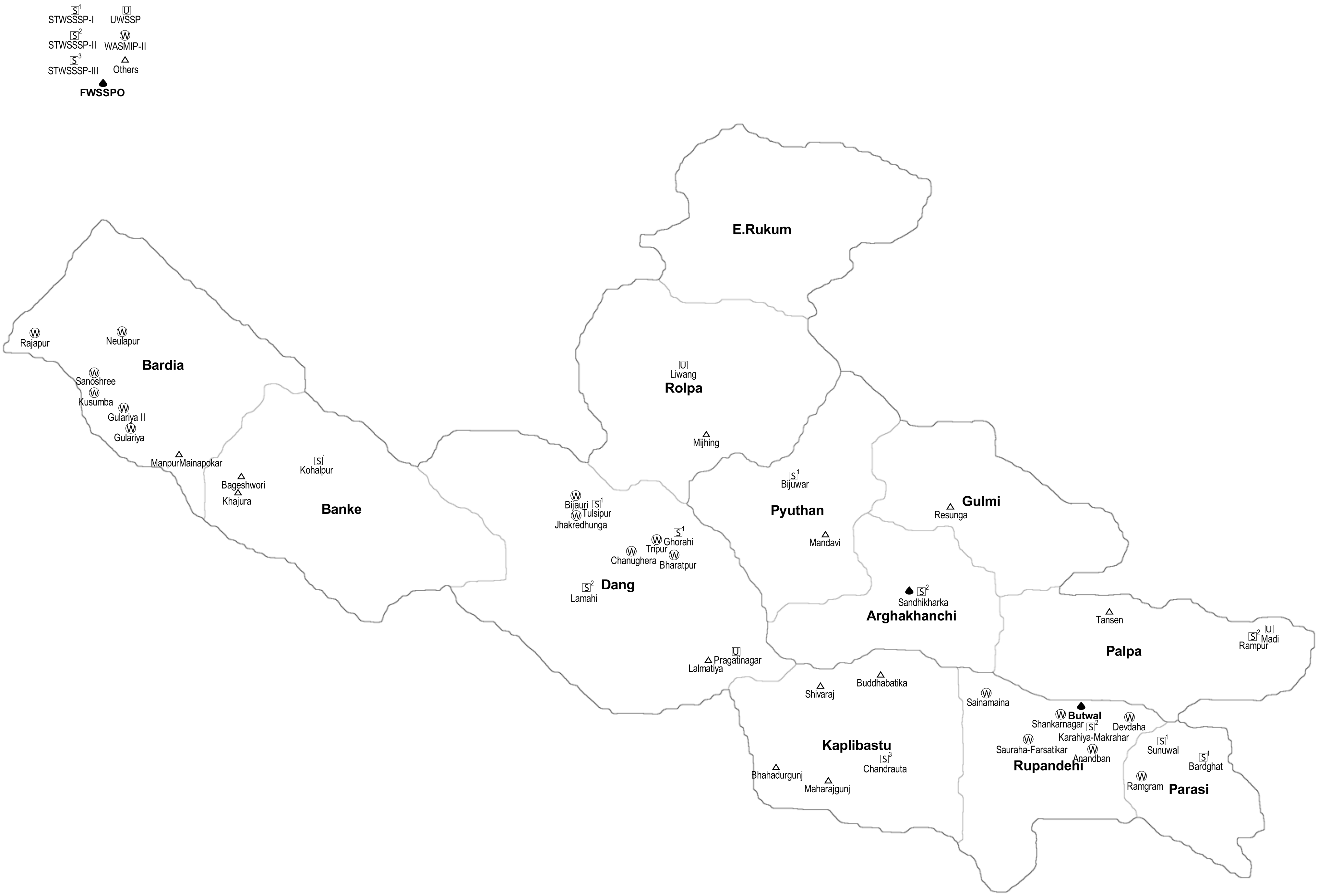


Province No.3

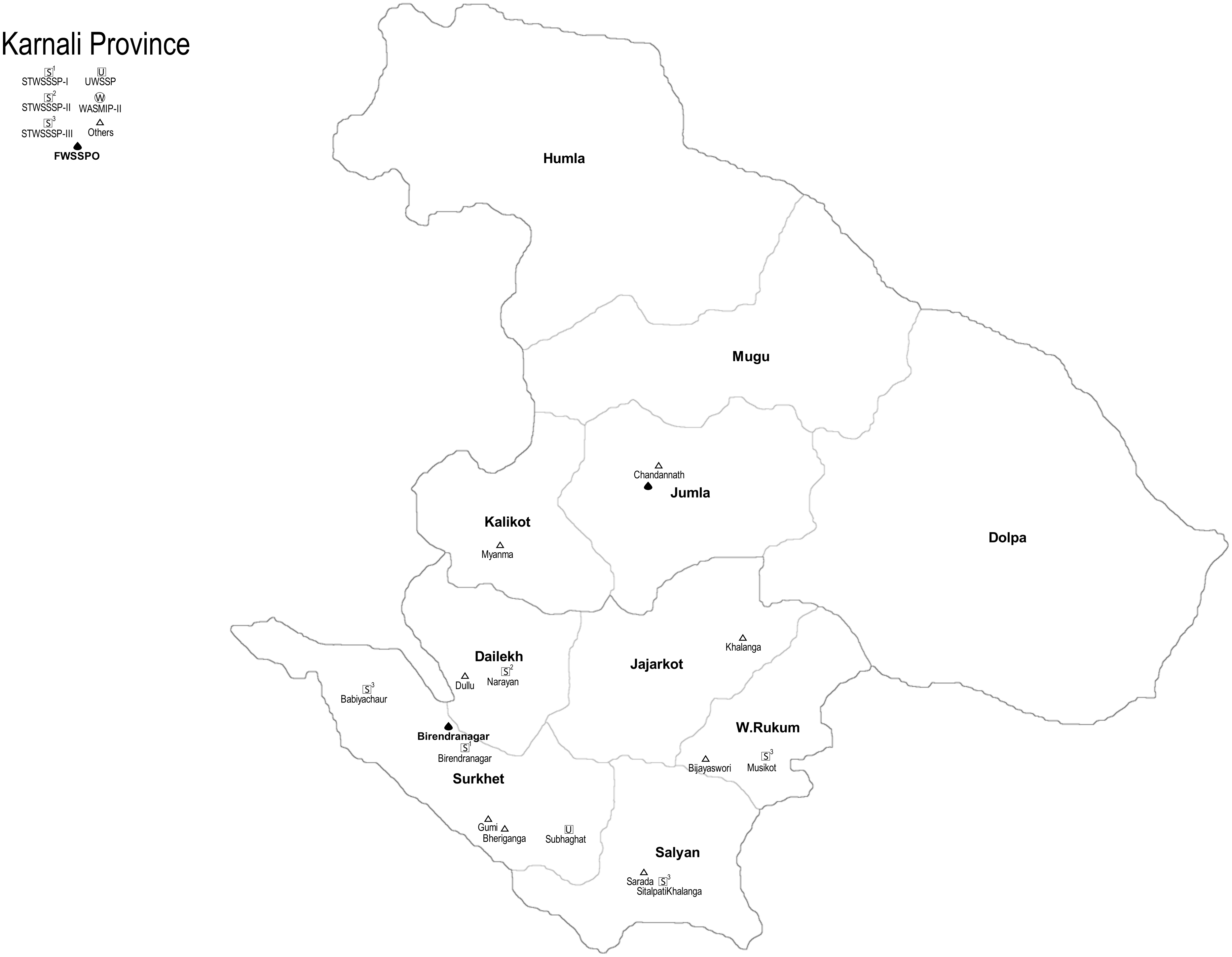
Gandaki Province



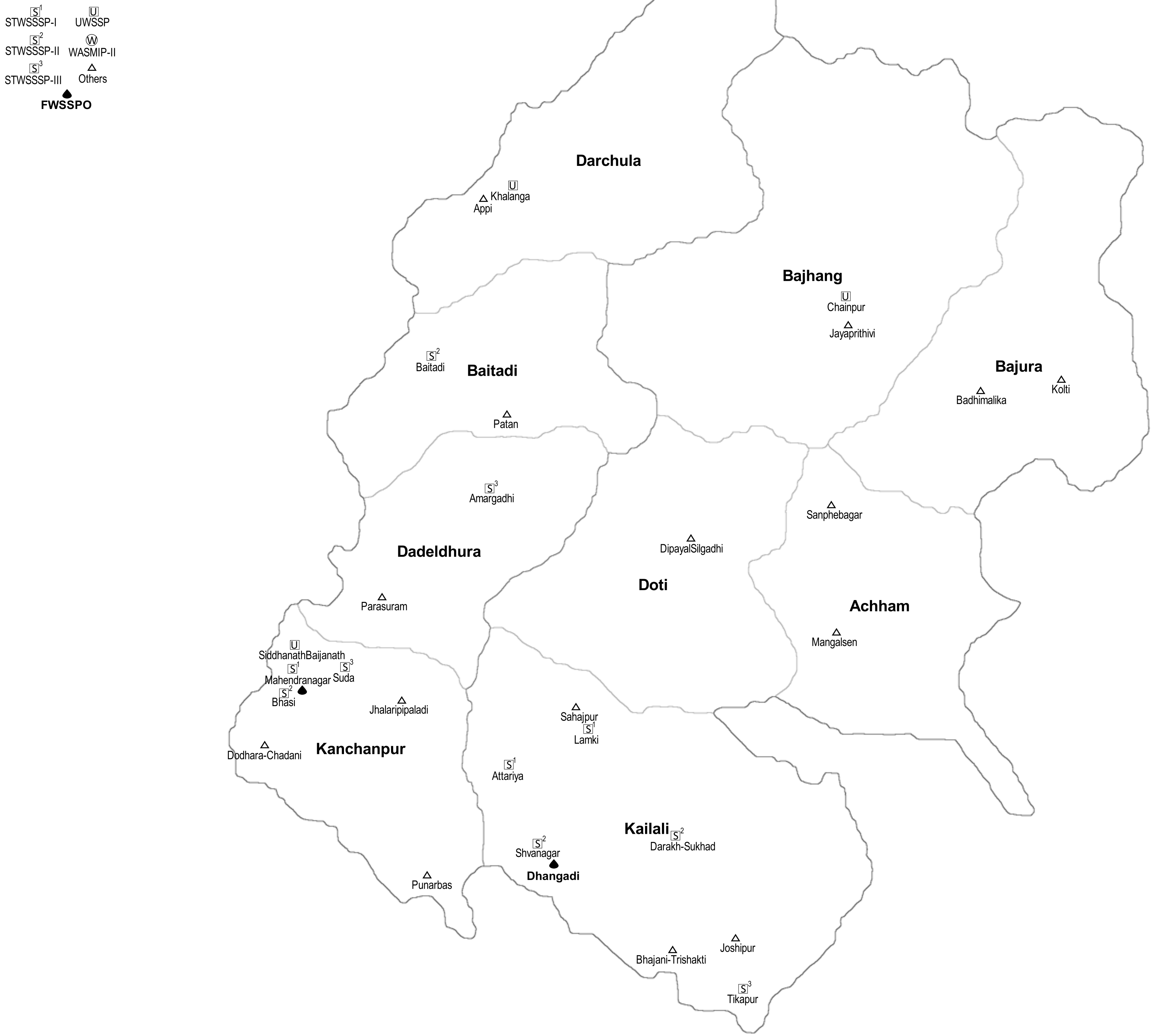
Province No.5



Karnali Province



Sudurpashchim Province



Appendix 2.15

SOP Final Version

The Capacity Development Project for the Improvement of Water Supply Management in Semi-Urban Areas (WASMIP II)

Standard Operating Procedure (SOP)
for
Water Supply Facility Operation and Maintenance
(Version 4)

Chapter 1 Introduction

Chapter 2 Directions for Use of this Procedure

Chapter 3 Standard Operating Procedure

- **Section 1 Intake Facility**
- **Section 2 Water Treatment Facility**
- **Section 3 Water Distribution Facility**
- **Section 4 Household Connections and Water Meters**
- **Section 5 Water Quality Management**
- **Section 6 Repair Work**
- **Section 7 Report of Inspection Result**
- **Section 8 Analysis of Water Supply Amount**

Chapter 4 Record Forms

Revision History

Version	Date	Remarks
1	September 2013	Prepared as WASMIP Model in Phase 1 Project
2	10th November, 2017	Revised the contents/composition and classified into 4 SOPs; Intake Facility, WTP (including Water Quality Management), Distribution Facility, Water Meter
3	16th July, 2018	Revised the contents/composition and classified into 8 SOPs by focusing on each purpose.
4	31st May, 2021	Added preface and finalized the contents.

Chapter 1

Introduction

1 Introduction

1.1 Background

Rapid water demand increase and deterioration of raw water quality are becoming serious, and securing safe drinking water is an urgent issue. However, WUSCs (Water Users and Sanitation Committee), which operate water supply facility and supply water to consumers, are facing with difficulties both technically and financially.

Considering this situation, JICA (Japan International Cooperation Agency) initiated the Project for Capacity Development on Water Supply Systems in Semi-Urban Areas in Nepal (project duration: from January 2010 to September 2013, hereafter "WASMIP I"). In the WASMIP I project, Business Plan and SOPs (Standard Operating Procedure) regarding operation and maintenance (O&M) of water supply facilities, and guidelines of financial and technical support to WUSC by WSSDO were developed. However, since WASMIP Model was formulated considering some WUSC's as models, it is not applicable to all WUSCs in semi-urban towns with population of 5,000 to 40,000, which have various facility composition and business environment. Therefore, it is required to improve applicability of the model.

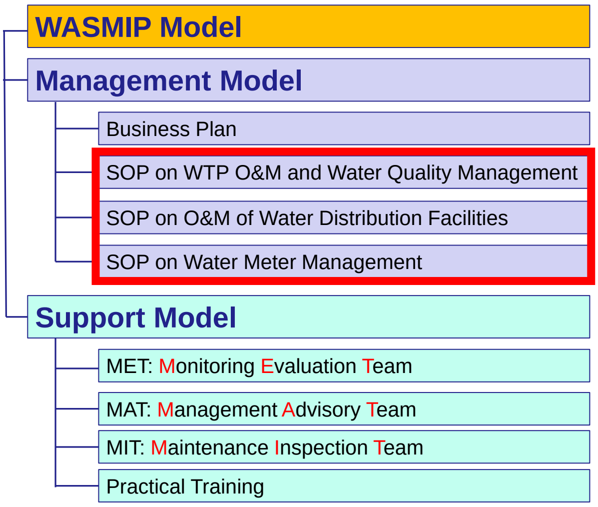


Figure 1.1 Structure of WASMIP Model Formulated in Phase 1 Project

In WASMIP II Project started in June 2016, "SOP on WTP O&M and Water Quality Management", "SOP on O&M of Water Distribution Facilities" and "SOP on Water Meter Management" as shown in **Figure 1.1** are revised and recomposed.

1.2 Purpose of the Revised SOP

Target of the revised SOP is WUSCs in semi-urban towns, and the main purpose of the revised SOP is as follows;

- Support/help WUSCs to conduct the appropriate O&M of water supply facilities
- Support/help WUSCs to manage/keep the appropriate records of O&M

Chapter 2

Directions for Use of this SOP

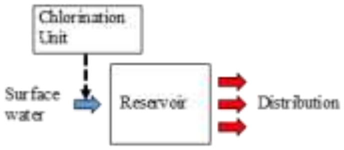
2 Directions for Use of this SOP

Since the number of target WUSCs in semi-urban towns of WASMIP-II is 229, each WUSC has various business environment, water source and water supply facilities. This revised SOP includes O&M procedures for various water supply facilities observed in 68 target WUSCs out of 229 WUSCs. According to the results of survey for 68 WUSCs, water treatment process had been categorized into five patterns as follows;

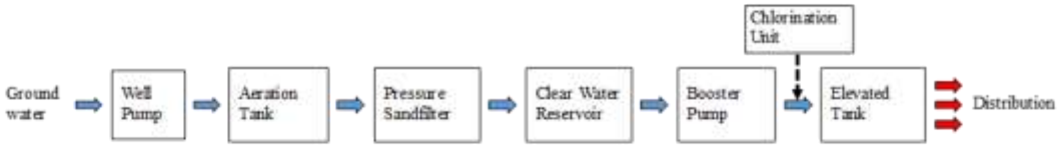
Pattern A

Pattern B

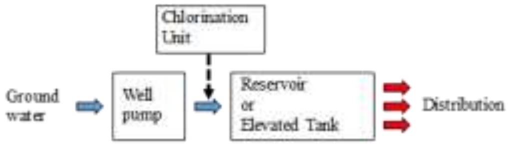
Pattern C



Pattern D



Pattern E



Firstly, each WUSC has to recognize the following points before using this SOP;

- Water treatment process (from the above five patterns)
- Facility/equipment

Secondly, each WUSC has to choose necessary SOPs and Forms which are suited to their own water treatment process and facilities/equipment, so that each WUSC can operate and maintain their own water supply facilities in accordance with chosen SOPs and Forms.

Thirdly, WUSC staff/operator shall conduct proper O&M works and keep necessary records into the Forms. These records shall be checked by the manager of WUSC periodically.

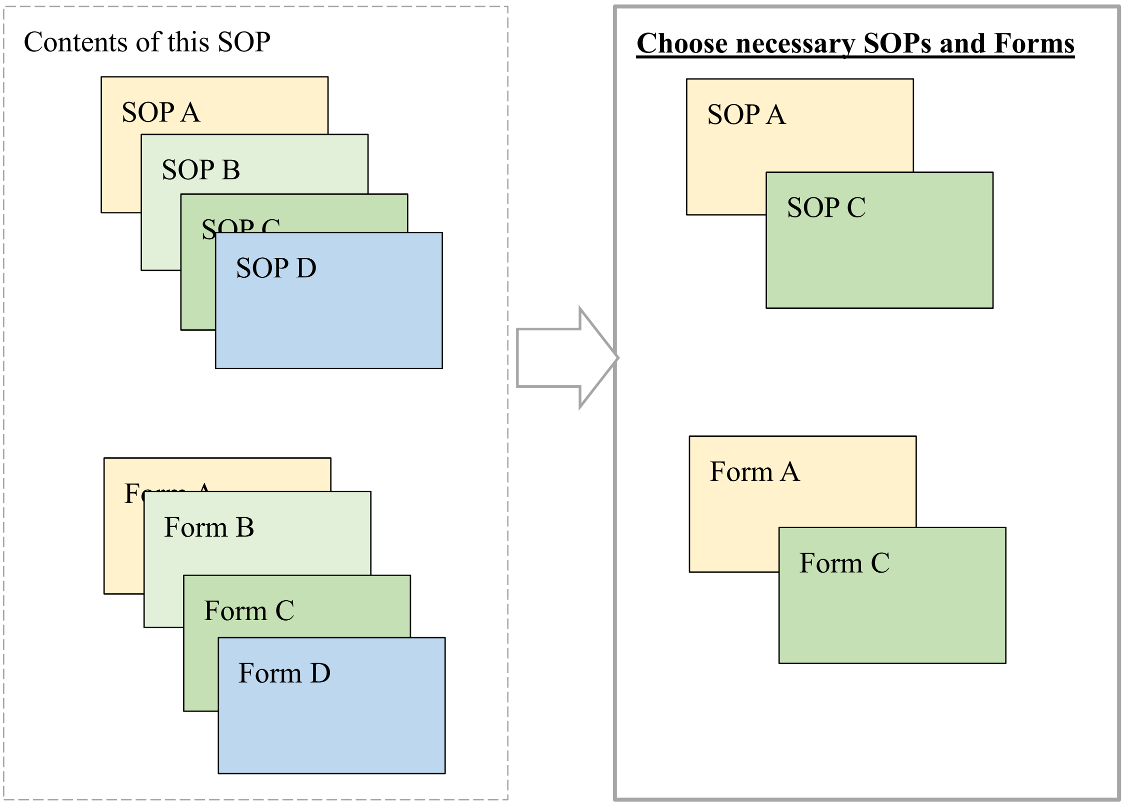


Figure 2.1 How to Use this SOP

In addition, summary of SOPs and video materials had also developed to understand the main points easily and visually. Summary of SOPs shows each standard procedure of the target facility/equipment and they are laminated. It is recommended that they are posted in front of each facility/equipment so that an operator can confirm/remind anytime. On the other hand, video materials shall be utilized in the education/training not only for newcomers but also experienced operator/engineer.

Chapter 3

Standard Operating Procedure

Section 1

Intake Facility

1 Outline of Intake Facility

1.1 Definition of Intake Facility in This SOP

Intake facility is defined as facilities and equipment which intake raw water such as surface water or ground water from the intake point and send/convey raw water to Water Treatment Plant (hereafter WTP) or Clear Water Reservoir/Service Reservoir directly. Typical Intake Facility of surface water is composed of intake structure, screen and conveyance pipelines which include shut valves, air valves, wash outs. On the other hand, typical Intake Facility of ground water is composed of deep tube well, well pump (submersible pump) and conveyance pipelines which include shut valves, air valves, wash outs.

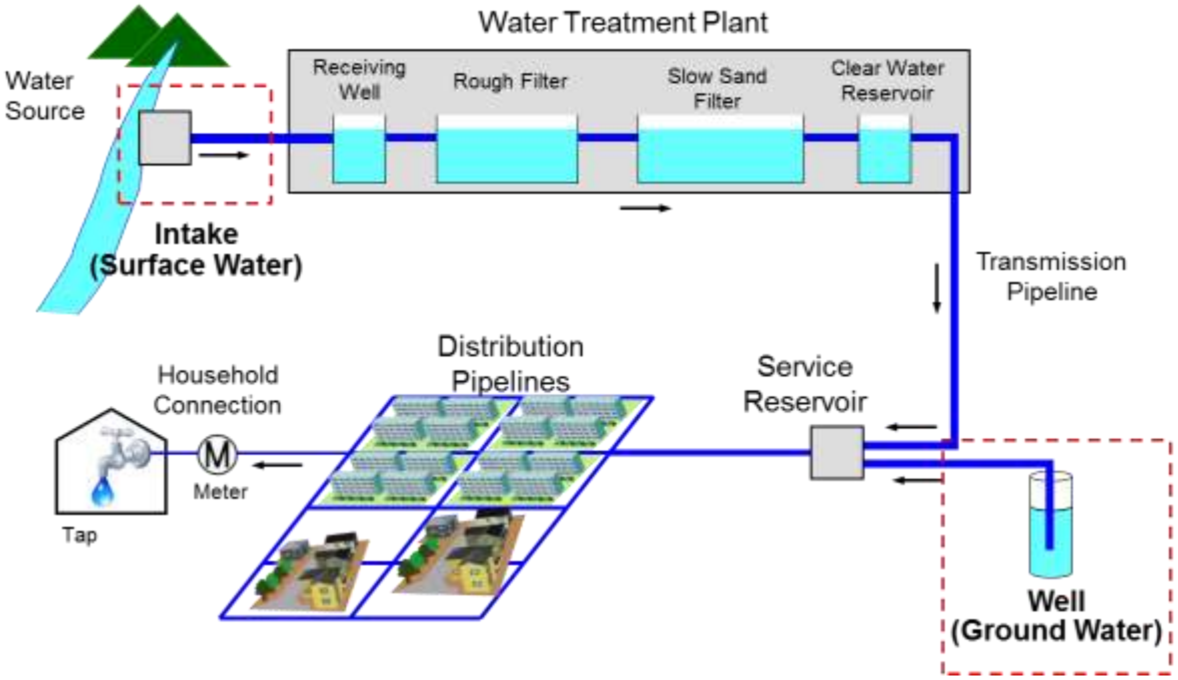


Figure 1.1 Scope of Intake Facility

1.2 Intake Structure

(1) Function of Intake Structure

Functions of Intake Structure are shown below;

- Intake the design flow rate continuously and stably
- Prevent from entering driftwood, rubbish and rocks etc.

(2) Type of Intake Structure

Typical Intake Structure observed in Nepal is open structure as shown in **Figure 1.2**.

Figure 1.2 Typical Intake Structure (Left: Pragatinagar WUSC, Right: Dhulabari WUSC)

1.3 Deep Well / Well Pump

(1) Function of Deep Well

Functions of Deep Well are shown below;

- Pump up ground water with the design flow rate continuously and stably
- Pump up ground water with suitable quality to drink

(2) Type of Deep Well

Typical Deep Well observed in Nepal is Deep Tube Well as shown in **Figure 1.3**.

Figure 1.3 Typical Intake Structure (Left: Pragatinagar WUSC, Right: Gauradaha WUSC)

1.4 Conveyance Pipelines

(1) Function of Conveyance Pipelines

Function of conveyance pipelines is to send raw water from intake point to Water Treatment Plant (hereafter WTP) or Clear Water Reservoir/Service Reservoir directly. Conveyance pipelines are equipped with valves, wash outs and air valve etc.

(2) Material of Pipelines

In Nepal, ductile cast iron pipe, uPVC pipe and HDPE pipe are used mainly. Characteristics of each material is shown in **Table 1.1**.

Ductile Cast Iron Pipe GI Pipe HDPE Pipe

Figure 1.4 Pipe Material

Table 1.1 Characteristics of each Pipe Material

Material	Advantage	Disadvantage
Ductile Cast Iron Pipe	・High pipe body strength ・High durability ・High flexibility of fitting	・Heavy weight ・Necessity of restraint joint
GI Pipe	・High pipe body strength ・High durability ・High process ability	・Requiring skilled worker for welding ・Cathodic protection is necessary ・Easy to corrode
HDPE Pipe	・High corrosion resistance ・Light weight	・Low pipe body strength (compare to DCIP) ・Weakness against ultraviolet rays

References: The Design Criteria for Water Supply Facilities 2012, Japan Water Works Association

(3) Valves

Valves are used for various purposes such as isolation of pipelines, drainage, flow control and blowout of air.

- ✓ **Gate Valve**: This valve is mainly used as shut-off valve. Basically, since this valve is used in full open and/or full close, it is unsuitable for flow control. Valve disc in valve box moves up and down, and opens and shuts.

- ✓ **Butterfly Valve:** This valve is used as shut-off valve and control valve. Valve disc in the valve box makes a valve rod in an axis, turns and opens and shuts.
- ✓ **Air Valve**: This valves are installed at convex points in the distribution pipelines to blowout air inside of pipelines.
- ✓ **Washout Valve**: Washout valves are installed for drainage of dirt after pipe laid work and when clean inside of pipelines.

Gate Valve Butterfly Valve Air Valve

Figure 1.5 Typical Valves installed on Conveyance Pipe

2 Standard Operating Procedure

2.1 Procedure for Intake Flow Management

Intake flow management shall be conducted in accordance with the following procedure. Precondition of this procedure is that an integrating flow meter is installed on the conveyance pipeline.

Procedure for intake flow management
Preparation (i) Make a plan for meter reading. The plan shall include time schedule of meter reading, staff allocation, transportation, record management, etc. **Daily Work** (ii) Read the meter at the designated time and record meter reading value in **Form 3.3-1**. Then calculate and record the daily intake amount. If WUSC has some intakes, the record sheet shall be prepared for each intake. (iii) While reading a meter, check the condition of the flow meter **Monthly Work** (iv) Sum up the daily intake amount of the **Form 3.3-1** on the last day of every month. (v) Sum up the monthly total of intake amount for each intake, and summarize the data in **Form 3.3-2**. **Yearly Work** (vi) Sum up the monthly total of intake amount, and summarize the data in **Form 3.3-3** on the last day of every fiscal year.

【Supplemental Explanation】

- **Regarding Procedure (i)**: To monitor the intake amount every 24 hours, meter reading shall be conducted at the same time each day.
- **Regarding Procedure (iii)**: If problems are observed, followed the procedure as shown in **Section 7**.

2.2 Intake Structure

2.2.1 Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Intake Structure are shown as follows. The results of daily O&M works shall be recorded in **Form 3.2-1** and **Form 3.3-4.**

Intake Structure

Pragatinagar WUSC

Dhulabari WUSC

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Garbage, oil or other abnormalities	✓ Remove garbage. ⇒ see **Photo 2.1**. ✓ If you find oil, stop taking water and take necessary measures.
Monthly	✓ Sediments (sand, etc.)	Remove sediments monthly (if necessary) ⇒ see **Photo 2.2**
Yearly	✓ Crack or Leakage on body	✓ Repair it.

Photo 2.1. Removing Garbage

Photo 2.2. Removing Sediments

2.3 Well Pump / Submersible Pump

Figure 2.1 Typical System of the Well Pump

2.3.1 Operation Procedure

The results of daily O&M works shall be recorded in **Form**, **3.2-3** and **Form 3.2-4**.

- Preparation before operation

  i. Check a leakage or the other abnormality at the pump area.
  ii. Select the pump to be operated.
  iii. Check the related valves are at the proper position (Discharge Valve: close, Wash-out Valve: close).
  iv. Check the pressure gauges indicate the original/zero value. (see the above 3, **Figure 2.1**)
  v. Check / record the Voltage, Ampere and Frequency of power incoming on the electrical panel.
  vi. Check / record the water level of the related tanks (if necessary).

- Start Operation

  i. Push the start button on the electrical panel.
  ii. Open the discharge valve slowly. (see the above 5, **Figure 2.1**)

iii. Adjust the flow rate and discharge pressure to the design value (indicated in the specification).

iv. Check / record the flow rate, discharge pressure (see the above 3, **Figure 2.1**), water level of the related tanks, voltage and current periodically.

- Stop Operation

i. Push the stop button on the electrical panel.

ii. In case the pump will be stopped for a long time, close the discharge valve slowly. (see the above 5, **Figure 2.1**)

2.3.2 Maintenance Procedure

Figure 2.2 shows the detail cross section of a Well Pump. Daily and periodically inspection shall be conducted in accordance with **Table 2.1**. The results of daily O&M works shall be recorded in **Form 3.2-3** and **Form 3.2-4**.

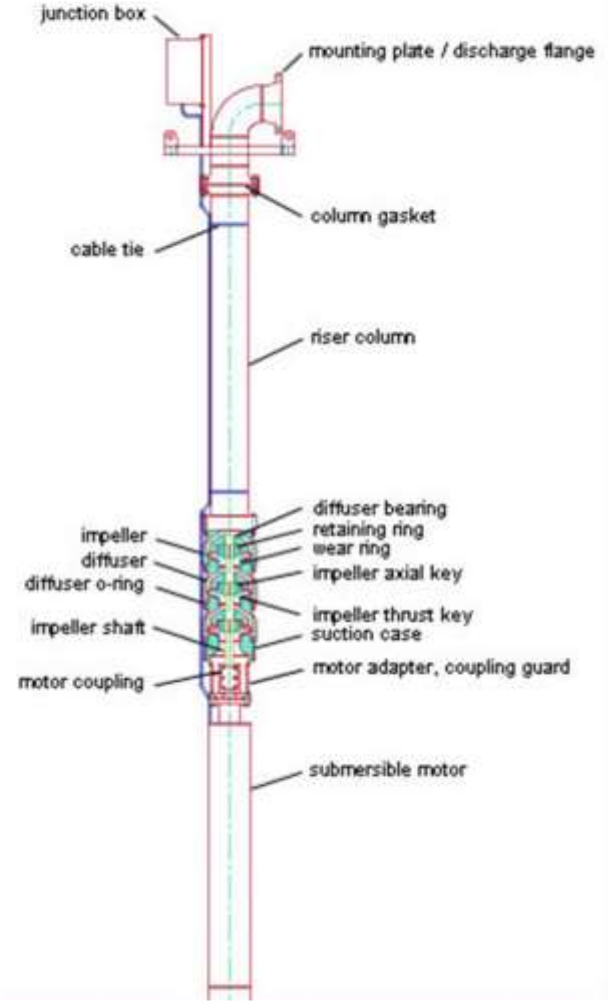


Figure 2.2 Detail Cross Section of Well Pump

Table 2.1 Monitoring and Inspection Points of Well Pump

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Abnormal noise, vibration and sound	✓ Touch the discharge pipe. ⇒ See **Photo 2.3**
	✓ Discharge pressure, flow rate, water level of the related tank	✓ Check/read the pressure gauge, flow meter and level meter (if installed). ⇒ See **Photo 2.4**
	✓ Voltage and current	✓ Check/read the ampere and voltage meter on the electrical panel. ⇒ See Photo-4 ✓ It shall be within the rated value or the value of commissioning.
Monthly	✓ Insulation	✓ Measure the insulation resistance value of motor/cable by using insulation meter. ⇒ See Photo-5 ✓ Acceptance criteria is more than 1.0 MΩ.
Yearly	✓ Condition of protective equipment (thermal protectors, immersion detectors etc.)	✓ Confirm whether they work properly.
	✓ Appearance, damage and other abnormality	✓ Pull up the well pump by using chain block etc. ✓ Observe the pump.
Every 2-3 Years	✓ Overhaul	✓ Ask supplier or manufacturer for overhaul. ✓ In case stand-by pump is not installed, another pump shall be prepared and installed.

Photo 2.3. Touching Discharge Pipe

Photo 2.4. Checking Pressure Gauge

(1) Replacement of typical components/parts

Since the durability of pump components changes depending on a variety of factors such as operating conditions, operating time, water quality and quality of each component/part, accurately determining of the life span of each component is quite difficult. **Table 2.2** shows the average durability/life Time of pump components based on the past data. These data can be used for reference in order to plan the maintenance schedule and prepare/secure the necessary budget.

Table 2.2 Average Durability/Life Time of Pump Components (for reference)

No.	Name of Components/Parts	Life Span (Years)	Disassembly Inspection		
			1 year	2 year	3 year
1	Impeller	10 Years			✓
2	Casing liner	5 Years			✓
3	Liner ring	5 Years			✓
4	Impeller ring	5 Years			✓
5	Shaft	10 Years			✓
6	Sleeve	5 Years			✓
7	Rolling bearing	5 Years			✓
8	Sliding bearing	5 Years			✓
9	Submersible bearing (rubber)	5 Years			✓
10	O Ring	Replace at every disassembly inspection		✓	✓
11	Sheet gasket	Replace at every disassembly inspection		✓	✓
12	Mechanical seal	2 Years		✓	✓
13	Gland packing	1 Year	✓	✓	✓
14	Lubricants(oil, grease)	1 Year	✓	✓	✓
15	Coupling bolt rubber	2 Years	✓	✓	✓
16	V belt	2 Years	✓	✓	✓

(2) Trouble Shooting

Typical troubles/abnormalities and its countermeasures of Well Pump are summarized in **Table 2.3**.

Table 2.3 Typical Troubles/Abnormalities and its Countermeasures of Well Pump

Type of Trouble / Abnormality	Countermeasures
Leakage	Stop the pump immediately and repair the leakage point.
Abnormal noise or vibration	Stop the pump immediately and investigate the causes as follows; ✓ Malfunction of the bearings: Repair/replace it. ✓ Other causes: Repair/replace the pump.
Overload of the motor	Stop the pump immediately and investigate the causes as follows; ✓ Excessive flow rate: Check/adjust the valve opening position of the discharge valve. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Lack of water flow	Stop the pump immediately and investigate the causes as follows; ✓ Insufficient valve opening position: Check/adjust the valve opening position of the discharge valve. ✓ Replace any worn parts. (Mechanical seals, bearings etc.) ✓ Lack of the water level of deep well ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Impossible to start the pump	Check the following causes; ✓ Power supply: In case of power cut, start the generator. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the control panel: Repair/replace the control panel.
Excessive Current	Stop the pump immediately and investigate the causes as follows; ✓ Phase interruption: Check continuity of each phase. ✓ Excess current due to sand entry in pump: Pull up the pump, disassemble and clean. ✓ Excess current due to voltage decrease: If the problem is not due to the effects of other loads, contact power company.
Unstable Current	Stop the pump immediately and investigate the causes as follows; ✓ Pump or motor bearing failure: Repair or replace it.
Decreased insulation	Stop the pump immediately and investigate the causes as follows; ✓ Underwater cable damage: Repair or replace it. ✓ Motor Damage: Repair or replace it.

2.4 Electrical Equipment

2.4.1 Electrical Panel

(1) Maintenance Procedure

Figure 2.3 and **Table 2.4** shows typical devices installed on surface of Electrical Panel (Pump Panel). **Figure 2.4** and **Table 2.5** shows typical devices installed on inside of Electrical Panel. Daily and periodically inspection shall be conducted in accordance with

Table 2.6. The results of O&M works shall be recorded in **Form 3.2-4** and **Form 3.2-5**

Basically, devices on panel surface shall be inspected daily and devices inside panel shall be inspected weekly, monthly or yearly.

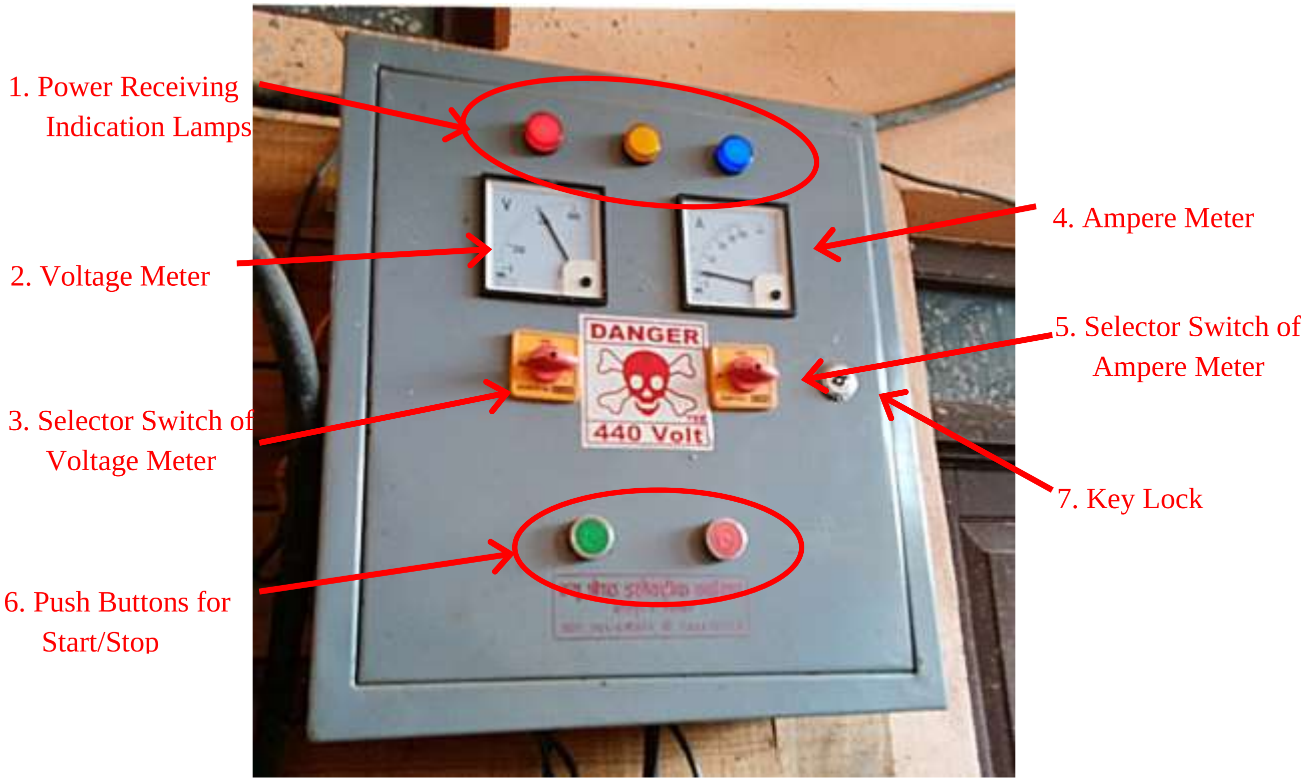


Figure 2.3 Devices on Panel Surface

Table 2.4 Purpose and Function of each Device on Panel Surface

No.	Device	Purpose & Function
1	Power Receiving Indication lams	Indicate whether the panel is energized or not.
2	Voltage Meter	Measure and indicate the voltage between two phases.
3	Selector Switch for Voltage Meter	Select two phases out of three to check the voltage.
4	Ampere Meter	Measure and indicate the electrical current of one phase.
5	Selector Switch for Ampere Meter	Select one phase out of three to check the electrical current.
6	Key Lock	Prevent foreign matter from coming in and strangers from touching inside.
7	Push Button for Start/Stop	Operate the pump.

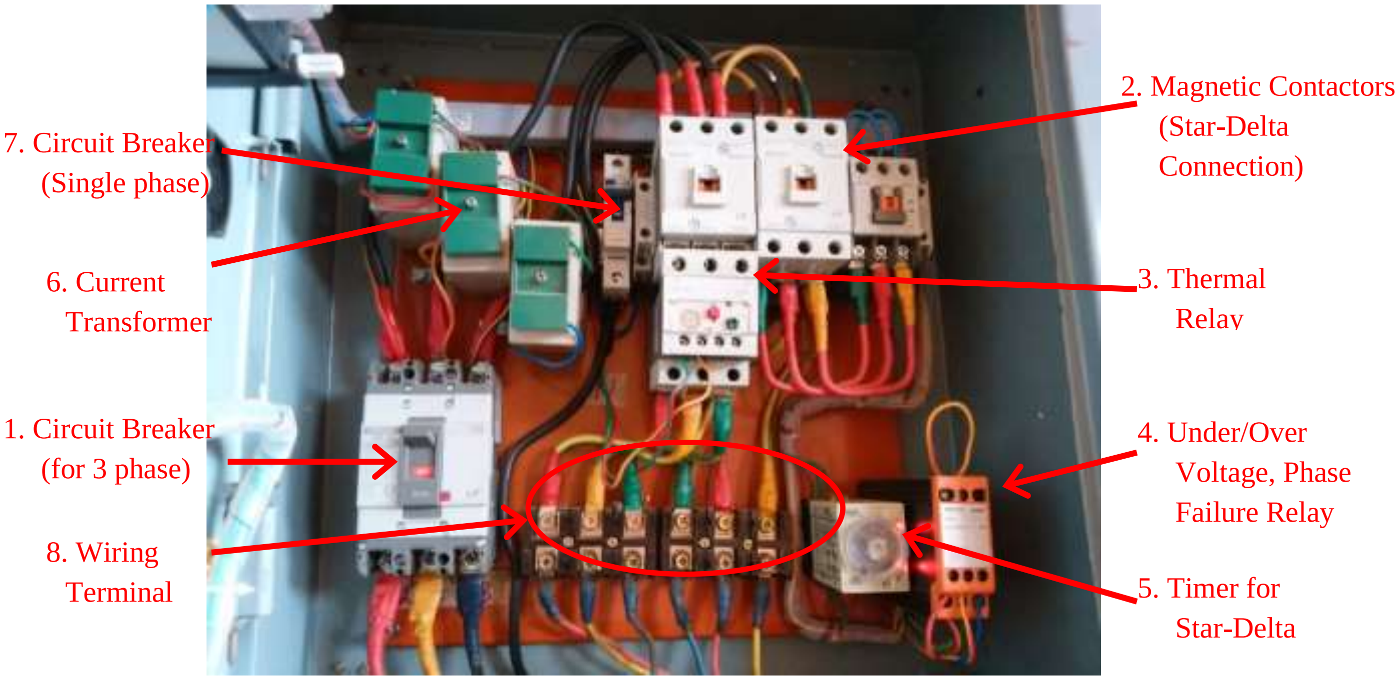


Figure 2.4 Devices of Inside Panel

Table 2.5 Purpose and Function of each Device inside Panel

No.	Device	Purpose & Function
1	Circuit Breaker for 3 phase	Main power switch of the panel. But, it originally functions as a protection from short circuit and burning trouble.
2	Magnetic Contactors	ON/OFF switch of the circuit. When you push the Start/Stop button on the surface, this contactor works accordingly.
3	Thermal Relay	Functions to protect the motor from over current and burning trouble.
4	Under/Over Voltage, Phase Failure Relay	Functions to protect the motor from abnormal voltage such as very low voltage which might cause overheating the motor and circuit.
5	Timer	Set the seconds to changeover the wiring connection from star mode to delta mode. **Don't touch this device.**
6	Current Transformer	Necessary intermediate device to indicate current value on the Ampere Meter.
7	Wiring Terminal	Wiring connection shall be done with dedicated wiring terminal instead of direct and taping connection.

Table 2.6 Monitoring and Inspection Points of Electrical Panel

Frequency	Monitoring / Inspection Points	Method
Weekly	✓ Identifications (Panel Surface)	✓ Check whether all lamps, switches have name tag.
	✓ Status/fault indication lamps (Panel Surface)	✓ Check whether all lamps light up brightly.
	✓ Voltage meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Ampere meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Cleanliness (Inside Panel)	✓ Check whether there is no dust, spider's nest, vermin etc. ⇒ See **Photo 2.5**.
	✓ Intrusion path (Inside Panel)	✓ Check whether there is no hole or crack on enclosure.
	✓ Noise (Inside Panel)	✓ Check whether there is no noise from components.
	✓ Cable (Inside Panel)	✓ Check whether there is no cut.
Monthly	✓ Voltage by clamp meter	✓ Measure voltage by using clamp meter. ⇒ See **Photo 2.6**. ✓ Acceptance criteria is ±10% of rating voltage.
	✓ Voltage on voltage meter (panel surface)	✓ Check voltage value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Ampere by clamp meter	✓ Measure ampere by using clamp meter. ⇒ See **Photo 2.7**. ✓ Acceptance criteria is less than rating ampere.
	✓ Ampere on ampere meter (panel surface)	✓ Check ampere value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Over/under Voltage Relay	✓ Check whether over-voltage trip test button works properly. ✓ Check whether under-voltage trip test button works properly.
	✓ Thermal Relay	✓ Check whether trip test button works properly.

Frequency	Monitoring / Inspection Points	Method
Yearly	✓ Continuity of Circuit Breaker	✓ Check the continuity by using insulation continuity tester. ⇒ See **Photo 2.8**.
	✓ Continuity of Magnetic Contactor	✓ Check the continuity by using insulation continuity tester.
	✓ Insulation between lines	✓ Measure the insulation by using insulation continuity tester. ✓ Criteria is shown as below; More than 1.0 MΩ: Good, More than 0.4 MΩ: Need to clean up or care, Less than 0.4 MΩ: Repair immediately
	✓ Earth Resistance	✓ Measure the earth resistance by using earth tester. ✓ Acceptance criteria is less than 10Ω.

Photo 2.5. Checking Cleanliness

Photo 2.6. Measuring Voltage

Photo 2.7. Measuring Ampere

Photo 2.8. Checking Continuity

Table 2.7 shows the electrical measuring instruments provided by WASMIP-II. These instruments shall be used in accordance with the instruction manual as shown in **Appendix 2-4**. Especially, <u>in case of checking/measuring the following items, **Circuit Breaker must be turned off for safety**.</u>

- ✓ Over/under Voltage Relay (Monthly)
- ✓ Thermal Relay (Monthly)
- ✓ Continuity of Circuit Breaker (Yearly)
- ✓ Continuity of Magnetic Contactor (Yearly)
- ✓ Insulation between lines (Yearly)
- ✓ Earth Resistance (Yearly)

Table 2.7 Outline of Procured Electrical Measuring Instruments

Item	Specification	Model/ Manufacturer
Digital clamp meter 	• Electric Current Range: 0.8 to 1,000 A Accuracy: ±1.5% (0-629.9A), ±2.0% (570-1049A) • Voltage (AC/DC) Range: 0 to 629.9 V Accuracy: ±1.2 to 1.5% (AC), ±1.2% (DC)	2007R/ Kyoritsu
Insulation continuity tester 	• Insulation Range: 0 to 1,999MΩ (Nominal output voltage: 250, 500, 1,000V) Accuracy: ±1.5% (20-200MΩ), ±10% (2,000MΩ) • Continuity Range: 0 to 1,999Ω Accuracy: ±1.5%	3007A/ Kyoritsu
Earth tester 	• Earth Voltage Range: 0 to 199.9 V Accuracy: ±1.0% • Earth Resistance Range: 0 to 1,999Ω Accuracy: ±2.0%	4105A/ Kyoritsu

(2) Trouble Shooting

If any trouble or abnormality is found in daily, weekly, monthly and yearly inspection, it shall be informed to the electrical engineer. The electrical engineer shall confirm the actual situation and judge whether it can be fixed/solved by himself or not.

If the electrical engineer can't fix/solve it, he have to contact with an electrical constructor or NEA as soon as possible. In case of easy maintenance such as replace of lamp etc, operator can fix/solve it in accordance with the instruction by the electrical engineer.

2.4.2 Stand-by Generator

(1) Maintenance Procedure

Basically, the Stand-by Generator shall be operated and maintained in accordance with the manufacturer's instruction manual. **Table 2.8** shows the typical monitoring/inspection points for reference. The results of daily O&M works shall be recorded in **Form 3.2-1**, **Form 3.2-2** and **Form 3.2-4**.

Stand-by Generator

Dhulabari WUSC **Manthali WUSC**

Table 2.8 Monitoring and Inspection Points of Stand-by Generator (for reference)

Frequency	Monitoring / Inspection Points	Method
Daily or Each Operation	✓ Leakage (coolant, oil, fuel), Loose fastenings / fixings, Worn belts, Loose connections etc.	✓ Visual inspection before start-up ⇒ See **Photo 2.9**
	✓ Level of Fuel, Engine oil and Coolant	✓ Visual inspection before start-up ⇒ See **Photo 2.10**
	✓ Condition of Battery / Fluid level etc.	✓ Visual inspection before start-up ⇒ See **Photo 2.11**
	✓ Voltage and current	✓ Check/read the voltage and ampere on the electrical panel. ⇒ See **Photo 2.12** ✓ Acceptance criteria is rated value or value during commissioning.
Every 2 Weeks	✓ Operational Check for 5 minutes	✓ Start up and check the operation condition in case of long-term stop.
Monthly	✓ Operational Check for 1 hour with 50 % load	✓ Start up and check the operation condition in case of long-term stop.
Every 250 hrs.	✓ Replace engine oil, engine oil filter cartridge, fuel filter etc.	✓ Replace them according to manufacturer's instruction manual.
Every 12,000 hrs.	✓ Overhaul of engine (Recommended)	✓ Outsource according to manufacturer's instruction manual.

Photo 2.9 Checking Loose Fastenings

Photo 2.10 Checking Level of Engine Oil

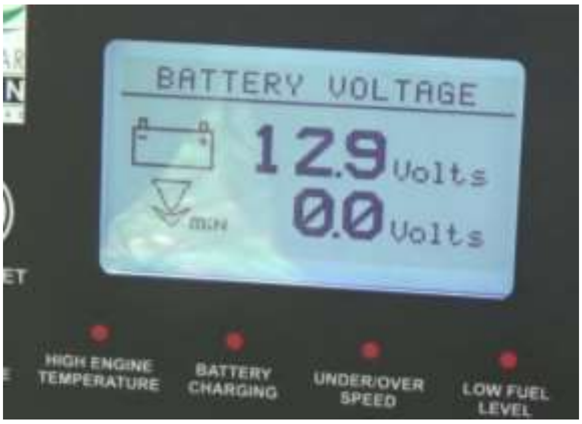


Photo 2.11 Checking Battery Condition

Photo 2.12 Checking Voltage and Ampere

(2) Trouble Shooting

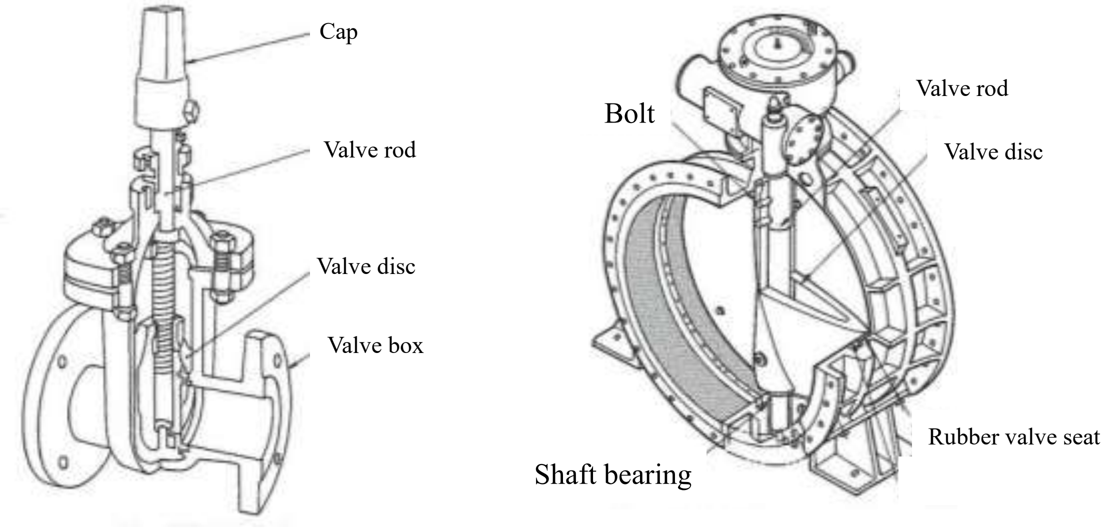
If any trouble or abnormality is found in daily, weekly, monthly and yearly inspection, it shall be informed to the electrical engineer. The electrical engineer shall confirm the actual situation and judge whether it can be fixed/solved by himself or not.

If the electrical engineer can’t fix/solve it, he has to contact with an electrical constructor or NEA as soon as possible. In case of easy maintenance such as replace of lamp etc, operator can fix/solve it in accordance with the instruction by the electrical engineer.

2.5 Common Problems and Countermeasures for Valves

(1) Gate Valve and Butterfly valve

Structure of gate valve and butterfly valve is shown in **Figure 2.5**, and problems and countermeasures for gate valve and butterfly valve is shown in **Table 2.9**.



Gate Valve

Butterfly valve

Figure 2.5 Structure of Gate Valve and Butterfly Valve

Table 2.9 Problems and Countermeasures for Gate Valve and Butterfly Valve

Valve	Problems	Causes	Countermeasures
Gate Valve	Impossible to open/shut a valve	A valve seat is filled with alien substances such as garbage and sand.	Removal of alien substances
		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 gears	Decomposition and parts cleaning. Replacement of parts of reduction gears
	Strong torque generation in valve operation Water leakage from ground of valve	A valve seat and a valve rod are filled with alien substances	Removal of alien substances
		Gland packing is tighten up too much.	Adjustment of gland packing nuts.
		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 an outcrop of valve rod, and surface of rod is a flaw.	Grinding or replacement of valve rod
	Water leakage 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

Valve	Problems	Causes	Countermeasures
		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	Impossible to open/shut a valve	A valve seat is filled with alien substances such as garbage and sand.	Remove alien substances Repair rubber valve seat Repair an edge of valve disc.
		Malfunction of reduction gears	Decomposition and parts cleaning. Replacement of parts of reduction gears.
	Water leakage from valve seat with abnormal torque in valve operation	Separation of rubber valve seat	Replacement of rubber valve seat
		A valve seat and a valve rod are filled with alien substances	Removal of alien substances
	Water leakage 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.

References: The Standard for Maintenance of Water Supply Facilities 2016, Japan Water Works Association

(2) Air Valve

Structure of air valve is shown in **Figure 2.6**, and problems and countermeasures for air valve are shown in **Table 2.10**.

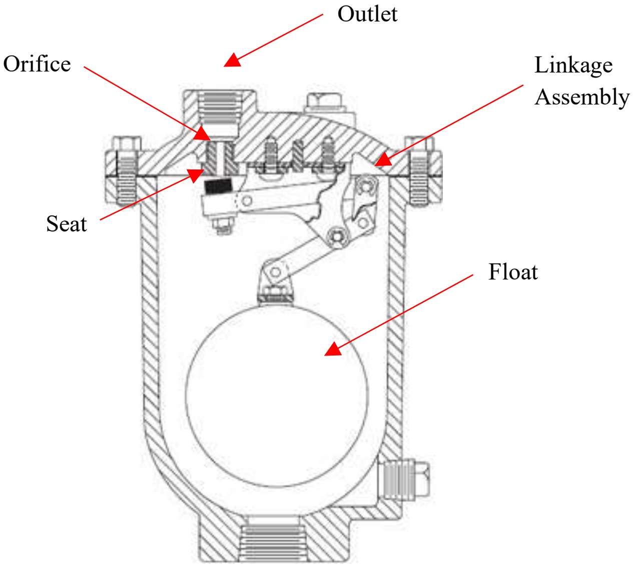


Figure 2.6 Structure of Air Valve

Table 2.10 Problems and Countermeasures for Air Valve

Valve	Problems	Causes	Countermeasures
Air Valve	When the float is closed, water flow is not stop.	The foreign object is jammed.	Cleaning for the Air Valve.
	There is the outside leakage.	The looseness of a plug cap.	Tighten the plug cap
		The looseness of a bolt and nut	Rearrangement

References: The Standard for Maintenance of Water Supply Facilities 2016, Japan Water Works Association

Section 2

Water Treatment Facility

1 Outline of Water Treatment Plant

1.1 Definition of Water Treatment Plant in This SOP

WTP is defined as facilities and equipment, which purify raw water such as surface water and ground water, and produce clear water satisfied with the water quality standards of National Drinking Water Quality Standards (hereafter NDWQS). In Nepal, typical WTP is composed of Receiving Well, Sedimentation Tank, Roughing Filter, Slow Sand Filter and Clear Water Reservoir as shown in **Figure 1.1**.

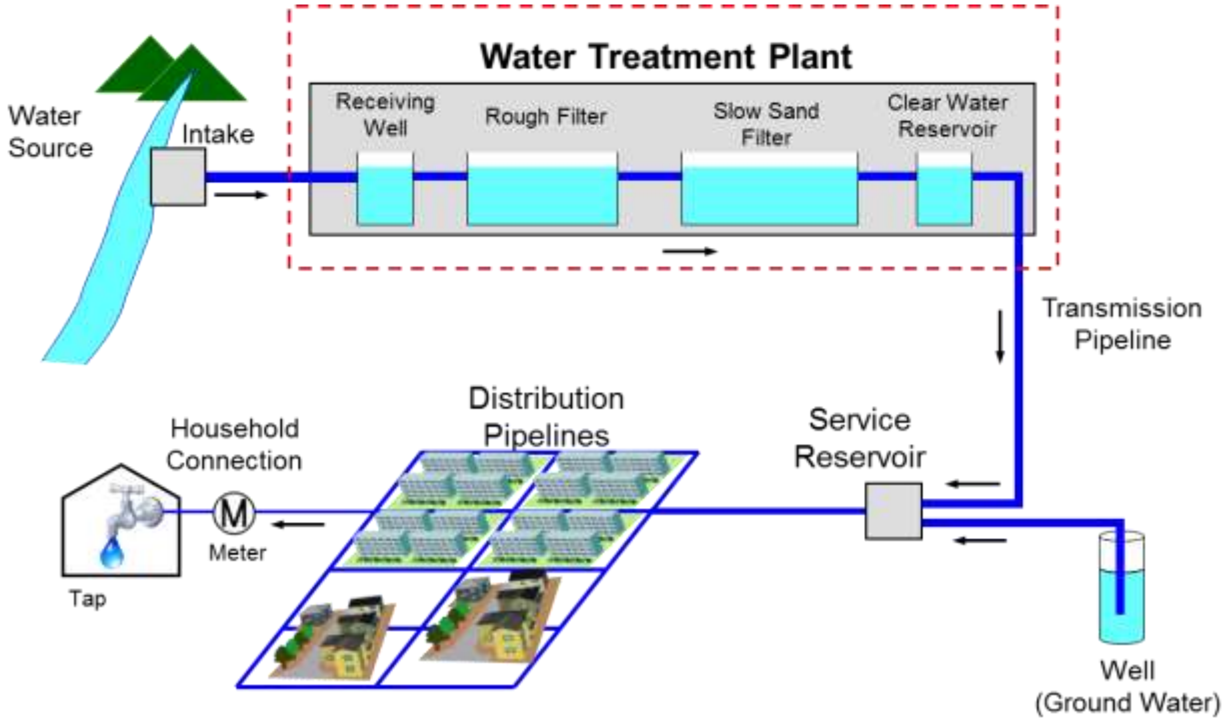


Figure 1.1 Scope of Water Treatment Plant

Water treatment processes observed in 68 Target WUSCs out of 229 WUSCs in semi-urban area had been classified into five patterns as shown in **Figure 1.2**. Therefore, the contents of this SOP is edited in accordance with the five patterns.

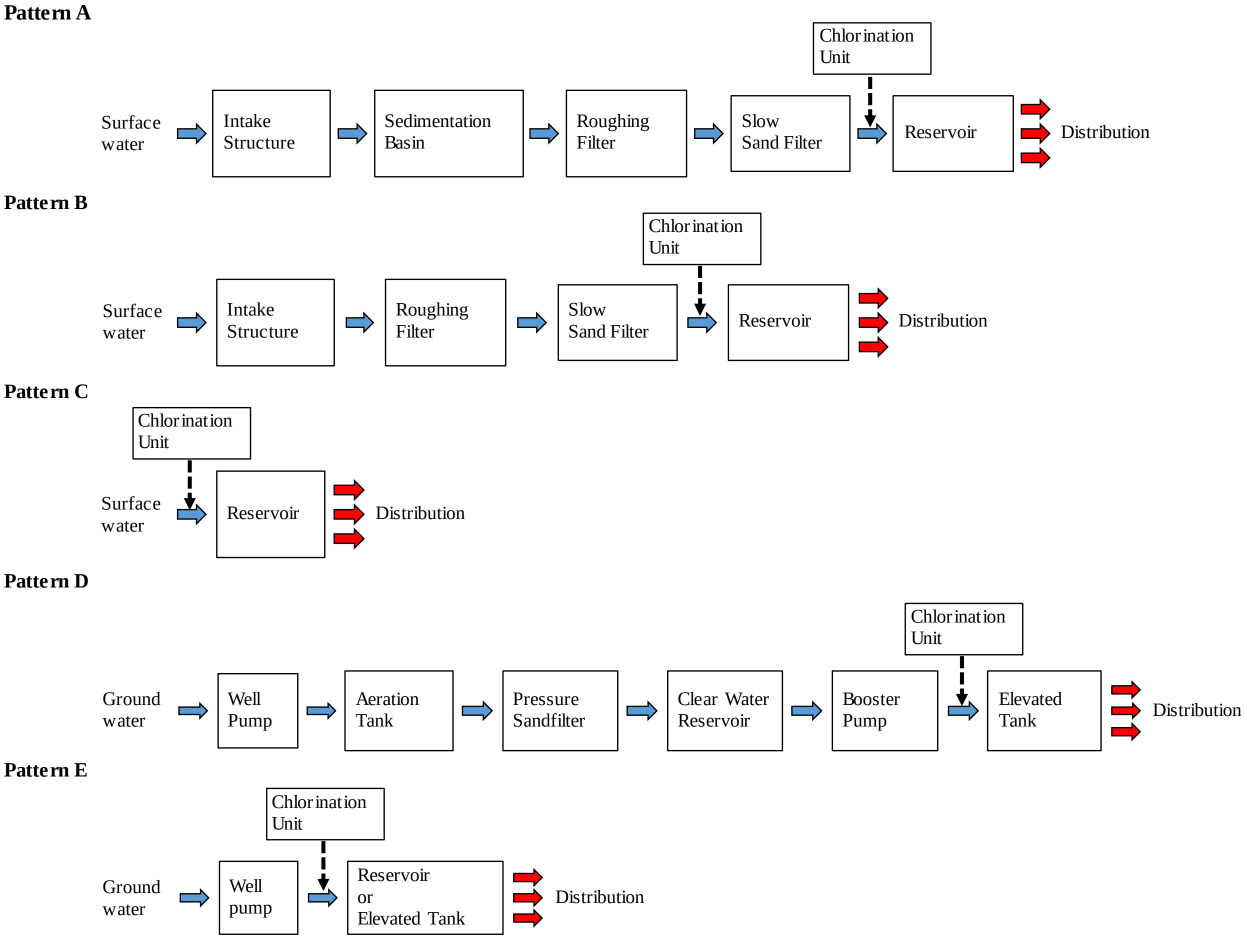


Figure 1.2 Classified Five Patterns of Water Treatment Process

1.2 Typical Water Treatment Facility in Nepal

1.2.1 Receiving Well / Collection Chamber

(1) Function of Receiving Well / Collection Chamber

Functions of Receiving Well and Collection Chamber are shown below;

- Control the variation of water level
- Measure the intake flow
- Control the intake flow in order to keep proper/stable water treatment
- Mix raw water from different intake points
- (In case of using chemicals,) Mix the chemicals such as coagulant and alkaline with raw water

(2) Types of Receiving Well / Collection Chamber

Photo 1.1 Rectangular Receiving Well (Left, Dhulabari WUSC), Ground Type Collection Chamber (Right, Besisahar WUSC)

1.2.2 Sedimentation Tank

(1) Function of Sedimentation Tank

Functions of Sedimentation Tank are shown below;

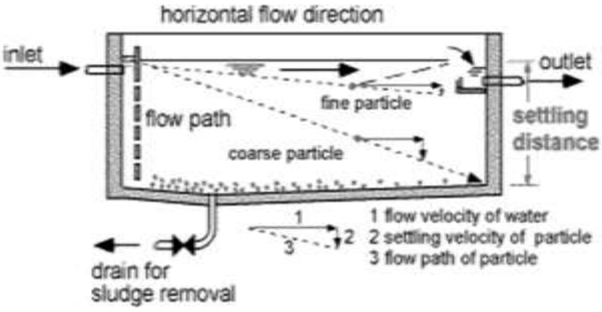
- Settle suspended particles included in raw water by gravity force
- Buffer/control the solid loading for the filter facility
- Remove the settled sludge outside

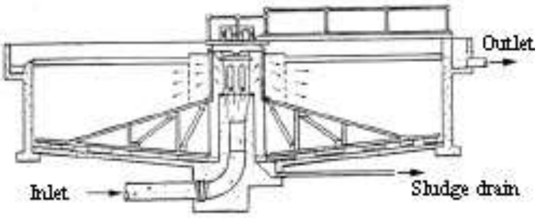
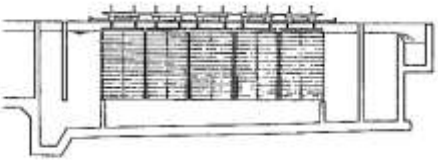
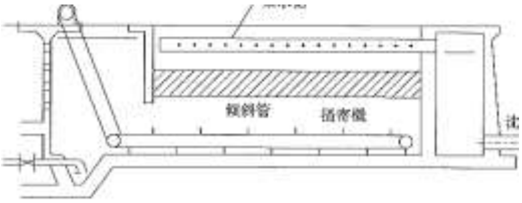
(2) Types of Sedimentation Tank

Basically, Sedimentation Tank is classified into two types, i) chemical sedimentation tank or coagulation - sedimentation tank and ii) plain sedimentation tank. The former, chemical sedimentation, accompany coagulation and flocculation processes before sedimentation. On the other hand, the later, plain sedimentation doesn't accompany coagulation and flocculation processes.

Furthermore, sedimentation tank can be classified into rectangular type and circular type based on its shape. In another view point, it can be classified into horizontal flow sedimentation tank, plate settler and tube settler. The details are summarized in **Table 1.1**. Most of target WUSCs have plain sedimentation tank which is rectangular type and horizontal flow.

Table 1.1 Types of Sedimentation Tank

Viewpoint	Type	Outline
Shape	Rectangular Sedimentation Tank	  **Pragatinagar WUSC**  **Karnaphuli WTP, Bangladesh (for reference)**

Viewpoint	Type	Outline
	Circular Sedimentation Tank	  **Singda WTP, India (for reference)**
Flow Direction and Structure	Horizontal Flow Plates Settler	
Flow Direction and Structure	Up-flow Tube Settler	  **Kitachiba WTP, Japan (for reference)**
	Horizontal flow Sedimentation Tank	same as Rectangular Sedimentation Tank

1.2.3 Roughing Filter

(1) Function of Roughing Filter

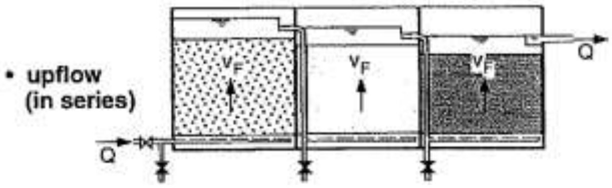
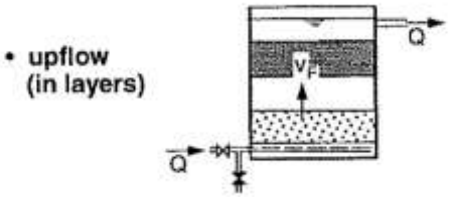
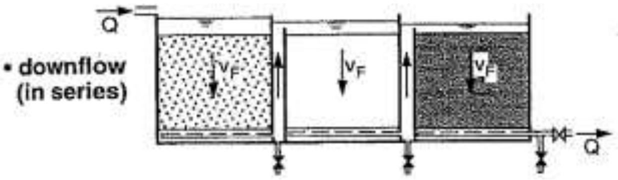
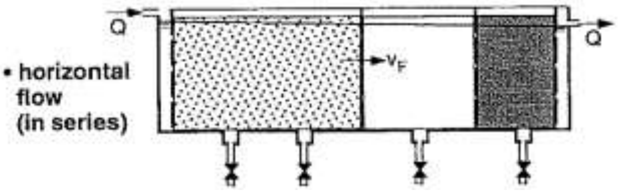
Functions of Roughing Filter are shown below;

- Reduce turbidity and algae included in raw water
- Buffer/reduce the solid loading on the Slow Sand Filter

(2) Types of Roughing Filter

Roughing Filter is classified into two types, i) vertical flow type and ii) horizontal flow type. Furthermore, vertical flow type can be classified into down flow type and up-flow type based on its flow direction. Basically, shape/structure of Roughing Filter is rectangular tank. The details are summarized in **Table 1.2**. Most of target WUSCs have horizontal flow roughing filter.

Table 1.2 Types of Roughing Filter

Type		Outline
Vertical Flow Roughing Filter	Up-flow Type	   **Kilinochchi WTP, Sri Lanka (for reference)**
	Down-flow Type	
Horizontal Flow Roughing Filter		  **Pragatinagar WUSC**

1.2.4 Slow Sand Filter

(1) Function of Slow Sand Filter

Functions of Slow Sand Filter are shown below;

- Remove suspended solids and dissolved substances in raw water by the function of biological film under an aerobic condition (DO: 6-7 mg/L*).

* Recommended value in Japan

(2) Types of Slow Sand Filter

Basically, shape/structure of Slow Sand Filter is rectangular tank with vertical/down flow. The basic process of slow sand filter is that raw water passes through sand layer at filtration rate of 0.1 to 0.3 m3/m2/h (less than 0.2 m3/m2/h is desirable). The filtered water is collected on perforated pipes laid over with the supporting gravel to prevent the filter sand from dropping into the perforated pipes.

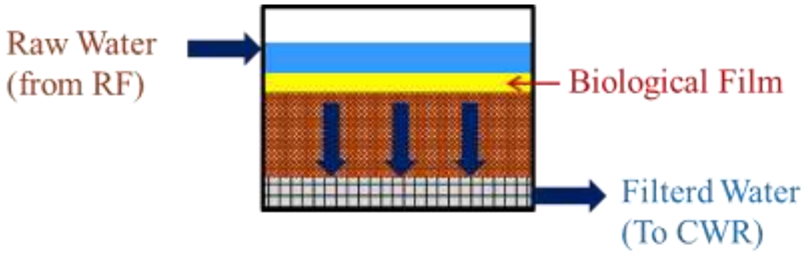


Photo 1.2 Outline of Roughing Filter (Left: Pragatinagar WUSC, Right: Beljhundi WUSC)

1.2.5 Rapid Sand Filter

(1) Function of Rapid Sand Filter

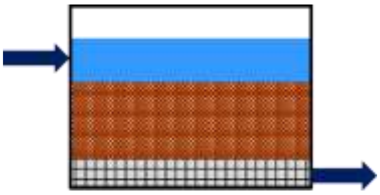
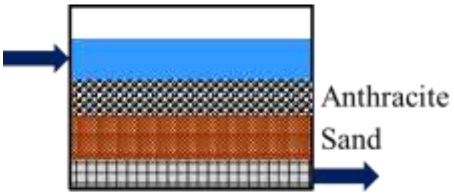
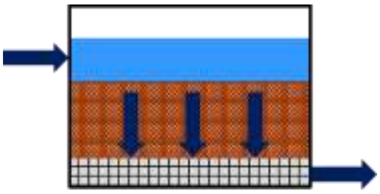
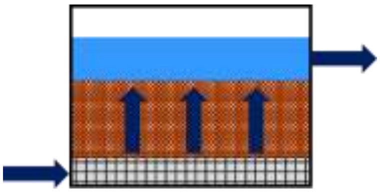
Functions of Rapid Sand Filter are shown below;

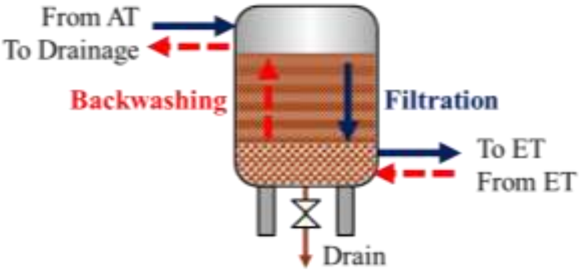
- Remove fine suspended solids which cannot be settled down in sedimentation tank after coagulation and flocculation by the function of sieving and adhesion to filter sand.

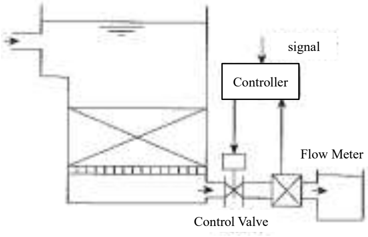
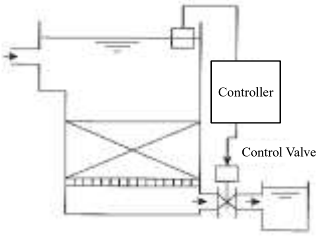
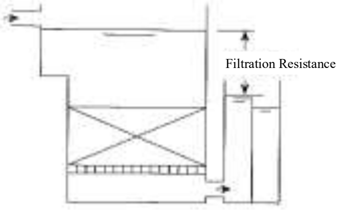
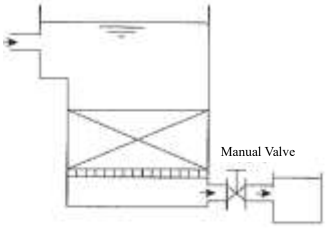
(2) Types of Rapid Sand Filter

Rapid Sand Filter can be classified according to the viewpoints such as constitution of filter bed, flow direction, hydraulic aspect and control method of filtration rate. Basically, Rapid Sand Filtration accompany coagulation process and/or flocculation and sedimentation processes. The details are summarized in **Table 1.3**.

Table 1.3 Types of Rapid Sand Filter

Viewpoint	Type	Outline
Constitution of Filter Bed	Single Layer Type	
	Multi-layer Type	
Flow Direction	Down Flow Type	
	Up-flow Type	

Viewpoint	Type	Outline
Hydraulic Aspect	Gravity Type	  **Karnaphuli WTP, Bangladesh (for reference)**
	Pressurized Type	  **Mangadh WUSC**

Viewpoint	Type	Outline
Control Method of Filtration Rate	Flow Control Type	
	Level Control Type	
	Equilibrium Type	
	Decrement Filtration Type	

1.2.6 Aeration Facility

(1) Function of Aeration Facility

Functions of Aeration Facility are shown below;

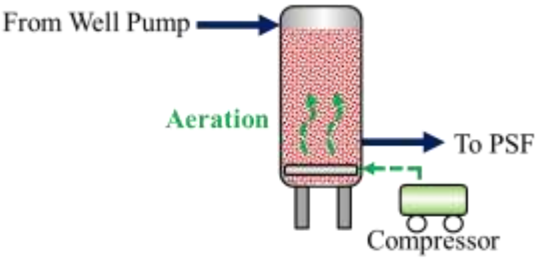
- Remove free Carbon Dioxide (CO_2) / Volatile Organic Compound (VOC) / Hydrogen Sulfide (H_2S) in raw water by bringing into contact with air.
- Oxidize Ferrous Hydroxide ($Fe (OH)_2$) to Ferric Hydroxide ($Fe (OH)_3$) by aeration.

$$2Fe(OH)_2 + 1/2O_2 + H_2O \rightarrow 2Fe(OH)_3$$

(2) Types of Aeration Facility

Aeration Facility is classified into packed tower type, cascade type etc. Packed tower type aeration facility (Aeration tank) is installed at some target WUSCs of which raw water is ground water including iron. The details are summarized in **Table 1.4**.

Table 1.4 Types of Aeration Facility

Type	Outline
Packed Tower Type	  **Gauradaha WUSC**
Cascade Type	 **Ningthempukhri WTP, India (for reference)**

1.2.7 Chlorination Unit

(1) Function of Chlorination Unit

Functions of Chlorination Unit are shown below;

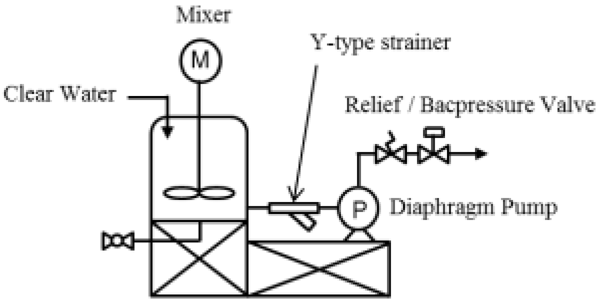
- Disinfect treated water by dosing chlorine.
- Control/keep proper Residual Chlorine value at water tap. (0.1 to 0.2 mg/L)

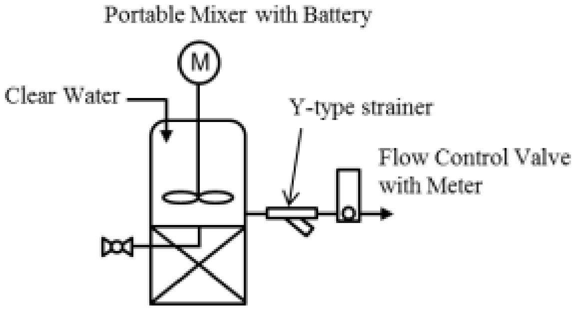
(2) Types of Chlorination Unit

The most widely used disinfectant is chlorine. Chlorine can be used/procured in solid (Bleaching powder), liquid and gaseous (cylinder) forms. Bleaching powder is commonly used in Nepal, since it is easy for handling and storage.

Chlorination Unit for bleaching powder is classified into automatic type and manual type. Automatic type chlorination unit consists of diaphragm pump and related parts, and manual type unit consists of flow control valve and related parts. The details are summarized in **Table 1.5**.

Table 1.5 Types of Chlorination Unit

Type	Outline
Automatic Type	  **Pragatinagar WUSC**

Type	Outline
Manual Type	  **Besisahar WUSC**
Chlorine Gas Injection Unit	 **Kilinochchi WTP, Sri Lanka (for reference)**

2 Standard Operating Procedure

2.1 Operation Management

2.1.1 Pattern A: Sedimentation + Roughing Filtration + Slow Sand Filtration + Disinfection

(1) Sedimentation Tank

1) Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Sedimentation Tank are shown as follows. The results of daily O&M works shall be recorded in **Form 3.2-1.**

Sedimentation Tank

Besisahar WUSC

Dhulabari WUSC

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Turbidity (Inlet)	✓ Measure the turbidity of inlet water by using turbidity meter. ⇒ See **Photo 2.1**.
Daily	✓ pH (Inlet)	✓ Measure the pH of inlet water by using Test Kit (ENPHO Kit). ⇒ See **Photo 2.2** and Instruction Manual of ENPHO Kit.
Daily	✓ Oil or other abnormalities	✓ If you find oil, stop inflow. ✓ Remove or drain it manually.
Daily	✓ Scum or Algae	✓ Remove it manually. ⇒ See **Photo 2.3**.
Weekly	✓ Amount of sediment (by observation)	✓ Observe the inside of tank.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.
Yearly	✓ Cleaning	✓ Drain the inside water completely. ✓ Carry out cleaning of the tank. ⇒ See clause b) and c) below.

Photo 2.1 Measurement of Turbidity

Photo 2.2 Measurement of pH

Photo 2.3 Removing Scum

a) Normal operation procedure

i. Close the drain valve and outlet valve (if exists).
ii. Check the condition.
iii. Open the inlet valve and fill water slowly.

iv. Open the outlet valve after filling water to the designed water level.
v. Once start the operation, it is not necessary to conduct the above procedures.

b) Timing of cleaning

Cleaning shall be performed **<u>at least once a year</u>**. However, it shall be carried out in the following cases;

i. Effluent water is more turbidly.
ii. Plenty of settled sediments are observed on the bottom of tank, especially upstream side.

c) How to clean

Cleaning of sedimentation tank is carried out by the following procedure;

i. Close the inlet valve
ii. Open the drain valve to drain settled sediments with inside water.
iii. Scrape the sediments toward the drainage.
iv. If the amount of settled sediments is too much to drain/wash out, remove it manually by using shovel and bucket. ⇒ See **Photo 2.4**.
v. Open the inlet valve for wash out.
vi. Clean the inlet chamber, walls and bottom of tank with inlet water. ⇒ See **Photo 2.5** to **2.7**.
vii. Close the drain valve
viii. Open the inlet valve and fill the tank with water.
(Once water level is reached to the outlet, treated water will flow into roughing filter.)

Notes;

1. In case there are two tanks, wash the tanks one by one to keep water supply.
2. In case of one tank only, open the by-pass valve during cleaning to send raw water for the next process.

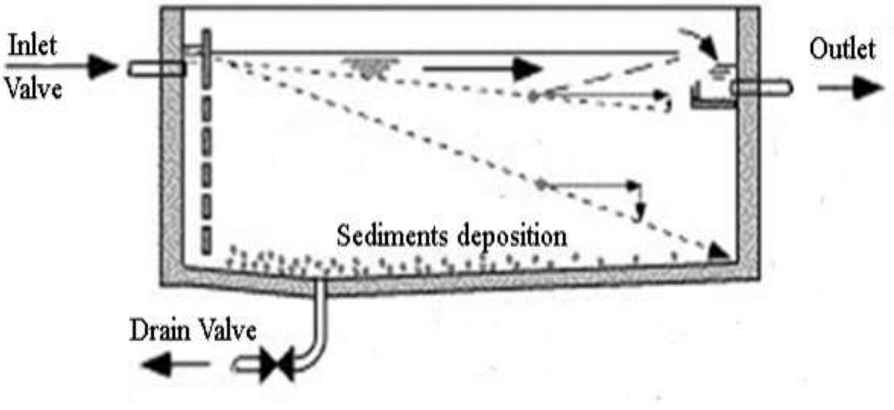


Figure 2.1 Cross Section of Sedimentation tank (SANDEC, 25.8.95)

Photo 2.4 Removing Settled Sludge

Photo 2.5 Cleaning of Inlet Chamber

Photo 2.6 Cleaning of Wall

Photo 2.7 Cleaning of Bottom with Water

d) How to stop the sedimentation tank

In case of long term maintenance or rehabilitation, the following procedure shall be conducted.

i. Close the inlet valve of the target sedimentation tank.
ii. Drain inside water from drainage valve completely.

2) Trouble Shooting

a) How to solve choked/clogged drainage pipe

When the drainage pipe is choked/clogged, the following procedure shall be conducted to solve it.

i. Close the inlet valve.
ii. Remove floating materials manually.
iii. Drain inside water by using a submersible pump.
iv. Wash out the inside of drainage pipe with sufficient pressured water by using pump.
v. If the choking/clogging is not solved, the drainage pipe shall be exposed, disassembled at joints and then cleaned inside.

vi. Check the condition whether drainage is possible or not.

(2) Roughing Filter (RF)

1) Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Roughing Filter are shown as follows. The results of daily O&M works shall be recorded in **Form 3.2-1.**

Roughing Filter

Besisahar WUSC

Pragatinagar WUSC

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Turbidity (Inlet)	✓ Measure the turbidity of inlet water by using turbidity meter. ⇒ See **Photo 2.8**.
Daily	✓ Water level (Filtration resistance)	✓ Confirm whether water can be seen on the filter media or not. ✓ If water can be seen, hydraulic cleaning shall be done. ⇒ See **Photo 2.9**.
Daily (if possible)	✓ Filtration rate (design value: 0.3 – 1.5 m/h)	✓ In case that flow meter or v-notch is installed, measure the filtration rate.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.

Photo 2.8 Measurement of Turbidity

Photo 2.9 Observation of Water Level (Left; Normal Condition, Right; High Water Level)

a) Normal operation procedure

i. Close the drain valve and outlet valve (if exists).
ii. Check the condition of filter media (gravel).
iii. Open the inlet valve and fill water slowly.
iv. Open the outlet valve after filling water to the designed water level.
v. Keep the filtration rate* between 0.3 and 1.5 m/hour (7.2 to 36 m/day) by adjusting the opening of outlet valve.
vi. Once start the operation, it is not necessary to conduct the above procedures except v.

Notes;

* Filtration rate can be measured/checked by flow meter (if installed) or the overflow depth at V-notch. **Figure 2.2** shows an example of filtration rate calculation in case of V-notch.

$Q = C\, h^{5/2}$

$C = 1.35 + (0.004/h) + (0.14{+}0.2/W^{1/2})\, (h/B{-}0.09)^2$

Q (m^3/s): Flow Rate
h (m): Overflow Depth (0.07 to 0.26 m and less than B/3 m)
B (m): Width of Channel (0.5 to 1.2 m)
W (m): Height from the Bottom of Channel to the Bottom of V-notch (0.1 to 0.75 m)

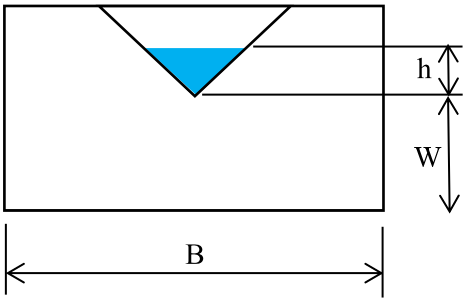


Figure 2.2 Example of Filtration Rate Calculation (V-notch)

b) Timing of cleaning

Cleaning of RF shall be carried out in the following cases;

i. Turbidity of outlet water is more than 10 NTU.
ii. Water level reach to the high water level.
iii. Abnormal condition; clogging, algae growth etc.

However, it is recommended to perform hydraulic cleaning **<u>at least once a month</u>**.

c) How to clean

Cleaning of RF is carried out by the following procedure;

i. Close the inlet valve
ii. Open the drain valve of the first compartment (upstream side) quickly in order to drain/wash out accumulated sludge with inside water.
iii. Open the inlet valve and fill the filter with water (Close the inlet valve).
iv. Open the drain valve of the first filter bed (upstream side) again quickly.
v. Check the appearance of drained water by observation.
vi. Close the drain valve of the first compartment.
vii. Repeat the procedure from iii to vi until the appearance of drained water is clean enough.
viii. Repeat the procedure from i to vii for the second and third compartment.
ix. Open the inlet valve gradually and fill the filter with water slowly. (Once water level is reached to the outlet, treated water will flow into Slow Sand Filter.)

d) How to remove, wash and install filter media (gravel) in filter

Washing of filter media is conducted in case that the above filter cleaning is not sufficient to remove accumulated sludge. Even if the filter cleaning is performed on a regular basis, it is recommended to remove and wash all filter media manually **once in three years**. Washing of filter media is conducted by the following procedure;

i. Close the inlet valve and drain inside water completely.
ii. Remove gravel from each compartment and place separately. ⇒ See **Photo 2.10** and **2.11**.
iii. Wash gravel separately with sufficient water at the appropriate place. ⇒ See **Photo 2.12**.
iv. Place the washed gravels in clean area.
v. Clean the walls and bottom of filter with water.
vi. Drain all inside water until the appearance of drained water is clean enough.
vii. Close all drain valves.
viii. Backfill the washed gravel to the original compartment. ⇒ See **Photo 2.13**.
ix. Open the inlet valve gradually and fill the filter with water slowly. (Once water level is reached to the outlet, treated water will flow into Slow Sand Filter.)

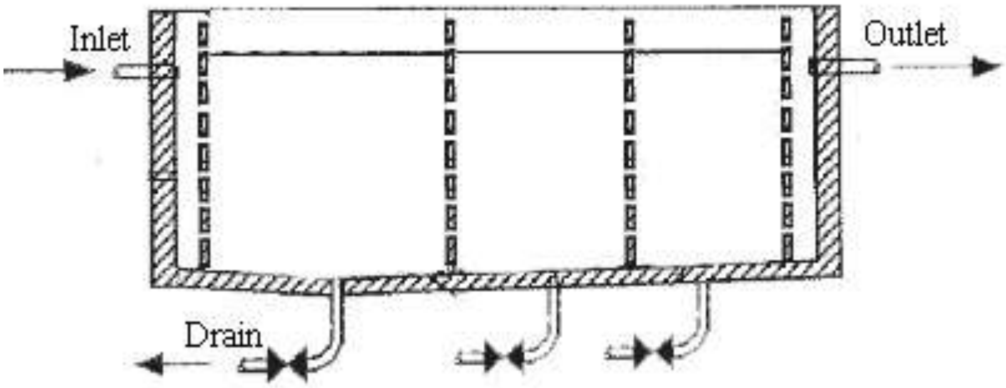


Figure 2.3 **Cross Section of Roughing Filter (SANDEC, 25.8.95)**

Photo 2.10 Excavating Gravel

Photo 2.11 Removing Gravel

Photo 2.12 Washing Gravel with Clean Water

Photo 2.13 Backfilling the Washed Gravel

e) How to stop RF

In case of long term maintenance or rehabilitation, the following procedure shall be conducted.

i. Close the inlet valve of the target Roughing Filter.

ii. Drain inside water from drainage valve completely.

2) Trouble Shooting

a) How to solve choked/clogged drainage pipe

When the drainage pipe is choked/clogged, the following procedure shall be conducted to solve it.

i. Close the inlet valve.

ii. Remove gravel from each compartment and place separately.

iii. Drain inside water by using a submersible pump.

iv. Wash out the inside of drainage pipe with sufficient pressured water by using pump.

v. If the choking/clogging is not solved, the drainage pipe shall be exposed, disassembled at joints and then cleaned inside.

vi. Check the condition whether drainage is possible or not.

(3) Slow Sand Filter (SSF)

1) Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Slow Sand Filter are shown as follows. The results of daily O&M works shall be recorded in **Form 3.2-1.**

Slow Sand Filter

Besisahar WUSC

Pragatinagar WUSC

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Turbidity (Inlet)	✓ Measure the turbidity of inlet and outlet water by using turbidity meter. ⇒ See **Photo 2.14**.
Daily	✓ Water level (Filtration resistance)	✓ Check/measure the water level. ⇒ See **Photo 2.15**. ✓ If water level is high and treated water amount is less than the design value, sand scraping shall be done.
Daily (if possible)	✓ Filtration rate (Design value: 0.1 - 0.2 m/h)	✓ In case that flow meter or v-notch is installed, measure the filtration rate. ⇒ See **Photo 2.16**.
Daily	✓ Condition of surface biofilm	✓ Confirm whether color of biofilm is normal or not. ✓ Confirm whether other abnormalities exist or not. ✓ If DO meter is available, measure dissolved oxygen value of treated water. (WHO Guideline: More than 3 mg/L)
In case of sand scraping	✓ Thickness of sand layer	✓ Measure the distance between top of the wall and sand surface. Thickness of sand layer can be calculated based on the as-built drawing. ⇒ See **Photo 2.17**. ✓ If the thickness is 500 mm or less, re-sanding shall be done.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.
Every 10 years	✓ Condition of gravel and under drain equipment	✓ Remove sand and/or gravel as required. ✓ Check the condition of gravel and under drain equipment.

Photo 2.14 Measurement of Turbidity

Photo 2.15 Measurement of Water Level

Photo 2.16 Measurement of Filtration Rate at V-notch

Photo 2.17 Measurement of Sand Layer Thickness

a) Normal operation procedure

i. Close the drain valve and outlet valve.

ii. Check the condition of sand;

- ✓ Sand level is even
- ✓ Crack on the surface
- ✓ Other abnormalities

iii. Open the inlet valve and fill water slowly.
iv. Open the outlet valve after filling water to the designed water level.
v. Keep the filtration rate between 0.1 and 0.2 m/hour (2.4 to 4.8 m/day) and water level between 1.0 and 1.1 m above the sand surface level by adjusting the opening of inlet/outlet valve.
vi. Once start the operation, it is not necessary to conduct the above procedures except v.

b) Timing of scraping sand

Scraping of sand shall be carried out **once in three months to six months** depending on the water level (filtration resistance) in SSF. It is recommended to carry out the scraping before start of rainy season. Basically, scraping sand shall be carried out when;

i. Filtration resistance (water level above the sand) increase.
ii. Treated water quality become difficult to satisfy with NDWQS.
iii. Abnormal condition in SSF is observed.

c) How to scrape and maintain the filter

Scraping of sand and maintenance work of the filter shall be carried out as follows;

i. Close inlet valve and remove all floating materials.
ii. Close outlet valve and open drain valve. In order to restart quickly, do not drain off inside water completely.
iii. Put on safety items such as gloves, helmet etc. before entering slow sand filter. It is recommended to use stage planks in order to protect sand layer. ⇒ See **Photo 2.18**.
iv. Wash / clean the walls of filter. ⇒ See **Photo 2.19**.
v. Remove algae and remaining scum.
vi. Start scraping approx. 10 to 30 mm of surface sand from one edge. ⇒ See **Photo 2.20**.
vii. Remove scraped sand to washing platform / area.
viii. Check / measure the thickness of sand layer. If it is 500 mm (lower limit), re-sanding must be done.
ix. Level the sand bed.

Photo 2.18 Preparation of Stage Planks

Photo 2.19 Cleaning Inside Walls

Photo 2.20 Scraping Surface Sand

(1) Cleaning walls

(2) Removing dried Biological Films

(3) Scraping dried Filter Sand (4) Completion of Scraping Filter Sand

(5) Sand Washer (6) Putting used sand into feeder

Figure 2.4 Scraping and Washing of Scraped Sand (Kilinochchi WTP, Sri Lanka)

d) Restart of filtration

i. If possible, fill the filter with treated water from under drain up to 10-20 mm above sand surface.
ii. Open the inlet valve and fill water slowly in order to avoid unevenness of the sand bed.
iii. Drain off treated water from the drain valve until the bio-film on the sand surface will be formed.*

* It will take from one day (in summer) to seven days (in winter) depending on the weather condition and raw water quality.

iv. Collect sample of treated water and check the turbidity.
v. After the turbidity of treated water is below 5 NTU, close the drain valve and open the outlet valve.

e) Washing of scraped filter sand

Basically, scraped filter sand shall be washed by the following method;

- ✓ Sand Washer (for Dhulabari WUSC)
- ✓ Sand Washing Unit
- ✓ Manual washing by using a sieve

In case that the cost to procure new sand is reasonable and the disposal of scraped sand can be done properly and legally, washing of scraped sand is not necessary.

- Procedure of washing sand by the sand washer

See the operation and maintenance manual of Dhulabari WTP as shown in **Appendix 2-1**.

- Procedure of washing sand by the sand washing unit

i. Connect the wash water hose with the drum as shown in **Figure 2.5**.
ii. Place scraped sand in the drum.
iii. Send wash water with required pressure; 0.2 MPa and volume; 15 to 20 times as much as the sand volume.
iv. Sand will be blown by washed water with pressure.
v. Dirt will be overflow along water from drum.
vi. Supply water until clear water is seen in drum.
vii. Drain water from drum after clear water is observed.
viii. Collect and store sand in clean place.

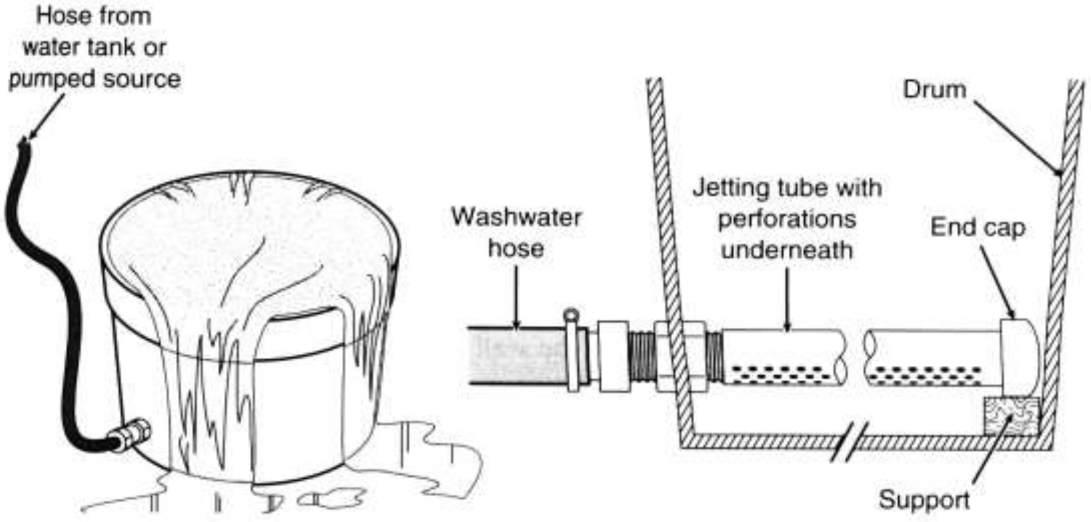
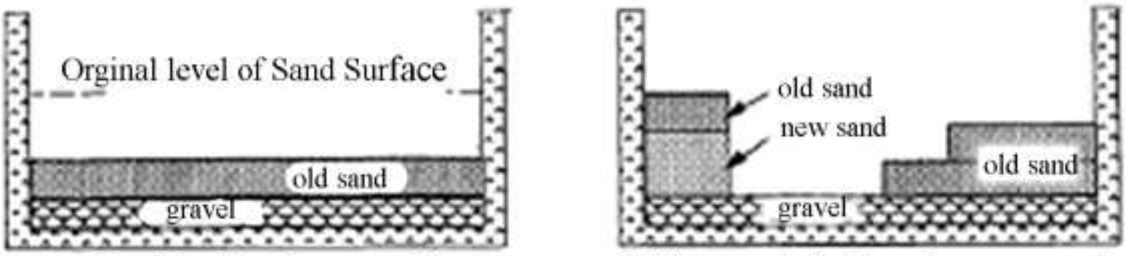


Figure 2.5 Washing of filter sand (Unknown, 2005- An Introduction to Slow Sand Filter)

f) Re-sanding of filter

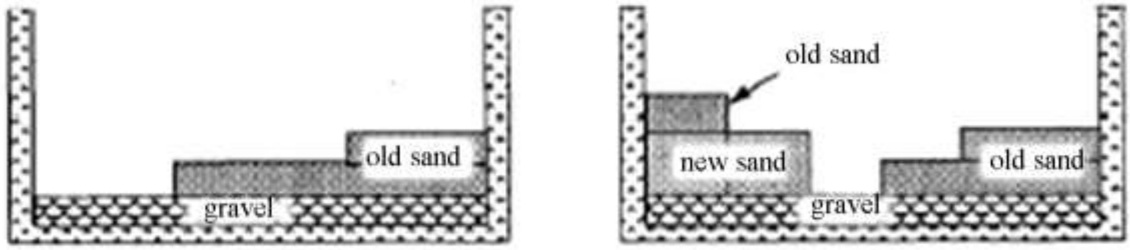
Re-sanding shall be carried out when the remaining thickness of sand layer reach up to 500 mm.

i. Remove the remaining sand (old sand) from a section of the filter and place it above the remaining sand on the other side. (See **Figure 2.6, b**)
ii. Carry and place the washed sand (new sand) on empty side. (See **Figure 2.6, c**)
iii. Level the new sand (the thickness of new sand is 400 to 500 mm).
iv. Carry the old sand and place on the top of the new sand. (See **Figure 2.6, d**)
v. Repeat the above activities from ii to iv, and fill the vacant space with the new sand. (See **Figure 2.6, e**)
vi. Place the old sand over the new sand.
vii. Level the sand with the designed thickness (800 to 900 mm). (See **Figure 2.6, f**)
viii. Fill the filter with water from under drain system slowly and carefully. If it is impossible to fill water from under drain system, fill water from the inlet.



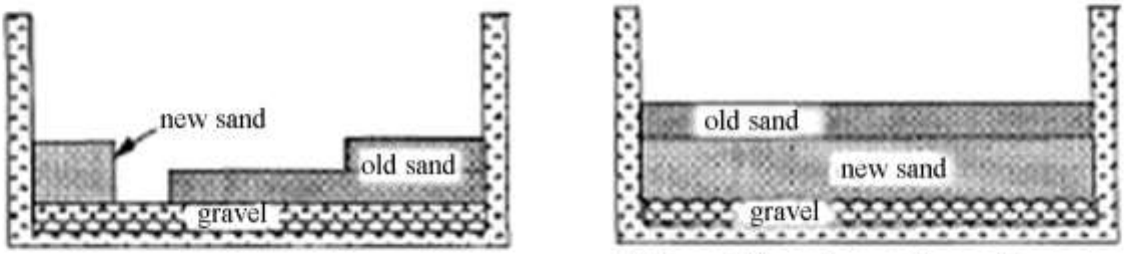
a. Sand bed level before re-sanding

d. Placement of old sand on new sand



b. Placement of old sand on old sand

e. Placement of additional new sand



c. Placement of new sand

f. Completion of resanding with new sand on bottom, old sand on top

Figure 2.6 Process of Re-sanding (AWWA, 1991)

g) How to stop SSF

In case of long term maintenance or rehabilitation, the following procedure shall be conducted.

i. Close the inlet valve of the target Filter.
ii. Drain inside water from drainage valve completely.
iii. Close the drainage valve and outlet valve.

2) Trouble Shooting

a) In case that water level reach to the high water level

i. Conduct a scraping sand in accordance with clause c) above.

b) In case that outlet turbidity exceeds 2 NTU

i. Drain the treated water.
ii. Check the filtration rate (Design value: 0.1 - 0.2 m/h) and adjust it, if necessary.
iii. Check the Dissolved Oxygen (DO)* of the treated water and condition of bio-film. In case of lack of DO, increase the filtration rate to increase DO.

Notes;

* WHO Guideline: More than 3 mg/L

(4) Clear Water Reservoir

1) Maintenance Procedure

Monitoring/inspection points, measures of Clear Water Reservoir are shown as follows. The water level shall be monitored to prevent overflow or shortage/suspension of water supply. The results of daily O&M works shall be recorded in **Form 3.2-1** or **Form 3.2-2.**

Clear Water Reservoir

Besisahar WUSC

Shankarnagar WUSC

Frequency	Monitoring/Inspection Points	Method
Daily	✓ Turbidity (Outlet) ✓ pH (Outlet) ✓ Color (Outlet) *if possible ✓ Taste and Odor (Outlet)	✓ Measure the turbidity of outlet water by using turbidity meter. ⇒ See **Photo 2.21.** ✓ Measure the pH of outlet water by using Test Kit (ENPHO Kit). ⇒ See **Photo 2.22** and **Instruction Manual of ENPHO Kit.** ✓ In case color meter is available, measure the color of outlet water. ✓ Check whether abnormal taste and odor are felt or not.
Daily	✓ Residual Chlorine (Outlet)	✓ Measure the residual chlorine of outlet water by using Test Kit (ENPHO Kit). ⇒see Instruction Manual of ENPHO Kit.
Daily	✓ Water level	✓ Check/measure the water level. ⇒ See **Photo 2.23**.
Monthly	✓ Electrical Conductivity (Outlet) ✓ Ammonia (Outlet) ✓ Nitrate (Outlet) ✓ Total Hardness (Outlet) ✓ Calcium (Outlet) ✓ E.coli (Outlet) ✓ Total Coliform (Outlet)	✓ Basically, outsource the analysis of these parameters. (Ammonia and Nitrate can be measured roughly by ENPHO Kit.)
Yearly	✓ Iron (Outlet) ✓ Manganese (Outlet) ✓ Chromium (Outlet) ✓ Fluoride (Outlet)	✓ Basically, outsource the analysis of these parameters. (Iron can be measured roughly by ENPHO Kit.)
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.

Photo 2.21 Measurement of Turbidity

Photo 2.22 Measurement of pH

Photo 2.23 Measurement of Water Level

2) Trouble Shooting

a) In case that clear water reservoir is empty

i. Stop the operation of chlorination unit.

b) In case that residual chlorine value at the outlet of clear water reservoir is much lower than the standard

i. Increase the discharge amount of chlorination unit.

c) In case that residual chlorine value at the outlet of clear water reservoir is much higher than the standard

i. Close the outlet valve and drain the inside treated water.

(5) Chlorination Unit

1) Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Chlorination Unit are shown as follows. The results of daily O&M works shall be recorded in **Form 3.2-1, Form 3.2-2** and **Form 3.2-4**.

Chlorination Unit

Pump Type

Gravity Type

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Appearance	✓ Observe.
	✓ Abnormal noise and vibration of mixer	✓ Hear and touch the motor cover. ⇒ See **Photo 2.24**.
	✓ Abnormal noise and vibration of pump (for Pump Type)	✓ Hear and touch the motor cover. ⇒ See **Photo 2.25**.
	✓ Heat generation of mixer	✓ Touch the motor cover. ⇒ See **Photo 2.24**.
	✓ Heat generation of pump (for Pump Type)	✓ Touch the motor cover. ⇒ See **Photo 2.26**.
	✓ Leakage or other abnormalities	✓ Observe.

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Liquid Level of Tank	✓ Check the liquid level. ⇒ See **Photo 2.27**. ✓ If the level is low, prepare 1.0 % chlorine solution (once a day, normally). ⇒ See **clause b)** below.
	✓ Discharge Pressure (for Pump Type)	✓ Check and read the pressure gauge. ⇒ See **Photo 2.28**.
	✓ Used Amount of Bleaching Powder	✓ Calculate the used amount of bleaching powder.
	✓ Stock of Bleaching Powder	✓ Check the remaining amount of bleaching powder.
Weekly	✓ Dosing Amount	✓ Measure the dosing amount. ⇒ See **Photo 2.29**.
Yearly	✓ Insulation of Mixer and Pump	✓ Measure by insulation continuity tester. ✓ Acceptance criteria is more than 1.0 MΩ.
	✓ Crack or Leakage on tank body	✓ Observe.

Photo 2.24 Daily Inspection of Mixer

Photo 2.25 Daily Inspection of Pump (Abnormal noise and vibration)

Photo 2.26 Daily Inspection of Pump (Heat generation)

Photo 2.27 Daily Inspection of Tank (Liquid level)

Photo 2.28 Daily Inspection of Pump (Discharge Pressure)

Photo 2.29 Weekly Inspection of Pump (Discharge Amount)

a) Procedure to Measure Dosing Amount of the Chlorine Solution

i. Confirm the required dosing amount of chlorine solution (refer to **Table 2.1**).

ii. Check / measure the actual dosing amount by using measuring cylinder once a week.

⇒ See **Photo 2.29**.

iii. If the dosing amount is larger or less than the required amount, adjust the pump stroke by the stroke adjusting screw* (See **Photo 2.30**). In case of Gravity Type, adjust the opening of discharge valve.

* Don’t touch the stroke adjusting screw while the pump is stopped.

iv. Check / measure the dosing amount again.

v. Write down the result on the record sheet.

Table 2.1 Required Dosing Amount of Chlorine Solution

Distributed Amount (m^3/day)	100		500		1,000	
Chlorin Dosing Rate	Dosing Amount of Chlorine Solution		Dosing Amount of Chlorine Solution		Dosing Amount of Chlorine Solution	
(mg/L)	(mL/min)	(L/hour)	(mL/min)	(L/hour)	(mL/min)	(L/hour)
0.5	3	0.2	17	1.0	35	2.1
1.0	7	0.4	35	2.1	69	4.1
1.5	10	0.6	52	3.1	104	6.2
2.0	14	0.8	69	4.1	139	8.3

Photo 2.30 Stroke Adjusting Screw

b) Procedure to prepare chlorine solution

i. Close all drain valves.

ii. Open windows for ventilation.

iii. Put on the safety tools as shown in **Figure 2.7**.*

iv. Measure the required amount of bleaching powder by the weighing scale according to **Table 2.2**.

Safety Goggles **Safety Mask** **Rubber Gloves**

Figure 2.7 Necessary Safety Tools

Figure 2.8 Example of Bleaching Powder and Weighing Scale

Table 2.2 Required Amount of Bleaching Powder (unit: kg, Available chlorine: 35 %)

Tank Volume (L)		1,000	500	300	200	10
Conc. of Solution (w/v %)	0.5	**14.3**	**7.1**	**4.3**	**2.9**	**0.14**
	1.0	**28.6**	**14.3**	**8.6**	**5.7**	**0.29**

v. Pour clear water up to half of the tank.

vi. Start mixing (Push the start switch on the control panel).

vii. Add the bleaching powder gradually in order to prevent from generating un-dissolved lumps as shown in **Photo 2.32**.

viii. Fill the tank with clear water.

ix. Continue to mix at least 30 minutes and check the condition of solution.

x. If sediments are remaining at the bottom of tank, open the drain valve to discharge it.

Photo 2.31 Preparation of Chlorine Solution

Photo 2.32 Appearance of Un-dissolved Lumps

< The following procedures shall be adopted for the chlorination equipment of Gauradaha, Dhulabari and Mangadh WUSC >

xi. Check the relay switch and mixer.**

xii. Transfer the chlorine solution to the chlorine solution storage tank.***

Notes;

* Ventilation and putting safety tools are required because bleaching powder is strong oxidizer.

** The mixer is interlocked by the level sensor.

*** Only chlorine solution without sediments shall be transferred to the storage tank.

c) Procedure of setting the dosing rate and amount of chlorine

Dosing rate of chlorine shall be set in accordance with **Table 2.3**.

Table 2.3 Recommended Chlorine Dosing Rate for Each Type of Water

(Design Guidelines for Community Based Gravity Flow Rural Water Supply Schemes Vol. VI, 2002, DWSS)

S.No.	Type of Water	Chlorine Dosing Rate (mg/L)
1	Deep well water	0.5 - 1.0
2	Shallow well water	1.0 - 1.5
3	Spring water	1.5 - 2.0
4	Turbid river water	2.0 - 2.5

Dosing amount of chlorine solution shall be calculated by the following formula;

$$\mathbf{W = Q \times Rs \times (100/C_1) \times (1/\rho) \times 10^{-3}}$$

W: Dosing amount (L/hr)
Q: Flow Rate (m^3/hr)
Rs: Dosing Rate of Chlorine (mg/L) ⇒See **Table 2.3**
C_1: Concentration of Chlorine Solution (%) ⇒1.0 %, normally
ρ: Specific Gravity

<An example of calculation>

Q = 100 m3/hr
Rs = 1.0 mg/L
C_1 = 1.0 (%)
ρ = 1.0
$W = 100 \times 1.0 \times (100/1.0) \times (1/1.0) \times 10^{-3}$
$= 10$ (L/hr)

The calculated / determined dosing rate and amount shall be summarized in a table as shown below for utilizing in daily O&M works.

Table 2.4 An Example of Summarized Chlorine Dosing Amount

	WTP		**Tube Well No.2**		**Tube Well No.3**	
Chlorin Dosing Rate	Chlorin Dosing Amount		Chlorin Dosing Amount		Chlorin Dosing Amount	
(mg/L)	(mL/min)	(L/hour)	(mL/min)	(L/hour)	(mL/min)	(L/hour)
0.5	90	5.4	**36**	**2.2**	**51**	**3.1**
1.0	179	10.7	**72**	**4.3**	**102**	**6.1**
1.5	**269**	**16.1**	**108**	**6.5**	**153**	**9.2**
2.0	**358**	**21.5**	144	8.6	204	12.2
Flow Rate Q (m3/day)	2,580		1,035		1,470	
DWSS Design Guideline	1.5-2.0 (Spring)		0.5-1.0 (Deep Well)		0.5-1.0 (Deep Well)	
			1.0-1.5 (Shallow Well)		1.0-1.5 (Shallow Well)	

d) Procedure of dosing the chlorine solution (for pump type of chlorination unit)

i. Confirm the required dosing amount of chlorine solution with **Table 2.1** and pump stroke according to the calibration curve.

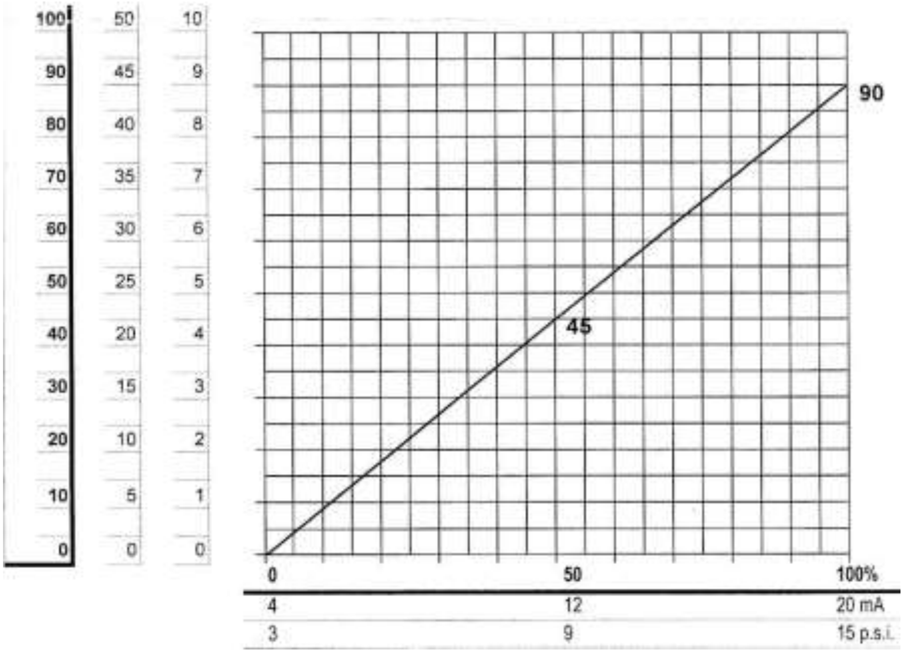


Figure 2.9. An Example of Calibration Curve of Dosing Pump

ii. Check the following points;

✓ The suction valve is opened.

✓ The strainer is clean and not clogged.

✓ Pressure gauge indicates proper value.

✓ Abnormalities such as leakage and damage are not observed.

Photo 2.33 The Location of Strainer, Suction Valve and Pressure Gauge

iii. Start the dosing pump (Push the start switch on the control panel).

iv. Set the pump stroke by the stroke adjusting screw (See **Photo 2.34**).*

* Don't touch the stroke adjusting screw during the pump is stopped.

Photo 2.34 **The Location of Stroke Adjusting Screw**

v. Check / measure the actual dosing amount by using measuring cylinder once a week.

Figure 2.10 Checking the Actual Chlorine Dosing Amount by Using Measuring Cylinder

vi. Keep the records of chlorine solution level of tank (daily), discharge pressure (daily), used amount of bleaching powder (when needed) and dosing amount (once a week).

e) Procedure of dosing the chlorine solution (for manual type of chlorination unit)

i. Confirm the required dosing amount of chlorine solution with **Table 2.1** and the valve opening position according to the calibration curve prepared during the commissioning.

ii. Check the following points;

- ✓ The suction valve is opened.
- ✓ The strainer is clean and not clogged.
- ✓ Abnormalities such as leakage and damage are not observed.

iii. Open the control valve and adjust the valve opening position of it.

iv. Check / measure the actual dosing amount by using measuring cylinder once a week.

v. Keep the records of chlorine solution level of tank (daily), discharge pressure (daily), used amount of bleaching powder (when needed) and dosing amount (once a week).

f) Procedure of dosing the chlorine solution (for chlorination manual dosing charger of Gauradaha, Dhulabari and Mangadh WUSC)

i. Check the following points;
  - ✓ The inlet valve and outlet valve are opened.
  - ✓ The floating valve is working properly.
  - ✓ Abnormalities such as leakage and damage are not observed.

ii. Set the dosing amount of manual dosing charger by setting the adjusting knob’s scale according to the calibration curve.

Photo 2.35 The Location of Adjusting Knob

iii. Check / measure the actual dosing amount by using measuring cylinder once a week.

iv. Keep the records of chlorine solution level of mixing and storage tank (daily), used amount of bleaching powder (when needed) and dosing amount (once a week).

2) Trouble Shooting

i. In case that sediments are remaining at the bottom of tank, open the drain valve to discharge it.

ii. In case that discharge amount is reduced or stopped, the following measures shall be taken.
  - ✓ Check whether the suction valve is opened.
  - ✓ Check whether the strainer is clean and not clogged.

iii. In case of pipe clogging, disassemble the related flanges and union joints etc. and flush / clean the inside of pipe with pressured water.

iv. In case that the floating valve of manual dosing charger is malfunction, change to the stand-by immediately.

v. In case of malfunction of pump, mixer or manual dosing charger etc., refer to each instruction manual.

3) Emergency

i. In case that inflow of raw water is stopped or the clear water reservoir is empty, stop chlorine dosing.
ii. In case that residual chlorine value of the clear well / reservoir is much lower than the standard, add the required amount of chlorine solution determined by the test.
iii. In case that residual chlorine value of the clear well / reservoir is much higher than the standard, drain the water inside the clear well / reservoir.

4) Safety

i. Put on safety tools such as eye protection goggles, rubber gloves and mask (see **Figure 2.7**) while handling chemical.
ii. Read carefully the MSDS (Material Safety Data Sheet) of bleaching powder as shown in **Appendix 2-2**.
iii. Avoid generating dust and skin / eye contact with bleaching powder.
iv. In case of skin and eye contact with bleaching powder, promptly wash the affected area with plenty of clean water and obtain medical attention immediately.
v. In case of inhalation of bleaching powder, move the victim to fresh air and obtain medical attention immediately.
vi. In case of ingestion of bleaching powder, the victim must rinse mouth thoroughly with clean water and drink plenty of clean water to dilute the chemical in his / her stomach. And also obtain medical attention immediately.
vii. Bleaching powder shall be stored by tightly closed containers in cool, dry and well-ventilated place. Keep it away from any combustible materials.

(6) Mechanical Equipment

1) Volute Pump

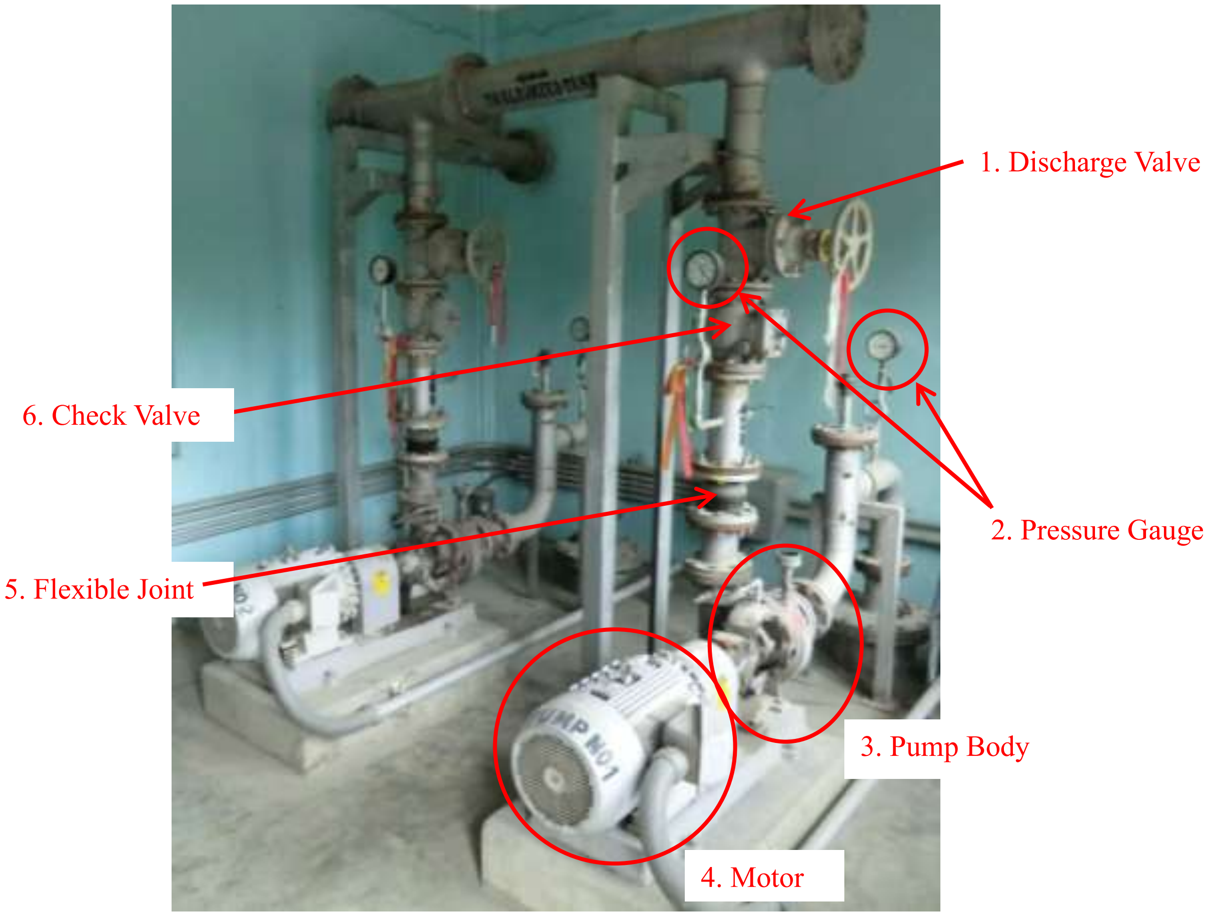


Figure 2.11 Typical System of the Volute Pump

a) Operation Procedure

The results of daily O&M works shall be recorded in **Form 3.2-3** and **Form 3.2-4**.

- Preparation before operation

  i. Check a leakage or the other abnormality at the pump area.
  ii. Select the pump to be operated.
  iii. Check the related valves are at the proper position (suction valve: open, discharge valve: close).
  iv. Check the pressure gauges indicate the original/zero value. (see the above 2)
  v. Check / record the Voltage, Ampere and Frequency of power incoming on the control panel.
  vi. Check / record the water level of the related tanks (if necessary).

- Start Operation

  i. Push the start button at the control panel.
  ii. Open the discharge valve slowly. (see the above 1)
  iii. Open the flow control valve slowly. (if it is installed)
  iv. Adjust the flow rate and discharge pressure to the design value (indicated in the specification).
  v. Check / record the flow rate, discharge / suction pressure (see the above 2), water level of the related tanks, voltage and current periodically.

Notes;

In case the pump is operated frequently, skip the above procedure from ii to iv.

- Stop Operation

  i. Push the stop button on the control panel.
  ii. Close the suction valve and suction valve. (In case the pump is stopped for a long time.)

Notes;

In case the pump is operated frequently, skip the above procedure ii.

b) Maintenance Procedure

Figure 2.12 shows the detail cross section of a volute pump. Daily and periodically inspection shall be conducted in accordance with **Table 2.5**. The results of daily O&M works shall be recorded in **Form 3.2-3** and **Form 3.2-4**.

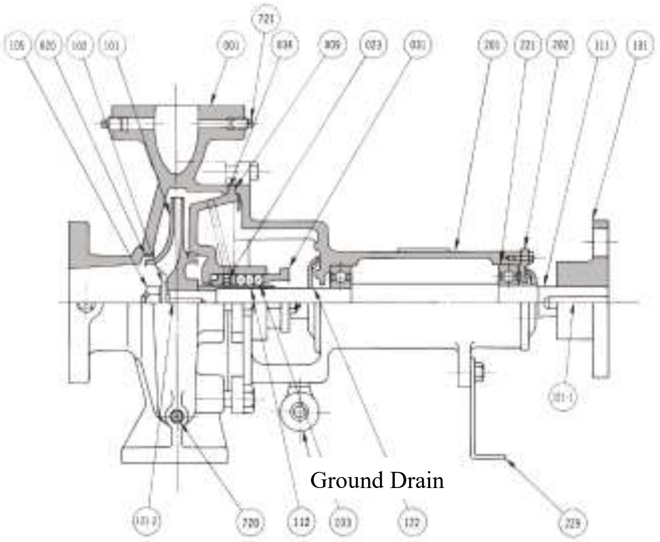


Figure 2.12 Detail Cross Section of Volute Pump

(Catalogue of Hitachi Industrial Equipment Systems Co., Ltd.)

Table 2.5 Monitoring and Inspection Points of Volute Pump

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Appearance, leakage or other abnormalities	✓ Observe.
	✓ Abnormal noise, vibration and sound	✓ Hear and touch the motor cover.
	✓ Lubricant level	✓ Check the lubricant level at the gauge.
	✓ Excessive heat generation of the gland packing	✓ Touch the motor cover. ⇒ See **Table 2.6**.
	✓ Discharge / suction pressure, flow rate, water level of the related tank	✓ Check and read the pressure gauge, flow meter and level meter.
	✓ Voltage and current (Control Panel)	✓ Check and read the voltage / ampere meter on the electrical panel. ⇒ See **Photo 2.36**. ✓ Acceptance criteria is rated value or value of commissioning.
Monthly	✓ Lubrication	✓ Lubricate oil and/or grease in accordance with the manufacturer's instruction manual. ⇒ See **Photo 2.37**.
	✓ Leakage condition of the gland packing	✓ Check / observe water leakage amount. ✓ Proper leakage amount can be calculated by the following formula; ✓ q (mL/min) = 0.5×d (mm, shaft dia.)
Yearly	✓ Bearing temperature*	✓ Outsource.
	✓ Vibration*	✓ Outsource.
	✓ Insulation	✓ Measure by insulation continuity tester. ✓ Acceptance criteria is more than 1.0 MΩ.
Every 1 to 4 years	✓ Replace bearing grease and lubricating oil	✓ Replace oil and/or grease in accordance with the instruction manual.
	✓ Replace gland packing*	✓ Outsource depending on the condition.
	✓ Overhaul*	✓ Outsource depending on the condition.

Notes: * Basically, WUSC shall ask the supplier/manufacturer to measure/conduct these items. Bearing Temperature and Vibration can be measured by using the measuring equipment as shown in **Figure 2.13**.

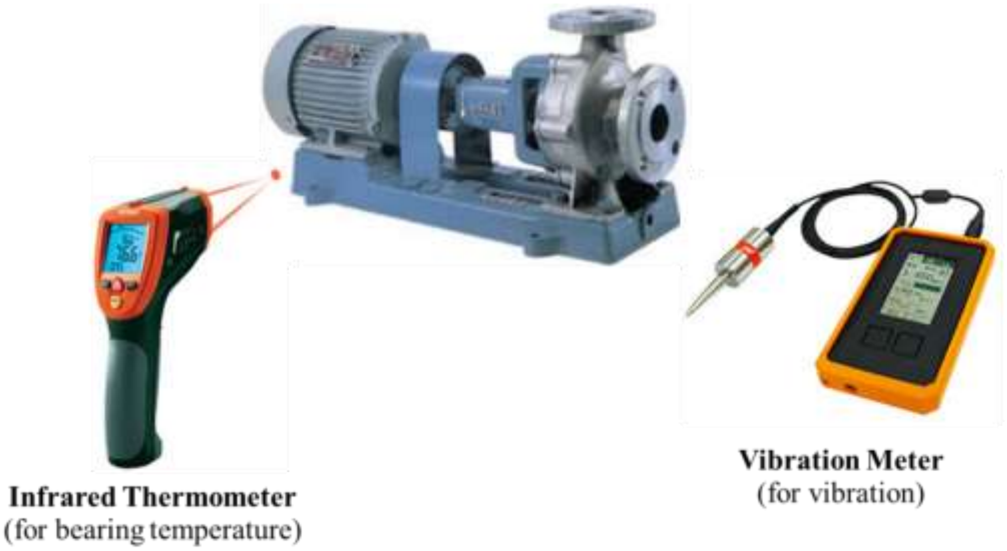


Figure 2.13 Measuring the Bearing Temperature and Vibration in Yearly Inspection

Photo 2.36 Checking Ampere

Photo 2.37 Lubricating

Table 2.6 Surface Temperature and Sense of Touch

Surface Temperature	Sense of Touch	Remarks
40 ℃	Somewhat warm	Feeling Slightly to the touch.
45 ℃	Warm	Feel comfortably warm.
50 ℃	Somewhat hot	Palm of the hand reddens if placed on the unit for extended periods.
60 ℃	Hot	Can hold your hand on the unit for 3-4 seconds.
70 ℃	Extremely hot	Can hold one finger on the unit for 3 seconds.
80 ℃	Extremely hot	Can hold one finger on the unit for only 1 seconds.

c) Trouble Shooting

Typical troubles/abnormalities and its countermeasures of Volute Pump are summarized in **Table 2.7**.

Table 2.7 Typical Troubles/Abnormalities and its Countermeasures of Volute Pump

Type of Trouble / Abnormality	Countermeasures
Leakage	Stop the pump immediately and repair the leakage point.
Abnormal noise or vibration	Stop the pump immediately and investigate the causes as follows; ✓ Cavitation: Check/adjust the valve opening position of the suction/discharge valve. ✓ Misalignment of the coupling: Re-alignment is necessary. ✓ Malfunction of the bearings: Check the lubricant level or repair/replace it. ✓ Other causes: Repair/replace the pump.
Heat generation	Stop the pump immediately and investigate the causes as follows; ✓ Misalignment of the coupling: Re-alignment is necessary. ✓ Malfunction of the bearings: Check the lubricant level or repair/replace it. ✓ Malfunction of the gland packing: Adjust its tightening. ✓ Other causes: Repair/replace the pump.
Overload of the motor	Stop the pump immediately and investigate the causes as follows; ✓ Excessive flow rate: Check/adjust the valve opening position of the discharge valve. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Lack of water flow	Stop the pump immediately and investigate the causes as follows; ✓ Insufficient valve opening position: Check/adjust the valve opening position of the suction/discharge valve. ✓ Malfunction of the foot valve: Repair/replace the foot valve. ✓ Air entrainment from the suction pipe: Additional tightening at the flange or repair the suction pipe. ✓ Air entrainment from the gland packing: Additional tightening of the gland packing or repair it. ✓ Lack of the water level of the suction tank: Pour water into the suction tank or repair the leakage of it. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Impossible to start the pump	Check the following causes; ✓ Power supply: In case of power cut, start the generator. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the control panel: Repair/replace the control panel.

2) Well Pump / Submersible Pump

Figure 2.14 Typical System of the Well Pump

a) Operation Procedure

The results of daily O&M works shall be recorded in **Form 3.2-3** and **Form 3.2-4**.

- Preparation before operation

  i. Check a leakage or the other abnormality at the pump area.
  ii. Select the pump to be operated.
  iii. Check the related valves are at the proper position (Discharge Valve: close, Wash-out Valve: close).
  iv. Check the pressure gauges indicate the original/zero value. (see the above 3, **Figure 2.21**)
  v. Check / record the Voltage, Ampere and Frequency of power incoming on the electrical panel.
  vi. Check / record the water level of the related tanks (if necessary).

- Start Operation

  i. Push the start button on the electrical panel.
  ii. Open the discharge valve slowly. (see the above 5, **Figure 2.21**)
  iii. Adjust the flow rate and discharge pressure to the design value (indicated in the specification).

iv. Check / record the flow rate, discharge pressure (see the above 3, **Figure 2.21**), water level of the related tanks, voltage and current periodically.

- Stop Operation

i. Push the stop button on the electrical panel.
ii. In case the pump will be stopped for a long time, close the discharge valve slowly. (see the above 5, **Figure 2.21**)

b) Maintenance Procedure

Figure 2.15 shows the detail cross section of a Well Pump. Daily and periodically inspection shall be conducted in accordance with **Table 2.8**. The results of daily O&M works shall be recorded in **Form 3.2-3** and **Form 3.2-4**.

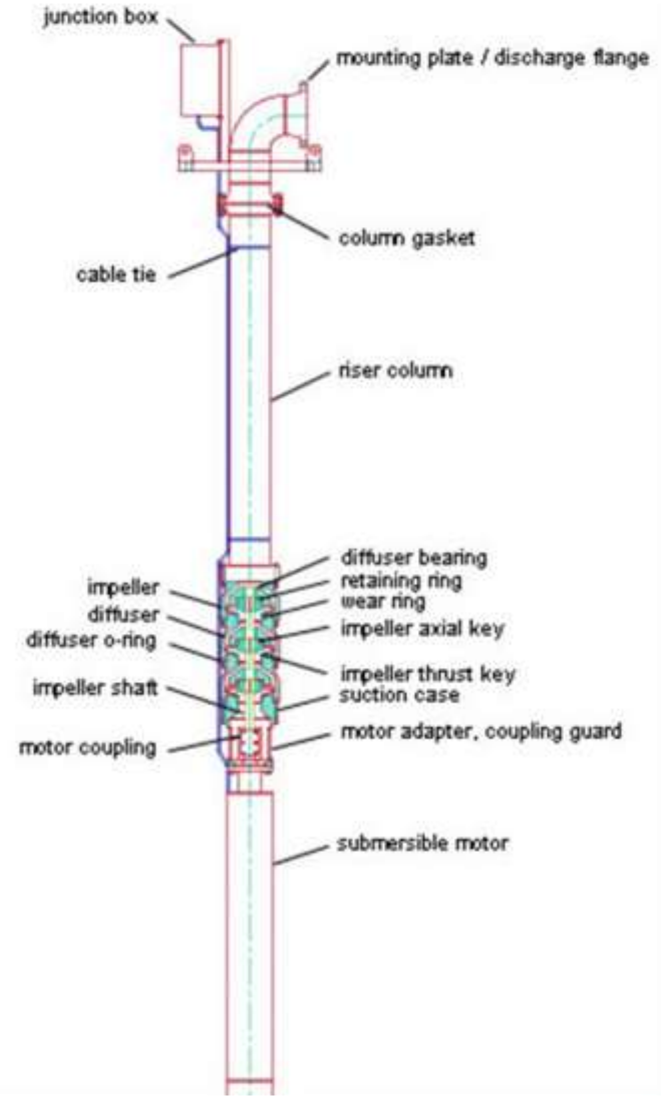


Figure 2.15 Detail Cross Section of Well Pump

Table 2.8 Monitoring and Inspection Points of Well Pump

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Abnormal noise, vibration and sound	✓ Touch the discharge pipe. ⇒ See **Photo 2.38**
	✓ Discharge pressure, flow rate, water level of the related tank	✓ Check/read the pressure gauge, flow meter and level meter (if installed). ⇒ See **Photo 2.39**
	✓ Voltage and current	✓ Check/read the ampere and voltage meter on the electrical panel. ⇒ See Photo-4 ✓ It shall be within the rated value or the value of commissioning.
Monthly	✓ Insulation	✓ Measure the insulation resistance value of motor/cable by using insulation meter. ⇒ See Photo-5 ✓ Acceptance criteria is more than 1.0 MΩ.
Yearly	✓ Condition of protective equipment (thermal protectors, immersion detectors etc.)	✓ Confirm whether they work properly.
	✓ Appearance, damage and other abnormality	✓ Pull up the well pump by using chain block etc. ✓ Observe the pump.
Every 2-3 Years	✓ Overhaul	✓ Ask supplier or manufacturer for overhaul. ✓ In case stand-by pump is not installed, another pump shall be prepared and installed.

Photo 2.38 Touching Discharge Pipe

Photo 2.39 Checking Pressure Gauge

c)

c) Replacement of typical components/parts

Since the durability of pump components changes depending on a variety of factors such as operating conditions, operating time, water quality and quality of each component/part, accurately determining of the life span of each component is quite difficult. **Table 2.9** shows the average durability/life time of pump components based on the past data. These data can be used for reference in order to plan the maintenance schedule and prepare/secure the necessary budget.

Table 2.9 Average Durability/Life Time of Pump Components (for reference)

No.	Name of Components/Parts	Life Span (Years)	Disassembly Inspection		
			1 year	2 year	3 year
1	Impeller	10 Years			✓
2	Casing liner	5 Years			✓
3	Liner ring	5 Years			✓
4	Impeller ring	5 Years			✓
5	Shaft	10 Years			✓
6	Sleeve	5 Years			✓
7	Rolling bearing	5 Years			✓
8	Sliding bearing	5 Years			✓
9	Submersible bearing (rubber)	5 Years			✓
10	O Ring	Replace at every disassembly inspection		✓	✓
11	Sheet gasket	Replace at every disassembly inspection		✓	✓
12	Mechanical seal	2 Years		✓	✓
13	Gland packing	1 Year	✓	✓	✓
14	Lubricants(oil, grease)	1 Year	✓	✓	✓
15	Coupling bolt rubber	2 Years	✓	✓	✓
16	V belt	2 Years	✓	✓	✓

d) Trouble Shooting

Typical troubles/abnormalities and its countermeasures of Well Pump are summarized in **Table 2.10**.

Table 2.10 Typical Troubles/Abnormalities and its Countermeasures of Well Pump

Type of Trouble / Abnormality	Countermeasures
Leakage	Stop the pump immediately and repair the leakage point.
Abnormal noise or vibration	Stop the pump immediately and investigate the causes as follows;

Type of Trouble / Abnormality	Countermeasures
	✓ Malfunction of the bearings: Repair/replace it. ✓ Other causes: Repair/replace the pump.
Overload of the motor	Stop the pump immediately and investigate the causes as follows; ✓ Excessive flow rate: Check/adjust the valve opening position of the discharge valve. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Lack of water flow	Stop the pump immediately and investigate the causes as follows; ✓ Insufficient valve opening position: Check/adjust the valve opening position of the discharge valve. ✓ Replace any worn parts. (Mechanical seals, bearings etc.) ✓ .Lack of the water level of deep well. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the pump: Repair/replace the pump.
Impossible to start the pump	Check the following causes; ✓ Power supply: In case of power cut, start the generator. ✓ Malfunction of the motor: Repair/replace the motor. ✓ Malfunction of the control panel: Repair/replace the control panel.
Excessive Current	Stop the pump immediately and investigate the causes as follows; ✓ Phase interruption: Check continuity of each phase. ✓ Excess current due to sand entry in pump: Pull up the pump, disassemble and clean. ✓ Excess current due to voltage decrease: If the problem is not due to the effects of other loads, contact power company.
Unstable Current	Stop the pump immediately and investigate the causes as follows; ✓ Pump or motor bearing failure: Repair or replace it.
Decreased insulation	Stop the pump immediately and investigate the causes as follows; ✓ Underwater cable damage: Repair or replace it. ✓ Motor Damage: Repair or replace it.

3) Compressor

See the operation and maintenance manual of Gauradaha WTP as shown in **Appendix 2-3**.

(7) Electrical Equipment

1) Electrical Panel

a) Maintenance Procedure

Figure 2.16 and **Table 2.11** shows typical devices installed on surface of Electrical Panel (Pump Panel). **Figure 2.17** and **Table 2.12** shows typical devices installed on inside of Electrical Panel. Daily and periodically inspection shall be conducted in accordance with **Table 2.13**. The results of O&M works shall be recorded in **Form 3.2-4** and **Form 3.2-5**.

Basically, devices on panel surface shall be inspected daily and devices inside panel shall be inspected weekly, monthly or yearly.

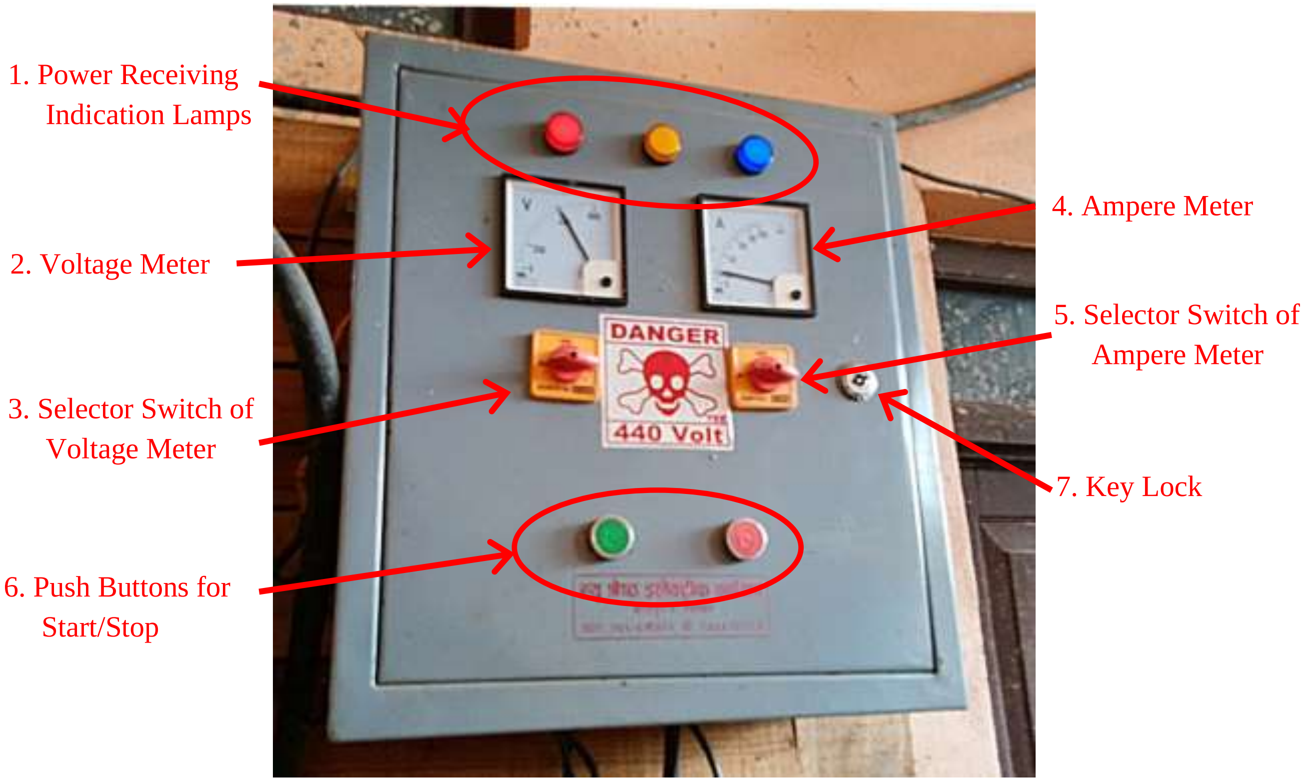


Figure 2.16 Devices on Panel Surface

Table 2.11 Purpose and Function of each Device on Panel Surface

No.	Device	Purpose & Function
1	Power Receiving Indication lamps	Indicate whether the panel is energized or not.
2	Voltage Meter	Measure and indicate the voltage between two phases.
3	Selector Switch	Select two phases out of three to check the

No.	Device	Purpose & Function
	for Voltage Meter	voltage.
4	Ampere Meter	Measure and indicate the electrical current of one phase.
5	Selector Switch for Ampere Meter	Select one phase out of three to check the electrical current.
6	Key Lock	Prevent foreign matter from coming in and strangers from touching inside.
7	Push Button for Start/Stop	Operate the pump.

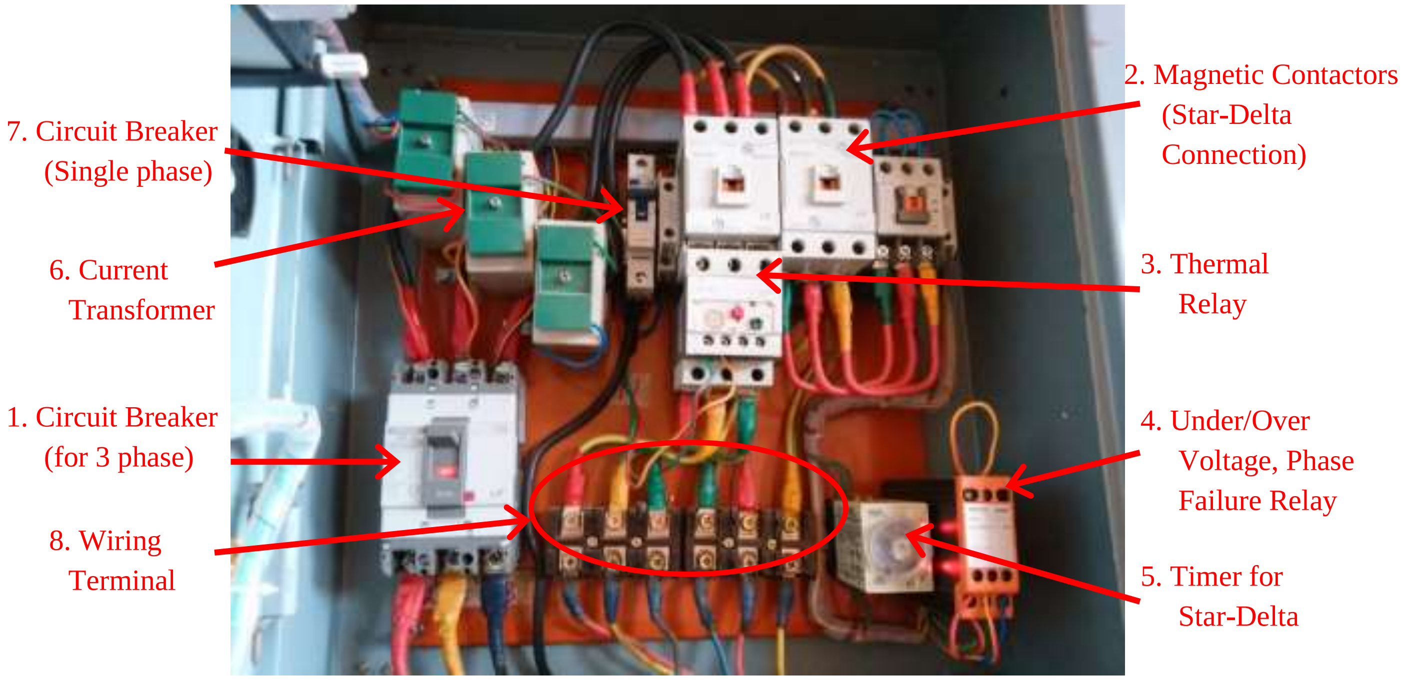


Figure 2.17 Devices of Inside Panel

Table 2.12 Purpose and Function of each Device inside Panel

No.	Device	Purpose & Function
1	Circuit Breaker for 3 phase	Main power switch of the panel. But, it originally functions as a protection from short circuit and burning trouble.
2	Magnetic Contactors	ON/OFF switch of the circuit. When you push the Start/Stop button on the surface, this contactor works accordingly.
3	Thermal Relay	Functions to protect the motor from over current and burning trouble.
4	Under/Over Voltage, Phase Failure Relay	Functions to protect the motor from abnormal voltage such as very low voltage which might cause

No.	Device	Purpose & Function
		overheating the motor and circuit.
5	Timer	Set the seconds to changeover the wiring connection from star mode to delta mode. **Don't touch this device.**
6	Current Transformer	Necessary intermediate device to indicate current value on the Ampere Meter.
7	Wiring Terminal	Wiring connection shall be done with dedicated wiring terminal instead of direct and taping connection.

Table 2.13 Monitoring and Inspection Points of Electrical Panel

Frequency	Monitoring / Inspection Points	Method
Weekly	✓ Identifications (Panel Surface)	✓ Check whether all lamps, switches have name tag.
	✓ Status/fault indication lamps (Panel Surface)	✓ Check whether all lamps light up brightly.
	✓ Voltage meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Ampere meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Cleanliness (Inside Panel)	✓ Check whether there is no dust, spider's nest, vermin etc. ⇒ See **Photo 2.40**.
	✓ Intrusion path (Inside Panel)	✓ Check whether there is no hole or crack on enclosure.
	✓ Noise (Inside Panel)	✓ Check whether there is no noise from components.
	✓ Cable (Inside Panel)	✓ Check whether there is no cut.
Monthly	✓ Voltage by clamp meter	✓ Measure voltage by using clamp meter. ⇒ See **Photo 2.41**. ✓ Acceptance criteria is ±10% of rating voltage.
	✓ Voltage on voltage meter (panel surface)	✓ Check voltage value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Ampere by clamp meter	✓ Measure ampere by using clamp meter. ⇒ See **Photo 2.42**. ✓ Acceptance criteria is less than rating ampere.

Frequency	Monitoring / Inspection Points	Method
Monthly	✓ Ampere on ampere meter (panel surface)	✓ Check ampere value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Over/under Voltage Relay	✓ Check whether over-voltage trip test button works properly. ✓ Check whether under-voltage trip test button works properly.
	✓ Thermal Relay	✓ Check whether trip test button works properly.
Yearly	✓ Continuity of Circuit Breaker	✓ Check the continuity by using insulation continuity tester. ⇒ See **Photo 2.43**.
	✓ Continuity of Magnetic Contactor	✓ Check the continuity by using insulation continuity tester.
	✓ Insulation between lines	✓ Measure the insulation by using insulation continuity tester. ✓ Criteria is shown as below; More than 1.0 MΩ: Good, More than 0.4 MΩ: Need to clean up or care, Less than 0.4 MΩ: Repair immediately
	✓ Earth Resistance	✓ Measure the earth resistance by using earth tester. ✓ Acceptance criteria is less than 10Ω.

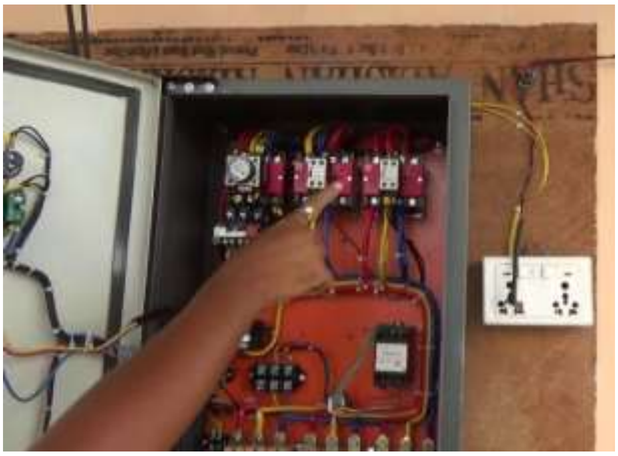


Photo 2.40 Checking Cleanliness

Photo 2.41 Measuring Voltage

Photo 2.42 Measuring Ampere

Photo 2.43 Checking Continuity

Table 2.14 shows the electrical measuring instruments provided by WASMIP-II. These instruments shall be used in accordance with the instruction manual as shown in **Appendix 2-2**. Especially, in case of checking/measuring the following items, **Circuit Breaker must be turned off for safety**.

- ✓ Over/under Voltage Relay (Monthly)
- ✓ Thermal Relay (Monthly)
- ✓ Continuity of Circuit Breaker (Yearly)
- ✓ Continuity of Magnetic Contactor (Yearly)
- ✓ Insulation between lines (Yearly)
- ✓ Earth Resistance (Yearly)

Table 2.14 Outline of Procured Electrical Measuring Instruments

Item	Specification	Model/ Manufacturer
Digital clamp meter 	• Electric Current Range: 0.8 to 1,000 A Accuracy: ±1.5% (0-629.9A), ±2.0% (570-1049A) • Voltage (AC/DC) Range: 0 to 629.9 V Accuracy: ±1.2 to 1.5% (AC), ±1.2% (DC)	2007R/ Kyoritsu
Insulation continuity tester 	• Insulation Range: 0 to 1,999MΩ (Nominal output voltage: 250, 500, 1,000V) Accuracy: ±1.5% (20-200MΩ), ±10% (2,000MΩ) • Continuity Range: 0 to 1,999Ω Accuracy: ±1.5%	3007A/ Kyoritsu

Item	Specification	Model/ Manufacturer
Earth tester 	- Earth Voltage Range: 0 to 199.9 V Accuracy: ±1.0% - Earth Resistance Range: 0 to 1,999Ω Accuracy: ±2.0%	4105A/ Kyoritsu

b) Trouble Shooting

If any trouble or abnormality is found in daily, weekly, monthly and yearly inspection, it shall be informed to the electrical engineer. The electrical engineer shall confirm the actual situation and judge whether it can be fixed/solved by himself or not.

If the electrical engineer can't fix/solve it, he have to contact with an electrical constructor or NEA as soon as possible. In case of easy maintenance such as replace of lamp etc, operator can fix/solve it in accordance with the instruction by the electrical engineer.

(8) Stand-by Generator

1) Maintenance Procedure

Basically, the Stand-by Generator shall be operated and maintained in accordance with the manufacturer's instruction manual. **Table 2.15** shows the typical monitoring/inspection points for reference. The results of daily O&M works shall be recorded in **Form 3.2-1**, **Form 3.2-2** and **Form 3.2-4**.

Stand-by Generator

Dhulabari WUSC

Manthali WUSC

Table 2.15 Monitoring and Inspection Points of Stand-by Generator (for reference)

Frequency	Monitoring / Inspection Points	Method
Daily or Each Operation	✓ Leakage (coolant, oil, fuel), Loose fastenings / fixings, Worn belts, Loose connections etc.	✓ Visual inspection before start-up ⇒ See **Photo 2.44**
	✓ Level of Fuel, Engine oil and Coolant	✓ Visual inspection before start-up ⇒ See **Photo 2.45**
	✓ Condition of Battery / Fluid level etc.	✓ Visual inspection before start-up ⇒ See **Photo 2.46**
	✓ Voltage and current	✓ Check/read the voltage and ampere on the electrical panel.⇒ See **Photo 2.47** ✓ Acceptance criteria is rated value or value during commissioning.
Every 2 Weeks	✓ Operational Check for 5 minutes	✓ Start up and check the operation condition in case of long-term stop.
Monthly	✓ Operational Check for 1 hour with 50 % load	✓ Start up and check the operation condition in case of long-term stop.
Every 250 hrs.	✓ Replace engine oil, engine oil filter cartridge, fuel filter etc.	✓ Replace them according to manufacturer's instruction manual.

Frequency	Monitoring / Inspection Points	Method
Every 12,000 hrs.	✓ Overhaul of engine (Recommended)	✓ Outsource according to manufacturer's instruction manual.

Photo 2.44 Checking Loose Fastenings

Photo 2.45 Checking Level of Engine Oil

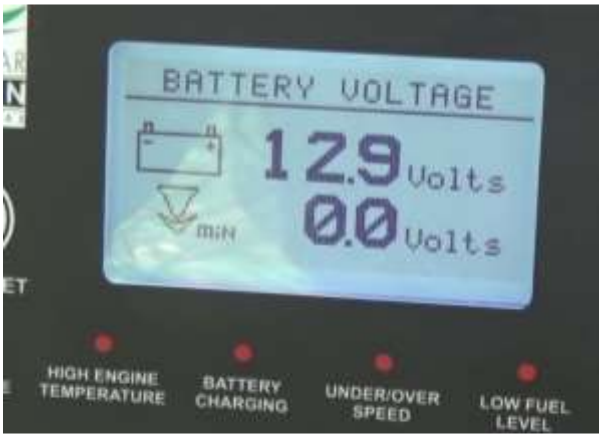


Photo 2.46 Checking Battery Condition

Photo 2.47 Checking Voltage and Ampere

2) Trouble Shooting

If any trouble or abnormality is found in daily, weekly, monthly and yearly inspection, it shall be informed to the electrical engineer. The electrical engineer shall confirm the actual situation and judge whether it can be fixed/solved by himself or not.

If the electrical engineer can't fix/solve it, he has to contact with an electrical constructor or NEA as soon as possible. In case of easy maintenance such as replace of lamp etc, operator can fix/solve it in accordance with the instruction by the electrical engineer.

2.1.2 Pattern B: Roughing Filtration + Slow Sand Filtration + Disinfection

This water treatment process has three kinds of processes; roughing filtration, slow sand filtration and disinfection except for sedimentation. Please see chapter 2.1.1 (2) to (7). The results of daily O&M works shall be recorded in **Form 3.2-1**, **Form 3.2-3** and **Form 3.2-4**.

2.1.3 Pattern C: Disinfection only (for surface water source)

This water treatment process has disinfection process only. Please see chapter 2.1.1 (5) to (7). The results of daily O&M works shall be recorded in **Form 3.2-1**, **Form 3.2-3** and **Form 3.2-4.**

2.1.4 Pattern D: Aeration + Rapid Filtration + Disinfection (Iron Removal Process)

This water treatment process has three processes; aeration, rapid filtration and disinfection. The results of daily O&M works shall be recorded in **Form 3.2-2**, **Form 3.2-3** and **Form 3.2-4.**

(1) Aeration Facility

1) Operation and Maintenance Procedure

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-2**)

<table>
<tr><th colspan="3">Aeration Facility</th></tr>
<tr><td colspan="3">
Gauradaha WUSC

Mangadh WUSC</td></tr>
<tr><td>Frequency</td><td>Monitoring / Inspection Points</td><td>Method</td></tr>
<tr><td>Daily</td><td>✓ Appearance and abnormalities</td><td>✓ Observe.</td></tr>
</table>

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Flow rate of inlet	✓ Check whether indication value of flow meter is showing the design value. ⇒ See **Photo 2.48**
	✓ Flow rate / pressure of air	✓ Check whether indication value of flow meter / pressure gauge is showing the design value. ⇒ See **Photo 2.49**
	✓ Water level	✓ Check water level of level gauge. ⇒ See **Photo 2.50**
	✓ Pressure	✓ Check whether indication value of pressure gauge is showing the design value. ⇒ See **Photo 2.51**
Yearly	✓ Leakage from tank body, related piping and valves	✓ Check a leakage or corrosion spot on tank body. ✓ If necessary, repair it according to the condition.
	✓ Condition of media	✓ Stop operation and drain inside water. ✓ Check the amount (level) and condition of media. ⇒ See **Photo 2.52** ✓ If necessary, refill or replace it according to the condition.

Photo 2.48 Inlet Flow Meter

Photo 2.49 Air Pressure Gauge

Photo 2.50 Level Gauge

Photo 2.51 Pressure Gauge of Tank

Photo 2.52 Appearance of Filter Media (Left: Before use, Right: After use)

a) Operation Procedure

A typical flow diagram of Aeration Tank is shown in **Figure 2.18**. The operation shall be conducted as follows.

- Preparation before operation

  i. Check the condition of filter media (volume, dirtiness etc.)
  ii. Close all related valves fully including the air supply piping.
  iii. Check the appearance of aeration tank and related pipes whether leakage or other abnormality is observed or not.
  iv. Check the condition of relief valves installed on the top of tank and air supply piping (No.2 in **Figure 2.18**).
  v. Check/clean the water level gauge (No.3 in **Figure 2.18**) installed on aeration tank.

vi. Check / record the Voltage, Ampere and Frequency of power incoming on the control panel.
vii. Check / record the water level of the related tanks.

- Starting Operation

i. Start the selected well pump and compressor (see chapter 2.1.1 (6) 2)).
ii. Open slowly the following valves; the drain valve (No.1 in **Figure 2.18**) firstly and inlet valve (No.4 in **Figure 2.18**) secondly.
iii. Adjust the inflow rate to the design value.
iv. Check the pressure and water level of aeration tank.
v. Verify the actual inflow rate and adjust/set the flow rate of supplied air by the control valve (No.5 in **Figure 2.18**).
vi. Check the appearance of drained water.
vii. Check / record the flow rate of inflow water/supplied air and pressure of the tank.
viii. Start the operation of Filter (see the next chapter (2) 1)).

- Normal Operation

i. Check / record the flow rate of inflow water/supplied air, water level and pressure of the tank.
ii. Check the appearance of aeration tank, related pipes and valves whether leakage or other abnormality is observed or not.

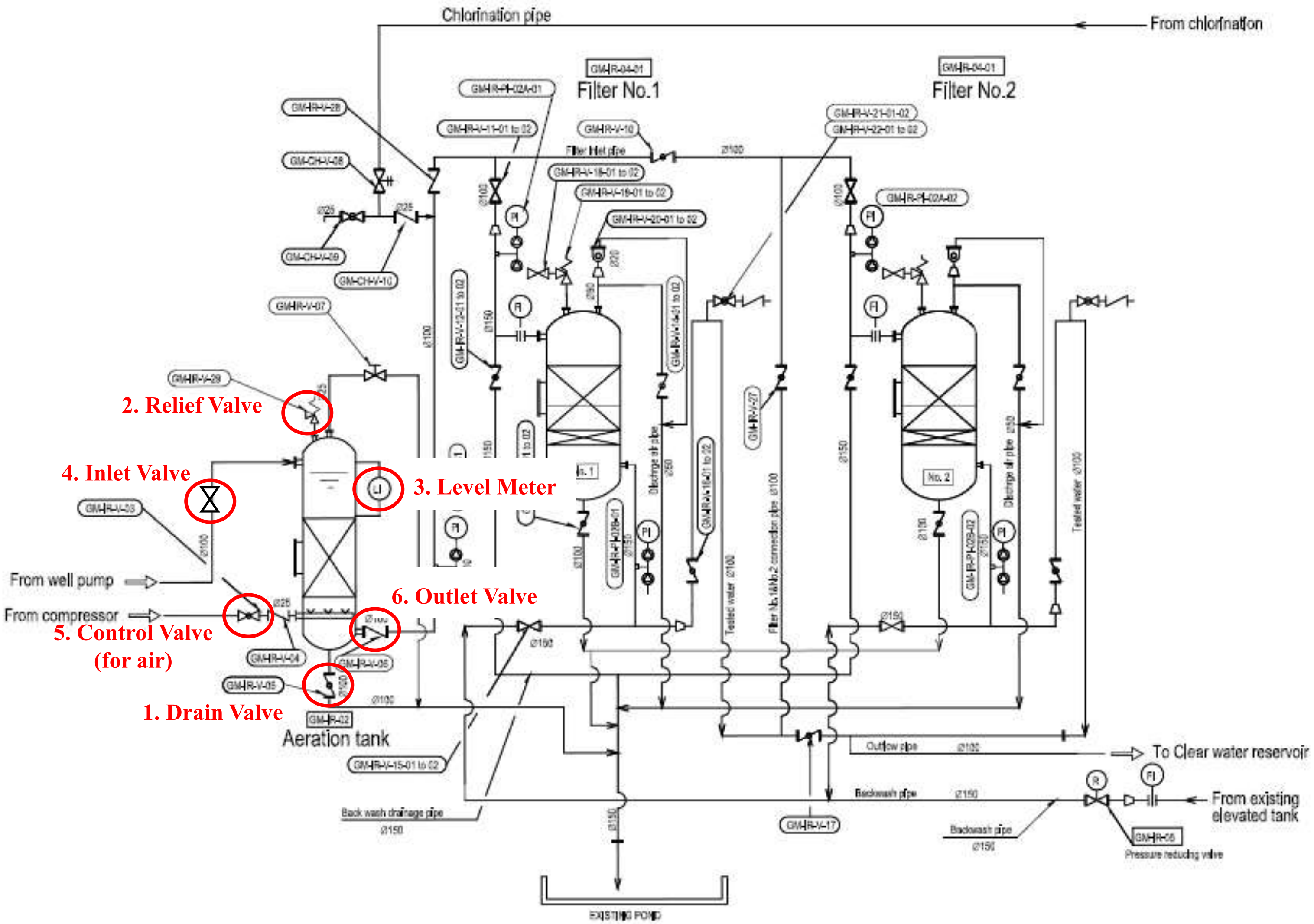


Figure 2.18 The Location of Related Valves of Aeration Tank

b) Trouble shooting

i. When the clear water reservoir is full, stop the operation or control the flow rate and operation time.
ii. In case that a leakage is observed, stop the operation and repair it.
iii. In case that the water supply is stopped or the supply amount is reduced, adjust the flow rate of supplied air accordingly.
iv. In case that any abnormal lamp turns on and/or abnormality is observed, stop the operation immediately and find/investigate the cause.

(2) Pressure Filter

1) Operation and Maintenance Procedure

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-2**)

<table>
<tr><th colspan="3">Pressure Filter</th></tr>
<tr><td colspan="2">
Gauradaha WUSC</td><td>
Mangadh WUSC</td></tr>
<tr><th>Frequency</th><th>Monitoring / Inspection Points</th><th>Method</th></tr>
<tr><td>Daily</td><td>✓ Turbidity (Outlet)</td><td>✓ Measure the turbidity of inlet and outlet water by using turbidity meter. ⇒ See Photo 2.53</td></tr>
<tr><td></td><td>✓ Appearance and abnormalities</td><td>✓ Observe.</td></tr>
<tr><td></td><td>✓ Flow rate of inlet</td><td>✓ Check whether indication value of flow meter is showing the design value. ⇒ See Photo 2.54</td></tr>
<tr><td></td><td>✓ Pressure of Inlet / Outlet</td><td>✓ Check whether indication value of pressure gauge is showing the design value. ⇒ See Photo 2.55</td></tr>
<tr><td></td><td>✓ Flow rate of backwash</td><td>✓ Check whether indication value of flow meter is showing the design value.</td></tr>
</table>

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Appearance of backwash waste water	✓ Check whether appearance / color of backwash wastewater is clean enough at the end of backwash.
Yearly	✓ Leakage from tank body, related piping and valves	✓ Check a leakage or corrosion spot on tank body. ✓ If necessary, repair it according to the condition.
	✓ Condition of filter media	✓ Stop operation and drain inside water. ✓ Check the amount (level) and condition of media. ✓ If necessary, refill or replace it according to the condition.

Photo 2.53 Measurement of Turbidity

Photo 2.54 Inlet Flow Meter

Photo 2.55 Pressure Gauge of Tank

a) Operation Procedure

A typical flow diagram of Pressure Filter is shown in **Figure 2.19**. The operation shall be conducted as follows.

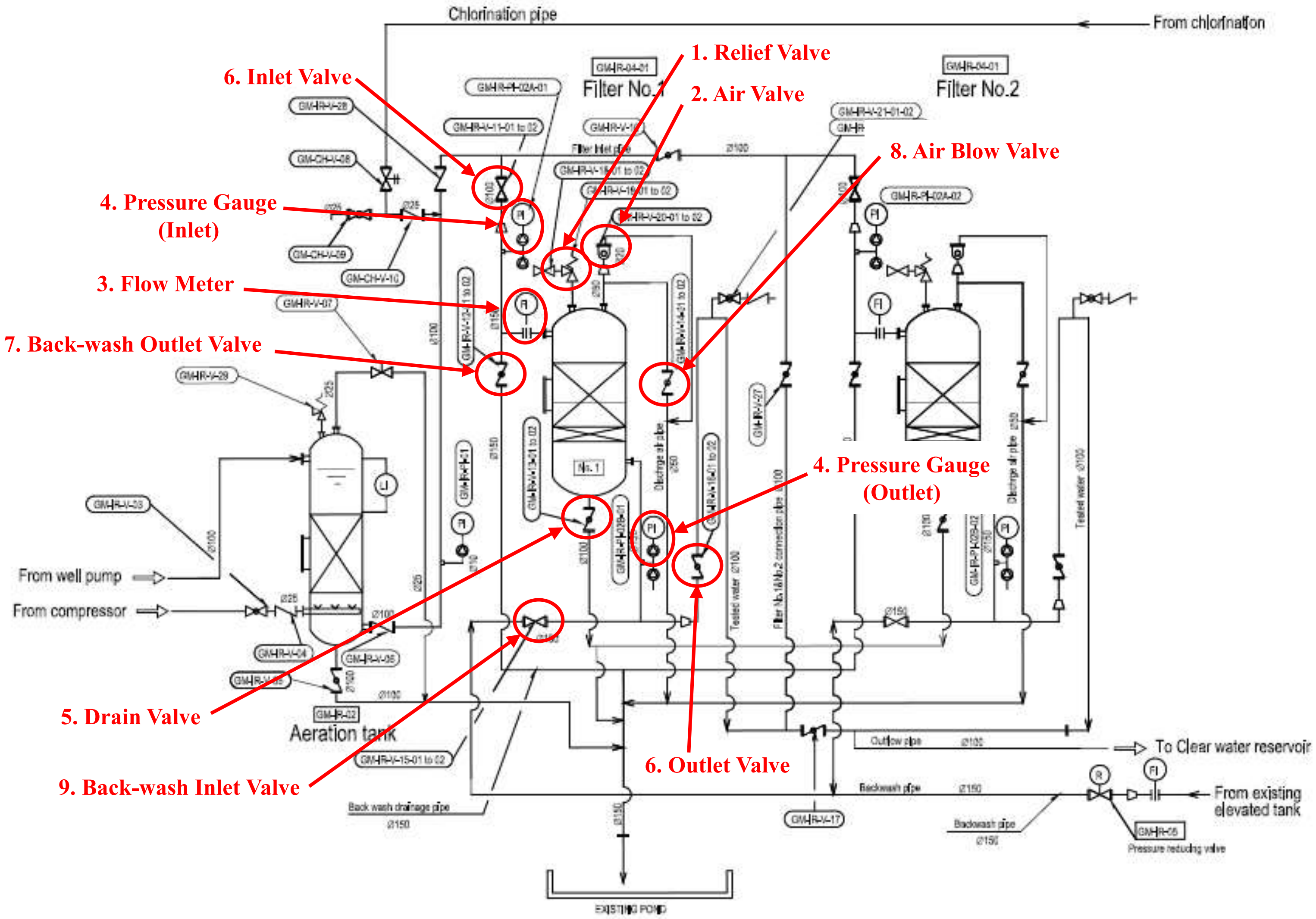


Figure 2.19 The Location of Related Valves of Pressure Filter

- Preparation before operation

  i. Check the condition of filter media (volume/thickness, evenness of surface, mud ball, dirtiness etc.)
  ii. Close all related valves fully.
  iii. Check the appearance of Pressure Filter and related pipes whether leakage or other abnormality is observed or not.
  iv. Check the condition of relief valve (No.1 in **Figure 2.19**), air valve (No.2 in **Figure 2.19**), flow meter (No.3 in **Figure 2.19**) and pressure gauges (No.4 in **Figure 2.19**).
  v. Check / record the Voltage, Ampere and Frequency of power incoming on the control panel.
  vi. Check / record the water level of the related tanks.

- Starting Operation (filtration)

  i. Open the drain valve (No.5 in **Figure 2.19**) fully, and open the inlet valve (No.6 in **Figure 2.19**) with intermediate opening.
  ii. Close the drain valve of Aeration Tank slowly.
  iii. Open the drain valve of another filter fully, and open the inlet valve of another filter with intermediate opening.
  iv. Check each inflow rate and adjust the opening of each inlet valves to the design flow rate evenly.
  v. Check the appearance of drained water.
  vi. If the appearance of drained water is clear enough, open the outlet valve and close the drain valve slowly for each filter.
  vii. Check whether each inflow rate is design value or not. If not, adjust the opening of each inlet valves to the design flow rate evenly.
  viii. Check / record the inflow rate and pressure of inlet/outlet of each filter.

- Normal Operation (filtration)

  i. Check / record the turbidity of treated water, the inflow rate and pressure of inlet/outlet of each filter periodically (at least once a day).
  ii. **<u>Conduct back-wash of each filter every 24 hours*</u>** in accordance with the procedure shown in the next chapter
  iii. Check the flow rate of back-wash and the appearance of back-wash wastewater.
  iv. Check / record the water level of the related tanks.
  v. Check a water leak and reaper if necessary.

vi. Check the appearance of each filter, related pipes and valves whether leakage or other abnormality is observed or not

Notes;

* In case that filtration resistance (differential pressure between inlet and outlet of Pressure Filter) increase, back-wash shall be performed.

- Procedure of Back-wash

The outline of back-wash procedure for Filter is shown in **Figure 2.20** and the detail procedure is shown as follows;

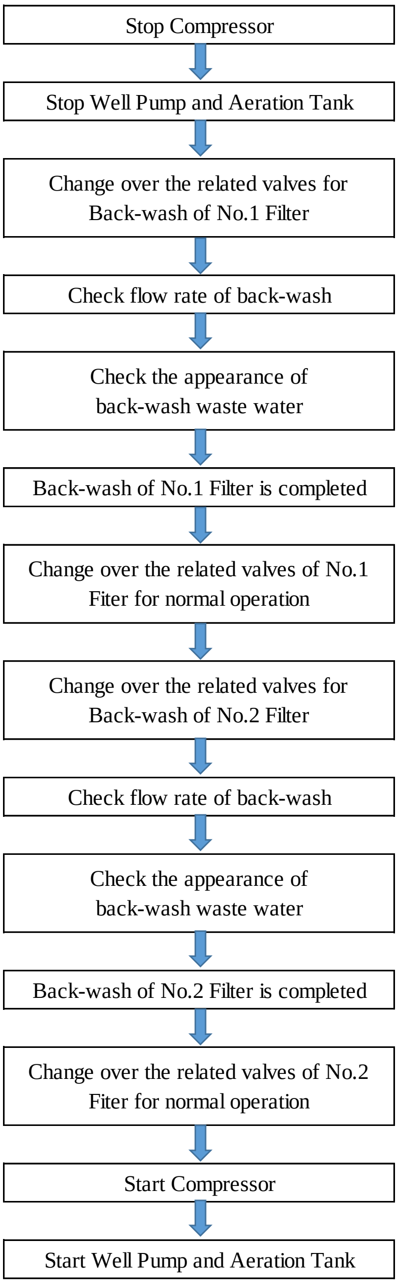


Figure 2.20 Outline of the Back-wash Procedure

i. Stop the operation of Compressor and Aeration Tank.
ii. Stop the Well Pump.
iii. Change over the related valves of No.1 Filter to the proper position as shown below;
    - ✓ Close the inlet valve of No.1 Filter.
    - ✓ Open the back-wash outlet valve (No.7 in **Figure 2.19**) and air blow valve of No.1 Filter (No.8 in **Figure 2.19**).
    - ✓ Close the outlet valve, back-wash outlet valve and back-wash inlet valve of No.2 Filter.
iv. Open the back-wash inlet valve (No.9 in **Figure 2.19**) of No.1 Filter slowly, and start the back-wash.
v. Check the back-wash flow rate whether its value indicates the design value or not, and record the value.
vi. Check the appearance of back-wash waste water.
vii. When the appearance of back-wash waste water is clear enough, close the back-wash inlet valve of No.1 Filter*.
viii. Repeat the above procedure from iii to vii for the No.2 Filter and conduct the back-wash. The proper position of related valves are as follows;
    - ✓ Close the inlet valve of No.2 Filter
    - ✓ Open the air blow valve of No.2 Filter
    - ✓ Close the outlet valve, back-wash outlet valve and back-wash inlet valve of No.1 Filter
    - ✓ Open the back-wash inlet valve of No.2 Filter slowly, and start the back-wash.

Notes;

* The desirable back-wash duration is at least 10 minutes, but it depends on the condition/dirtiness of filter media.

b) Trouble Shooting

i. When the clear water reservoir is full, stop the operation or control the flow rate and operation time.
ii. In case that a leakage is observed, stop the operation and repair it.
iii. In case that the water quality, especially turbidity, color and iron is changed/deteriorated, the following measures shall be taken.
    - ✓ Check/adjust the flow rate of supplied air for Aeration Tank.
    - ✓ Stop the operation of Pressure Filter, and check the condition of inside filter media. (Volume/thickness, evenness of surface, mud ball, dirtiness etc.)

iv. In case that the differential pressure between inlet and outlet of Pressure Filter is increased, the following measures shall be taken.

- ✓ Conduct the back-wash immediately.
- ✓ Change/increase the frequency of back-wash.
- ✓ Stop the operation of Pressure Filter, and check the condition of inside filter media (volume/thickness, evenness of surface, mud ball, dirtiness etc.), and also the other abnormalities.

v. In case that any abnormal lamp turns on and/or abnormality is observed, stop the operation immediately and find/investigate the cause.

(3) Clear Water Reservoir

See chapter 2.1.1 (4).

(4) Chlorination Unit

See chapter 2.1.1 (5).

(5) Well Pump, Booster Pump and Electrical Equipment

See chapter 2.1.1 (6) and (7).

2.1.5 Pattern E: Disinfection Only (for ground water source)

This water treatment process has disinfection process only. Please see chapter 2.1.1 (5) to (7). The results of daily O&M works shall be recorded in **Form 3.2-2**, **Form 3.2-3** and **Form 3.2-4**.

Section 3

Water Distribution Facility

1 Outline of Water Distribution Facility

1.1 Definition of Water Supply Facility in This SOP

Water distribution facility is defined as facilities and equipment which distribute clear water (purified and/or disinfected) from service reservoirs to a water supply service area. Water distribution facility is composed of service reservoirs, water distribution pipelines which include shut valves, air valves, washouts and fire hydrants.

Water distribution facility does not include household connections, and it is described in **Section 4**.

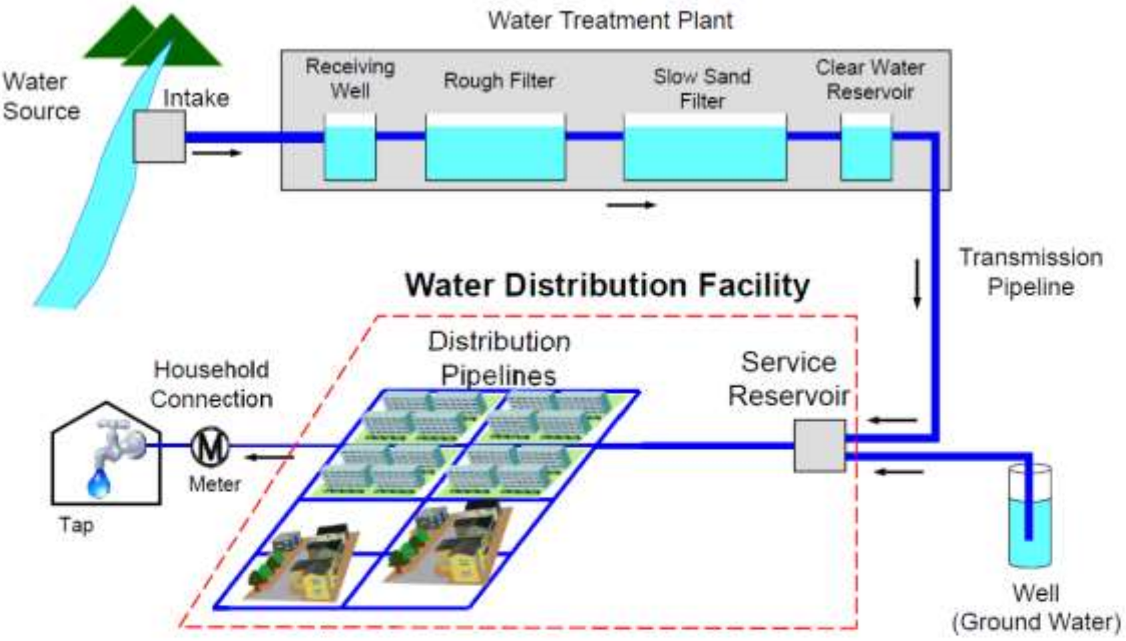


Figure 1.1 Water Distribution Facility

1.2 Service Reservoir

(1) Function of Service Reservoir

Functions of service reservoir are shown below;

- (a) Absorption of water demand fluctuation
- (b) Water storage for fire fighting
- (c) Water storage for emergency

To fulfill its function, it is required that service reservoirs shall have appropriate capacity. Generally, the smaller the scale of water demand, the larger the water demand fluctuation.

Therefore, required capacity of service reservoir shall be decided based on the scale of water demand.

(2) Type of Service Reservoir

There are two types of service reservoir, one is ground type (underground and on the ground) and another one is elevated type. Regarding construction cost, ground type is cheaper than elevated type. Therefore, if there is a suitable place for reservoir construction to supply water by gravity, ground type service reservoir should be given priority. Otherwise, elevated type is chosen.

Photo 1.1 Ground Type

Photo 1.2 Elevated Type

1.3 Distribution Pipelines

(1) Function of Distribution Pipelines

Function of distribution pipelines is to distribute treated water from a service reservoir to a town. Distribution pipelines are equipped shut valves, washouts, air valve and fire hydrants for maintenance, blowout of air inside pipelines and firefighting.

(2) Material of Pipelines

In Nepal, mainly ductile cast iron pipe, uPVC pipe and HDPE pipe are used. Character of each material is shown in **Table 1.1**.

Ductile Cast Iron Pipe GI Pipe HEPE Pipe

Photo 1.3 Pipe Material

Table 1.1 Character of Pipe by Material

Material	Advantage	Disadvantage
Ductile Cast Iron Pipe	・High pipe body strength ・High durability ・High flexibility of fitting	・Heavy weight ・Necessity of restraint joint
GI Pipe	・High pipe body strength ・High durability ・High process ability	・Requiring skilled worker for welding ・Cathodic protection is necessary ・Easy to corrode
HDPE Pipe	・High corrosion resistance ・Light weight	・Low pipe body strength (compare to DCIP) ・Weakness against ultraviolet rays

References: The Design Criteria for Water Supply Facilities 2012, Japan Water Works Association

(3) Valves

In a water distribution system, valves can be used for such various purpose as isolation of pipelines, drainage, flow control, blowout of air and firefighting water supply. Photos of valves are shown in **Photo 1.4**.

- **Gate Valve**: This valve is mainly used as shut-off valve. Basically, since this valve is used in full open and/or full close, it is unsuitable for flow control. Valve disc in valve box moves up and down, and opens and shuts.
- **Butterfly Valve**: This valve is used as shut-off valve and control valve. Valve disc in the valve box makes a valve rod in an axis, turns and opens and shuts.
- **Air Valve**: This valves are installed at convex points in the distribution pipelines to blowout air inside of pipelines.
- **Washout Valve**: Washout valves are installed for drainage of dirt after pipe laid work and when clean inside of pipelines.
- **Fire Hydrant**: A fire hydrant is installed for firefighting water supply. Since necessary amount of firefighting water is large, small diameter pipelines (100mm and less) basically should not equip fire hydrants.

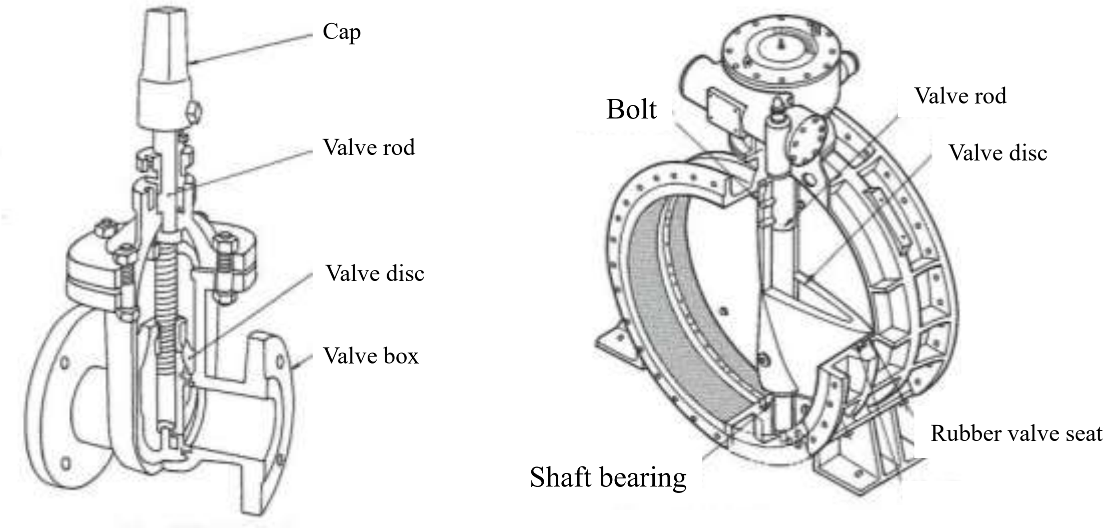
Gate Valve Butterfly Valve Air Valve Fire Hydrant

Photo 1.4 Valves

(4) Common Problems and Countermeasures for Valves

(a) Gate Valve and Butterfly valve

Structure of gate valve and butterfly valve is shown in **Figure 1.2**, and problems and countermeasures for gate valve and butterfly valve is shown in **Table 1.2**.



Gate Valve Butterfly valve

Figure 1.2 Structure of Gate Valve and Butterfly Valve

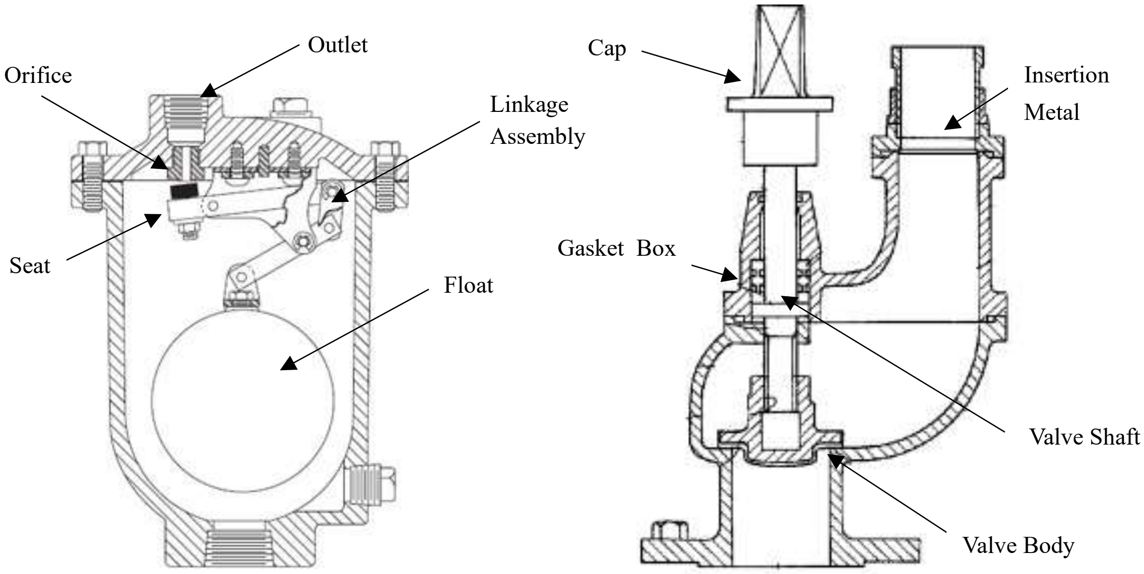
Table 1.2 Problems and Countermeasures for Gate Valve and Butterfly Valve

Valve	Problems	Causes	Countermeasures
Gate Valve	Impossible to open/shut a valve	A valve seat is filled with alien substances such as garbage and sand.	Removal of alien substances
		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 gears	Decomposition and parts cleaning. Replacement of parts of reduction gears
	Strong torque generation in valve operation Water leakage from ground of valve	A valve seat and a valve rod are filled with alien substances	Removal of alien substances
		Gland packing is tighten up too much.	Adjustment of gland packing nuts.
		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 an outcrop of valve rod, and surface of rod is a flaw.	Grinding or replacement of valve rod
	Water leakage 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	Impossible to open/shut a valve	A valve seat is filled with alien substances such as garbage and sand.	Remove alien substances Repair rubber valve seat Repair an edge of valve disc.
		Malfunction of reduction gears	Decomposition and parts cleaning. Replacement of parts of reduction gears.
	Water leakage from valve seat with abnormal torque in valve operation	Separation of rubber valve seat	Replacement of rubber valve seat
		A valve seat and a valve rod are filled with alien substances	Removal of alien substances
	Water leakage 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.

References: The Standard for Maintenance of Water Supply Facilities 2016, Japan Water Works Association

(b) Air Valve and Fire Hydrant

Structure of air valve and fire hydrant is shown in Figure 1.3, and problems and countermeasures for air valve and fire hydrant is shown in Table 1.2.



Air Valve

Fire Hydrant

Figure 1.3 Structure of Air Valve and Fire Hydrant

Table 1.3 Problems and Countermeasures for Air Valve and Fire Hydrant

Valve	Problems	Causes	Countermeasures
Air Valve	When the float is closed, water flow is not stop.	The foreign object is jammed.	Cleaning for the Air Valve.
	There is the outside leakage.	The looseness of a plug cap.	Tighten the plug cap
		The looseness of a bolt and nut	Rearrangement
Fire Hydrant	Impossible to open/shut a valve	The direction of opening and closing is the opposite.	Confirmation of the indication direction of cap.
		The curving of the valve shaft.	Replacement of the valve shaft.
		The foreign object is jammed.	Overhaul and maintenance
		The parts is damaged.	Overhaul and maintenance
	Water leakage of joint side and flange side	The looseness of a bolt and nut.	Tighten a bolt and nut.
		The gasket is deteriorated.	Overhaul and replacement of a gasket.
	Water leakage grand part	The method of tightness of grand gasket is weak.	Tighten of bolt pressing gasket.
		The O ring is worn down and deteriorated.	Replacement

References: The Standard for Maintenance of Water Supply Facilities 2016, Japan Water Works Association

(5) Preparation of Pipeline Network Map for Maintenance

(a) Necessity of Pipeline Network Map

Since distribution pipelines are buried under ground, it is difficult to confirm its condition. Additionally, enormous length and various material pipelines are buried in various environments. To conduct appropriate maintenance of pipelines like this, putting the information of pipelines together is necessary. That is why pipeline network map is necessary.

Therefore, pipeline network map should be made and utilized for pipeline maintenance work. This map can help engineers not only to grasp existing pipelines but also plan distribution network improvement.

Information which shall be indicated on the map is shown in **Table 1.4**, and sample of pipeline network map is shown in **Figure 1.4**.

Table 1.4 Information which shall be indicated on the Map

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

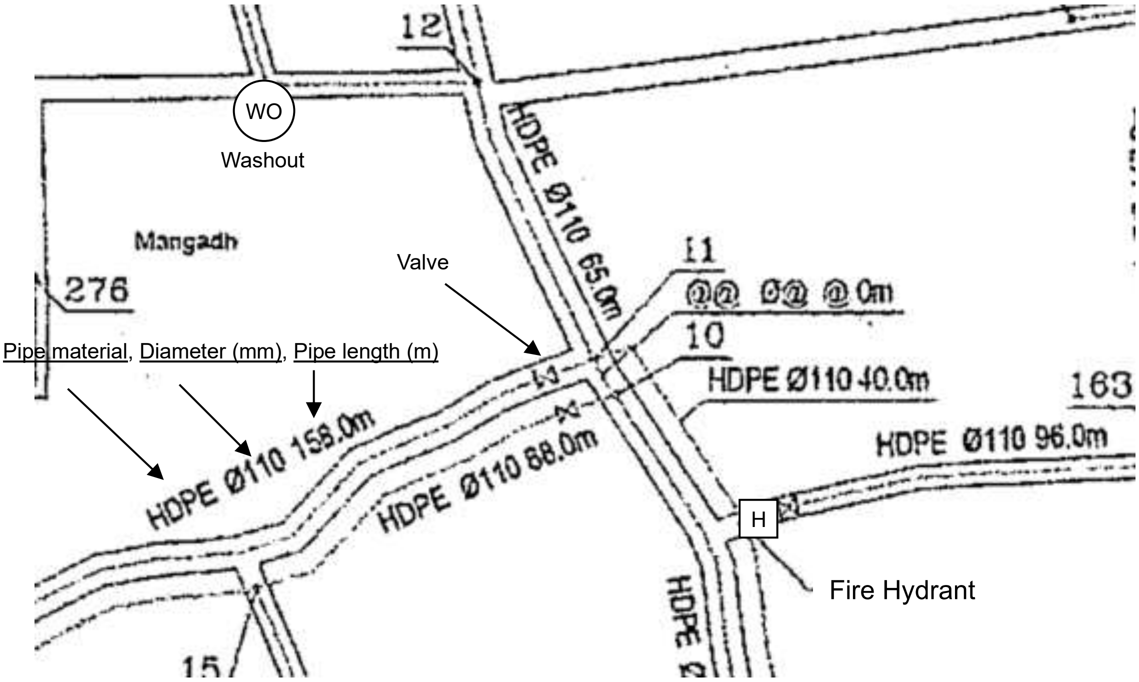


Figure 1.4 Sample of Pipeline Network Map

(b) Periodical Update of the Map

To expand water supply area and improve water supply service, water utilities lay new pipelines and replace old pipelines as necessary.

Therefore, the map shall be updated periodically to reflect the actual status of pipelines.

(c) Idea of Map Utilization for Other Purpose

Since the maps are linked together with the pipelines information, the map can shared the information to other staffs and be centralized. Therefore, the 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 take measures.

2 Standard Operation Procedure

2.1 Operation Management

(a) Procedure for Distribution Flow Management

This procedure shows a record procedure of water distribution flow from a service reservoir. Precondition of this procedure is that an integrating flow meter is equipped on an outlet pipeline of a service reservoir.

Procedure for distribution flow management
Preparation
(i) Make a plan for bulk meter reading. The plan shall include time schedule of meter reading, staff allocation, transportation, record management, etc.
Daily Work
(ii) Read the meter at the designated time and record meter reading value in **Form 3.3-1** attached in **Chapter 4**. Then calculate and record daily water distribution flow. If WUSC has plural reservoirs, the record sheets has to be prepared for each reservoir.
(iii) While reading a meter, check the condition of the flow meter
Monthly Work
(iv) Sum up daily water distribution flow on the **Form 3.3-1** on the last day of every month.
(v) If WUSC has plural reservoirs, sum up the monthly total of distribution flow on the monthly summary sheet attached in **Form 3.3-2** after the procedure (iv).
Yearly Work
(vi) Sum up monthly water distribution flow in **Form 3.3-3** on the last day of every fiscal year.

【Supplemental Explanation】

- **Regarding Procedure (i)**: To monitor the 24 hours water supply flow, meter reading shall be conducted at the same time each day.
- **Regarding Procedure (iii)**: If problems are detected, they has to be handled following the report procedure shown in **Section 7**.

2.2 Facility Maintenance

(1) Service Reservoir

(a) Procedure for daily inspection

This procedure shows a daily patrol and inspection procedure for service reservoir.

Procedure for daily inspection	
(i)	Make a daily inspection plan for service reservoir(s). The plan shall include staff allocation, transportation, record management, etc.
(ii)	Patrol the reservoir site(s) once a day.
(iii)	Confirm the condition of the reservoir(s) and related facilities with check sheet (**Form 3.3-4**) attached in **Chapter 4** by visual inspection.

【Supplemental Explanation】

- **Regarding Procedure (i)**: Frequency of patrol is once a day.
- **Regarding Procedure (ii)**: If problems are detected, they has to be handled following the reporting procedure shown in **Section 7**.

(b) Procedure for cleaning inside of the reservoir

This procedure shows a cleaning procedure of service reservoir. Since the cleaning frequency of reservoir(s) depend on the water quality, each WUSC shall decide the frequency considering their water quality. In case that water contains many alien substances, once-a-year cleaning is recommended in this SOP.

Procedure for cleaning inside of the reservoir	
(i)	Announce the duration of water supply suspension to customers (if necessary)
(ii)	Close an inlet valve of the reservoir
(iii)	Stop chlorine injection (if necessary)
(iv)	Close an outlet valve of the reservoir after water level of the reservoir sinks
(v)	Open a drain valve of the reservoir, and drain remained water
(vi)	Ventilate to let in fresh air and let out the air containing chlorine

(vii) Wash dirt inside of the reservoir away, and drain from a drain pipe

(viii) Check the condition of walls and roof from inside (concrete cracks, rust of pipes, etc.) visually with check sheet (**Form 3.3-4**) attached in **Chapter 4**.

(ix) Close a drain valve of the reservoir

(x) Open an inlet valve and store water

(xi) Open an outlet valve and resume chlorine injection (if necessary) and water supply

【Supplemental Explanation】

- **Regarding Procedure (i)**: If WUSC has only one reservoir, water supply is suspended due to the cleaning. In that case, WUSC has to announce regarding water supply suspension, such as date of cleaning, period of the suspension, etc. to customers.
- **Regarding Procedure (iii)**: If chlorine is injected at the reservoir, chlorine injection shall be stopped.
- **Regarding Procedure (v)**: If there is some problem to drain water which contains free residual chlorine, water shall be drained after neutralization.
- **Regarding Procedure (vii)**: Before entering into a reservoir, corrosion situation of ladder or steps shall be confirmed. When entering into a reservoir, a hard hat and fall-prevention harness shall be used.
- **Regarding Procedure (viii)**: If problems are detected, they has to be handled following the reporting procedure shown in **Section 7**.

(2) Distribution Pipeline

(a) Procedure for Patrol Inspection for Distribution Pipelines

This procedure shows a patrol inspection procedure for distribution pipelines. Objects of patrol inspection are not only pipelines but also valves, air valves, wash outs, fire hydrant and valve boxes.

Procedure for patrol inspection
(i) Make a patrol inspection plan for distribution pipeline. The plan shall include frequency of patrol, routes of patrol, staff allocation, transportation, record management, etc.
(ii) Conduct patrol inspection. Water leakage, damage of valve boxes, inundation of valve boxes are main items of the inspection.
(iii) Confirm the condition of the pipelines with check sheet (**Form 3.3-4** and **Form 3.3-5**) by visual inspection.

【Supplemental Explanation】

- **Regarding Procedure (i)**: Decide the frequency of pipeline patrol based on the situation of pipelines and resources for the patrol. The following table shows the frequency of the patrol as a reference.

- **Regarding Procedure (ii)**: Not only outside but also inside of valve boxes need to be checked. If an inundation of boxes (especially boxes for air valves) is found, drain the water immediately.

Table 2.1 Example of Frequency of Pipeline Patrol

Category	Frequency	Remarks
Old pipelines	1 cycle per month	40 years and more after construction
Other pipelines	4 cycle per year	

Section 4

Household Connections and Water Meters

1 Outline of Household Connection and Water Meter

1.1 Definition of Household Connection in This SOP

Household connection is defined as a facility which draws pipe water from a distribute pipeline into a household. Basically, a water meter is equipped on a household connection pipeline.

In this SOP, pipes, fittings, valves and water meter (from service saddle to water meter) are defined as household connection.

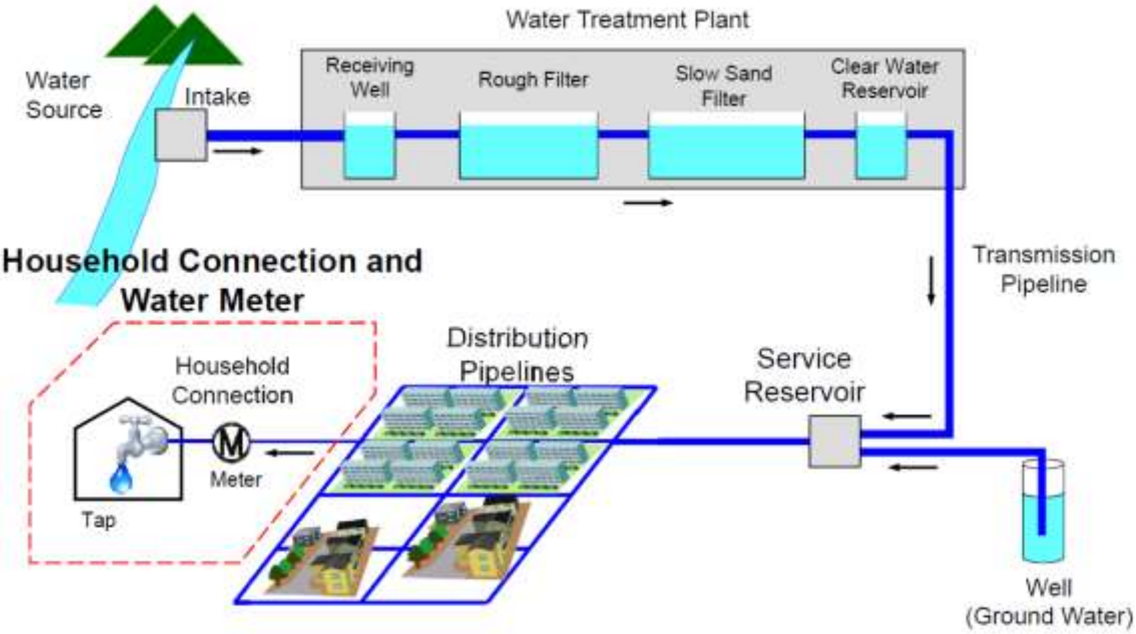


Figure 1.1 Household Connection and Water Meter

1.2 Pipes for Household Connections

In WUSCs in semi-urban towns, mainly HDPE pipe and GI pipe are used for household connections. HDPE pipe is usually used from distribution pipe to right before water meter, and GI pipe is used around water meter.

GI Pipe HEPE Pipe

Photo 1.1 Pipe Material

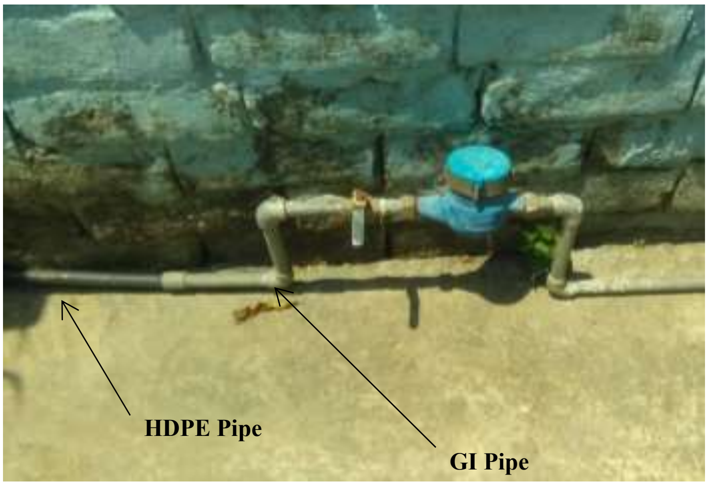


Photo 1.2 Pipe Material for Household Connections

1.3 Water Meters

(1) Function of Water Meters

Water meters, which are attached to household connection pipes, are equipment to measure water consumption of users. Metered value is used for the calculation of water charges and management of water demand.

Therefore, following characteristics are required to water meters;

- Good measuring accuracy
- Durability
- Sufficient capacity
- Good sensitivity
- Wide measuring range
- Ease in reading
- Ease in handling

(2) Type of Water Meter

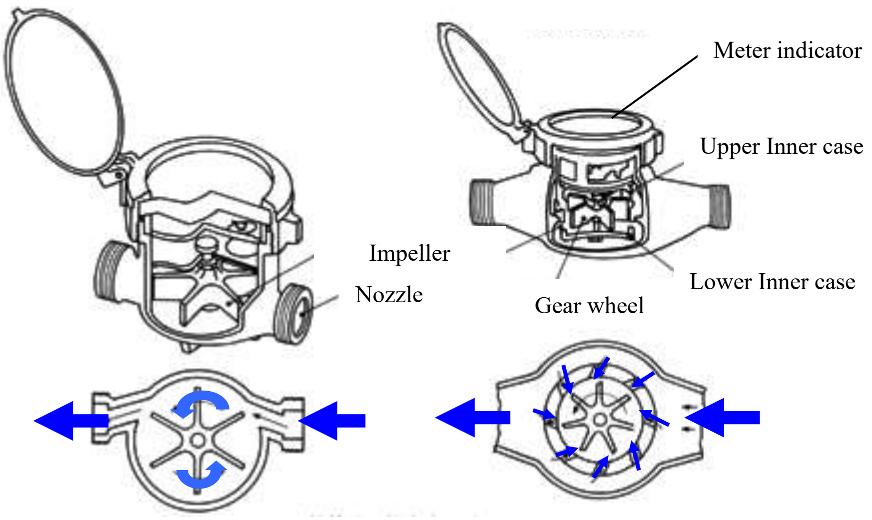
Vane wheel type flow meters are generally used as domestic water meter. Meter mounts are threaded for diameters 15 – 40 mm and flanged for diameters 50 – 350 mm, in general.

(a) Vane Wheel 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 measure 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. Diameter of this type of flow meter is generally 13 mm.

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. Diameter of this type of flow meter is generally 20 to 40 mm.



Single Jet Type Multi Jet Type

Figure 1.2 Structure of Vane Wheel Type Flow Meter

(b) 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.

(c) 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.

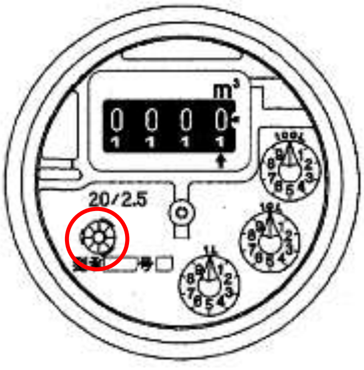


Figure 1.3 Rotary Index

(3) Consideration Points for Water Meter Storage and Installation

(a) Consideration Points for Safety's Sake of Meter Installation

- To pay attention not to drop water meters while carrying them since there are possibilities of injury.
- Not to touch directly a screw joint part of 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. Installation failure may be caused by using inappropriate tools for plumbing.
- Not to pour hot or boiling water into the water meter. When hot water more than 40 degrees flows in a water meter, there is a possibility to damage the inside plastic parts.

(b) Consideration Points for Water Meter Storage

- Not to give water meter strong shock. When a water meter falls, there is a possibility of meter damage and might be difficult to measure the amount of flow if 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 if the shaft bearing of the impeller is damaged.

- To cover nozzles of water meters in order that wind cannot blow into the inside of the meter during storage. When air blows inside, it is possible that vane wheel can turn by the wind. To put caps on the nozzles of water meters to prevent this from happening.
- To cover nozzles of water meters in order to prevent entering alien substances into water

meters during storage. If alien substances enter water meters, it might be difficult to measure since the alien substances obstruct the rotation of the impeller.

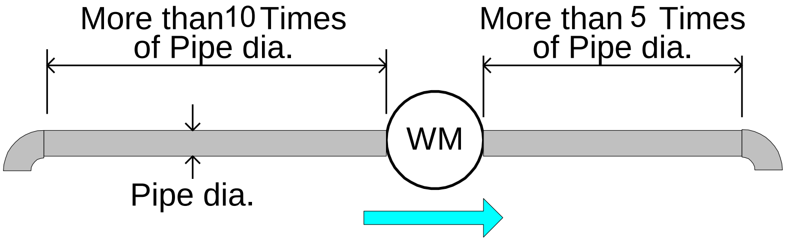
(c) Consideration Points for a Location of Water Meter installation

- To select the place where installation and replace of a water meter are easy since it is necessary to replace water meter periodically (recommended in every 8 years).
- To select the place where meter reading is easy. Since it is necessary to conduct meter reading periodically, water meters shall be installed at an appropriate place, where is dry and not submerged.
- To select a place where there is no influence of vibration. It might be difficult to measure accurately because the rotation of the impeller can be affected by vibration.

(d) Consideration Points for Water Meter installation

- A water meter for domestic (15 mm diameter, i.e. vane wheel jet type water meter) shall be installed horizontally in each house.
- To set the meter horizontally with indicator upward according to the arrow shown on the meter.

- In order to prevent the influence of turbulence causing inaccurate weighing and to ensure proper metering, straight pipe length that is at least 10 times of pipe diameter are required in upstream of a water meter, and at least 5 times of pipe diameter are required in downstream.



- The inside of the pipe should always be cleaned before water meter installation. It might be difficult to measure accuracy because alien substances inside the pipe might obstruct the rotation of the impeller or even destroy the meter.

(4) Indicator of Water Meter

Meter reading is the foundation of billing. 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.

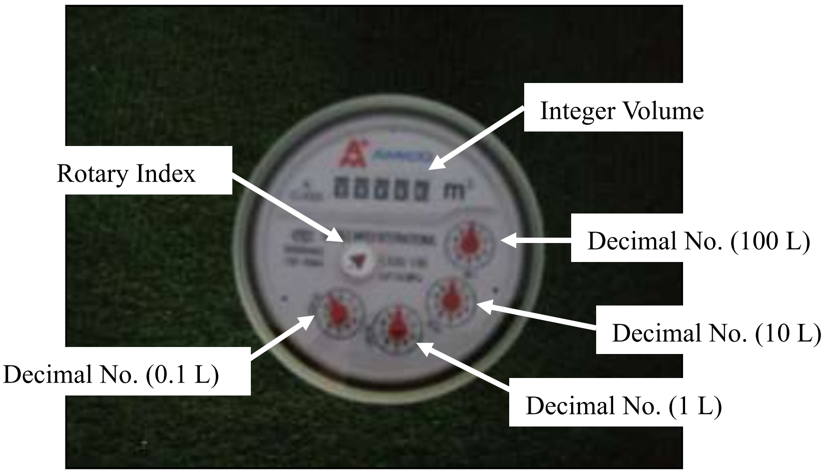


Photo 1.3 Indicator of Water Meter

1.4 Responsibility of Installation and Maintenance for Household Connection

WUSCs and customers have responsibilities of installation and maintenance for a water meter and a house connection respectively. The division of roles for installation and maintenance are shown in **Table 1.1**.

Table 1.1 Responsibility of WUSCs and Customers

Item	Category	WUSCs	Customers
Household Connection Installation	Supply	-	○
	Installation	○	-
	Cost Allocation	-	○ (supply and installation)
Water meter Installation	Supply	○	-
	Installation	○	-
	Cost Allocation	-	○ (supply and installation)
Maintenance (repair/replacement)	Supply	○	-
	Installation	○	-
	Cost Allocation	-	○ (supply and installation)

1.5 Introduction of Water Meter Calibration Equipment

(1) Outline of Water Calibration Equipment

Water meter calibration equipment was introduced at Technical Support Center (TSC) in Itahari Municipality to calibrate all water meters before installation to households.

Schematic diagram of the equipment is shown in **Figure 1.4**.

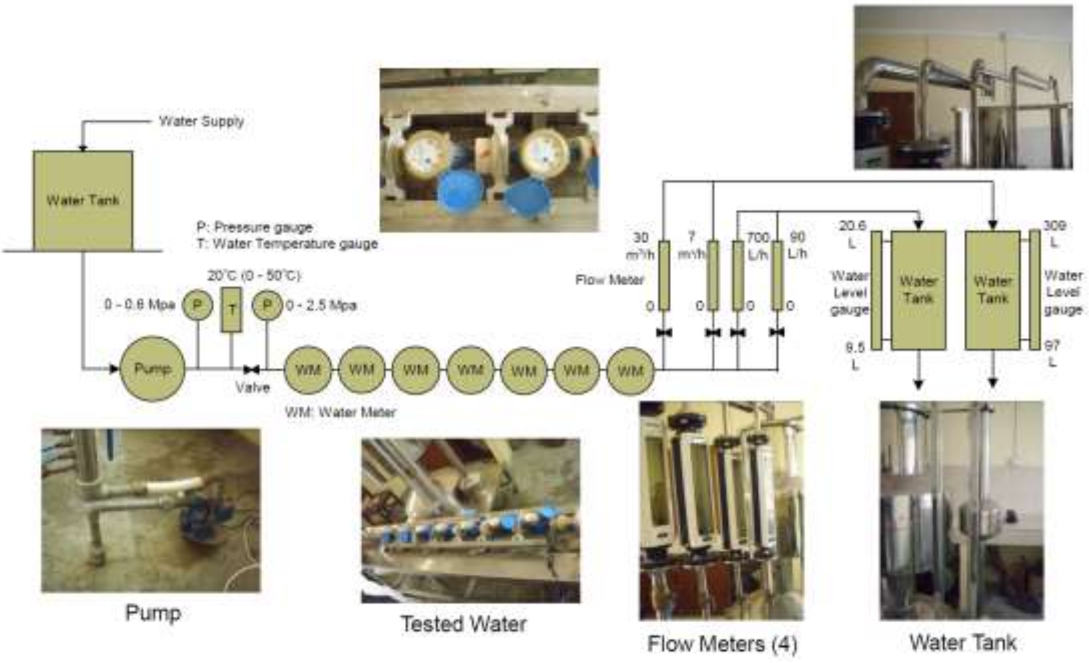


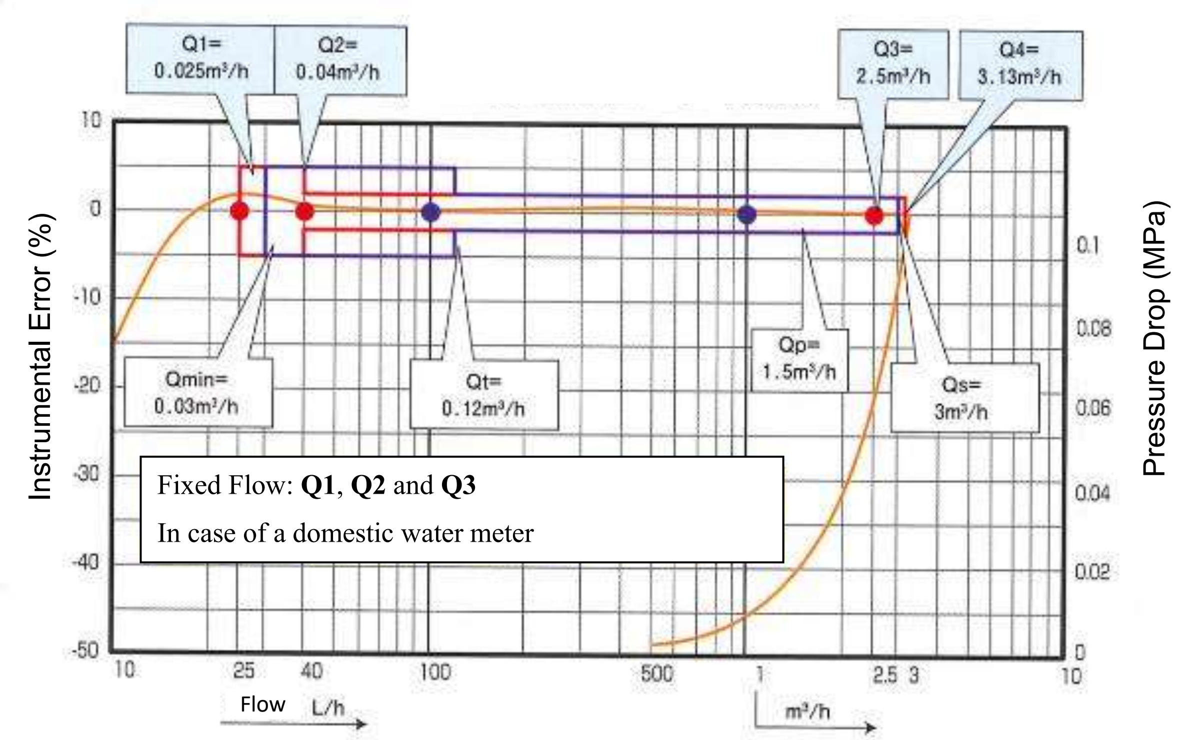
Figure 1.4 Schematic Diagram of Water Meter Calibration Equipment

(2) Verification Tolerance of Domestic Water Meter

Verification tolerance means the allowable instrumental error. Verification tolerance for domestic water meter (15 mm) is shown in **Figure 1.5**. Verification tolerance is ±2.0% for a small flow range and ±5.0% for a high flow range.

In acceptance inspection, there are 3 points (from Q1 to Q3 shown below) to check the flow rate.

- Q1: Rated minimum flow
- Q2: Flow at a transition point between a small flow range and a high flow range (Q2 = Q1 x 1.6)
- Q3: Rated maximum flow
- Q4: Critical flow (Q4 = Q3 x 1.25)



Fixed Flow: **Q1**, **Q2** and **Q3**

In case of a domestic water meter

Figure 1.5 Tolerance for Domestic Water Meter (15 mm)

(3) Use Tolerance

Use tolerance means the allowable instrumental error used in periodical inspections. Use tolerance is 2 times of verification tolerance.

Measurement method of use tolerance is shown in **Figure 1.6**.

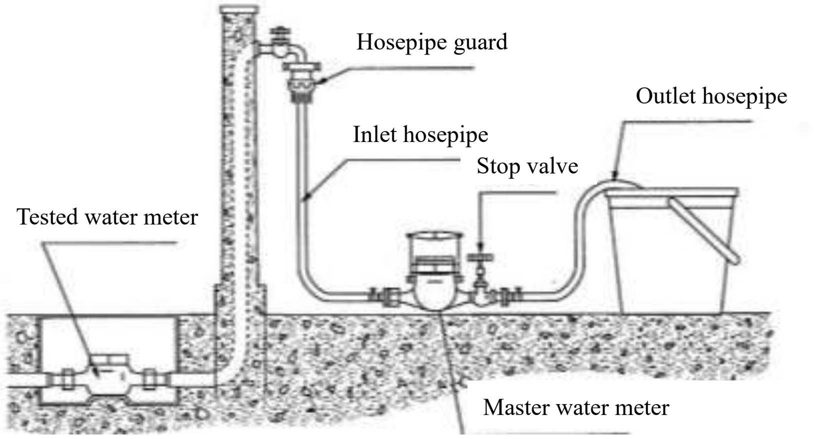


Figure 1.6 Measurement Method of Use Tolerance

Calculation method of instrumental error is shown below.

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

E: Instrumental error (%) (It shall be smaller than use tolerance)

I: Measured flow of tested water meter (L)

Q: Measured flow of master water meter (L)

[Example of Calculation]

- **Case 1**

Table 1.2 Sample of Test Data 1

Water meter	Initial Value	Final Value	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% ･･･ OK!

- **Case 2**

Table 1.3 Sample of Test Data 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% ･･･ N.G! (Replace Tested Meter)

1.6 Common Problems and Countermeasures for 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.

Problems and countermeasures for water meter is shown in **Table 1.4** to **Table 1.10**.

Table 1.4 Problems and Counter Measures for Water Meter (No Indicator Proceeding)

Cause	Instance	Measure
Alien substances such as sands, rust and pipe material get into gear portion, and stop a meter	･Indicator stops immediately after opening the valve. ･Meter indicator stops suddenly. ･No indicator proceeding.	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. ･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. ･Damaged meters should be checked to confirm the meter functions.

References: Technical data from water meter manufacturer

Table 1.5 Problems and Counter Measures for Water Meter (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

References: Technical data from water meter manufacturer

Table 1.6 Problems and Countermeasures for Water Meter (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.

References: Technical data from water meter manufacturer

Table 1.7 Problems and Countermeasures for Water Meter (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.

References: Technical data from water meter manufacturer

Table 1.8 Problems and Countermeasures (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.

References: Technical data from water meter manufacturer

Table 1.9 Problem and Countermeasures (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

References: Technical data from water meter manufacturer

Table 1.10 Problems and Countermeasures for Water Meter (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. · Damaged meters should not be used.

References: Technical data from water meter manufacturer

2 Standard Operation Procedure

2.1 Maintenance

(a) Procedure for household connection facility management

This procedure shows a management procedure for household connections. This procedure aims to analyze cause of water meter malfunction, quality of products, quality of manufacturer and life of water meter by maintaining water meter installation records and repair records.

Procedure for Household Connection Facility Management

New Water Meter Installation

(i) Make a water meter installation record immediately after new water meters are installed (**Form 3.4-1** attached in **Chapter 4)**.

Water Meter Replacement

(ii) Replace water meter if malfunction of water meter is found out.

(iii) Carry the replaced water meter back to WUSC's office. Then analyze the causes of malfunction.

(iv) Make a water meter replacement record after completion of cause analysis (**Form 3.4-1 and Form 3.4.2**).

(v) Submit the record sheet to WUSC's manager.

【Supplemental Explanation】

- **Regarding Procedure (iii)**: Water meter failures are categorized such as no proceeding indicator, delay of indicator, inverse rotation of indicator, leakage from meter, unclearness of meter and meter damage. Refer to "**1.6 Common Problems and Countermeasures for Water Meter**" in this SOP when analyzing.

(b) Procedure for a use tolerance test

This procedure shows a use tolerance test. This test is conducted in case that a consumer complains the meter reading value if necessary.

Use tolerance means the allowable instrumental error used in periodical inspections. Acceptable use tolerance is ±10.0% for a small flow range and ±4.0% for a high flow range. (Verification tolerance is ±5.0% for a small flow range and ±2.0% for a high flow range.)

Procedure for tolerance test

(i) Install a master water meter temporary to a household connection (refer to **Figure 1.6**).

(ii) Exhausts air inside of the meter and pipes by running water.

(iii) Fully open the stop valve of the master meter.

(iv) Open the faucet slowly, and adjust water flow to test flow.

(v) Fully close the stop valve, and read values of both water meters.

(vi) Remove the master meter.

(vii) Calculate use tolerance by using **Form 3.4-3**.

(viii) Submit the record sheet to WUSC’s manager.

【Supplemental Explanation】

- **Regarding Procedure (vii)**: Refer to “**1.5(3) Use Tolerance**” in this SOP when calculating use tolerance.

Section 5

Water Quality Management

1 Outline of Water Quality Management

1.1 Definition and Purpose of Water Quality Management

Water Quality Management for water supply is defined as follows;

- **To examine whether drinking water is clean and safe**
- **To construct the system which can continuously provide clean and safe drinking water**

The scope of water quality management is Intake (surface water and ground water), WTP, Service Reservoir, Distribution Pipelines and Water Tap at household as shown in **Figure 1.1**.

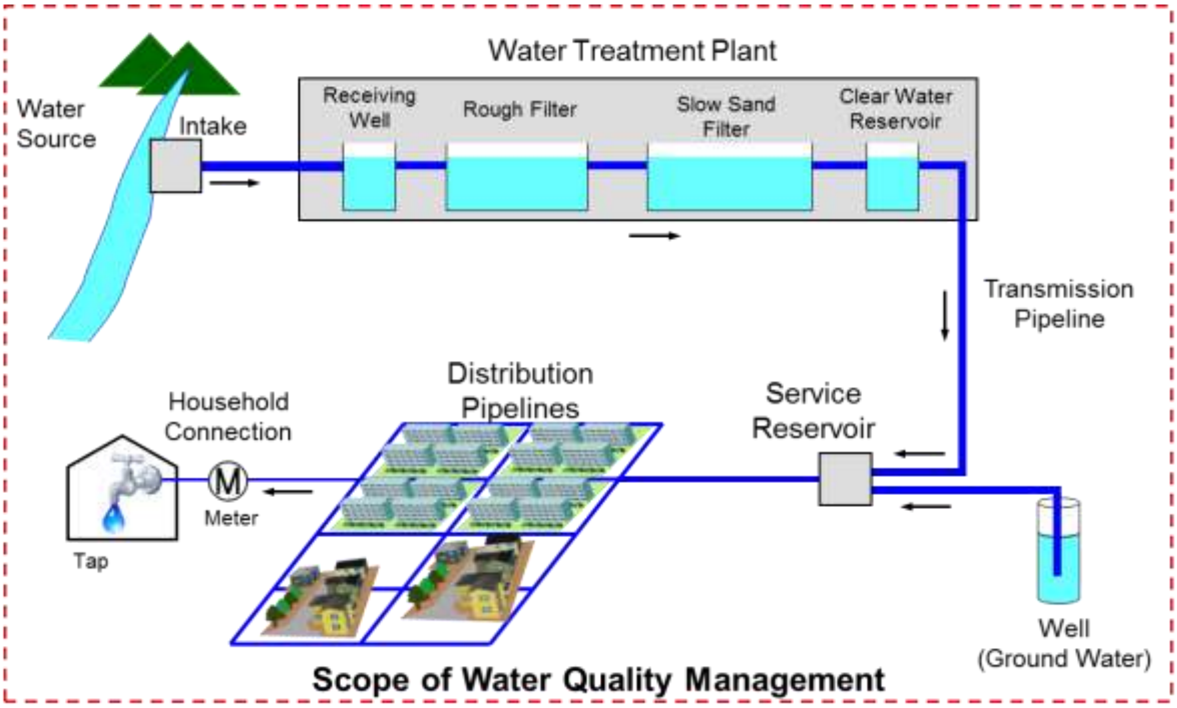


Figure 1.1 Scope of Water Quality Management

The purpose of Water Quality Management is as follows;

"To conduct synthetic management of the entire water supply system from the water source, water treatment processes to the tap, so that tap water is always in conformity with NDWQS, kept hygienically safe and in normal condition."

Water treatment processes observed in 68 Target WUSCs out of 229 WUSCs in semi-urban area had been classified into five patterns as shown in **Figure 1.2**. Therefore, the contents of this SOP is edited in accordance with the five patterns.

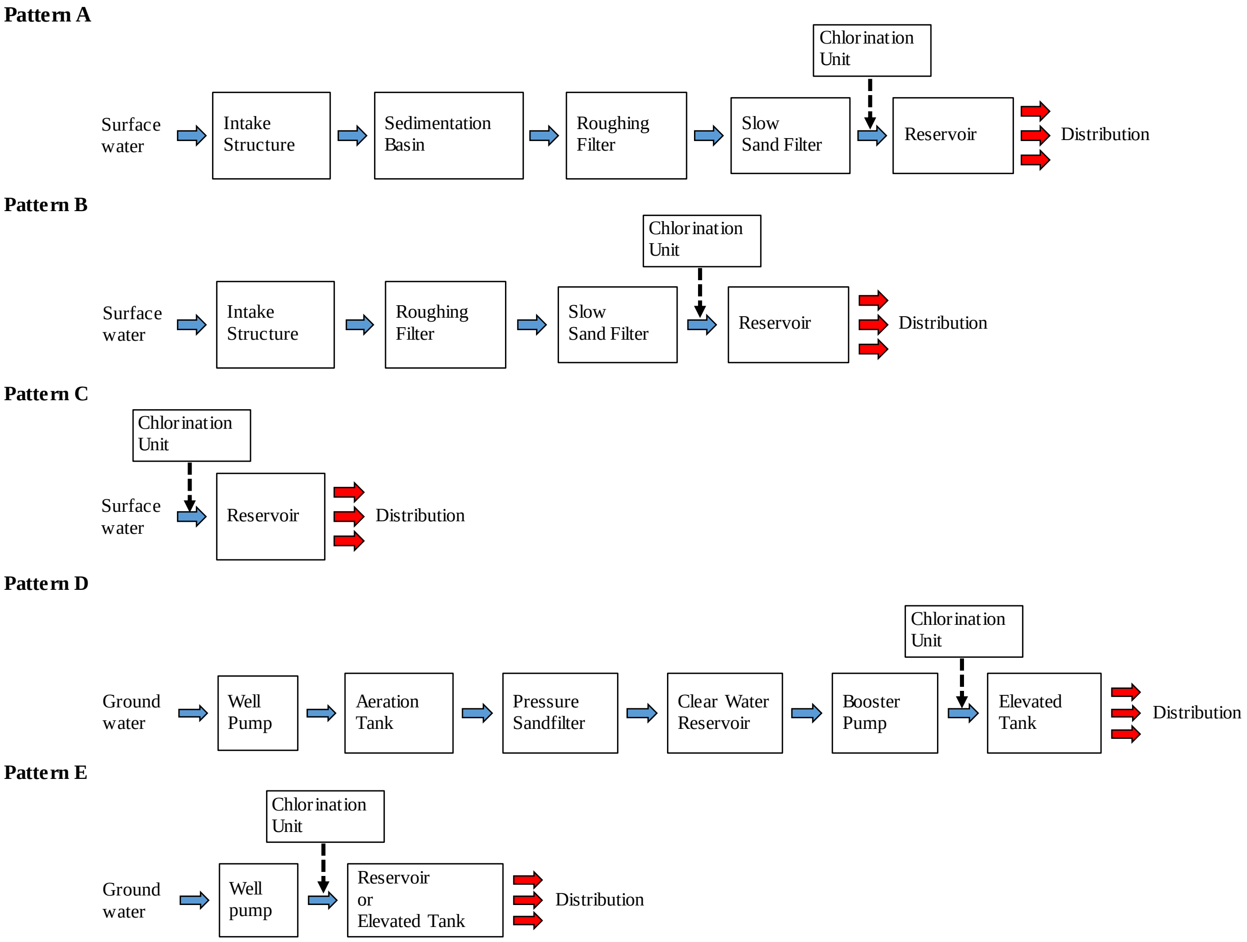


Figure 1.2 Classified Five Patterns of Water Treatment Process

1.2 Important Points on Water Quality Management

1.2.1 What is Water Quality ?

Water Quality is the characteristics of water which is categorized into the following points;

- **Physical characteristics;** Turbidity, Color, Odor etc.
- **Chemical characteristics;** pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS) etc.
- **Biological characteristics;** Coliform organisms, E.coli etc.

1.2.2 Factors related to Water Quality Management

The following factors are related to Water Quality Management.

- Measurement of water quality, water quality survey and collection of related information

- Water quality management of distribution system (Setting a target value of residual chlorine)
- Receiving complaints/inquiries from customers and response to them
- Collection of information on water quality preservation
- Preparation of a plan for water quality preservation with related organizations

1.2.3 Steps of Water Quality Management

Water quality monitoring and control for water supply have following steps;

- Setting goal and planning
- Water quality analysis
- Appropriate O&M for WTP and water source area
- Maintenance and analysis of water quality records
- Taking measures to improve water quality

1.2.4 Water Quality Standard

Water quality standard for drinking water are stipulated in NDWQS, and there are 27 parameters including physical, chemical and microbiological requirements as shown in **Table 1.1**.

Table 1.1 National Drinking Water Quality Standards, 2062

No.	Parameter	Concentration Limit		No.	Parameter	Concentration Limit	
Physical Requirements				14	Lead	0.01	mg/L
1	Turbidity	5 (10)*	NTU	15	Ammonia	1.5	mg/L
2	pH	6.5-8.5	-	16	Chloride	250	mg/L
3	Color	5 (15)*	TCU	17	Sulphate	250	mg/L
4	Taste and Odor	Non-objectionable		18	Nitrate	50	mg/L
5	TDS	1,000	mg/L	19	Copper	1	mg/L
6	Electrical Conductivity	1,500	µS/cm	20	Total Hardness (as CaCO3)	500	mg/L
Chemical Requirements				21	Calcium	200	mg/L
7	Iron	0.3 (3)*	mg/L	22	Zinc	3	mg/L
8	Manganese	0.2	mg/L	23	Mercury	0.001	mg/L
9	Arsenic	0.05	mg/L	24	Aluminium	0.2	mg/L
10	Cadmium	0.003	mg/L	25	Residual Chlorine	0.1-0.2	mg/L
11	Chromium	0.05	mg/L	**Microbiological Requirements**			
12	Cyanide	0.07	mg/L	26	*E.Coli* (MPN/100mL)	0	
13	Fluoride	0.5-1.5	mg/L	27	Total Coliform (MPN/100mL)	0 in 95%samples	

* Values in parenthesis refers the acceptable values only when alternative is not available.

Required parameters to be measured/reported are stipulated for each water source, rural surface water and rural ground water as shown in **Table 1.2**. There are 16 parameters for each water source. The difference is only yellow part. Chromium is required for rural surface water, and Arsenic is required for rural ground water.

Table 1.2 Required Parameters to be Measured/Reported for each Water Source

< For Rural Surface Water >

No.	Parameter	Concentration Limit	
Physical Requirements			
1	Turbidity	5 (10)*	NTU
2	pH	6.5-8.5	-
3	Color	5 (15)*	TCU
4	Taste and Odor	Non-objectionable	
5	Electrical Conductivity	1,500	μS/cm
Chemical Requirements			
6	Iron	0.3 (3)*	mg/L
7	Manganese	0.2	mg/L
8	Chromium	0.05	mg/L
9	Fluoride	0.5-1.5	mg/L
10	Ammonia	1.5	mg/L
11	Nitrate	50	mg/L
12	Total Hardness (as CaCO3)	500	mg/L
13	Calcium	200	mg/L
14	Residual Chlorine	0.1-0.2	mg/L
Microbiological Requirements			
15	*E.Coli* (MPN/100mL)	0	
16	Total Coliform (MPN/100mL)	0 in 95%samples	

< For Rural Ground Water >

No.	Parameter	Concentration Limit	
Physical Requirements			
1	Turbidity	5 (10)*	NTU
2	pH	6.5-8.5	-
3	Color	5 (15)*	TCU
4	Taste and Odor	Non-objectionable	
5	Electrical Conductivity	1,500	μS/cm
Chemical Requirements			
6	Iron	0.3 (3)*	mg/L
7	Manganese	0.2	mg/L
8	Arsenic	0.05	mg/L
9	Fluoride	0.5-1.5	mg/L
10	Ammonia	1.5	mg/L
11	Nitrate	50	mg/L
12	Total Hardness (as CaCO3)	500	mg/L
13	Calcium	200	mg/L
14	Residual Chlorine	0.1-0.2	mg/L
Microbiological Requirements			
15	*E.Coli* (MPN/100mL)	0	
16	Total Coliform (MPN/100mL)	0 in 95%samples	

* Values in parenthesis refers the acceptable values only when alternative is not available.

Frequency of water quality monitoring for rural water supply system is stipulated in "Implementation Directives for NDWQS, 2062 (hereafter Directives)" as shown in **Table 1.3**. *E.Coli* and Total Coliform shall be measured three times in a year, in pre-monsoon, during monsoon and post-monsoon season.

Table 1.3 Required Monitoring Frequency of each Parameter for Rural Water Supply System

No.	Parameter	Monitoring Frequency	No.	Parameter	Monitoring Frequency
Physical Requirements			14	Lead	Yearly
1	**Turbidity**	Daily	15	Ammonia	Monthly
2	**pH**	Daily	16	Chloride	Monthly
3	**Color**	Daily	17	Sulphate	Yearly
4	**Taste and Odor**	Daily	18	Nitrate	Monthly
5	TDS	Quarterly	19	Copper	Yearly
6	Electrical Conductivity	Monthly	20	Total Hardness (as CaCO3)	Monthly
Chemical Requirements			21	Calcium	Monthly
7	Iron	Yearly	22	Zinc	Yearly
8	Manganese	Yearly	23	Mercury	Yearly
9	Arsenic	Yearly	24	Aluminium	Yearly
10	Cadmium	Yearly	25	**Residual Chlorine**	Daily
11	Chromium	Yearly	**Microbiological Requirements**		
12	Cyanide	Yearly	26	*E.Coli* (MPN/100mL)	Three times a year
13	Fluoride	Yearly	27	Total Coliform (MPN/100mL)	Three times a year

The outline of each parameter is shown in **Appendix 5-1** for reference.

2 Standard Operating Procedure

2.1 Procedure of Water Quality Test

Basically, POTATEST and ENPHO Water Test Kit are used to measure / monitor the important daily parameters such as **Turbidity, pH, Residual Chlorine** etc. at WUSCs. Since turbidity can’t be measured by ENPHO Water Test Kit, at least Turbidity Meter shall be prepared by own. The measurable parameters of each Test Kit are shown in **Table 2.1**. In WASMIP-II Project, .ENPHO Water Test Kit and Turbidity Meter (tube type) are provided for 68 Target WUSCs

The other 11 parameters out of 16 required parameters shall be measured at DWSS Regional Lab., DWSS Central Lab. or other private Lab in accordance with NDWQS and Directives.

Table 2.1 Measurable Parameters of each Test Kit

No.	Category	Parameter*	Concentration Limit*		POTATEST (Wagtech)	ENPO Water Test Kit	Remarks
1	Physical	Turbidity	5	NTU	✓		
2		pH	6.5-8.5	-	✓	✓	
3		Color	5	TCU			
4		Taste and Odor	Non-objectionable				
5		TDS	1,000	mg/L			
6		Electrical Conductivity	1,500	mg/L			
7	Chemical	Iron	0.3	mg/L		✓	
8		Manganese	0.2	mg/L			
9		Arsenic	0.05	mg/L			
10		Cadmium	0.003	mg/L			
11		Chromium	0.05	mg/L			
12		Cyanide	0.07	mg/L			
13		Fluoride	0.5-1.5	mg/L			
14		Lead	0.01	mg/L			
15		Ammonia	1.5	mg/L		✓	
16		Chloride	250	mg/L		✓	
17		Sulphate	250	mg/L			
18		Nitrate	50	mg/L		✓	
19		Copper	1	mg/L			
20		Total Hardness (as CaCO3)	500	mg/L		✓	
21		Calcium	200	mg/L			
22		Zinc	3	mg/L			
23		Mercury	0.001	mg/L			
24		Aluminium	0.2	mg/L			
25		Residual Chlorine	0.1-0.2	mg/L	✓	✓	
26	Micro biological	*E.Coli* (MPN/100mL)	0		✓		
27		Total Coliform (MPN/100mL)	0 in 95%samples		✓	✓	
28	Others	Temperature	°C			✓	not included in NDWQS
29		Phosphate	mg/L			✓	not included in NDWQS

Figure 2.1 POTATEST (Wagtech, Left) and ENPHO Water Test Kit (Right)

The detail procedure of each Test Kit is shown in **Appendix 5-2** and **Appendix 5-3**.

2.2 Procedure of Water Quality Management for Surface Water

2.2.1 Pattern A: Sedimentation + Roughing Filtration + Slow Sand Filtration + Disinfection

(1) Target Water Quality at each Process

This water treatment process has four kinds of processes; pre-sedimentation, roughing filtration, slow sand filtration and disinfection. Each process has each target water quality. **Figure 2.2** shows the location to be checked and monitored water quality, and **Table 2.2** shows the target water quality at each suggested location.

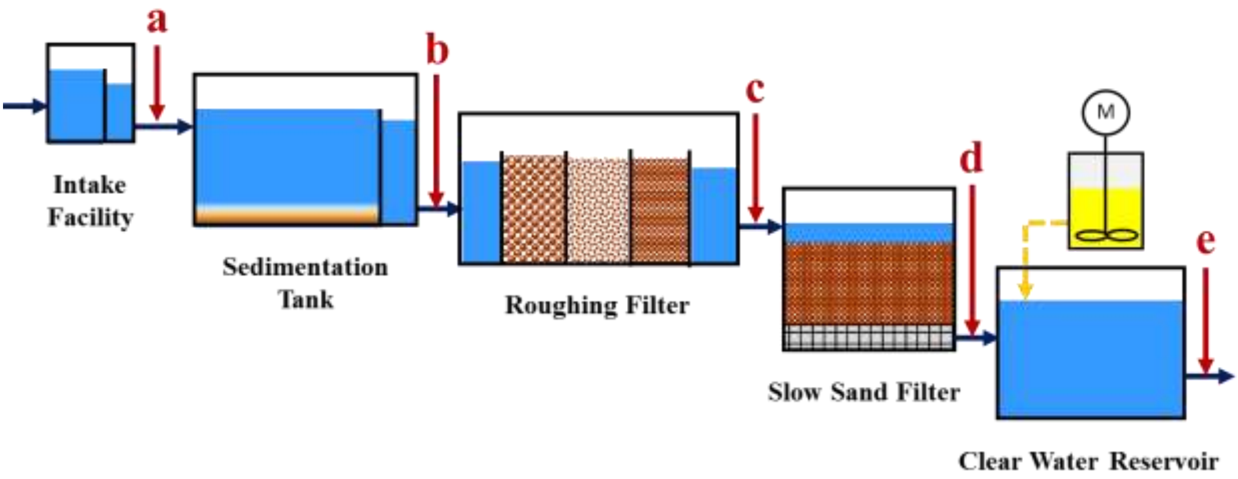
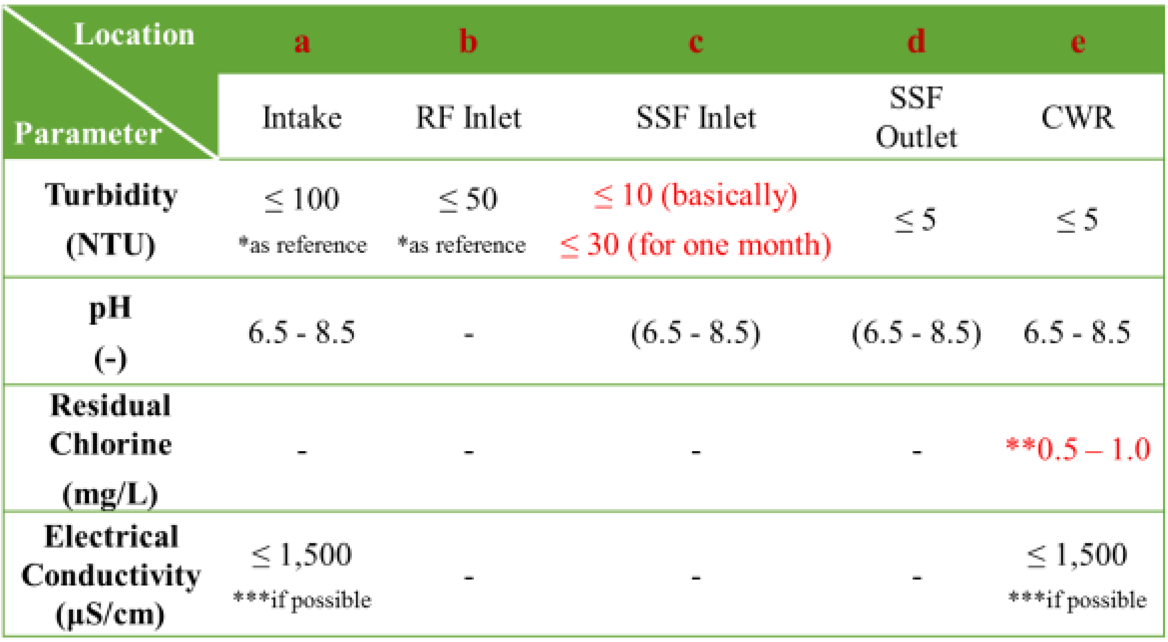


Figure 2.2 The Location to be Checked and Monitored Water Quality of Pattern A

Table 2.2 Target Water Quality at each Location of Pattern A



Location / Parameter	a	b	c	d	e
	Intake	RF Inlet	SSF Inlet	SSF Outlet	CWR
Turbidity (NTU)	≤ 100 *as reference	≤ 50 *as reference	≤ 10 (basically) ≤ 30 (for one month)	≤ 5	≤ 5
pH (-)	6.5 - 8.5	-	(6.5 - 8.5)	(6.5 - 8.5)	6.5 - 8.5
Residual Chlorine (mg/L)	-	-	-	-	**0.5 – 1.0
Electrical Conductivity (µS/cm)	≤ 1,500 ***if possible	-	-	-	≤ 1,500 ***if possible

* Turbidity of Raw Water and RF Inlet Water shall be checked as reference.

** Residual Chlorine shall be adjusted/controlled to keep the value at water tap between 0.1 and 0.2 mg/L.

*** In case that EC Meter is available, EC shall be checked.

(2) Water Quality Management at Intake (a)

1) Example of Sampling Point

Basically, **sampling point of each suggested location shall be selected by considering human safety**.

It is necessary to avoid slip, falling down or unusual positions etc.

Outlet of Intake Facility is suitable for sampling.

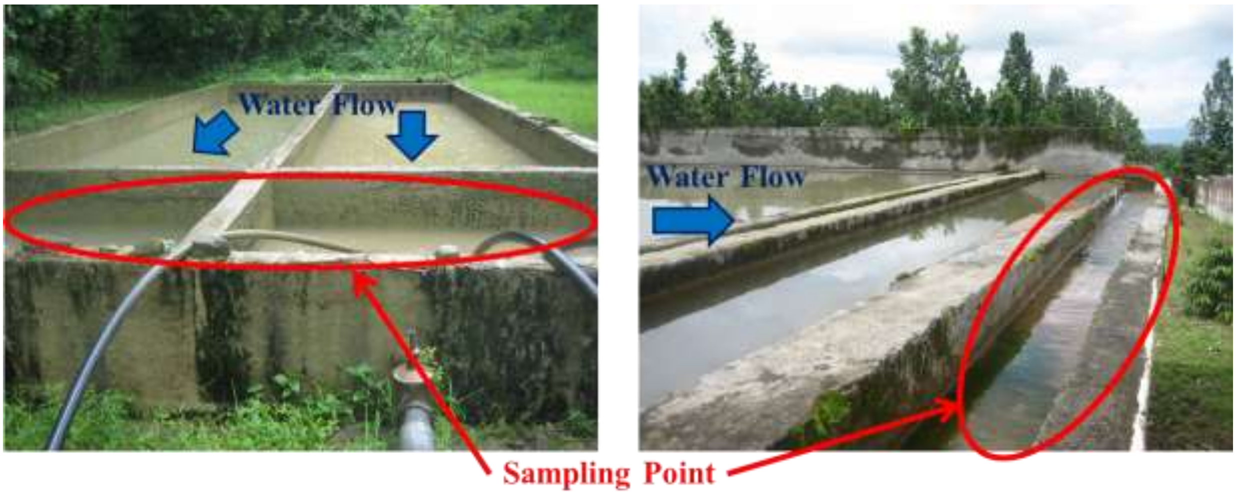
2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-1**.

- ✓ Turbidity
- ✓ pH
- ✓ EC (if possible)

(3) Water Quality Management at Sedimentation Tank (b)

1) Example of Sampling Point



Outlet of Sedimentation Tank is suitable for sampling.

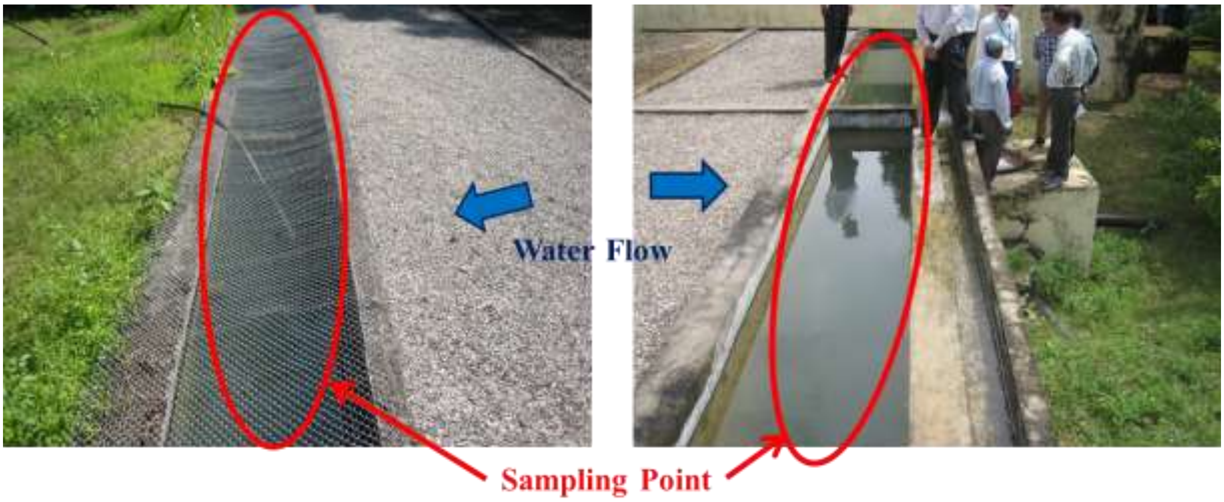
2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-1**.

- ✓ Turbidity
- ✓ pH

(4) Water Quality Management at Roughing Filter (c)

1) Example of Sampling Point



Outlet of Roughing Filter is suitable for sampling.

2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-1**.

- ✓ Turbidity

The target value of turbidity is **<u>less than 10 NTU normally</u>**. In case that it exceeds 10 NTU, allowable limit is **<u>less than 30 NTU for one month only</u>**.

In case that the turbidity of outflow is more than 10 NTU, the following measures shall be taken.

- Reduce the intake flow (by adjusting the opening of inlet valve)
- Stop intake (Close the inlet valve)
- Cleaning of RF ⇒See **Chapter 3, Water Treatment Facility, 2.1.1 (2)**
- Washing the filter media outside of RF ⇒See **Chapter 3, Water Treatment Facility, 2.1.1 (2)**

(5) Water Quality Management at Slow Sand Filter (d)

1) Example of Sampling Point

Outlet of Slow Sand Filter is suitable for sampling. It is necessary to avoid slip, falling down or unusual positions by using water sampler as shown in **Figure 2.3**.

Figure 2.3 Typical Type of Water Sampler

2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-1**.

- ✓ Turbidity

The target value of turbidity is **<u>less than 5 NTU</u>**.

In case that the turbidity of outflow is more than 5 NTU, the following measures shall be taken.

- Reduce the intake flow (by adjusting the opening of outlet or inlet valve)
- Stop intake (Close the inlet valve)
- Check the condition of surface biofilm, and measure dissolved oxygen value (desired value: 6-7 mg/L)

(6) Water Quality Management at Clear Water Reservoir (e)

1) Example of Sampling Point

Manhole of Clear Water Reservoir is suitable for sampling. It is necessary to avoid slip, falling down or unusual positions by using water sampler as shown in **Figure 2.3**.

2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-1**.

- ✓ Turbidity: Target value is l**ess than 5 NTU**
- ✓ pH: Target value is **6.5 to 8.5**
- ✓ Taste and Odor: Target value is **non-objectionable**
- ✓ Residual Chlorine: Target value is **0.1 to 0.2 mg/L (at the end point)**
- ✓ Color (if possible) : Target value is less than 5 TCU

2.2.2 Pattern B: Roughing Filtration + Slow Sand Filtration + Disinfection

This water treatment process has three kinds of processes; roughing filtration, slow sand filtration and disinfection except for sedimentation. Please check/monitor the point **a**, **c**, **d** and **e** as shown in **Figure 2.2**, chapter 2.2.1. The results of water quality shall be recorded in **Form 3.2-1**.

2.2.3 Pattern C: Disinfection only (for surface water source)

This water treatment process has disinfection process only. Please check/monitor the point **a** and **e** as shown in **Figure 2.2**, chapter 2.2.1. The results of water quality shall be recorded in **Form 3.2-1**.

2.3 Procedure of Water Quality Management for Ground Water

2.3.1 Pattern D: Aeration + Rapid Filtration + Disinfection (Iron Removal Process)

(1) Target Water Quality at each Process

This water treatment process has four kinds of processes; aeration, rapid filtration and disinfection. Each process has each target water quality. **Figure 2.4** shows the location to be checked and monitored water quality, and **Table 2.3** shows the target water quality at each suggested location.

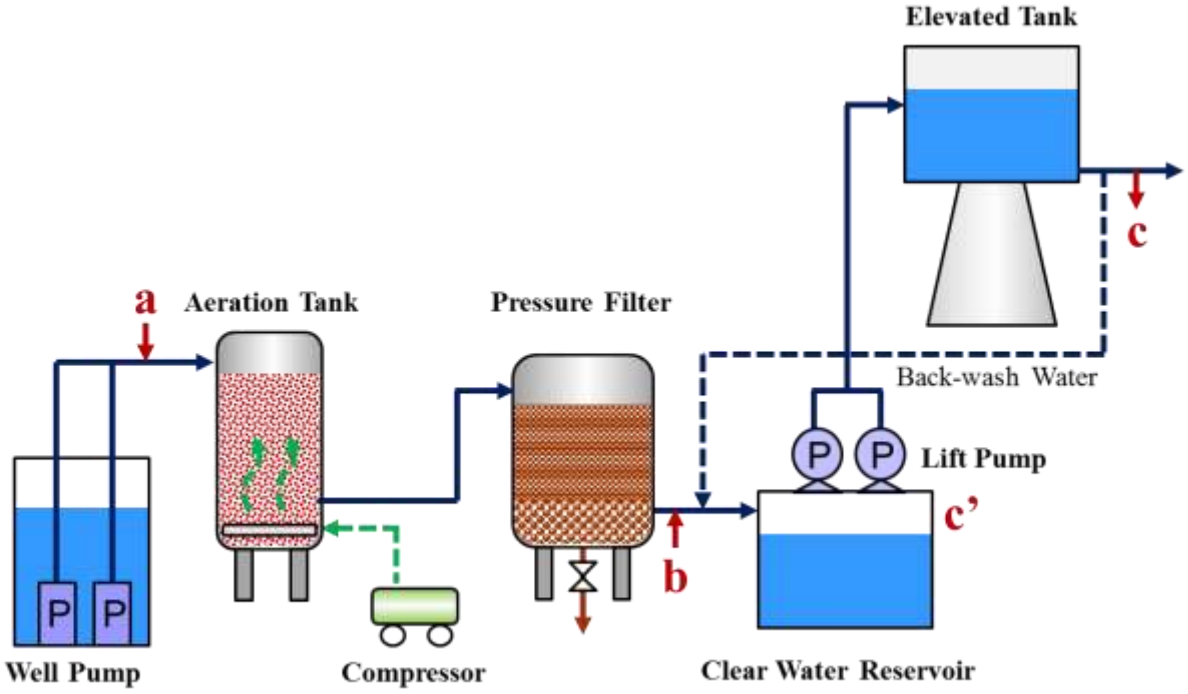


Figure 2.4 The Location to be Checked and Monitored Water Quality of Pattern D

Table 2.3 Target Water Quality at each Location of Pattern D

Location Parameter	a	b	c / c’
	Intake (Well)	PF Outlet	ET / CWR
Turbidity (NTU)	≤ 100 *as reference	≤ 5	≤ 5
pH (-)	6.5 - 8.5	(6.5 - 8.5)	6.5 - 8.5
Iron (mg/L)		≤ 0.3	≤ 0.3
R-Cl (mg/L)	-	-	**0.5 – 1.0
EC (μS/cm)	≤ 1,500 ***if possible	-	≤ 1,500 ***if possible

***1** Turbidity of Raw Water (at Intake) shall be checked as reference.

***2** Iron shall be checked at least once a year.

***3** Residual Chlorine shall be adjusted/controlled to keep the value at water tap between 0.1 and 0.2 mg/L.

***4** In case that EC Meter is available, EC shall be checked monthly.

(2) Water Quality Management at Intake/Well (a)

1) Example of Sampling Point

Wash out is suitable for sampling.

2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-2**.

- ✓ Turbidity

- ✓ pH
- ✓ EC (if possible)

(3) Water Quality Management at Pressure Filter (b)

1) Example of Sampling Point

Drainage is suitable sampling point to check the treated water of each Pressure Filter.

In case that the drain valve can’t be operated easily due to the problem with accessibility, the inlet of Clear Water Reservoir is also applicable as sampling point.

2) Water Quality Monitoring and Control

The following parameter shall be measured every day, and the results shall be recorded in **Form 3.2-2**.

- ✓ Turbidity

(4) Water Quality Management at Elevated Tank (c) or Clear Water Reservoir (c')

1) Example of Sampling Point

The following points is suitable for sampling of the Elevated Tank.

- ✓ Wash out installed on the distribution pipe
- ✓ Drainage

In case that the above points can't be used, the manhole of Clear Water Reservoir is applicable for sampling.

2) Water Quality Monitoring and Control

The following parameters shall be measured every day, and the results shall be recorded in **Form 3.2-2**.

- ✓ Turbidity: Target value is l**ess than 5 NTU**
- ✓ pH: Target value is **6.5 to 8.5**
- ✓ Taste and Odor: Target value is **non-objectionable**
- ✓ Residual Chlorine: Target value is **0.1 to 0.2 mg/L (at the end poitn)**
- ✓ Color (if possible) : Target value is less than 5 TCU

2.3.2 Pattern E: Disinfection Only (for ground water source)

This water treatment process has disinfection process only. Please check/monitor the point **a** and **c/c'** as shown in **Figure 2.4**, chapter 2.2.4. The results of water quality shall be recorded in **Form 3.2-2**.

2.4 Procedure of Water Quality Management for Distribution Facility

1) Location to be Checked and Monitored Water Quality

Water quality of distribution water should be checked and monitored

- at appropriate places
- at appropriate intervals (= frequency)

Methods and criteria of sampling are shown in "Paragraph 3 and 4 of Implementation Directives for National Drinking Water Quality Standard, 2062".

2) Methods and Sampling

In general the sample should be taken from distribution pipeline in gravity fed and pumping schemes. The sampling points should be fixed as follows;

- ✓ One sample point shall be selected for each 5 km of primary, secondary and tertiary distribution pipelines.
- ✓ Public stand posts shall be preferred as sampling points as far as possible
- ✓ If there is no public stand post the private tap connected with the shortest connection pipe should be taken as sampling point.
- ✓ If both public tap stands and private taps are not available, a sampling point should be on the distribution pipe line itself.
- ✓ In case of privately supplied hotels, industries, hospitals, commercial establishments, offices and residential buildings, the sample point should be the outlet of the water tank or reservoir.

3) Criteria for selection of Sampling Points

- ✓ The sample should be representative in terms of temporal and spatial variability of quality.
- ✓ The sampling points should be uniformly distributed throughout the distribution system taking in account of the population and number of branches.
- ✓ The samples should be taken from the reservoirs and storage tanks.
- ✓ For water quality monitoring and surveillance, in addition to the aforementioned points, with due attention to the contamination risk samples should be taken from source, low pressured zones of the distribution pipeline and pipe joints.

An example of suitable sampling points in the distribution network is shown in **Figure 2.5**.

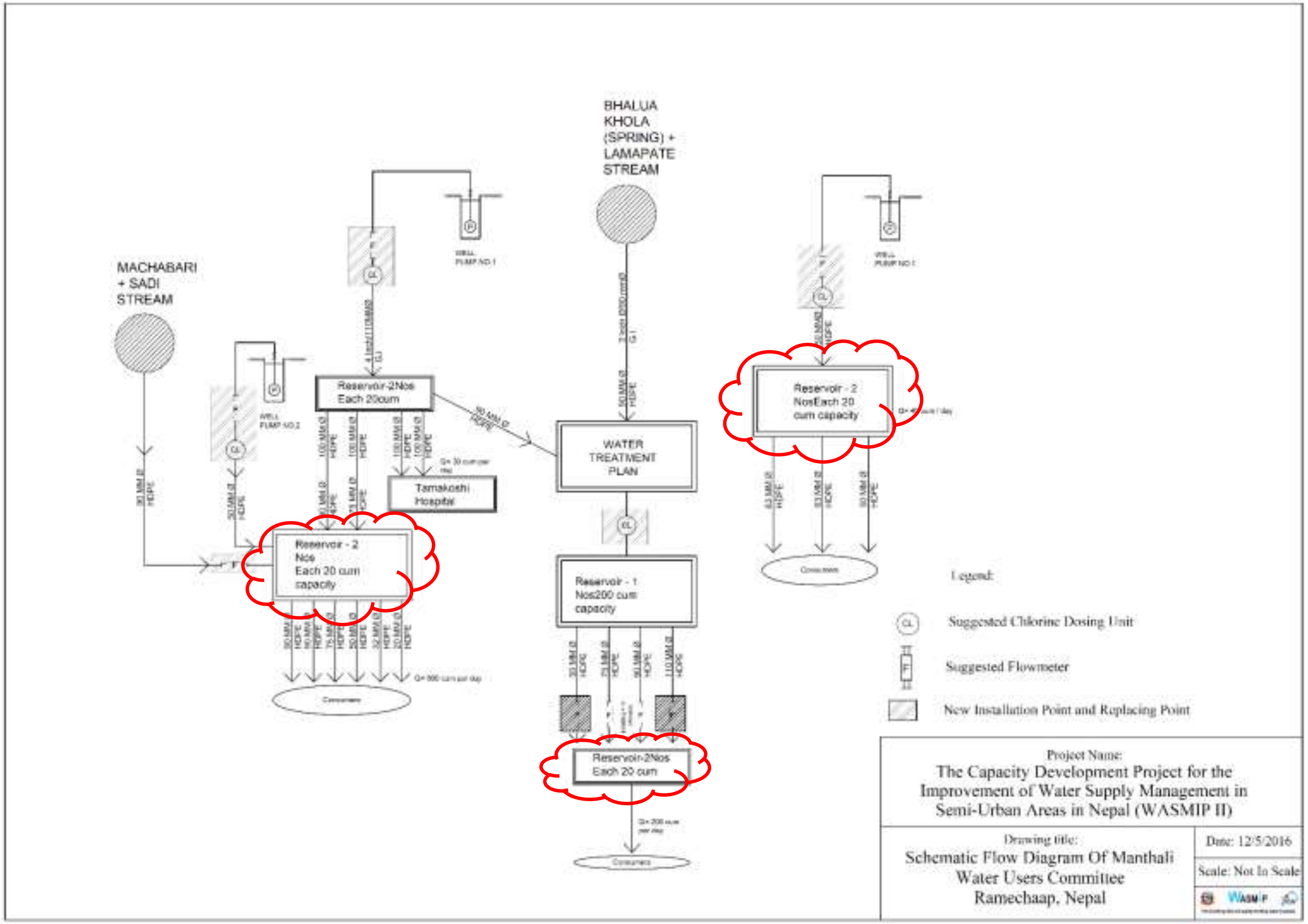


Figure 2.5 An Example of Suitable Sampling Points in the Distribution Network

2.5 Trouble Shooting

In case of water quality trouble, following measures should be taken in order to minimize its influence.

- ✓ Investigate the source
- ✓ Identify the causative substance
- ✓ Remove the causative substance
  (If impossible, it is necessary to stop water intake and distribution)
- ✓ Inform consumers / stakeholders

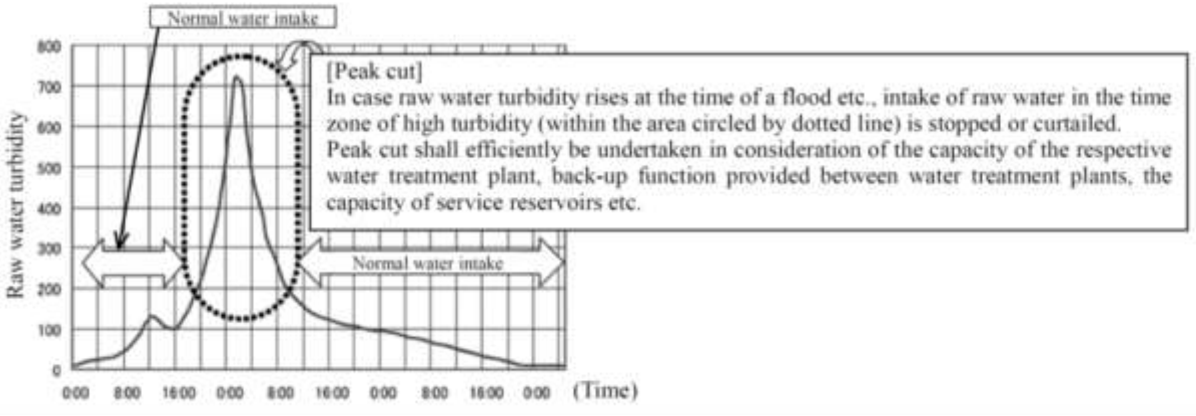
In order to take appropriate measures quickly, following advance preparations are necessary.

- ✓ Confirm the source of water pollutant around the intake point.
  It is necessary to confirm the place of sources, distance from sources to intake point and reaching time.
- ✓ Monitor raw water quality and abnormalities around intake point every day.
- ✓ Establish the reporting and contact system.
- ✓ Prepare the manual on water quality trouble.

2.5.1 Case 1: High Turbidity of Raw Water

Following action and measures are necessary.

- ✓ Measure / Monitor water quality of raw water and RF treated water at appropriate frequency.
- ✓ In case that engineer/operator get an information of heavy rain or the high turbidity of raw water is observed, measuring/monitoring of raw water turbidity shall be conducted more frequently.
- ✓ If the turbidity of RF treated water will exceed 30 NTU, the intake shall be stopped until the turbidity will decrease less than 30 NTU.
- ✓ The water level Clear Water Reservoir/Elevated Tank shall be monitored carefully, and also the distribution flow rate shall be controlled accordingly.
- ✓ In case that the distribution flow will be reduced or stopped, necessary information shall be provided to consumers.



[Peak cut]
In case raw water turbidity rises at the time of a flood etc., intake of raw water in the time zone of high turbidity (within the area circled by dotted line) is stopped or curtailed. Peak cut shall efficiently be undertaken in consideration of the capacity of the respective water treatment plant, back-up function provided between water treatment plants, the capacity of service reservoirs etc.

Figure 2.6 Outline of Peak Cut

Reference: "Water Supply Facilities Maintenance Manual 2006" (Japan Water Works Association)

2.5.2 Case 2: Contamination by toxic substances

Following action and measures are necessary.

- ✓ Stop water intake immediately.

  It is better to stop water distribution at the same time.

- ✓ Identify the toxic substance by the reaction of fish* or physicochemical method.

  * Reactions such as floating on a water surface or rolling.

- ✓ Inform consumer not to drink.

2.5.3 Case 3: Odor due to industrial or domestic wastewater

Following action and measures are necessary.

- ✓ Stop water intake according to the situation.
- ✓ Inform consumers.

  In case of low odor intensity, consumer can use (drink) tap water after boiling.

2.5.4 Case 4: Contamination by night soil or domestic wastewater

Following action and measures are necessary.

- ✓ Increase the dosing rate of post-chlorine.
- ✓ Stop water intake according to the situation.

- ✓ Inform consumers.

2.5.5 Case 5: Excessive chlorine dosing

Following action and measures are necessary.

- ✓ Stop water distribution.
- ✓ Drain treated water from reservoir or distribution main.

  In case that the R-Cl value of drain water is high, it is necessary to dechlorinate it. High R-Cl value may cause environmental damage such as the mass death of fishes.
- ✓ Inform consumers not to drink.

2.5.6 Case 6: Lack of chlorine dosing

Following action and measures are necessary.

- ✓ Stop water distribution.
- ✓ Increase the dosing rate of post-chlorine.
- ✓ Inform consumers not to drink.

2.5.7 Case 7: Red or black colored water at water tap

Red or black colored water at water tap due to iron oxide or manganese oxide.

Accordingly, following action and measures are necessary.

- ✓ Drain from distribution pipe.
- ✓ Control (= increase) pH value of treated water.
- ✓ Rehabilitate or replace distribution pipe.

2.5.8 Case 8: White colored water at water tap

White colored water at water tap due to fine bubbles or eluted zinc from galvanized pipe.

Accordingly, following action and measures are necessary.

- ✓ Identify the causative substance (fine bubble or Zn)
- ✓ In case that Zn will be detected,

- Drain from distribution pipe.
- Replace distribution pipe (to change the material of pipe).

Section 6

Repair Work

1 Outline of Repair Work

In order that a water supply system can work, various facilities and equipment composing water supply system have to work properly. Therefore, to maintain function of water supply system, influence which the system receive from problems and malfunction of each facility and equipment should be as minimum as possible.

There are following measures to minimize the influence of problems and malfunction;

(a) Procure/Store Stand-by Equipment

If WUSC has stand-by equipment, it is able to operate a water supply system continuously in case that malfunction of equipment occurs. Additionally, it is possible to have an enough time for repair work.

If it takes a time for repair parts procurement, securing stand-by equipment is recommended. (Lift pump, chlorine dosing pump, etc.)

(b) Procure/Store Spare/Repair Parts

If WUSC has spare/repair parts, it is able to repair equipment immediately. Therefore, spare parts and repair parts as shown below are recommended to procure and store.

- Spare parts of which replacement frequency is high
- Repair parts of which marketability is low

(c) Standardization of Type and Specification of Equipment

In a limited situation of budget and storage space, it is required that quantity and kinds of spare/repair parts should be reduced as much as possible. From this point of view, standardization of type and specification of equipment is effective. Additionally, procurement of spare and repair parts becomes easier by standardization of equipment specification.

(d) Cause Analysis of Problems and Malfunction of Equipment

Cause analysis helps to find out the main causes/problems and the parts damaged frequently etc. It is recommended to remove/solve the root cause of problems based on the result of cause analysis, so that problems including malfunction would be reduced. And also, it will be possible to procure/store the spare and repair parts with high frequency of replacement.

To conduct the analysis, records of malfunction and repair work shall be maintained properly.

(e) Securing Budget for Repair Work

To conduct O&M and repair work appropriately, budget is required. WUSC has to calculate/summarize the total cost of O&M and repair work every fiscal year, so that they can estimate and secure the budget of the next fiscal year. Therefore, the cost of O&M and repair work shall be recorded properly.

2 Standard Operation Procedure

2.1 Repair Work for Civil Structures

This procedure shows a procedure of repair work for civil structures, such as concrete structure of intake facility, water treatment facility, and service reservoir and so on. Before starting a repair work, necessary arrangement of material, tools and equipment shall be completed.

Procedure for Repair Work of Civil Structures
(i) Announce the duration of water supply suspension to customers. (if necessary)
(ii) Confirm the situation and take photos before starting the repair work.
(iii) Conduct necessary preparation work including valve operation.
(iv) Conduct repair work.
(v) Take photos after the completion of repair work
(vi) Conduct cleaning, necessary valve operation and resume water supply operation
(vii) Prepare a repair work report as shown in **Form 3.6-1**.

【Supplemental Explanation】

- **Regarding Procedure (i)**: If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work, period of the suspension etc. to customers.

2.2 Repair Work for Pipelines

This procedure shows a procedure of repair work for pipelines. Before repair work, necessary arrangement for material, working tools and machines shall be completed.

Procedure for Repair Work of Pipelines
(i) Announce the duration of water supply suspension to customers. (if necessary)
(ii) Confirm the situation and take photos before starting the repair work.
(iii) Conduct preparation work and necessary valve operation for isolation of water leakage pipeline.

Procedure for Repair Work of Pipelines
(iv) Conduct repair work. (v) Take photos after the completion of repair work (vi) Conduct cleaning, necessary valve operation and resume water supply operation (vii) Prepare a repair work report as shown in **Form 3.6-2**.

【**Supplemental Explanation**】

- **Regarding Procedure (i)**: If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work, period of the suspension, possibility of turbid water at water tap etc. to customers.

2.3 Repair Work for Mechanical and Electrical Equipment

This procedure shows a procedure of repair work for mechanical and electrical equipment. Before starting a repair work, necessary arrangement of material, tools and equipment shall be completed.

Procedure for Repair Work of Mechanical/Electrical Equipment
(i) Announce the duration of water supply suspension to customers. (if necessary) (ii) Confirm the situation and take photos before starting the repair work. (iii) Conduct necessary preparation work including valve operation and isolation of power supply if necessary. (iv) Conduct repair work by supplier/manufacturer. (v) Take photos after the completion of repair work (vi) Conduct cleaning, necessary valve operation and resume water supply operation (vii) Prepare a repair work report as shown in **Form 3.6-3**.

【**Supplemental Explanation**】

- **Regarding Procedure (i)**: If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work, period of the suspension etc. to customers.

Section 7

Report of Inspection Result

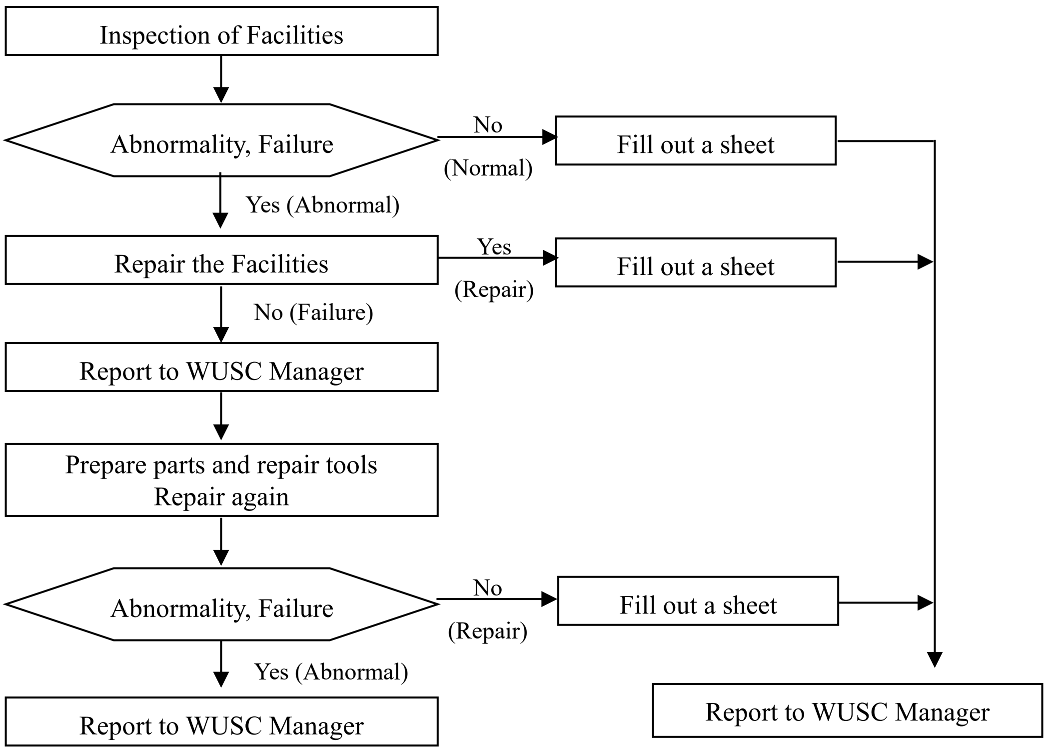
1 Standard Operation Procedure

Report procedures in daily work and emergency are shown in the section.

1.1 Report of Inspection and Repair Work in Daily Work

At the time of the regular investigation of the water supply facilities, WUSC staffs make inspection records, and report them to the manager of WUSC. When the abnormalities and problems in the water facilities are detected, staffs repair it and inform the result to the manager of WUSC. The responsible person of WUSC has to report and/or request WSSDO to support if necessary.

Report Procedure of Inspection and Repair Work in Daily Work



1.2 Report in Emergency

In case of emergency, the top priority is to protect life of residents/WUSC staff and to secure safety. In order to inform rapidly, WUSC staff need to identify the fact properly and inform it to the manager/board members immediately. The manager/board members must make a decision whether it is necessary to inform residents or not, collect accurate information or not. Contact network system of each WUSC shall be established so that residents can provide information to WUSC.

Emergency situations are classified into;

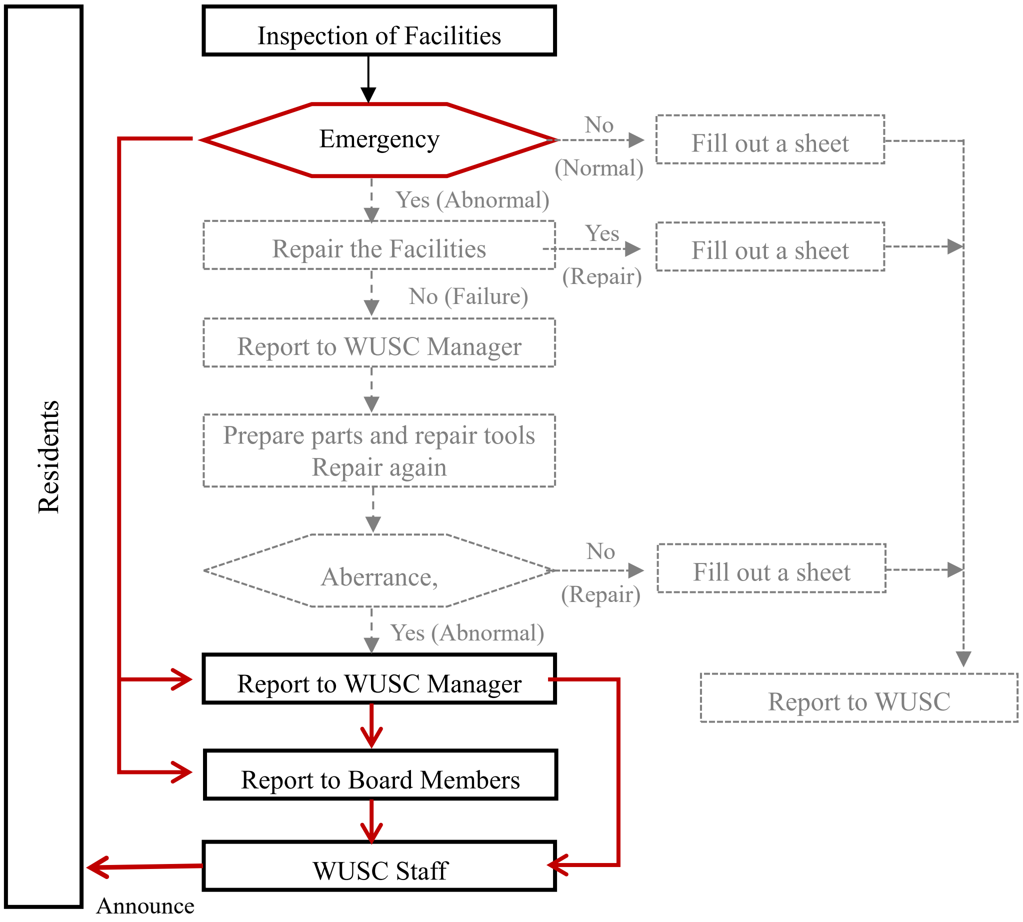
- (i) Suspension of water supply (large scale power failure, damage of facilities, water contamination etc.)
- (ii) Natural disaster (earthquake, damages caused by floods, landslide, fire disaster, abnormal climate, infectious disease)
- (iii) Terrorism (threat, destructive activities)

The emergency in this SOP is defined as (i) suspension of water supply.

The procedures under the emergency situation are shown below.

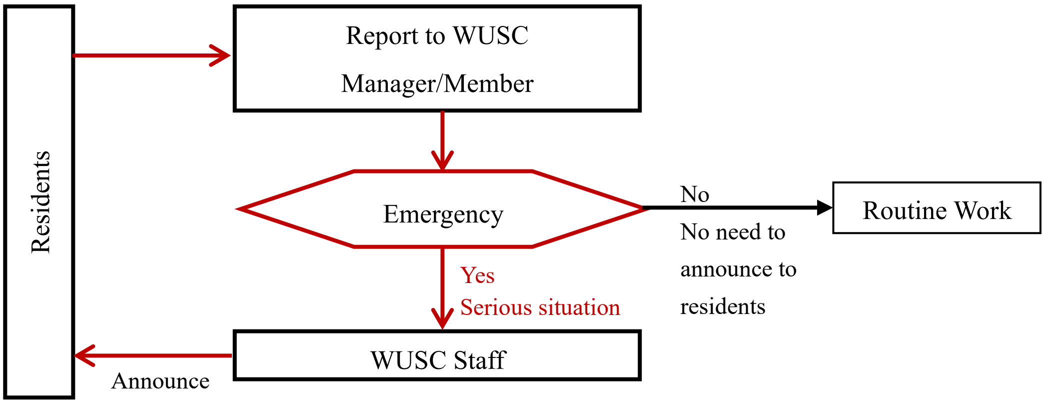
Report Procedure in Emergency

In Case that Serious Problems is Found out by WUSC Staff



Report Procedure in Emergency

In Case that Serious Problems Found out by Residents



Section 8

Analysis of Water Supply Amount

1 Analysis of Water Flow

WUSC is able to know the condition of the facilities by analyzing water flow data. For example, water loss in raw water pipeline is estimated comparing water flow data between at water source and at receiving well. Water loss in water distribution pipelines is estimated comparing water flow data between bulk flow meter of a service reservoir and sum of customers' water meter value. If WUSC has a data, it is possible to diagnose the condition of facilities by itself.

In this section, introduce diagnosis procedure by using water flow amount data.

2 Standard Operation Procedure

By a simple comparison of water flow data, WUSC can estimate water loss and its ratio roughly in water supply facilities. WUSC is able to decide the necessity of water supply facility improvement based on the result of estimation.

Report Procedure of Rough Estimation of Water Loss and Loss Ratio

Water Loss in Raw Water Transmission Facility

(i) Calculate monthly water flow (Q1) at water sources.

(ii) Calculate monthly water flow (Q2) at receiving well in WTP.

(iii) Water loss in a raw water transmission facility is Q1-Q2.

(iv) Water loss rate in a raw water transmission facility is (Q1-Q2)/Q1.

Water Loss in Distribution Facility

(v) Calculate monthly water flow (Q3) at a service reservoir.

(vi) Calculate monthly water consumption (Q4) from reading value of customer meter.

(vii) Water loss in distribution networks is Q3-Q4.

(viii) Water loss rate in distribution networks is (Q3-Q4)/Q3.

【Supplemental Explanation】

- **Regarding Procedure (i)**: If there are plural water sources, water flow amount of all water sources has to be added up.

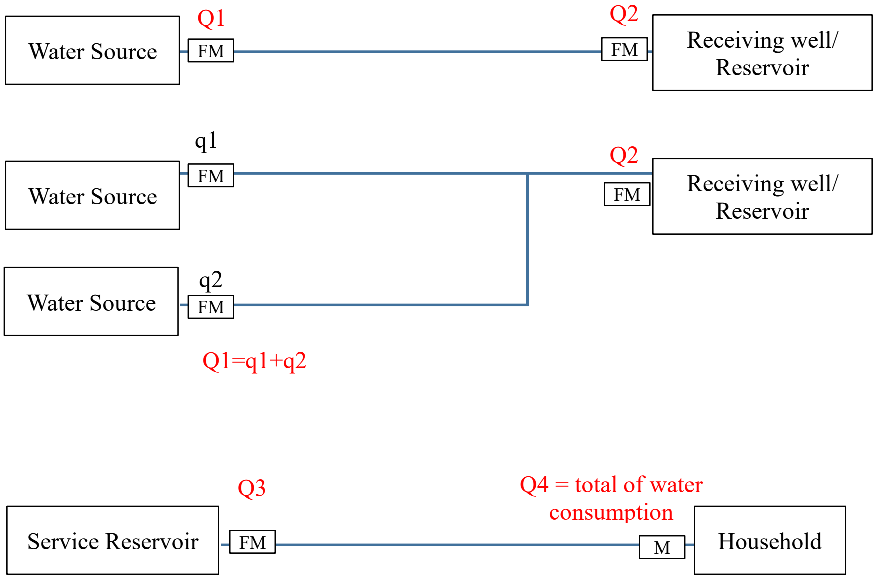


Figure 2.1 Water Flow Dater for Rough Water Loss Estimation

Appendix 2.16

SOP Final Version Appendix

List of Appendixes

Appendix 2-1	MSDS of Bleaching Powder
Appendix 2-2	Manual of Electrical Measuring Devices
Appendix 2-3	SOP of Rapid Sand Filter
Appendix 5-1	Outline of 27 Water Quality Parameters
Appendix 5-2	POTATEST Manual

GRASIM INDUSTRIES LIMITED
CHEMICAL DIVISION
BIRLAGRAM, NAGDA (M.P.)

MATERIAL SAFETY DATA SHEET

STABLE BLEACHING POWDER

1. IDENTIFICATION OF THE PRODUCT AND COMPANY

1.1.	Product Name	:	Stable Bleaching Powder (Calcium Hypochlorite)
1.2.	Chemical Formula	:	Ca $(OCl)_2$
1.3.	Use	:	Disinfections, Sanitation, Bleaching Oxidation, etc.
1.4.	Manufacturer	:	**GRASIM INDUSTRIES LIMITED** **CHEMICAL DIVISION** **BIRLAGRAM, NAGDA (M.P.) INDIA** **Tel.:0091-7366-246760-66** **Fax: 0091-7366-246767** **E-Mail:grasimchem@adityabirla.com**
1.5.	Supplier	:	

2. COMPOSITION & IDENTIFICATION INGREDIENTS

2.1.	Chemical Identity	:	Calcium Hypo Chlorite
2.2.	Ingredients	:	Calcium Hypo Chlorite 35% Available Chlorine

3. HAZARD IDENTIFICATION

3.1. Oxidising Substance, Class - 5.1

4. FIRST – AID MEASURES

4.1.	Skin and Eye Contact	: Promptly wash the affected area with plenty of water and obtain medical attention immediately.
4.2.	Inhalation	: Move the victim to fresh Air, obtain medical attention. In case of respiratory failure provide artificial respiration.
4.3.	Ingestion	: Have victim rinse mouth thoroughly with water & drink plenty of water to dilute material in the stomach. But never give anything by mouth if victim is unconscious. Obtain medical attention immediately.

5. FIRE FIGHTING MEASURES

5.1.	Extinguishing Media	: Water
5.2.	Unsuitable Extinguishing Media	: Not Known
5.3.	Special Exposure Hazards	: Chlorine Gas
5.4.	Special Protective Equipment	: Self contained Breathing Apparatus
5.5.	Combustion Products	: Non Combustible but decomposes due to heat

6. ACCIDENTAL RELEASE MEASURES

6.1.	Personal Precautions	: Avoid Eye & Skin contact. Avoid inhalation. Use appropriate personal protective equipments.
6.2.	Environmental Precautions	: Prevent material entering to sewers or confined spaces.
6.3.	Clean up procedure	: Do not touch spilled material. Prevent it entering sewers. Dry manual lifting of spilled material is suggested.

7. HANDLING AND STORAGE

7.1.	Handling Precautions	: Avoid generating dust. Avoid skin & eye contact. General ventilation is required.
7.2.	Storage	: Store tightly closed containers in cool, dry & well-ventilated place. Keep away from sunlight. Keep away from combustible materials.

7. HANDLING AND STORAGE

7.3.	Incompatible Materials	:	Acids, organic compounds, Metal oxides, Ammonia, urea & amines etc.
7.4.	Other Information	:	The storage area should have a non-combustible & corrosion resistant floor.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

8.1.	Exposure Controls	:	Adequate ventilation. Process or Personnel enclosures, P.P.E. etc. Avoid dust generation.
8.2.	Personal Protective Equipment	:	
8.2.1.	Respiratory Protection	:	Anti Dust mask & Respirator with an acid gas cartridge for chlorine.
8.2.2.	Eye Protection	:	Chemical Safety Goggles & face shield
8.2.3.	Skin Contact	:	Impervious rubber hand gloves, coveralls, boots etc.
8.2.4.	Hygiene Measures	:	Wash hands with soap & water thoroughly after handling, especially before eating. Also change contaminated clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1.	Appearance		
9.1.1.	Form	:	Powder
9.1.2.	Colour	:	White
9.1.3.	Odour	:	Chlorine Odour
9.2.	Safety Data		
9.2.1.	pH	:	11.5 (5% Solution)
9.2.2.	Boiling Point	:	Not Applicable
9.2.3.	Melting Point	:	Decomposes at temperatures above 100 degree C
9.2.4.	Flash Point (Closed Cup)	:	Not Applicable
9.2.5.	Flammability (Solid, Gas)	:	Not Combustible
9.2.6.	Auto flammability	:	Not Applicable
9.2.7.	Explosive Properties	:	Strong Oxidising Agent, so it has serious fire and explosion risk
9.2.8.	Oxidising Properties	:	Strong Oxidiser
9.2.9.	Vapour Pressure	:	Not Applicable
9.2.10.	Bulk Density	:	0.9 – 1.3 gm/cc

9. PHYSICAL AND CHEMICAL PROPERTIES

9.2.11. Solubility

In water : 23.4 gms/100 ml. Water at 40 degree C

In solvents : Not Known

9.2.12. Partition coefficient (Water) : Not Known

9.3. Other Data

9.3.1. Vapour Density : Not Applicable

9.3.2. Evaporation Rata : Not Applicable

9.3.3. Conductivity : Not Known

9.3.4. Viscosity : Not Applicable

9.3.5. Volatiles : Non Known

10. STABILITY AND REACTIVITY

10.1. Stability : Normally unstable (losses available chlorine by 2% on heating at 100 degree C).

10.2. Reactivity : Reactive

10.3. Conditions to avoid : Excessive Heat

10.4. Materials to avoid : Incompatible Materials (See 7.3)

10.5. Hazardous decomposition (Products) : Nacent Oxygen, Chlorine, Calcium Chlorate

11. TOXICOLOGICAL INFORMATION

11.1. Health Effects

11.1.1. Skin & Eye : Dust can cause eye irritation. Solution can cause chemical burns.

11.1.2. Inhalation : Dust may irritate nose, throat & upper respiratory tract.

11.1.3. Ingestion : May cause burns to the mouth & digestive tract.

11.2. Other effects : Skin irritation may occur from repeated or prolonged skin contact.

11.3. LD$_{50}$ Oral (Rat) : 805 mg/Kg.

12. ECOLOGICAL INFORMATION

12.1. Mobility : No

12. ECOLOGICAL INFORMATION

12.2. Persistence and Degradability	:	Degradable
12.3. Bioaccumulative Potential	:	Not determined
12.4. Ecotoxicity	:	Non-Toxic
12.5. Behaviour in Sewage	:	Imporves sewage quality.

13. DISPOSAL CONSIDERATIONS

13.1. Product Disposal	:	Untreated SBP waste must never be discharged directly in to sewers. Review National / Regional regulations
13.2. Packaging Disposal	:	Packing material does not get contaminated & can be disposed off by usual methods in accordance with National or Regional requirement.

14. TRANSPORT INFORMATION

14.1. UN No. & Symbols	:	2208, "Oxidizing Substance".
14.2. Road and Rail Transport (ADR/RID)	:	Not Known
14.3. GGVE / GGVS	:	Not Known
14.4. IMDG Code	:	Not Known
14.5. Air Transport (ICAO/IATA)	:	Not Known
14.6. P Phrases	:	Not Known
14.7. S Phrases	:	Not Known

15. REGULATORY INFORMATION

15.1. Health and Safety Information on Labels	:	Oxidising Material Class – 5.1
15.2. RTECS	:	Not Known

16. OTHER INFORMATION

The information & date contained in the "Material Safety Date Sheet" is drawn from following sources:

a) CIS (No. C40) of Indian Chemical Manufactures Association

b) CHEMINFO of Canadian Centre of Occupational Health & Safety.

c) Our own experience.

NOTE:

Above "Material Safety Date Sheet" is for information only. GRASIM INDUSTRIES LIMITED, Chemical Division does not take any guarantee or legal liability under any circumstances for the same. The Physical data presented herein does not purport to be the specifications.

Orientation on Electrical Measuring Devices

WASMIP-II

April 9 , 2018

Gaidakot

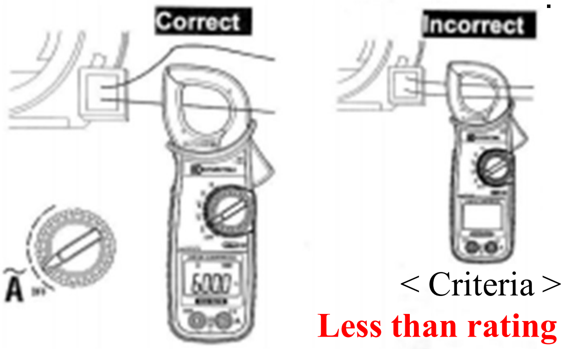
1.Digital Clamp Meter

1.1 Measurements

- Press the trigger to open the current sensor and clamp the one conductor under test.

1.1.1 ACA

- Set the function switch to ACA position.

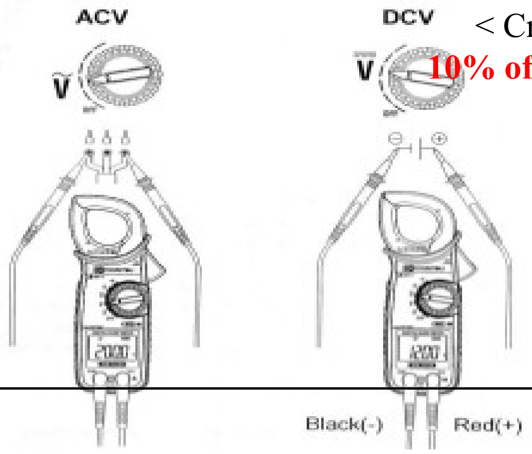


< Criteria >

Less than rating value

1.1.2 ACV/DCV

- Set the function switch to ACV or DCV position.
- Connect the test leads to V/Ω and COM terminals

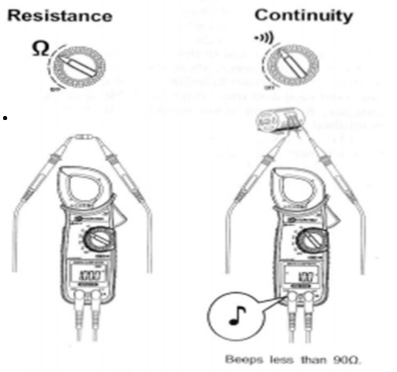


< Criteria >

10% of rating value

1.1.3 Resistance (Continuity) Measurement

- Set the function switch to resistance or continuity position.
- Connect the test leads to V/Ω and COM terminals.



1.1.4 Hold Function

•Press the Hold key. “ H” will be displayed.

•Press the Hold key again to release the display.

1.1.5 Sleep Function.

•Automatically powers off the instrument in about 10 min after the last switch or key operation.

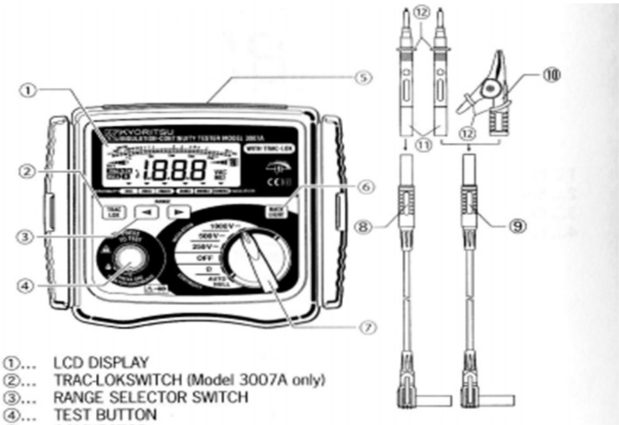
•Press the HOLD key and power on the instrument to disable the sleep function.

1.1.6 Battery Replacement

- Replace the batteries when a “BATT” mark is indicated on the LCD.
- Do not try to replace the batteries if the surface of the instrument is wet.
- Disconnect the test leads from the object under test and power off the instrument before opening the battery compartment cover for battery replacement.
- Do not mix old and new batteries.

2. Digital Insulation - Continuity Tester

2.1 Instrument Layout



①... LCD DISPLAY
②... TRAC-LOKSWITCH (Model 3007A only)
③... RANGE SELECTOR SWITCH
④... TEST BUTTON
⑤... CONNECTOR
⑥... BACK LIGHT SWITCH (Model 3007A only)
⑦... FUNCTION SWITCH
⑧... TEST PROBE (RED)
⑨... TEST PROBE (BLACK)
⑩... ALLIGATOR CLIP (BLACK)
⑪... PLOBE (BLACK & RED)
⑫... BARRIER

LCD Display

1... INSULATION RESISTANCE SCALE
2... BAR GRAPH
3... CONTINUITY SCALE
4... LIVE CIRCUIT WARNING

	AC LIVE CIRCUIT WARNING	DISCHARGE VOLTAGE
SAFE	0~2V	0~2V
◄ ϟ	3~30V	3~60V
◄▮ ϟ	31~60V	61~120V
◄▮▮ ϟ	61~120V	121~240V
◄▮▮▮ϟ	120V over	240V over

5... TRACK/LOK MODE
6... AUTONULL OPERATION
7... BATTERY VOLTAGE WARNING
8... CONTINUITY/INSULATION RESISTANCE RANGE SETTING
9... UNIT

UTPUT VOLTAGE GRAPH (INSULATION RESISTANCE)

	FUNCTION SETTING PER RATED OUTPUT VOLTAGE
◄	1~24%
◄▮	25~49%
◄▮▮	50~74%
◄▮▮▮	75~99%
◄▮▮▮▮	100% or over

.PUT VOLTAGE RANGE
12... MEASUREMENT VALUES

2.2 Preparation for Measurement

- The cover can be detached and put on the back side of the main body during measurement.

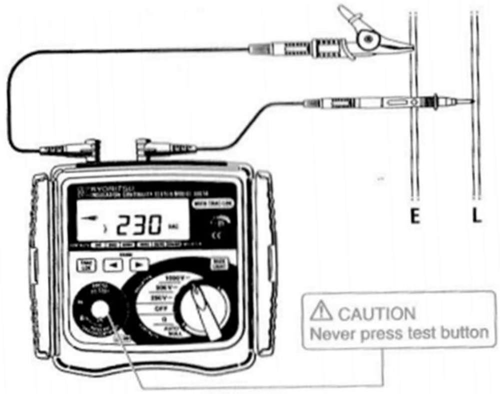
lethod of removing the cover

Method of storing the cover

2.3 Operation

2.3.1 Voltage Check

- Connect the test probe (black) to the earth side and the test probe (red) to the line side of the circuit under test.
- Ensure that the live circuit warning is not lit and the audible warning is not present.
- If the live circuit warning is lit and the buzzer sounds, never press the test button.
- Re-check that the breaker for the circuit under test is "OFF".

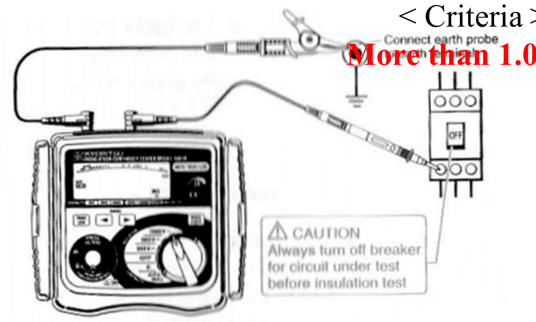


DANGER!

- Do not perform measurements on energized live circuits.
- Always keep your fingers and hand behind the barrier on test probe to avoid the possible shock hazard.
- Never make measurements with battery compartment cover removed.

2.3.2 Insulation Resistance Measurement

- Set the function switch to the desired range.
- Connect the test probe (black) to the earth terminal of the circuit under test.
- Put the tip of the test probe (red) to the circuit under test and press the test button. The buzzer sounds intermittently during measurement.
- Read the resistance value from the LCD.
- Keep the test probe still connected to the circuit under test, release the test button to discharge capacitance in the circuit after measurement.



< Criteria >

More than 1.0 MΩ

- Never press the test button if the live circuit warning is indicated or the warning buzzer sound. This may damage the circuit.
- Conduct the voltage warning check before measurement to ensure that the circuit under test is de-energized.
- Do not touch the circuit under test immediately after testing.

2.3.3 Continuity Measurement (Resistance Tests)

- Set the Function switch to “AUTO NULL” position.
- Short the test probes (red) and (black) and press the test button. The resistance of the test probes is displayed and memorized with microprocessor.
- Set the Function switch to “Ω”.
- Connect the test probes to the circuit under test and press the test button.
- Read the resistance value from the LCD.

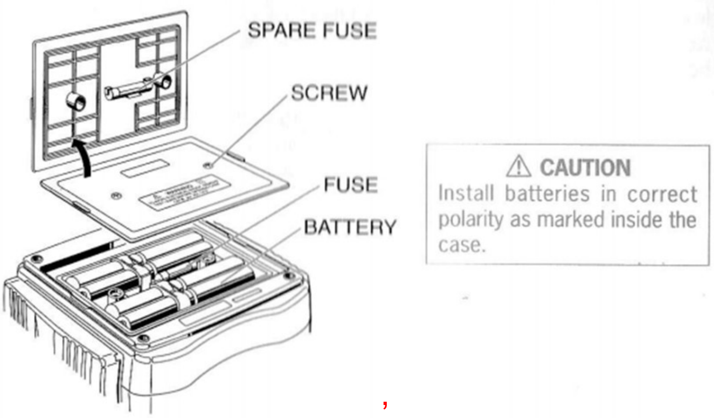
2.4 Battery and Fuse Replacement.

BATTERY

- Disconnect the test probes from the instrument.
- Open the battery compartment cover by unscrewing the metal screw.
- Replace all eight batteries with new ones.

FUSE

- Disconnect the test probe from the instrument.
- Open the battery compartment cover by unscrewing the metal screw.
- Replace the fuse.

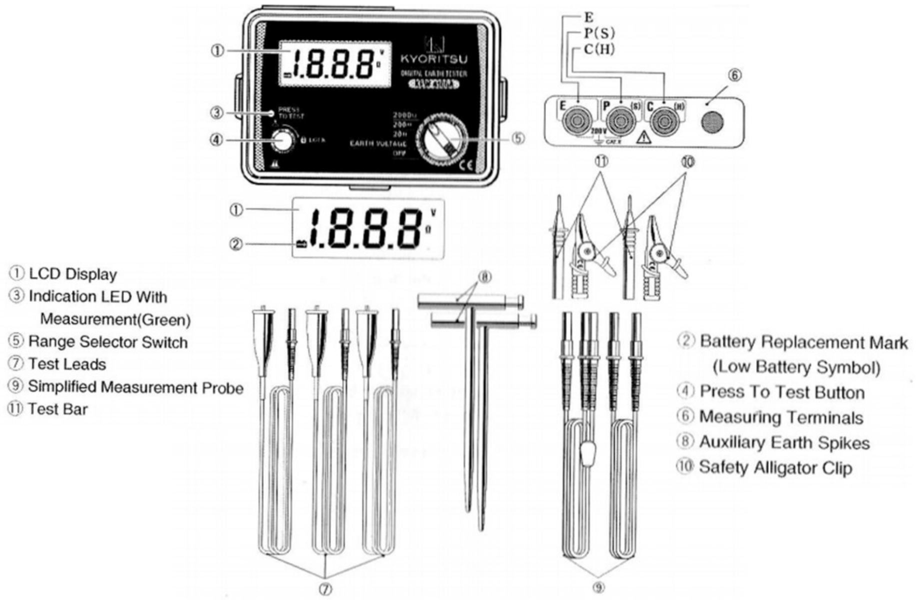


⚠ CAUTION
Install batteries in correct polarity as marked inside the case.

- To clean the instrument, wipe it with silicon cloth or soft cloth to remove dust or dirt.
- Never use any solvent such as benzene acetone etc.

3. Digital Earth Tester

3.1 Layout Diagram



3.2 Preparation for Measurement

Battery Voltage Check

- Turn on the instrument. If the display is clear without low battery symbol showing, battery voltage is sufficient.
- If the display blanks or low voltage is indicated,, replace the batteries.

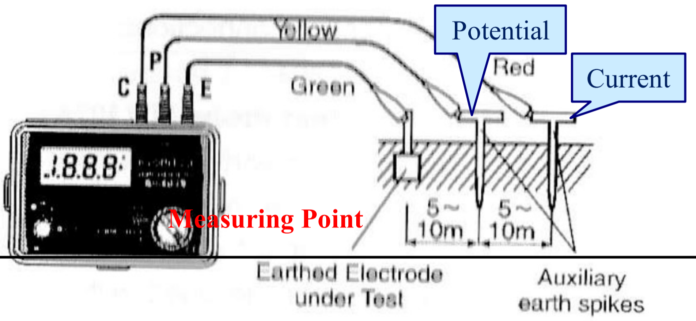
Connecting Test Probe.

- Insert the plug of the probe securely into the terminals of the instrument.
- Loose connection may result in inaccurate measurements.

3.3 Precise Measurement

Test Probe Connection

- Stick two auxiliary earth spikes into ground deeply.
- Aligned at an interval of 5-10m (from earthed equipment)
- Connect green wire on earthed equipment, yellow on Potential spike and red on Current spike as shown in drawing.



< Criteria >

Less than 10 Ω

Earth Voltage Measurement

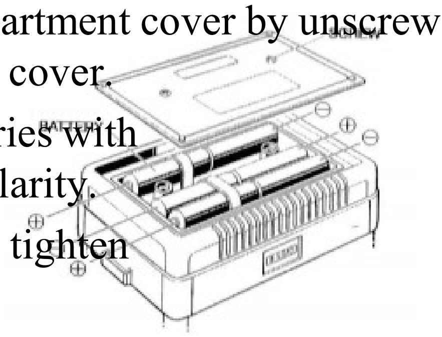
- Set the range switch to Earth Voltage position.
- Earth Voltage will be displayed (should be 3V or less, more than 3V may result in excessive errors)
- Make measurement after reducing voltage by turning off the power of the equipment under test.

Precise Measurement

- Initially set the range switch to 2000Ω and press test button.
- Set the value to 200 Ω and 20 Ω if Earth resistance is very low.
- The value displayed is the Earth Resistance.

3.4 Battery Replacement

- Turn off the Device
- Disconnect the test probes from the instrument.
- Open the battery compartment cover by unscrewing the metal screw on battery cover.
- Replace all eight batteries with new ones in correct polarity.
- Put back the cover and tighten the screws.



4. Safety Work

Please use the following safety tools for your s

Thank you all

Appendix 2-3

SOP of Rapid Sand Filter

1 Detailed Operating Procedure

1.1 Operation Management

(1) Rapid Sand Filter (Self Backwashing Type)

1) Operation and Maintenance Procedure

Operation procedure, monitoring/inspection points, measures and trouble shootings of Rapid Sand Filter (Self Backwashing Type, hereafter RSF) are shown as follows.

<table>
<tr><th colspan="3">Rapid Sand Filter (Self Backwashing Type)</th></tr>
<tr><td colspan="3">
Chandragadi-I WUSC</td></tr>
<tr><th>Frequency</th><th>Monitoring / Inspection Points</th><th>Measures</th></tr>
<tr><td rowspan="2">Daily</td><td>✓ Turbidity (Outlet)</td><td>✓ Check raw water quality (especially microorganism).
✓ Check/control the condition of coagulation, flocculation and clarification process.
✓ Check/adjust filtration rate.
✓ Control/change the duration/frequency of backwash.</td></tr>
<tr><td>✓ Filtration rate (as per the design value)</td><td>✓ Adjust the valve opening.
✓ Check Well Pump.</td></tr>
</table>

Frequency	Monitoring / Inspection Points	Measures
Daily	✓ Filtration resistance	✓ Control/change the duration/frequency of backwash. ✓ Check/control the condition of coagulation, flocculation and clarification process. (mainly due to carry over of floc) ✓ Check the condition of filter media.
	✓ Flow rate of backwash	✓ Adjust the valve opening. ✓ Adjust the flow rate of backwash pump.
	✓ Appearance of backwash waste water	✓ Control/change the duration/frequency of backwash.
Yearly	✓ Leakage or other abnormality on tank body, related piping and valves	✓ Repair.
	✓ Condition of filter media (Dirtiness, Thickness, Unevenness, Mud-ball etc.)	✓ Check ✓ Replenish (if thickness is decreased.) ✓ Replace (if necessary or every 10-15 years).
	✓ Condition of walls, trough and other components	✓ Check ✓ Clean/repair (if necessary)
Every 10 years	✓ Condition of underdrain system	✓ Check ✓ Clean/repair (if necessary)

a) Operation Procedure

A typical flow diagram of self backwashing type RSF is shown in **Figure 1.1**. The operation shall be conducted as follows.

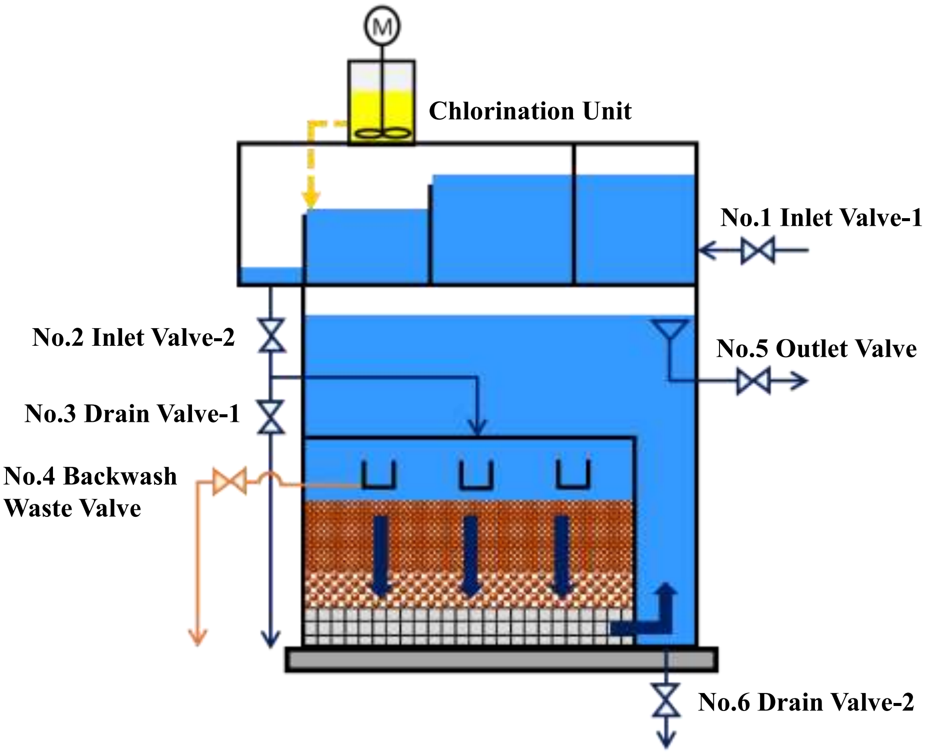


Figure 1.1 Typical Flow Diagram of RSF (Self Backwashing Type, Chandragadi-I WUSC)

- Preparation before operation
  i. Check the condition of filter media (volume/thickness, evenness of surface, mud ball, dirtiness etc.)
  ii. Check the appearance of RSF, related valves and pipes whether leakage or other abnormality is observed or not.
  iii. Close all related valves fully.
  iv. Check / record the Voltage, Ampere and Frequency of power incoming on the control panel.
  v. Check / record the water level of the related tanks.
  vi. Check / record the condition of the chlorination unit.

- Starting Operation (filtration)
  i. Open the Inlet Valve-1 (No.1 in Figure 1.1), Inlet Valve-2 (No.2 in Figure 1.1) and Drain Valve-1 (No.3 in Figure 1.1).
  ii. Check the appearance of drained water.
  iii. After the appearance of drain water is clean enough, open the Drain Valve-2 (No.6 in Figure 1.1) and close the Drain Valve-1.
  iv. Check the appearance of drained water.
  v. After the appearance of drain water is clean enough, open the Outlet Valve (No.5 in Figure 1.1) and close the Drain Valve-2.
  vi. Check whether each inflow or filtration rate is design value or not. If not, adjust the opening of Inlet Valve-2.
  vii. Check / record the inflow or filtration rate and water level of each filter.

- Normal Operation (filtration)
  i. Check / record the turbidity of treated water, the inflow or filtration rate and water level of each filter periodically (at least once a day).
  ii. Conduct back-wash of each filter every 24 hours in accordance with the procedure shown in the next chapter
  iii. Check the flow rate of back-wash and the appearance of back-wash wastewater.
  iv. Conduct the daily monitoring and inspection work as shown in the above table, and record the results into the Form 3.2-1.

- Procedure of Back-wash

The back-wash procedure of self backwashing type RSF is shown as follows;

i. Adjust/decrease the inflow rate to the design value of running RSFs except for the target RSF.

<example>

In case that the design capacity of RSF is 1,000 m^3/day and total number of RSF is two, the inflow rate shall be adjusted from 2,000 m^3/day to 1,000 m^3/day for the backwash of one RSF.

ii. Close the Inlet Valve-2 of the target RSF (No.2 in Figure 1.1).
iii. Open the Backwash Waste Valve (No.4 in Figure 1.1) of the target RSF slowly, and start the back-wash.
iv. Check the backwash flow rate and record the value (if possible).
v. Check the appearance of back-wash waste water.
vi. When the back-wash is finished, close the Backwash Waste Valve and open the Inlet Valve-2 of the target RSF slowly.
vii. Repeat the above procedure from ii to vi for the next RSF and conduct the back-wash.

b) Trouble Shooting

i. In case that the water quality is changed/deteriorated, the following measures shall be taken.

Water Quality Trouble	Countermeasure
The appearance/color of unfiltered water looks white.	✓ Adjust/decrease the filtration rate and check the water quality of treated water. If it is not improved, stop the operation. ✓ Adjust the dosing rate of coagulant and/or alkali to the proper value.
Turbidity of treated water increase.	✓ Adjust/increase the dosing rate of coagulant in case of lacking it. ✓ Adjust/increase the time of backwash in case of insufficient backwash. ✓ Adjust/increase the frequency of backwash in case of filtration with negative pressure. ✓ Maintain/repair the filter bed, under drain system etc.
The appearance/color of treated water looks dark brown due to leakage of manganese (Mn).	✓ Adjust/increase the dosing rate of chlorine. ✓ Replace of filter media (manganese sand). ✓ Newly install a demanganization facility.
The appearance/color of treated water looks red due to leakage of iron (Fe).	✓ Adjust/increase the dosing rate of chlorine or flow rate of air.
The appearance/color of treated water looks green due to leakage of algae/plankton.	✓ Adjust/increase the dosing rate of chlorine. ✓ Newly install a two-stage flocculation facility.
Leakage of microorganism	✓ Adjust/increase the dosing rate of chlorine. ✓ Adjust/increase the time/frequency of backwash in case of filtration with negative pressure.

ii. In case that the filtration resistance is increased, the following measures shall be taken.

Main Cause	Countermeasure
Filtration clogging is occurred due to growth of plankton.	✓ Dose the chemical to decrease plankton at the intake. ✓ Adjust/increase the time/frequency of backwash in case of filtration with negative pressure. ✓ Adjust/increase the dosing rate of chlorine. ✓ Clean the inside of Sedimentation Tank.
Filtration clogging is occurred due to fine sand which is not removed by scraping after installation of filter sand.	✓ Investigate the particle size distribution of filter sand. ✓ Scrape and remove fine sand on the surface.
The particle size of filter sand is small.	✓ Observe the condition until fine sand will be removed by backwash. ✓ If the condition is not improved, replace the half of existing sand with new sand satisfied with the specification.
The effect of backwash is not sufficient.	✓ Adjust/increase the time, frequency and flow rate of backwash. ✓ Adjust the time of surface wash or air scouring.
Clogging is occurred by foreign substance such as vinyl sheet etc.	✓ Remove the foreign substance. ✓ Clean/remove the foreign substance floating on the surface of Sedimentation Tank or RSF. ✓ Install a screen at the intake. ✓ Install a roof or cover on RSF.

iii. In case that a gush of filter sand during backwashing is observed, the following measures shall be taken.

- ✓ Conduct unevenness inspection of filter media.
- ✓ Replace or maintain the filter media and check/inspect the condition of underdrain system at the same time.
- ✓ If any problem or damage is found on the underdrain system, repair it.

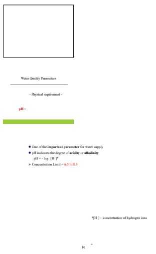
iv. In case that a surface unevenness of filter sand and/or gravel is found, the following measures shall be taken.

- ✓ Replace or maintain the filter media.
- ✓ Reconsider the backwash condition; time, frequency, flow rate, surface wash/air scouring condition etc.
- ✓ Modify to avoid entering air into backwash water.

v. In case that a mud ball and/or crack on the surface of filter sand is found, the following measures shall be taken.

- ✓ Reconsider the backwash condition; time, frequency, flow rate, surface wash/air scouring condition etc.
- ✓ Replace or maintain the filter media.

vi. In case that a leakage is observed, stop the operation and repair it.



Appendix 5-1

Water Quality Parameters

- Physical requirement -

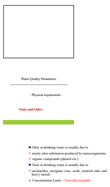
Turbidity :

- One of the **important parameter** for water su
- Turbidity in drinking water is usually due to

✓ clay particles, microorganisms, organic com and other particulate matters

➢ Concentration Limit (Maximum Value) = 5 N

* In case that alternative is not available,



Water Quality Parameters

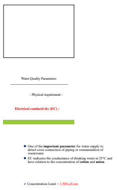
- Physical requirement -

Color :

- Color in drinking water is usually due to
  - ✓ dissolved or colloidal organic compounds (
    fulvic acid)
  - ✓ dissolved metals (iron, manganese)
  - ✓ industrial waste water
- Color cause undesirable appearance and
  washing.

➢ Concentration Limit = 5 TCU

* In case that alternative is not available, 15



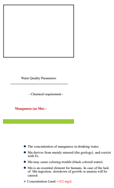
Water Quality Parameters

- Physical requirement -

Total dissolved solids :

- The concentration of suspended and dissolved su
in drinking water.
- Total dissolved solids has relation to taste of drin

➢ Concentration Limit = 1,000 mg/L



Water Quality Parameters

- Chemical requirement -

Total iron (as Fe) :

- The concentration of iron in drinking water.
- Fe derives mainly from rock or mineral (the geol
- Fe may cause coloring trouble and has relation to odor of drinking water.
- Fe is an essential element for humans.

➢ Concentration Limit = 0.3 mg/L

* In case that alternative is not available, 3.0

Water Quality Parameters

- Toxic substances -

Cadmium (as Cd) :

- The concentration of cadmium in drinking water.
- Cd derives from mining wastewater or industrial wastewater.
- Cd is one of the toxic metals and may cause proteinuria or Itai-Itai disease*.

➢ Concentration Limit = 0.003 mg/L

* Itai-Itai disease, occurred in Toyama Prefecture, Japan from 1910s to 1970s, was caused by Cd poisoning. One's arms and legs are hurt by this disease.

Water Quality Parameters

- Toxic substances -

Arsenic (as As) :

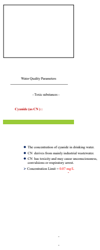
- The concentration of arsenic in drinking water.
- As derives from hot springs, mining wastewater o
  industrial wastewater.
- As is one of the toxic metals and order of the toxi
  follows.

AsH > As > As > (CH) AsOOH

➢ Concentration Limit = 0.05 mg/L

3+ 5+

3



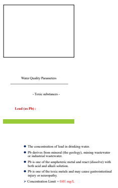
Water Quality Parameters

- Toxic substances -

Chromium (as Cr) :

- The concentration of chromium in drinking water
- Cr derives from mining wastewater or industrial wastewater.
- Cr is an essential element for humans, however o ingestion of much Cr may cause respiratory disea cancer.

➢ Concentration Limit = 0.05 mg/L



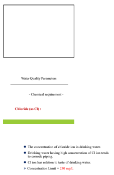
Water Quality Parameters

- Chemical requirement -

Fluoride (as F) :

- The concentration of fluoride ion in drinking wat
- Drinking water having high concentration of F io cause **mottled teeth** in case of long-term intake.

➢ Concentration Limit = 0.5 to 1.5 mg/L



Water Quality Parameters

- Chemical requirement -

Chloride (as Cl) :

- The concentration of chloride ion in drinking water.
- Drinking water having high concentration of Cl ion tends to corrode piping.
- Cl ion has relation to taste of drinking water.

➢ Concentration Limit = 250 mg/L

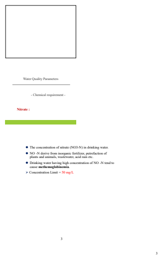
Water Quality Parameters

- Chemical requirement -

Ammonia (free ammonia) :

- The concentration of NH3 and intermediate, whic decomposed easily by potassium permanganate (under an alkali condition, in drinking water.
- Ammonia derives from putrefaction of plants anc fertilizer, night soil etc.

➢ Concentration Limit = 1.5 mg/L



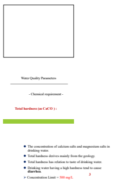
Water Quality Parameters

- Chemical requirement -

Sulphate (as SO_4) :

- The concentration of sulphate ion (SO42-) in drin
- SO_4^{2-} derives from mineral (the geology) or acid r

➢ Concentration Limit = 250 mg/L



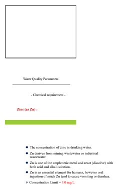
Water Quality Parameters

- Chemical requirement -

Copper (as Cu) :

- The concentration of copper in drinking water.
- Cu derives from mining wastewater, industrial wa or agricultural chemical.
- Cu is an essential element for humans, however o ingestion of a few grams of Cu tend to cause vom diarrhea.

➢ Concentration Limit = 1.0 mg/L



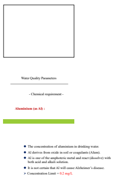
Water Quality Parameters

- Chemical requirement -

Calcium (as Ca) :

- The concentration of calcium in drinking water.
- Ca derives mainly from silicate, carbonate or sulf
- Ca is an essential element for humans.

➢ Concentration Limit = 200 mg/L



Water Quality Parameters

- Toxic substances -

Mercury (as Hg) :

- The concentration of mercury in drinking water.
- Hg derives from mineral (the geology), industrial wastewater or agrochemical.
- Hg is one of the toxic metals and may cause cent nervous system disease.

➢ Concentration Limit = 0.001 mg/L

Water Quality Parameters

- Chemical requirement -

Free residual chlorine (as Cl) :

- The concentration of hypochlorous acid (HCl hypochlorite ion (OCl) in drinking water.
- Free residual chlorine shows **sterilizing effect** in drinking water.
- The sterilizing effect and oxidizability will be changed by pH of drinking water.

➢ Concentration Limit = 0.1 to 0.2 mg/L

Appendix 5-2

wagtech WTD
a division of Palintest Ltd

POTATEST

WAG-WE10005

a division of Palintest Ltd

Wagtech WTD is a leading manufacturer and supplier worldwide of scientific instruments for use in:

Water Quality Testing, General Environmental Monitoring, Agriculture, Health, Education and Construction Industries.

Our products are used by scientists, engineers and technicians working in research, education and industry throughout the world

Details of the products can be found in our catalogues as follows:

Water Quality and Environmental Testing
Comprehensive range of water testing instruments covering portable water testing, BOD/COD/Toxicity digital instrumentation, mobile laboratories, hydrology and groundwater monitoring, general laboratory equipment and training.

Laboratory Equipment & Scientific Instruments
A comprehensive range of general laboratory equipment for use in a wide range of industries.

POTATEST

The Wagtech WTD range of portable water testing laboratories contain the essential components for testing the quality of water to both W.H.O. and E.C. guidelines/regulations.

The system is modular, enabling end users to tailor units to their exact requirements. The POTATEST is generally supplied as a complete bacteriological and physico-chemical testing laboratory, and these operating instructions detail all the necessary procedures for a complete bacteriological analysis.

The operating instructions for the physico-chemical equipment and accessories are included in the individual carrying cases.

If a different system or alternative parameters are required, additional instructions will be issued as appropriate.

SECTION 1: POTATEST COMPONENTS

1. Single Chamber Incubator
2. Set 18 Aluminium Petri Dishes & Rack
3. 12v Rechargeable Incubator Battery
4. Universal Mains Adaptor / Battery Charger (100 – 240v)
5. 12v Battery Connection Cable With Crocdile Clips
6. 12v Electrical Cable For Car Cigarette Lighter Socket
7. Membrane Filtration Unit And Landline
8. Pistol Grip Hand Vacuum Pump
9. Incubator Calibration Kit
10. Spirit Thermometer
11. Stop Watch
12. 38.1g Membrane Lauryl Sulphate Broth Media
13. 200 X Membrane Filters – 47mm Diameter, 0.45µm
14. 200 X Absorbent Pads
15. Pad Dispenser
16. 20 X Media Measuring Device (Mmd)
17. Tweezers / Forceps
18. Tube Lubricating Grease
19. Pen
20. Magnifier Lens
21. 4 X Polypropylene Bottles
22. 5 X Plastic Pasteur Pipettes
23. Screwdriver
24. De-Ion Water Pack
25. Colour Comparator
26. 250 X DPD1 Tablet Reagents
27. 250 X DPD3 Tablet Reagents
28. Pocket pH Meter – Wag-WE30020
29. pH 7 Buffer Solution
30. Turbidity Tube – 3-Part
31. Hard Carry Case
32. Rucksack
33. Operation Manual

OPTIONAL ACCESSORIES

A wide range of additional chemical parameters can be measured using the tablet reagents with the Colour Comparator. (See APPENDIX 2).

SECTION 2: ASSEMBLY OF FILTRATION APPARATUS

1. Hand Vacuum Pump
2. Filtrate Flask
3. Sampling Cup
4. Graduated Aluminium Reservoir Tube
5. Membrane Support & Compression Holder
6. Sealing Gaskets
7. Bronze Sintered Support

The assembly of the reservoir tube filtration base

SECTION 3: PREPARING BACTERIOLOGICAL MEDIA IN A CENTRAL LABORATORY

3.1 For 200 tests, dissolve the 38.1 grams of Membrane Lauryl Sulphate Broth (MLSB) (supplied in a pre-weighed container) in 500 ml distilled water in a flask or beaker.

3.2 Heat the mixture to ensure the powder is fully dissolved, but do not boil.

3.3 Pour the medium into the 50ml plastic bottles provided and ensure that they contain no residues of previous MLSB or cleansing agent.

3.4 Replace bottle tops but leave them slightly loose - do not tighten.

3.5 Sterilise bottles upright in an autoclave. Sterilise at 121°C for 10 minutes, or place bottles in a pressure cooker and maintain steam at pressure for 15 minutes. Remove bottles, allow to cool, tighten the tops and then store in the cool and dark.

3.6 For 10 tests use the Media Measuring Device (MMD) as explained in Section 3.10.

3.7 When the media has cooled to room temperature, pour about 2mls onto each membrane pad sufficiently to saturate the pad.

3.8 When the pad is fully saturated, pour off any excess MLSB.

3.9 PRE-PREPARED MEDIA

3.9.1 Media Ampoules are sterile ampoules containing 2 ml of dissolved media. They have the advantage of convenience and of always being sterile. These ampoules are available for Faecal Coliform Counts (pack of 50) (WE10468) and Total Coliform Counts (pack of 50) (10470). Simply unscrew the cap, pour the media onto the pad and discard the empty ampoule.

3.9.2 NutriDisks: Consists of a sterile petri dish with the pad impregnated with dehydrated MLSB media. This is re-hydrated using sterile distilled water.

Note: Owing to the larger size of the pre-sterilised petri dishes for the NutriDisks and Monitors then the number that will fit in the incubator is reduced. If this is a problem then refer to the POTAFLEX System.

3.10 MEMBRANE LAURYL SULPHATE MEDIA MEASURING DEVICE (MMD)

3.10.1 If up to ten analyses are only required, the Media Measuring Device can be applied.

3.10.2 Boil at least 100ml of clean water for at least two minutes to sterilise it and allow to cool.

3.10.3 The MMD containers are pre-sterilised. Take a level spoonful of media from the stock container with the blue scoop spatula and dispense the media into the clear plastic bottle. Hold the spoon via the bottle lid and do not touch the spatula itself.

Dispense the level spoonful of the media into the clear plastic bottle.

3.10.4 Repeat the above procedures until 10 spoonfuls of the media have been dispensed into the bottle.

3.10.5 Pour the sterilised water into the media measuring device and seal the lid tightly.

3.10.6 Shake the bottle so that the media is completely dissolved.

SECTION 4: PREPARING BACTERIOLOGICAL MEDIA IN THE FIELD

4.1 Choose the cleanest water available e.g. rainwater, filtered water, or, if necessary, stand raw water in a container overnight. Do not use water, which has been chlorinated. Boil the water for at least two minutes cover and allow to cool. Filter 200ml of the water through the membrane (2 x l00ml). If the water is turbid, more than one membrane may be required. Prepare a total of 500 ml of filtered water.

4.2 Check that the pH of the prepared water is in the range 6.5-8.0. In the exceptional circumstances the pH of the filtered water may not be in this range then adjust the pH using dilute sodium hydroxide solution (increases pH) or dilute hydrochloric acid (reduces pH).

4.3 Add the contents of a pre-weighed container of 38.1 grams of Membrane Lauryl Sulphate Broth (MLSB) to the 500ml of the prepared water and heat to aid dissolving.

4.4 Dispense the dissolved MLSB into the clean 50ml polypropylene bottles.

4.5 Replace bottle tops and tighten firmly.

4.6 Place the filled bottles in a prepared pressure cooker and heat sterilise for 15 minutes. Ensure that the bottles do not come into contact with the bottom of the pressure cooker.

4.7 Continue with procedures 3.7 in Section 3.

SECTION 5: SAMPLING FROM A RIVER OR STREAM

5.1 Take the sample as near as possible to the main flow and not too close to the edge where the water may be still and unrepresentative.

5.2 Care must be taken not to introduce floating matter or material from the edge of the water course into the water sample. Therefore, it may be preferable to attach the sampling cable to the sterilised sampling cup and take the sample from a bridge or other overhanging location. Alternatively, the cup may be cast into the water from the edge and pulled slowly and carefully back towards the operator.

SECTION 6: USE OF BACTERIOLOGICAL MEDIA

6.1 The dissolved media should remain stable for 6-8 weeks. However, if there are any signs of contamination e.g. yellowing, cloudiness etc., discard.

6.2 Ideally, to reduce the possibility of contamination, use the bottle of media only on a daily basis and use a fresh bottle on each subsequent day. However, if this is not possible, then the bottle must be resealed immediately and the media may be re-sterilised by boiling in a water bath for 15 minutes.

6.3 Clean empty media bottles thoroughly before re-use. Any residues should be washed out with hot water; cleaned with a little detergent; rinsed several times in clean water, dried and stored in a clean environment with the tops replaced.

6.4 The MLSB solution may be applied to the pads for up to 6 hours before sampling, if stored in a cool environment. This procedure can reduce the number of operations in the field.

6.5 If the MLSB powder is stored in dry, cool conditions it should have a shelf life of 5 years.

SECTION 7: ASEPTIC PROCEDURES

7.1 General hygiene and aseptic procedures are of paramount importance and extra care must be taken when outside the central laboratory, i.e. in the field.

7.2 Everything must be kept clean and sterile, particularly on the following surfaces:

  a. Inner surface of the sampling cup

  b. Inner surface of the filter funnel

  c. Filter membrane and support pads

  d. Upper surface of the membrane support

  e. Inside of the petri dishes

  f. Support pad dispenser arm, and forceps

7.3 Dry the filtration unit and sampling cup dry by using clean tissue paper.

7.4 Pour 1 ml of methanol into the sampling cup and swirl. (The methanol can be stored in the plastic bottles provided).

7.5 Place the sample cup in a normal upright position away from anything inflammable.

7.6 Using the cigarette lighter provided, ignite the methanol. Whilst the methanol is still burning invert the filtration unit into the sample cup.

7.7 Wait for at least 15 minutes to ensure that the sample cup and filtration unit are sterile. Methanol burns anaerobically to form Formaldehyde which ensures a complete sterilisation.

7.8 Pour any residual solution away.

7.9 The above sterilisation procedures 6.3 to 6.8 should be carried out immediately before sampling and after the filtration of each sample.

7.10 Either reusable aluminium petri dishes or pre-sterilised disposable plastic petri dishes may be used. If aluminium dishes are selected, they must be sterilised in boiling water prior to use. After sterilisation, ensure that the dishes are allowed to dry. Other methods of sterilisation can be employed, including autoclaving, or placing the aluminium dishes in a conventional oven at 300°C for 30 minutes.

7.11 Pads are supplied sterile in cartridges of 100. A sterile pad dispenser is supplied for introducing the pads into the petri-dishes. It is preferable to dispense pads at base, prior to going to the sampling point; in this way the dispenser may be kept attached to a pad cartridge and remain clean and sterile. If it is necessary to dispense pads in the field, every care must be taken not to contaminate the pad dispenser or cartridge. Immediately a cartridge is finished, a new one should be attached to the dispenser. Do not leave the dispenser unattached and if no pad dispenser is available use sterile forceps.

7.11.1 Before handling a membrane filter with the forceps it should be flamed sterilised thus: hold the forceps tips in a flame for 5 seconds and allow to cool before handling the membrane.

SECTION 8: PROCESSING SAMPLES FOR COLIFORM ANALYSIS

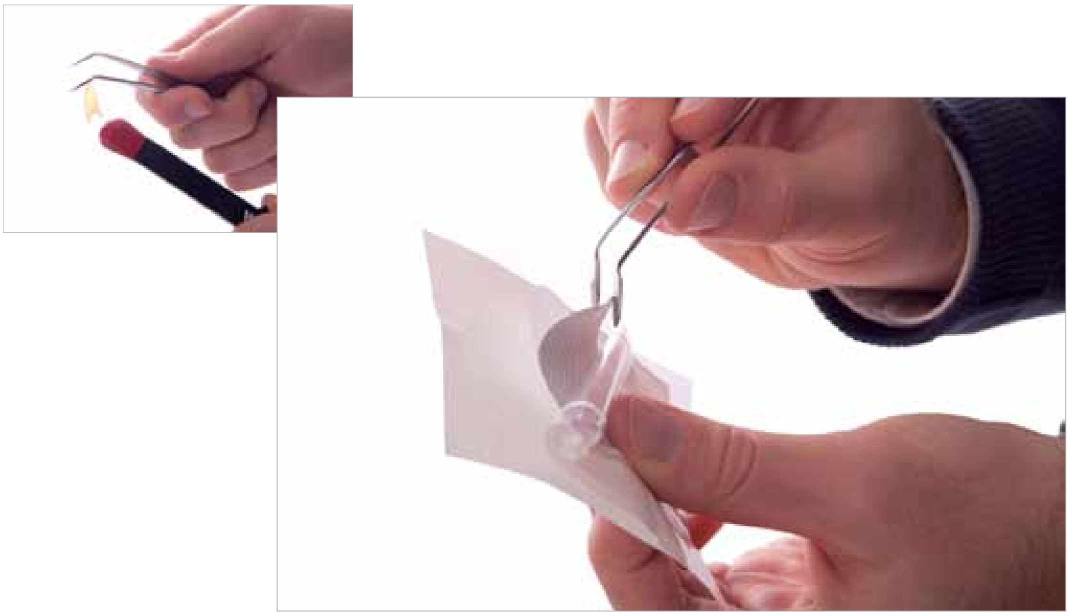
8.1 All samples must be incubated within 6 hours of sampling.

8.2 Dispense a growth pad into a sterile petri dish and saturated with MLSB as in Section 3.

Dispensing of growth pad

8.3 Loosen the filter funnel and remove from the base support.

8.4 Sterilise the forceps using a flame and allow to cool. Using these forceps, place a sterile membrane onto the bronze membrane support, grid side up. If the membrane tears or becomes contaminated discard it and use a new one.



Lock the membrane in place by pushing the filter funnel firmly down into position.

8.6 Pour the water sample into the filter funnel up to the 100 ml graduation.

Pour water sample up to 100 ml graduation

8.7 Connect the hand vacuum pump to the filtration unit base and pump to suck the water sample through the membrane.

Apply hand pump to pass the water through membrane

8.8 When all the water has been filtered, release the vacuum pump and use the sterile forceps to take the membrane from the filtration unit.

Use the sterile forceps to take the membrane from the filtration unit

Place the membrane on top of the pad which has been saturated with the MLSB media.

Place membrane on top of MLSB saturated pad

8.10 Replace the petri-dish lid and label with sample number, place, date, time, etc.

8.11 Place the petri-dish into the petri-dish rack and repeat the process for all the samples and then place the filled rack into the incubator.

8.12 It is important to note that when the last sample has been processed, a resuscitation period of between 1 hour to 4 hours must be observed before incubating. This allows any physiologically stressed coliforms to recover before culturing.

8.13 To incubate faecal coliforms, select the temperature of 44°C and place the loaded petri-dish rack inside the incubator. For total coliform analysis, select the temperature of 37°C.

8.14 The minimum incubation period is 14 hours following a 4 hour resuscitation..

SECTION 9: COUNTING COLIFORMS AND RECORDING THE RESULT

1. Note which incubator is set for 44°C or 37°C.
2. Following incubation~ switch off the power and remove each petri dish from one of the incubators and record the temperature setting.
3. Place the petri dishes on a flat surface.
4. Remove the lids and, count all the yellow colonies irrespective of size count Use a hand lens, if necessary. Count the colonies within a few minutes, as the colours are liable to change on cooling and standing. Ignore those colonies that are not yellow e.g. pink & transparent colonies.

5. Once the number of yellow colonies has been determined for each incubator and assuming that 100ml of sample has been filter, this value equals the number of coliforms per 100 ml. Samples that were incubated at 37°C are Total Coliforms, whilst those incubated at 44°C are Faecal (Thermotolerant) Coliforms.
6. Record the results using the record sheets provided.

SECTION 9: FAECAL STREPTOCOCCI ANALYSIS

Principle

9.1 This is the membrane filtration method for the detection and enumeration of Faecal Streptococci. This method can be used with all types of water except where the turbidity of the sample is too high to allow passage of the water through the membrane. The application of the equipment is the same as Section 8A. The water sample is filtered through the membrane that is capable of retaining the bacteria. The membrane is incubated on Slanetz and Bartley Agar and presumptive Faecal Streptococci multiply as red or maroon colonies after incubation.

9.2 AGAR MEDIA PREPARATION

9.2.1 Suspend 42 grams of the Slanetz & Bartley Media in 1 litre of distilled water and bring to the boil to dissolve the agar completely. Excessive heating must be avoided.

9.2.2 Dispense into the sterile plastic disposable petri dishes (Note, the aluminium petri-dishes do not have sufficient depth).

9.2.3 Allow the agar to cool and solidify. It should be a clear agar and fill the petri dish to a depth of about 3mm. It must not be re-melted.

9.3 CONSUMABLES

Cellulose nitrate membranes
0.45 mm pore size
Slanetz and Bartley media
Sterile plastic petri dishes

9.4 EQUIPMENT

Cellulose nitrate membranes

9.5 PROCDEURE

9.5.1 Set up the filtration apparatus and filter the water sample as in Section 3.

9.5.2 When the water sample is filtered, take the membrane filter using the sterile forceps, lay it on the prepared agar in the petri dish, replace the lid, load the petri-dish rack and place this in the incubator.

9.5.3 For potable waters, incubate at 37°C for 48 hours. For untreated waters, incubate at 37°C for 4 hours and 44°C for 44 hours.

9.5.4 Count the number of pink and maroon colonies. These are recorded as the number of presumptive Faecal Streptococci per volume of water filtered, normally 100ml.

SECTION 10: SELECTING THE OPTIMUM VOLUMES FOR MEMBRANE FILTRATION

The optimum volume of sample is that which will allow the most accurate enumeration of bacteria. This is achieved when the number of faecal coliform colonies on the membrane following incubation is in the range of 20-200. If there are less than 10 colonies, then there is the possibility of statistical error and more than 200 colonies are difficult to count.

Potable Waters

10.1 The number of faecal coliform bacteria in treated water samples,ideally should be zero. Thus the preferred sample volume is 100 ml, and a count of zero faecal coliform bacteria per 100 ml is indicative of a microbiologically safe water supply. If the counts exceeds 1 faecal coliform per 100 ml or 10 faecal coliforms per 100 ml. Contamination is indicated and action is urgently required.

Raw Waters

10.2 For source waters and partially treated waters including those which are ground water derived, it is valuable to adjust the sample volume to obtain faecal coliform counts in the optimum range 10-200. It may be useful to process more than one volume on the first occasion a water is sampled. In such cases it is not necessary to re-sterilise the filtration equipment between different volumes of the same sample, provided that the smaller volume is processed first. Typical volumes which may be appropriate for various water types are shown in the following table. They are only guidelines; there is no substitute for experience of a given source.

	APPROPRIATE VOLUME		
SOURCE OF SAMPLE	100ML	50ML	10ML
Lakes, Reservoirs, & Rivers & other surface sources	*	**	***
Wells, boreholes, other protected water sources	*	**	*
Water treatment plant partially treated	**	**	*
Water treatment plant fully treated	***		
Distribution system	***		

*** Normal Volume or First Choice ** Likely Volume * Possible Volume

SECTION 11: OPERATION OF INCUBATORS

111.1Incubator Power Supplies

The Incubator can be powered by any of the three sources below:

a. Mains electricity 240V AC, via the mains adapter/ charger unit (This is the preferable source)

b. 12V DC rechargeable battery included.

c. An external battery 12V DC e.g. via the vehicle cigarette lighter attachment.

11.2 Power Supply Procedures

11.2.1 The incubator is powered by an external combined mains adapter/ battery charger unit. The 12V battery is recharged by:

a. Switching off the incubator.

b. Connect the two crocodile clips to the battery (red-positive, black-negative).

c. Plug the lead into the round DC port on the side of the incubator.

d. Switch on the mains supply to the mains adapter.

e. Charge for at least 8 hours. If time is not available, check with a simple voltmeter that the voltage of the battery is 13+ volts after the recharge

Charging the battery

11.2.2 The 12v battery can also be recharged with a car battery recharger, using the “trickle-charge” mode. Do not use the “fast-charge mode”, as this could damage the battery.

11.2.3 If using the cigarette lighter attachment, start the vehicle’s engine and then connect to the incubator. To avoid draining the car battery and to ensure there is enough power for the full incubation cycle, it is preferable to incubate whilst the vehicle’s engine is running. Do not connect the incubator whilst starting the engine.

11.2.4 When using the battery, do not run the incubation cycle more than once, without recharging the battery before each incubation cycle, as this can reduce the lifetime of the battery.

11.2.5 To reduce power consumption, locate the equipment in the warmest ambient conditions available e.g. inside a building on a table, not on a cold stone floor or outside. Store the battery fully charged.

11.2.6 If the mains electricity supply is unreliable, connect both the battery AND the mains supplies with the AC and DC leads. This ensures there is a battery back-up supply i.e. the battery automatically switches on if there is a mains power cut, thus continuing the incubation cycle.(Note The colour coding for the mains lead is as follows: [(i) Brown - Live (ii) Blue – Neutral (iii)Yellow/Green – Earth].

11.3 Connect to the mains power supply via the mains adapter/charger unit and press on the power switch on the incubator.

11.4 Press the switch for the required temperature and the red light will be illuminated to indicate that the heater is operating.

11.5 The red light will go out when the temperature is reached and will re-illuminate when the heater is required.

11.6 If the mains power ceases and the POTAKIT is also connected to the battery, Then the incubator should remain on, the incubator will be then powered by the battery.

Operation from battery

Operation from mains

11.7 Calibration Procedure

Prior to delivery the incubator in the Potatest will have been calibrated. It is ready for use. However from time to time it may be necessary to re-calibrate, particularly after periods of pro-longed use or if the results obtained indicate there may be a problem with the temperature in the chamber. For example you see no colonies after testing samples you know should be contaminated. This could indicate the temperature is too high and killing the bacteria. As a minimum we recommend checking the temperature of your indicator once a month. The calibration process is relatively straight forward although a little time is required to achieve optimum results.

1. Remove the crosshead screw in the centre of the white lid of the incubator
2. Identify the specially modified calibration petri dishes included in the Incubator Calibration kit. These are housed in a separate box. It comprises a rack of petri dishes with a hole in the centre and some Blu-Tac for sealing.
3. Take 6 or 7 of the normal petri dishes and place them in the petri dish rack. Take the calibration petri dishes and remove them from the band that secures them. Place them into the rack on top of the normal petri dishes.
4. Insert the thermometer through the hole in the incubator lid and down into the calibration petri dishes. Seal the gap around the thermometer if desired using the Blu-Tac or any other material appropriate for the task. This set up allows an accurate reading of the temperature experienced in the petri dishes during an actual incubation.
5. Switch on the incubator and set to 37°C
6. Allow the temperature to stabilise and note the temperature.

7. Locate the two small holes on the back of the incubator. These are the micro switches that either increase or decrease the temperature. Each click of the microswitch (either using a pencil or screwdriver) increases or decreases the temperature by 0.1°C
8. If the temperature is lower than 36.5°C, press the microswitch on the right hand side the appropriate number of times, for example if you need to raise the temperature by 0.5°C press it 5 times. This should switch on the heater shown by the glowing red heat indicator light. There is a significant time delay between pressing one of the microswitches and seeing the unit stabilise again – don't keep pressing the switch believing nothing is happening.
9. When the light switches off, note the temperature.
10. If the temperature is still low repeat steps 6 & 7.
11. If the temperature is higher than 37.5°C, press the microswitch on the left hand side the appropriate number of times.
12. Allow the incubator to cool down and note the temperature when the heater light switches on. If the temperature is still too high repeat step 10.
13. When the temperature is correct, switch the temperature to 44°C and repeat steps detailed above at 44°C

11.8 Filtration Unit

Always dry the filtration apparatus, funnel, membrane support, filter base and filtration flask thoroughly at the end of use, ensuring it is clean. This avoids the build-up of an oxide layer on the aluminium components. Smear a small quantity of silicone grease around the rubber O-rings which seal the components.

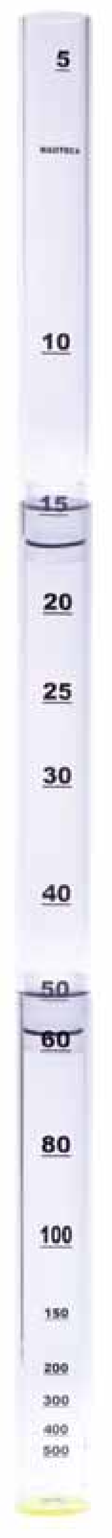
11.9 Carrying Case

Although the case has been made to a very high specification, care should be taken to avoid falls or other impacts. The components are robust and sealed on manufacture, but in humid environments they will not resist corrosion indefinitely. Always avoid the entry of water into the base of the case and dry any moisture or spillages of water immediately.

TURBIDITY TUBE INSTRUCTIONS

3-Part Turbidity Tube

For field testing of turbidity in drinking water



Introduction

1. Connect the tubes together.
2. Gradually pour the water into the tube.
3. Look from the top of the tube, through the water, at the cross at the bottom of the tube.
4. Continue to fill the tube with water until the cross just disappears.
5. Read the level of the water where it aligns with the graduation and record that value. If the water level is in between two gradations, estimate the value.
6. The tube is graduated in NTU units (5 to 500).
7. The drinking water should have a value lower than 5 NTU - i.e. the whole tube is filled and the cross on the tube does not disappear.

DIGITAL pH / TEMPERATURE METER INSTRUCTIONS: WAG-WE30020

pHTestr

Large Screen Waterproof pH / Temperature Tester Double Junction

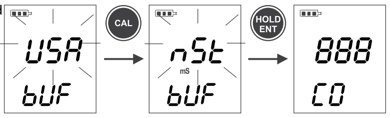
Introduction
Thank you for selecting our microprocessor waterproof pH tester. This manual provides a step-by-step guide to operate the testers.

Before you begin:
Condition your pHTestr electrodes by immersing it in electrode storage solution or tap water for at least 30 minutes before use. DO NOT use de-ionized water.

Your tester features USA (pH 4.01, pH 7.00 and pH 10.01) or NIST (pH 4.01, pH 6.86, and pH 9.18) standards. Select either one to suit your requirements.

1. While pressing the HOLD/ENT button, switch on the tester by pressing the ON/OFF button.
2. Release the HOLD/ENT button. The display will flash either USA or NIST.
3. Press CAL button to toggle between the two buffer set standards.
4. Press the HOLD/ENT button to confirm the selection of the buffer set.

With meter powered off, press HOLD/ENT and ON/OFF at the same time. First release ON/OFF button the HOLD/ENT button.



After buffer selection, whole LCD segment lights up and goes back to measurement mode.

Figure 1: Buffer Selection Sequence

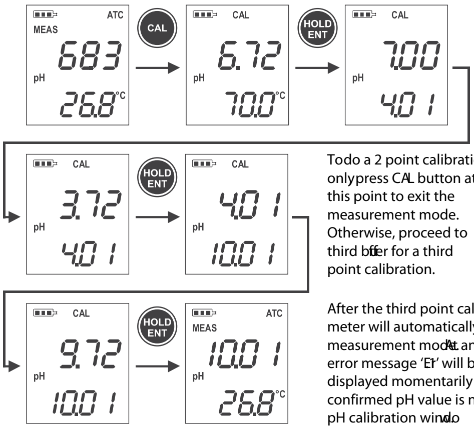
pH Calibration
Calibration should be done regularly, preferably once a week. You can calibrate up to three points using either the USA or the NIST buffer set standards.

1. Press ON/OFF button to switch unit on.
2. Dip electrode about 2 to 3 cm into the pH standard buffer solution.
3. Press the CAL button to enter calibration mode. The 'CAL' indicator will be shown. The upper display will show the measured reading based on the last calibration while the lower display will indicate the pH standard buffer solution.

   Note: All testers have dual display during calibration mode

   Note: To abort calibration, press the CAL button.
4. Allow about 2 minutes for the tester reading to stabilize before pressing the HOLD/ENT button to confirm the first calibration point. The upper display will be calibrated to the pH standard buffer solution and the lower display will then be toggling in between readings of the next pH standard buffer solution.
5. Repeat with other buffers if necessary. Rinse electrode in tap water before dipping into next buffer.

   Note: The calibration mode allows you to perform up to three calibration points before returning to the measurement mode automatically. However, if you opted to have only one or two calibration points, simply skip the remaining calibration points by exiting to the measurement mode by pressing the CAL button.



To do a 1 point calibration only press CAL button at this point to exit the measurement mode. Otherwise, proceed to second buffer for a second point calibration.

To do a 2 point calibration only press CAL button at this point to exit the measurement mode. Otherwise, proceed to third buffer for a third point calibration.

After the third point calibration, the meter will automatically return to the measurement mode. At any point, error message 'Er' will be displayed momentarily if the confirmed pH value is not within the pH calibration window.

Figure 2: Example of pH Calibration Sequence

DIGITAL pH / TEMPERATURE METER INSTRUCTIONS: WAG-WE30020

pH Measurement

1. Press the ON/OFF button to switch the tester on.
2. Dip the electrode about 2 to 3 cm into the test solution. Stir and let the reading stabilize. For pHSpear, pierce the penetrating tip electrode through your semi solid sample as per the desired depth. Rotate left and right several times and tilt to ensure sample contact.
3. Note the pH value or press HOLD/ENT button to freeze the reading. To release the reading, press HOLD/ENT again.
4. Press ON/OFF to turn off tester. If you do not press a button for 8.5 minutes, the tester will automatically shut off to conserve batteries.

HOLD Function

This feature lets you freeze the display for a delayed observation

1. Press HOLD/ENT button to freeze the measurement. A 'HOLD' indicator will be displayed and the measurement will be frozen.
2. Press HOLD/ENT again to release the measurement. The 'HOLD' indicator will not be displayed anymore indicating the held measurement is released.

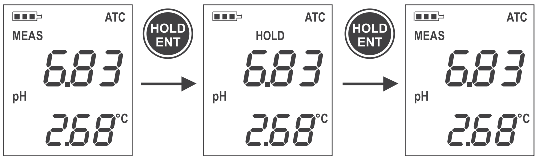


Figure 3: Example of HOLD Function

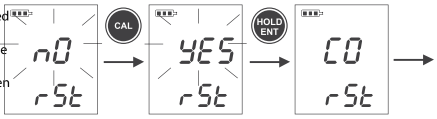
User Reset

You can reset the pH calibration to the factory default by using the user reset function.

Buffer set selection and temperature user calibration are not affected by the user reset function.

1. Switch off the tester.
2. While pressing the 'CAL' button, press and release the ON/OFF button to enter the 'User Reset' selection menu. The screen will display 'rSt' on the bottom display with a flashing 'nO' selection.
3. Use the 'CAL' button to toggle between 'nO' and 'YES' selection.
    - nO deactivates reset selection
    - YES activates the reset selection
4. Press the HOLD/ENT button to confirm the selection made.
5. If you have selected 'YES', the unit will show 'CO' momentarily and proceed to the measurement mode with the calibration reset back to factory default value.
6. If 'nO' is selected, the unit will proceed to the measurement mode without any calibration reset performed.

With meter powered off, press CAL and ON/OFF at the same time. First release ON/OFF button then CAL button.



After buffer selection, whole LCD segment lights up and goes back to measurement mode.

Figure 4: User Reset Sequence

Automatic Temperature Compensation (ATC)

Through its in-built temperature sensor, the measurement error due to the changes in electrode sensitivity due to changes in temperature is compensated to give the actual pH reading of the sample measured.

Temperature Calibration

From the measurement mode,

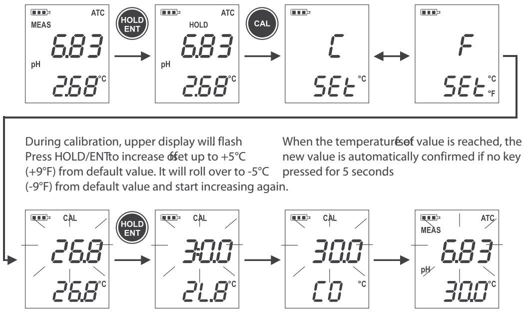
1. Press the HOLD/ENT button to bring the tester to the 'HOLD' mode.
2. Press the CAL button for 3 seconds to switch to the °C or °F mode setting selection screen. Pressing the CAL button continuously for 3 seconds allows you to toggle in between the °C and °F mode setting selection screen.
3. Release the CAL button to confirm your mode selection and the display will go to the temperature calibration mode with the upper display flashing. The upper display shows the current measured temperature reading based on the last set offset and the lower display shows the current measured temperature reading based on factory default calibration.
4. Dip the tester into a solution of known temperature and allow time for the in built temperature sensor to stabilize.

DIGITAL pH / TEMPERATURE METER INSTRUCTIONS: WAG-WE30020

5. Press the HOLD/ENT button to set the upper display to the temperature value of the solution.

6. Once the new temperature setting is reached, the new value is automatically confirmed and returns to the measurement mode if no button is pressed after 5 seconds.

   Notes: To exit this program without confirming the calibration, press the CAL button before the automatic confirmation takes place.



Continuous pressing of CAL button (approx. 3 seconds) to toggle between temperature setting of °C & °F

Release CAL button to start entering new temperature

During calibration, upper display will flash Press HOLD/ENT to increase offset up to +5°C (+9°F) from default value. It will roll over to -5°C (-9°F) from default value and start increasing again.

When the temperature set value is reached, the new value is automatically confirmed if no key is pressed for 5 seconds

Figure 5: Temperature Calibration Sequence

Electrode Maintenance

1. Rinse the electrode with tap water or electrode storage solution after each measurement. Care has to be taken not to damage the sensor's glass electrode especially while rinsing the pHSpear penetrating tip electrode.

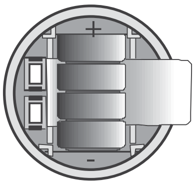
2. In aggressive chemicals, dirty or viscous solutions, and solutions with heavy metals or proteins, take readings quickly and rinse electrode immediately afterward.

3. If possible, keep a small piece of paper or sponge in the electrode cap – moistened with clean water or electrode storage solution (NOT de-ionized water) – and close the cap over the electrode.

Changing Batteries

1. Open battery compartment lid (with attached lanyard loop).

2. Remove old batteries; replace with fresh ones. Note polarity



Self-Diagnostic Messages

Low Battery Indicator	▮▮▮	3 Bars indicates Battery is full (100%)
	▮▮	2 Bars indicates 50% of the battery life is left
	▮	1 Bar indicates 25% of the battery life is left
	▯	Blinking battery casing indicates the need to replace batteries with fresh ones as specified by manufacturer
Over Range/ Under Range signal	Or / Ur (Still)	Electrode is not in contact with solution or electrode is failing.
		Replacement sensor is not connected properly to the tester during sensor replacement
		Measured pH value or temperature value exceeds its specified maximum or minimum value
	ATC / Or / Ur (Blinking)	Blinking 'ATC', 'Or' or 'Ur' indicates that there is a short or open circuit at the built in temperature sensor
Error Message	Er.0	Temperature calibration error of attempting to calibrate tester to a value which is out of range or under range
	Er.1	pH calibration error of attempting to confirm a calibration value which is not within the specified calibration window

Electrode Replacement

You can replace the electrode module at the fraction of the cost of a new tester. When the tester fails to calibrate or gives fluctuating readings in calibration standards, you need to change the electrode.

1. With dry hands, grip the ribbed tester collar with electrode facing you. Twist the collar counter clockwise (see picture A). Save the ribbed tester collar and O-ring for later use.

2. Pull the old electrode module away from the tester.

3. Align the four tabs on the new module so that they match the four slots on the tester (see picture B).

4. Gently push the module onto the slots to sit it in position. Push the smaller O-ring fully onto the new electrode module. Push the collar over the module and thread it into place by firmly twisting clockwise.

Note: It is necessary that you re-calibrate your tester prior to measurement after an electrode replacement.

DIGITAL pH / TEMPERATURE METER INSTRUCTIONS: WAG-WE30020

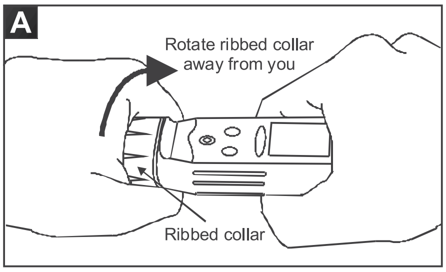
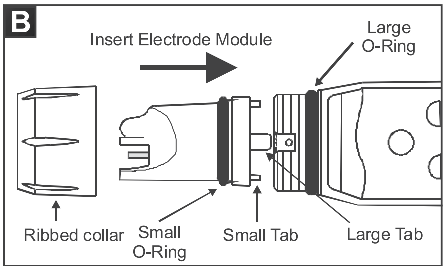


Figure 6: Removal of collar from tester



Water quality testing • pools • spas • aquariums
• aquaculture • hydroponics • ecology studies
• water and wastewater treatment • boilers
• steam generators • car washes • sanitation plants
• labs • food sectors and more!

Warranty

The waterproof WAG-WE30020 is warranted to be free from manufacturing defects for 1 year and electrode module for 6 months. If repair, adjustment or replacement is necessary and has not been the result of abuse or misuse within the time period, please return the tester – freight prepaid – and correction will be made without charge. Out of warranty products will be repaired on a charge basis.

Return of Items

Authorisation must be obtained from your distributor before returning items for any reason. When applying for authorisation, please include information regarding the reason the item(s) are to be returned.

Note: We reserve the right to make improvements in design, construction and appearance of products without notice. Prices are subject to change without notice.

Specifications

Large Screen Testers	WAG-WE30020
pH Range:	-1.00 to 15.00 pH
Resolution:	0.01 pH
Relative Accuracy:	0.01 pH
Calibration Points:	Up to 3 points
Buffer Set Standard Selection:	USA - 4.01/7.00/10.01 NIST - 4.01/6.86/9.18
Calibration Window (USA buffer set standard):	± 1.00 pH (pH 4.01 & pH 10.01) ± 1.50 pH (pH 7.00)
Calibration Window (NIST buffer set standard):	± 1.00 pH (pH 4.01 & pH 9.18) ± 1.25 pH (pH 6.86)
Temperature Display:	0-50°C or 32.0-122.0°F
Automatic Temperature Compensation (ATC):	Yes
Temp Resolution:	0.1°C / °F
Temp Accuracy:	0.5°C / 0.9°F
Temp Calibration Window:	± (5°C/9°F) from default value
Auto Off:	After 8.5 minutes from last key press
User Reset:	Yes
Non-Volatile Memory Backup:	Yes
LCD Display:	Dual
Power Requirement:	4 x 1.5V "A76" micro Alkaline Batteries
Battery Life:	>500 hours
Operating Temperature:	0-50°C
Tester Dimensions:	6.5"L x 1.5"∅ (165mm x 38mm)
Weight:	3.25oz (90g)

COLOUR COMPARATOR: WAG-WE10195

POTATEST Comparator

The Wagtech WTD Comparator and Discs provide a versatile method of water testing. Accurate and reliable for the professional analyst, quick and easy for the casual user.

The Wagtech WTD Comparator with interchangeable colour discs is so simple to use - just add the tablet reagent to the test sample, place in the Comparator and match against the appropriate disc. Colour discs are available for a complete range of water test parameters.

Wagtech WTD Discs are produced by the latest technology which enables the colours to be printed from a pallet of over two million different shades ensuring a perfect match against the colours produced in each test.

The following pages describe the use of the Wagtech WTD Comparator and Discs, and give instructions for the wide range of water tests that can be performed using this equipment.

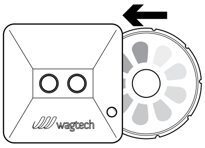
Introduction

The Wagtech WTD Comparator is used in conjunction with a range of interchangeable colour discs. The Comparator and Discs are integrated with the Wagtech WTD system of water analysis. The Comparator is used to compare the colour produced in each test against the standard test colours provided on the disc. Colour discs are available for a complete range of water test parameters. The Wagtech WTD Comparator uses 13.5 mm, 10 ml square test tubes. The Wagtech WTD Comparator, discs and test tubes conform to international dimensions and are interchangeable with most standard comparator systems.

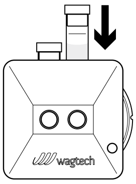
Instructions for use

For carrying out specific tests are given on separate instruction sheets. The instructions below describe the general use of the Comparator in all water tests :

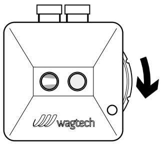
1. Select the correct colour disc for the parameter under test. Insert the disc into the Comparator ensuring the numbers are facing the user.



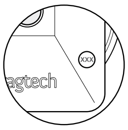
2. Place the square test tube containing the treated sample in the right-hand side of the tube holder. A square test tube containing sample only should be placed in the left-side of the tube holder to compensate for any inherent colour in the sample.



3. Hold the Comparator against a source of white light, such as north daylight, or use a Wagtech WTD Light Unit, and rotate the disc until the colours are seen to match.



4. Take the disc reading which appears in the aperture on the front of the Comparator



Light Unit

The optional Wagtech WTD Light Unit Wag-WE10198 is a portable lighting device which fits directly onto the Wagtech Comparator. The unit produces the optimum white light for matching test solutions against Comparator discs. It eliminates the inconsistencies caused by variable daylight conditions or artificial light. The Light Unit is available as an optional extra.

The Wagtech WTD Light Unit is fitted with rechargeable batteries and has an internal photocell to maintain standard light output irrespective of battery condition. A green LED on the top of the unit illuminates to indicate that the light output is satisfactory for colour matching. When this LED goes out, it indicates that the unit needs recharging.

Care and Maintenance

Wagtech WTD Comparators and Discs are suitable for both laboratory and field use and are designed to give long and trouble-free operation. The Comparator body and Disc surfaces should be kept clean by occasionally wiping with a damp cloth and then drying carefully. On no account should solvents or abrasive materials be used.

Comparator Discs are colour fast and long-lasting. To ensure maximum life, replace discs in the plastic wallet after use. Avoid constant exposure to strong sunlight or exposure to sources of heat. Wagtech WTD square test tubes are made from a high quality grade of crystal polyacrylate. Test tubes should be kept clean by rinsing and drying after use. Tubes which become scratched or discoloured through repeated use should be discarded.

COLOUR COMPARATOR: WAG-WE10195

Order Codes
WAG-WE10195 Wagtech WTD Comparator with two Square Test Tubes

WAG-WE10197 Square Test Tubes, 13.5 mm, 10 ml polyacrylate (Pack of 5)

WAG-WE10198 Portable Light Unit Codes
Colour Discs (see individual test instructions)

Chlorine (DPD) Colour Match Method

Test For Free, Combined and Total Chlorine in Water
0 – 1.0 mg/l
0 – 2.0 mg/l
0 – 5.0 mg/l

Chlorine and chlorine-release compounds are widely used for the disinfection of drinking water and swimming pools, for the control of micro-biological growth in cooling water, and in many other water treatment systems. Accurate measurement of the chlorine residual is an essential aspect of the control of these chlorination processes.

The chlorine level can be expressed in terms of the free chlorine, combined chlorine or total chlorine residuals. For the majority of applications measurement of the free chlorine residual is the most important. The Wagtech WTD DPD Chlorine method provides a simple means of measuring free, combined and total chlorine residuals for a series of test ranges up to a level of 5 mg/l.

Method

This Wagtech WTD Chlorine test uses the DPD method and now internationally recognised as the standard method of testing for chlorine and other disinfectant residuals. In the Wagtech WTD DPD method the reagents are provided in tablet form for maximum convenience and simplicity of use.

Free chlorine reacts with diethyl-phenylene diamine (DPD) in buffered solution to produce a pink colouration. The intensity of the colour is proportional to the free chlorine concentration. Subsequent addition of excess potassium iodide induces a further reaction with any combined chlorine present. The colour intensity is now proportional to the total chlorine concentration; the increase in intensity represents the combined chlorine concentration. In this way it is possible to differentiate between free and combined chlorine present in the sample.

The colour intensities are measured by comparison against colour standards using a Wagtech WTD Comparator and Disc.

Reagents and Equipment
Wagtech WTD DPD No 1 Tablets
Wagtech WTD DPD No 3 Tablets
Wagtech WTD Comparator
Wagtech WTD Comparator Disc
Square Test Tubes, 13.5 mm, 10 ml Wag-WE10197

Disc Wag-WE10210 (CD 011/1) covers the range 0-1 mg/l chlorine in steps 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 1.0 mg/l

Disc Wag-WE10212 (CD 011/2) covers the range 0 - 2.0 mg/l chlorine in steps 0.2, 0.4, 0.6, 0.8, 1.0,1.2, 1.4, 1.6 and 2.0 mg/l

Disc Wag-WE10214 (CD 011/5) covers the range 0 - 5.0 mg/l chlorine in steps 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 and 5.0 mg/l

Test Instructions

1. Rinse a square test tube with sample leaving two or three drops of sample in the tube.
2. Add one DPD No 1 tablet, crush tablet and then fill the test tube with sample to the 10 ml mark. Mix to dissolve tablet.
3. Place the test tube in the Comparator and match immediately against the disc in the usual manner (see Comparator instructions).
4. The disc reading represents the free chlorine residual as milligrams per litre. Stop the test at this stage if only free chlorine determination is required.
5. If it is desired to measure combined or total chlorine residual continue the test on the same test portion. Add one DPD No 3 tablet, crush and mix to dissolve.
6. Allow to stand for two minutes for maximum colour development.
7. Place the test tube in the Comparator and match in the usual manner. The disc reading now represents the total chlorine residual as milligrams per litre.
8. The combined chlorine residual as milligrams per litre is obtained by subtracting the first comparator disc reading from the second.
   ie Combined Chlorine = Total Chlorine -Free Chlorine.

   Note: A too high chlorine level (above 10 mg/l) can cause bleaching of the pink coloration formed in the DPD test and give a false negative result. If a colourless test solution is obtained when chlorine is known to be present, check for the possibility of bleaching by repeating the test on a sample diluted with chlorine-free water.

APPENDIX 1: WHO GUIDELINES FOR PHYSICO-CHEMICAL QUALITY

The chief reference point for all matters concerning Drinking Water Quality is a publication by the World Health Organisation (WHO).

The main purpose of the "Guidelines for Drinking Water Quality" is the protection of Public Health. There are now three published Volumes (1 to 3).

The Guidelines outline in great detail the definition of "Safe Drinking Water" and why every effort should be made to achieve a drinking-water quality as safe as practicable. Diseases related to contamination of drinking-water constitute a major burden on human health. Interventions to improve the quality of drinking-water provide significant benefits to health.

The Guidelines describe reasonable minimum requirements of safe practice to protect the health of consumers and/or derive numerical "guideline values" for constituents of water or indicators of water quality. Neither the minimum safe practices nor the numeric guideline values are mandatory limits.

Below you will see the recommended Guideline Values for some of the parameters of drinking water quality that are of significance to public health and related issues.

PARAMETERS	GUIDELINE VALUE
Arsenic	10 ug/l
Barium	0.7 mg/l
Chlorine	5 mg/l
Chromium	0.05 mg /l
Coliforms faecal	0 CFU
Fluoride	1.5 mg/l
Lead	10 ug/l
Manganese	0.4 mg/l
Nitrate	50 mg/l
Nitrite	3 mg/l
Selenium	10ug/l
Turbidity	5 NTU

There are also other important parameters which may affect the acceptability of drinking water quality but for which no guideline value has been established with regards health. These include:

Aluminium, Chloride, Conductivity (EC), Copper, Hardness, Hydrogen Sulphide, Iron, pH, Sodium, Sulphate and Total Dissolved Solids (TDS).

The WHO Guidelines for drinking water quality are available from Wagtech WTD free of charge or can be downloaded from the WHO website:

http://www.who.int

APPENDIX 2: ADDITIONAL REAGENTS FOR USE WITH THE WAGTECH COLOUR COMPARATOR

The Wagtech WTD Colour Comparator included with the POTATEST, is supplied with reagents and discs to test for Chlorine (Free, Combined and Total). However, the full list of reagents that can be used with the Colour Comparator are shown below and can be ordered separately from Wagtech WTD. Additional consumables and reagents for the POTATEST are listed in full in appendix 4, page 35). Further technical details are shown in our Water Quality Testing Catalogue, available upon request.

Colour Discs

Test	Range mg/l	
Alkalinity (Alkavis)	0 – 250	Wag-WE10200
Aluminium	0 – 0.5	Wag-WE10202
Ammonia	0 – 1.0 (N)	Wag-WE10204
Bromine	0 – 2.0	Wag-WE10206
Bromine	0 – 8.0	Wag-WE10208
Chlorine DPD	0 – 5.0	Wag-WE10210
Chlorine DPD (Mono & Di Chloramine)	0 – 5.0	Wag-WE10212
Chlorine DPD (combined & total)	0 – 5.0	Wag-WE10214
Chlorine DPD	(total)	Wag-WE10216
Chlorine HR	0 – 50	Wag-WE10218
Chlorine HR	0 – 250	Wag-WE10220
Copper (Coppercol)	0 – 5.0	Wag-WE10222
Fluoride	0 – 1.5	Wag-WE10224
Hydrogen Peroxide LR	0 – 2.0	Wag-WE10226
Hydrogen Peroxide	HR 0 – 100	Wag-WE10228
Iron LR	0 – 1.0	Wag-WE10230
Iron MR	0 – 5	Wag-WE10232
Maganese	0 – 0.03	Wag-WE10234
Molybdate HR	0 – 100	Wag-WE10236
Nitrate (Nitratest)	0 – 20 (N)	Wag-WE10238
Nitrite (Nitricol)	0 – 0.5 (N)	Wag-WE10240
Ozone	0 – 2.0	Wag-WE10242
pH value (Bromocresol Purple		Wag-WE10244
pH value (Bromothymol Blue)		Wag-WE10246
pH value (Phenol Red)	6.8 – 8.4	Wag-WE10248
pH value (Thymol Blue)		Wag-WE10250
pH value (Universal pH)		Wag-WE10252
PhosphateLR	0 – 4.0	Wag-WE10254
Phosphate HR	0 – 100	Wag-WE10256
Silica	0 – 4.0	Wag-WE10258
Sulphide	0 – 0.5	Wag-WE10260
Zinc	0 – 4.0	Wag-WE10262

Comparator Reagents, Pack 250 tests

Test	Range mg/l	
Alkalinity (Alkavis)	0 – 250	Wag-WE10300
Aluminium	0 – 0.5	Wag-WE10302
Ammonia	0 – 1.0 (N)	Wag-WE10304
Bromine	0 – 2.0	Wag-WE10306
Bromine	0 – 8.0	Wag-WE10308
Chlorine DPD	0 – 5.0	Wag-WE10310
Chlorine DPD (Mono & Di Chloramine)	0 – 5.0	Wag-WE10312
Chlorine DPD (combined & total)	0 – 5.0	Wag-WE10314
Chlorine DPD (total)		Wag-WE10316
Chlorine HR	0 – 250	Wag-WE10318
Copper (Coppercol)	0 – 5.0	Wag-WE10320
Fluoride	0 – 1.5	Wag-WE10322
Hydrazine Powder	0 – 0.5	Wag-WE10324
Hydrogen Peroxide LR	0 – 2.0	Wag-WE10326
Hydrogen Peroxide HR	0 – 100	Wag-WE10328
Iron LR	0 – 1.0	Wag-WE10330
Iron MR	0 – 5	Wag-WE10332
Maganese	0 – 0.03	Wag-WE10336
Molybdate HR	0 – 100	Wag-WE10338
Nitrate (Nitratest)	0 – 20 (N)	Wag-WE10340
Nitrite (Nitricol)	0 – 0.5 (N)	Wag-WE10342
Ozone	0 – 2.0	Wag-WE10344
pH value (Bromocresol Purple)		Wag-WE10346
pH value (Bromothymol Blue)		Wag-WE10348
pH value (Phenol Red)	6.8 – 8.4	Wag-WE10350
pH value (Thymol Blue)		Wag-WE10352
pH value (Universal pH)		Wag-WE10354
Phosphate	LR 0 – 4.0	Wag-WE10356
Phosphate HR	0 – 100	Wag-WE10358
Silica	0 – 4.0	Wag-WE10360
Sulphide	0 – 0.5	Wag-WE10362
Zinc	0 – 4.0	Wag-WE10364

APPENDIX 3: WATER QUALITY REPORTS

Water Authority:

District: Date:

Sampler/Analyst:

Sample Number:

1. Location:
2. Source:
3. Time:
4. Physical Description:
5. Odour/Taste:
6. Faecal Coliform Count:
7. Total Coliform Count:
8. Turbidity:
9. Free Chlorine:
10. Combined Chlorine:
11. Conductivity:
12. Temperature:
13. pH:
14. Nitrate:
15. Nitrite:
16. Ammonia:
17. Aluminium:
18. Boron:
19. Copper:
20. Fluoride:
21. Magnesium:
22. Manganese:
23. Hardness:
24. Ozone:
25. Sulphate:
26. Sulphide:
27. Phosphate:
28. Zinc:

APPENDIX 4: RE-ORDERING INFORMATION

DESCRIPTION	
Membrane Filtration Unit	Wag-WE10400
Spares Kit for Filtration Unit, comprising of filter disk and gasket kit	Wag-WE10402
Pack of 20 for POTATEST	Wag-WE10406
Sterile plastic petri dishes (50 mm diameter by 11 mm depth) pack of 700	Wag-WE10410
Pair tweezers	Wag-WE10412
Cigarette lighter	Wag-WE10414
Hand Lens	Wag-WE10416
Screwdriver	Wag-WE10418
Lubricating grease – 60g tube	Wag-WE10420
Nail clippers	Wag-WE10422
Spare internal battery for POTALAB	Wag-WE10424
Spirit thermometer for checking incubator temperature	Wag-WE10426
WagPac – disposable water sample bags (Pack of 500)	Wag-WE10428
Media Measuring Device (MMD) (pack of 5)	Wag-WE10429

DESCRIPTION	
3-Part Turbidity Tube, 5-500 JTU	Wag-WE10438

DESCRIPTION	
Coliform Starter Pack, 200 grid membranes, pads and growth medium for 200 tests	Wag-WE10450
Lauryl Sulphate Broth, 500g (2,600 tests)	Wag-WE10452
Lauryl Sulphate Broth, 38.1 g (200 tests)	Wag-WE10454
Lauryl Sulphate Broth, 1.92g sachets (10 tests),pack of 25	Wag-WE10456
Faecal Streptococci Starter Pack (Slanetz & Bartley Medium) for 200 tests	Wag-WE10458
Absorbent pads and membranes (pack of 200) (pack of 1000)	 Wag-WE10460 Wag-WE10462
Pad dispenser	Wag-WE10464

Pre-prepared Media These are small ampoules and vials which contain a pre-prepared 2ml quantity of media. Being pre-prepared, they have the advantage of convenience and of always being sterile.	
Faecal Coliform Ampoules, 2ml (Pack of 40)	Wag-WE10468
Total Coliform Ampoules, 2ml (Pack of 40)	Wag-WE10470

wagtech WTD
a division of Palintest Ltd

Palintest Ltd
Palintest House
Team Valley
Gateshead
Tyne + Wear
NE11 0NS
United Kingdom

Tel +44 (0) 191 491 0808
Fax +44 (0) 191 482 5372
info@wagtech.co.uk
www.wagtech.co.uk

Appendix 2.17

SOP Final Version Record Form

Form 3.1-1

Daily Intake of Water Source Record Sheet

Name of the Source		Approved by	
Month/Year		Prepared by	

Day	Time of Meter Reading (hour:minute)	Meter Reading Value (m^3)	Daily Intake Amount (m^3/day)	Remarks
1	10:00	A	B-A	
2	10:00	B	C-A	
3		C		
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	10:00	D	E-D	
31	10:00	E	F-E	
1st day (next Month)		F		
Total				
Daily Average				
Daily Maximum				
Daily Minimum				

Form 3.1-2

Monthly Intake of Water Source Summary Sheet

Month/Year	
Approved by	
Prepared by	

Day	Daily Intake of Water Source					
	Source A (m^3/day)	Source B (m^3/day)	Source C (m^3/day)	Source D (m^3/day)	Source E (m^3/day)	Total (m^3/day)
1						
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						
Total (m^3/month)						
Daily Average						
Daily Maximum						
Daily Minimum						

Form 3.1-3

Annual Intake of Water Source Summary Sheet

Fiscal Year	
Approved by	
Prepared by	

Month	Monthly Intake (m^3/month)	Daily Average (m^3/day)	Daily Maxmum (m^3/day)	Daily Minimum (m^3/day)
Srawan				
Bhadra				
Asoj				
Kartik				
Mangsir				
Poush				
Magh				
Falgun				
Chaitra				
Baisakh				
Jestha				
Ashadh				
Total				

Form 3.2-1

Daily Operation Record Sheet (Pattern A, B, C)

Date : / / ( )

Approved by	
Prepared by	

Weather Conditions (Time: :)

Weather	Sunny ・Cloudy ・Rainy ・Windy ・Stormy
Ambient Temperature	°C

WTP Operation (Time: :)

Intake	Turbidity	NTU
	pH	-
	Electrical Conductivity	μS/cm
	Garbage, oil or other abnormalities	
Sedimentation Tank	Turbidity (Inlet)	NTU
	pH (Inlet)	-
	Oil or other abnormalities	
	Scum or Algae	
Roughing Filter	Turbidity (Inlet)	NTU
	Water level (Filtration resistance)	m
	* Filtration rate (design value: 0.3 – 1.5 m/h)	m/h
Slow Sand Filter/ Rapid Sand Filter	Turbidity (Inlet)	NTU
	Water level (Filtration resistance)	m
	* Filtration rate (design value: 0.1 – 0.2 m/h)	m/h
	Condition of surface biofilm	
Clear Water reservoir	Turbidity (Outlet)	NTU
	pH (Outlet)	-
	Color (Outlet)	-
	Taste and Odor (Outlet)	-
	Residual Chlorine (Outlet)	mg/L
	Water level	m

Power Incoming (Time: :)

NEA	Daily / Total: / kWh
Diesel Generator	Daily / Total: / kWh
Voltage	(NEA / DG) V
Frequency	(NEA / DG) Hz
Ampare	(NEA / DG) A
Generator Operation Time	Daily / Total: / Hours

Chlorination Facility (Time: :)

Flow Rate	L/Hour	Settting Value:
Discharge Pressure (Pump Type)	No.1: MPa	No.2: MPa
Liquid Level	m	
Used Amount of BP	(in case of preparing the solution) kg	
Stock of BP	bags	

Comments:

Form 3.2-2

Daily Operation Record Sheet (Pattern D, E)

Approved by	
Prepared by	

Date : / / ( )

Weather Conditions (Time: :)

Weather	Sunny ・Cloudy ・Rainy ・Windy ・Stormy
Ambient Temperature	°C

WTP Operation (Time: :)

Tube Well	Turbidity	NTU
	pH	-
	Electrical Conductivity	µS/cm
Aeration Tank	Flow rate of Inlet	m3/h
	Flow rate of supplied air	m3/h
	Water level	m
	Pressure	MPa
Pressure Filter	Turbidity (Outlet)	NTU
	Flow rate of Inlet	m3/h
	Pressure (Inlet)	MPa
	Pressure (Outlet)	MPa
	Flow rate of Back-wash	m3/h
	Appearance of backwash waste water	
Elevated Tank/ Clear Water reservoir	Turbidity (Outlet)	NTU
	pH (Outlet)	-
	Color (Outlet)	-
	Taste and Odor (Outlet)	-
	Residual Chlorine (Outlet)	mg/L
	Water level	m

Power Incoming (Time: :)

NEA	Daily / Total: / kWh
Diesel Generator	Daily / Total: / kWh
Voltage	(NEA / DG) V
Frequency	(NEA / DG) Hz
Ampare	(NEA / DG) A
Generator Operation Time	Daily / Total: / Hours

Chlorination Facility (Time: :)

Flow Rate	L/Hour	Settting Value:
Discharge Pressure (Pump Type)	No.1: MPa	No.2: MPa
Liquid Level	m	
Used Amount of BP	(in case of preparing the solution) kg	
Stock of BP	bags	

Comments:

Form 3.2-3

Daily Operation Record Sheet (Pump)

Date : / / ( )		Approved by	
		Prepared by	

Weather Conditions (Time: :)

Weather		Ambient Temperature	

Well Pump

Pump No. (Time)		**No.1 (:)**	**No.2 (:)**	**No.3 (:)**	**No.4 (:)**	**No.5 (:)**
Flow Rate	(m3/h)					
Discharge Pressure	(MPa)					
Ampare	(A)					
Voltage	(V)					
Operation Time (Daily)	(hr)					
Operation Time (Total)	(hr)					
Pump No. (Time)		**No.6 (:)**	**No.7 (:)**	**No.8 (:)**	**No.9 (:)**	**No.10 (:)**
Flow Rate	(m3/h)					
Discharge Pressure	(MPa)					
Ampare	(A)					
Voltage	(V)					
Operation Time (Daily)	(hr)					
Operation Time (Total)	(hr)					

Transmission Pump

Pump No. (Time)		**No.1 (:)**	**No.2 (:)**	**No.3 (:)**	**No.4 (:)**	**No.5 (:)**
Flow Rate	(m3/h)					
Discharge Pressure	(MPa)					
Suction Pressure	(MPa)					
Ampare	(A)					
Voltage	(V)					
Operation Time (Daily)	(hr)					
Operation Time (Total)	(hr)					

Comments:

Form 3.2-4

Daily Inspection Record Sheet

Approved by	
Prepared by	

Date : / / ( )

Daily Inspection Items (Mechanical)		**Check**	**Daily Inspection Items (Electrical)**		**Check**
Intake / Tube Well	Water level		Electrical Panel (Intake Pump)	Analog / digital meter indication	
	Gabage, oil or other abnormalities			Status / fault lamp test	
Intake Pump No.1 (Well Pump)	Abnormal noise and vibration			Abnormal noise from components	
	Condition of pressure gauge and flow meter			Cleanliness	
	Appearance of valves and pipes			Smell, burn mark or other abnormalities	
	Leakage or other abnormalities		Electrical Panel (Transmission Pump)	Analog / digital meter indication	
Intake Pump No.2 (Well Pump)	Abnormal noise and vibration			Status / fault lamp test	
	Condition of pressure gauge and flow meter			Abnormal noise from components	
	Appearance of valves and pipes			Cleanliness	
	Leakage or other abnormalities			Smell, burn mark or other abnormalities	
Transmision Pump No.1 (Horizontal Volute Pump)	Appearance of pump, motor, valves and pipes		Electrical Panel (Chlorination Unit)	Analog / digital meter indication	
	Abnormal noise, vibration and sound			Status / fault lamp test	
	Lubricant level			Abnormal noise from components	
	Excessive heat generation of the gland packing			Cleanliness	
	Condition of pressure gauge and flow meter			Smell, burn mark or other abnormalities	
	Leakage or other abnormalities		Generator	Visual inspection / Leakage (coolant, oil, fuel)	
Transmision Pump No.2 (Horizontal Volute Pump)	Appearance of pump, motor, valves and pipes			Visual inspection /Loose fastenings / fixings	
	Abnormal noise, vibration and sound			Visual inspection / Worn belts, Loose connections etc.	
	Lubricant level			Level of Fuel	
	Excessive heat generation of the gland packing			Level of Engine oil	
	Condition of pressure gauge and flow meter			Level of Coolant	
	Leakage or other abnormalities			Condition of Battery / Fluid level etc.	
Chlorine Dosing Equipment (Pump Type)	Appearance of tank, mixer, pump and valves			Voltage and current	
	Abnormal noise and vibration of mixer/pump				
	Heat generation of mixer/pump				
	Leakage or other abnormalities				
Chlorine Dosing Equipment (Manual Type)	Appearance of tank, mixer and valves				
	Abnormal noise and vibration of mixer				
	Condition of small generator				
	Leakage or other abnormalities				

Comment :

< Criteria > √: good, ×: Need to be repaired / replaced

Form 3.2-5

SOP_Appendix. Periodical Inspection for Electrical Facility

Definition of frequency and method

Nominal	Actual freq.	Main purpose	Method
Daily	everyday	Operation recording	Visually. Under running condition.
Weekly	once a week	Appearance Check	Visually. Under running condition.
Monthly	every 1~2 month	Easy check of function	Mainly visually. stappage of facility required.
Yearly	once or twice a year	Detailed check of each component	Measurement w/ Testers. Stopping facility

Items and Frequency

Facility	Equipment	Item	Frequency		
			Weekly	monthly	yearly
Power Receiving	Disconnector, Change-over Switch	Appearance	O	O	O
		Function	O	O	O
Pump Panel (surface)	Indication Lamp, voltage meter, ammeter (ampere), switches	Appearance	O	O	O
		Insulation Test			O
		Volt Amp Reading	O	O	O
Pump Panel (inside)	Circuit breaker, magnetic contactor, thermal relay, timer (for Y-D), Under/voltage relay, Wiring	Appearance/noise	O	O	O
		Relay settings		O	O
		Volt Amp measurment		O	O
		Insulation Test			O
Cabling	Cable Seath, Conductor	Appearance	O	O	O
		Insulation Test			O
Load (motor-pump)	Motor- terminal, motor-wiring	Apperance/noise	O	O	O
		Insulation Test			O
		Operation Record	O	O	O
		Vibration and temperature			O
Earth	Earth electrode	Earth resistance			O
Other	Operation Recording	-	(Daily)	-	-

Form 3.2-5

[WEEKLY] CHECK

(Pump Facility)

Location:
(Facility): ____________________

Motor Specification:

Rated Capacity (kW/HP) __________

Rated Voltage (V) ____________**Rated Current(A)** __________

DATE (yyyy-mm-dd)		
from	~	to

Sr. No.	Inspection Date (mm-dd)		Visual (panel surface)						Visual (panel inside)			Cable	Operating Procedure	
		Item	Identifications	Status/falut indication lamps	Voltage meter		Ampere meter		Cleanliness	Intrusion path	Noise	Sheath	Change-over	stop/ start frequency
		Criteria	All lamps, switches have name tag	All lamps light up brightly	Proper functioning & zero adjustment	selector switch functions properly	Proper functioning & zero adjustment	selector switch functions properly	No dust, spider's nest, vermins	No hole or crack on enclosure	No noise from components	No cut observed.	To be turned off, breaker of switch first	Less than 3 time/hour
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

Remarks:

Evaluation Criteria

✓ : Good	×: No care or need to be replaced
△ : Need to be improved	—: Not available to be checked

(Checked/Approved by:)

(Recorded by:)

Form 3.2-5

[MONTHLY] CHECK LIST

(Pump Facility)

Location:
(Facility): ______________________________

Motor Specification:

Rated Capacity (kW/HP) _________

Rated Voltage (V) ___________**Rated Current(A)** _________

DATE (yyyy-mm-dd)		
from	~	to

Sr. No.	Inspection Date (mm-dd)	Inspection Items for Electrical Panel Condition																						
		Item	Voltage and Ampere Check															Item	Relay Function and Adjustment !STOP LOAD BEFORE CHECKING!					
			Voltage by clamp meter			Voltage on voltmeter			Ampere by clamp meter			Ampere on ammeter			Power factor				Over/under Voltage Relay			Over current (thermal) Relay		Timer for Y-D
			RY	YB	BR	RY	YB	BR	R	Y	B	R	Y	B	R	Y	B		Over-voltage trip test button works	Under-voltage trip test button works	To be set voltages ±10% of rating of motor	Trip test button works	Rating ampere is set (approx. [kW] x 2 for 400V)	Not less than 5 [sec]
		Criterina	±10% of rating			±3% of clampmeter value			less than rating value			±3% of clampmeter value			more than 85% (depend on application)			Criteria						
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								

Remarks:

Evaluation Criteria

✓ : Good	×: No care or need to be replaced
△ : Need to be improved	—: Not available to be checked

(Checked/Approved by:)

(Recorded by:)

Form 3.2-5

[YEARLY] CHECK LIST

(Pump Facility)

Location:
(Facility):

Motor Specification:

Rated Capacity (kW/HP) _________

Rated Voltage (V) ___________**Rated Current(A)** _________

DATE (yyyy-mm-dd)		
from	~	to

Sr. No.	Inspection Date (yyyy-mm-dd)	**Inspection Items for Electrical Panel Condition !DISCONNECT POWER SUPPLY BEFORE CHECKING!**														**Motor & Pump Conditions**					
		Item	**Continuity Test of Components by Clamp-multi Tester**							**Insulation Test**				**Earth Resistance Test**		Item	**Vibration and Temperature**				
			Circuit Breaker			Magnetic Contactor			Fuse	Against Ground (Earth)	Between Lines (load to be disconnected)			For Arrester	For 400V		Bearing Vibration		Bearing Temperature		
			MCCB1	MCB1	MCB2	K1	K2	K3	Fuse	UVW (All) - E	Panel side					Criteria	Drive End	Non-Drive End	Drive End	Non-Drive End	Shaft
											U1-V1	V1-W1	W1-U1								
		Criterina								More than 1.0 MΩ: Good, More than 0.4 MΩ: Need to clean up or care, Less than 0.4 MΩ: Repair immediately				Less than 10Ω			Less than 7.3 [mm/s]		Less than ambient 'temperature +40°C'		
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

* These items shall be measured by supplier or manufacturer.

Remarks:

Evaluation Criteria

✓ : Good	×: No care or need to be replaced
△ : Need to be improved	—: Not available to be checked

(Checked/Approved by:)

(Recorded by:)

Form 3.3-1

Daily Water Distribution Flow Record Sheet

Name of the Reservoir		Approved by	
Month/Year		Prepared by	

Day	Time of Meter Reading (hour:minute)	Meter Reading Value (m^3)	Daily Water Distribution Flow (m^3/day)	Remarks
1	10:00	A	B-A	
2	10:00	B	C-A	
3		C		
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	10:00	D	E-D	
31	10:00	E	F-E	
1st day (next Month)		F		
Total				
Daily Average				
Daily Maximum				
Daily Minimum				

Form 3.3-2

Monthly Water Distribution Flow Summary Sheet

Month/Year	
Approved by	
Prepared by	

Day	Daily Water Distribution Flow				
	Reservoir A (m^3/day)	Reservoir B (m^3/day)	Reservoir C (m^3/day)	Reservoir D (m^3/day)	Total (m^3/day)
1					
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					
Total (m^3/month)					
Daily Average					
Daily Maximum					
Daily Minimum					

Form 3.3-3

Annual Water Distribution Flow Summary Sheet

Fiscal Year	
Approved by	
Prepared by	

Month	Monthly Flow (m^3/month)	Daily Average (m^3/day)	Daily Maxmum (m^3/day)	Daily Minimum (m^3/day)
Srawan				
Bhadra				
Asoj				
Kartik				
Mangsir				
Poush				
Magh				
Falgun				
Chaitra				
Baisakh				
Jestha				
Ashadh				
Total				

Form 3.3-4

Daily Inspection Record Sheet for Civil Structure

Date (date/month/year)

Approved by

Prepared by

Facility	Strucure	Check Item	Check	Information
Intake WTP	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Service Reservoir	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Pipeline	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		

レ: No Problem, ×: Detection of Problems (If problems are detected, add information such as location and problem outline.)

Repair Work Record Sheet for Civil Structures

Approved by	
Prepared by	
Repair Work Period	

Category	Item	Information
Location Information	Site Name	
	Category	☐Fence/Wall, ☐Concrete Structure, ☐Metal Goods, ☐Paint, ☐Others ( )
Facility Information	Problems	☐Water Leakage, ☐Damage of Main Structure, ☐Rust of Metal Goods, ☐Damage of Paint, ☐Others ( )
	Repaired Part	
	Construction Year	
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

Form 3.3-6

Patrol Inspection Record Sheet for Valve Boxes

(Boxs for Valves, Air Valves, Fire Hydrant)

Date (date/month/year)	
Approved by	
Prepared by	

No.	Valve ID	Pipe Diameter	Appearance, Leakage, Strange Noise, inundation, etc.	Remarks

Form 3.3-7

Repair Work Record Sheet for Pipelines

Approved by	
Prepared by	
Repair Work Period	

Category	Item	Information
Location Information	Site Address	
	Category	☐Distribution Pipelines, ☐Valves, ☐Household Connections, ☐Others ( )
Facility Information	Pipe Material	☐DCI Pipe, ☐PVC Pipe, ☐HDPE Pipe, ☐GI Pipe, ☐Others ( )
	Diameter	
	Construction Year	
	Pipe Position	☐Buried Pipeline, ☐River/Canal Crossing Pipeline, ☐Others ( )
	Earth Cover of Pipe	
	Problems	☐Water Leakage, ☐Others ( )
	Leakage Pioint	☐Joint, ☐Pipe Body, ☐Tapping Saddle, ☐Valves, ☐Others ( )
	Leakage Detection	☐Patrol, ☐Call from Customers, ☐Others ( )
	Cause of Water Leakage	☐Slip Out of Joint, ☐Corrosion of Pipe Body, ☐Incident by Third Party, ☐Others ( )
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

Form 3.4-1

Water Meter Installation/Replacement Record Sheet

Tap Number	User Name	Adress	Installation			1st Replacement				2nd Replacement				3rd Replacement			
			Date (dd/mm/yy)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.

Form 3.4-2

Cause Analysis of Water Meter Malfunction Record Sheet

Approved by Prepared by Repair Work Period	

Category	Item	Information
User Information	Tap Number	
	User Name	
	Address	
Meter Problem Information	Replacement Date	
	Life of Water Meter	
	Category of malfunction	☐no proceeding indicator, ☐delay of indicator, ☐inverse rotation of indicator, ☐derangement, ☐leakage from meter, ☐unclearness of meter, ☐ meter damage
	Cause of Malfunction	

Photo (cause of malfunction)	Photo (cause of malfunction)

Form 3.4-3

Use Torelance Test Record Sheet

Approved by Prepared by Date of Test	

Category	Item	Information
User Information	Tap Number	
	User Name	
	Address	
Tested Meter	Initial Value	
	Final Value	
	Difference (I)	
Master Meter	Initial Value	
	Final Value	
	Difference (Q)	
Use Tolerance	Cause of Malfunction	E (%) = (I-Q)/Q x 100, E is 10% and less => O.K. / over 10% => N.G.

Photo (Test Situation)	Signature
	User
	WUSC

Repair Work Record Sheet for Civil Structures

Approved by	
Prepared by	
Date	

Category	Item	Information
Location Information	Site Name	
	Category	☐Fence/Wall, ☐Concrete Structure, ☐Metal Goods, ☐Paint, ☐Others ( )
Facility Information	Problems	☐Water Leakage, ☐Damage of Main Structure, ☐Rust of Metal Goods, ☐Damage of Paint, ☐Others ( )
	Repaired Part	
	Construction Year	
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

Form 3.6-2

Repair Work Record Sheet for Pipelines

Approved by	
Prepared by	
Date	

Category	Item	Information
Location Information	Site Address	
	Category	☐Distribution Pipelines, ☐Valves, ☐Household Connections, ☐Others ( )
Facility Information	Pipe Material	☐DCI Pipe, ☐PVC Pipe, ☐HDPE Pipe, ☐GI Pipe, ☐Others ( )
	Diameter	
	Construction Year	
	Pipe Position	☐Buried Pipeline, ☐River/Canal Crossing Pipeline, ☐Others ( )
	Earth Cover of Pipe	
	Problems	☐Water Leakage, ☐Others ( )
	Leakage Pioint	☐Joint, ☐Pipe Body, ☐Tapping Saddle, ☐Valves, ☐Others ( )
	Leakage Detection	☐Patrol, ☐Call from Customers, ☐Others ( )
	Cause of Water Leakage	☐Slip Out of Joint, ☐Corrosion of Pipe Body, ☐Incident by Third Party, ☐Others ( )
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

Form 3.6-3

Repair Work Record Sheet for Mechanical/Electrical Equipment

Approved by	
Prepared by	
Date	

Item	Information
Name of Equipment	
Period of Repair Work	
Outline of Repair Work	
Repair Cost (NPR)	

Photo (Before Repair)	Photo (After Repair)

Appendix 2.18

Simplified SOPs

< Summary of SOP > 1-1

Intake Flow Management

a) Daily Work

i. Read the meter at the designated time and record meter reading value in **Form 3.3-1**. Then calculate and record the daily intake amount. If WUSC has plural intake facilities, the record sheet shall be prepared for each intake.

ii. While reading a meter, check the condition of the flow meter.

b) Monthly Work

i. Sum up the daily intake amount of Form 3.3-1 on the last day of every month.

ii. Sum up the monthly total of intake amount for each intake and summarize the data in Form 3.3-2.

c) Yearly Work

i. Sum up the monthly total of intake amount and summarize the data in **Form 3.3-3** by the end of every fiscal year.

Photo-1. Indicator of Water Meter

< Summary of SOP > 1-2

Daily & Periodic Inspection of Intake Structure

The following points shall be checked in daily and periodic inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** to **Form 3.2-3** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Garbage, oil or other abnormalities	✓ Remove garbage. ⇒ see **Photo-1**. ✓ If you find oil, stop taking water and take necessary measures.
Monthly	✓ Sediments (sand, etc.)	✓ Remove sediments monthly (if necessary) ⇒ see **Photo-2**
Yearly	✓ Crack or Leakage on body	✓ Repair it.

Photo-1. Removing Garbage

Photo-2. Removing Sediments

< Summary of SOP > 1-3

Operation Procedure of Well Pump

a) Preparation Before Operation

i. Check a leakage or the other abnormality at the pump area.
ii. Select the pump to be operated.
iii. Check the related valves are at the proper position (Discharge Valve: close, Wash-out Valve: close).
iv. Check the pressure gauges indicate the original/zero value.
v. Check / record the Voltage, Ampere and Frequency of power incoming on the electrical panel.
vi. Check / record the water level of the related tanks (if necessary).

Photo-1. Typical System of the Well Pump

b) Start Operation

i. Push the start button on the electrical panel.
ii. Open the discharge valve slowly.
iii. Adjust the flow rate and discharge pressure to the design value (indicated in the specification).
iv. Check / record the flow rate, discharge pressure, water level of the related tanks, voltage and current periodically.

c) Stop Operation

i. Push the stop button at the electrical panel.
ii. Close the discharge valve. (In case the pump will be stopped for a long time.)

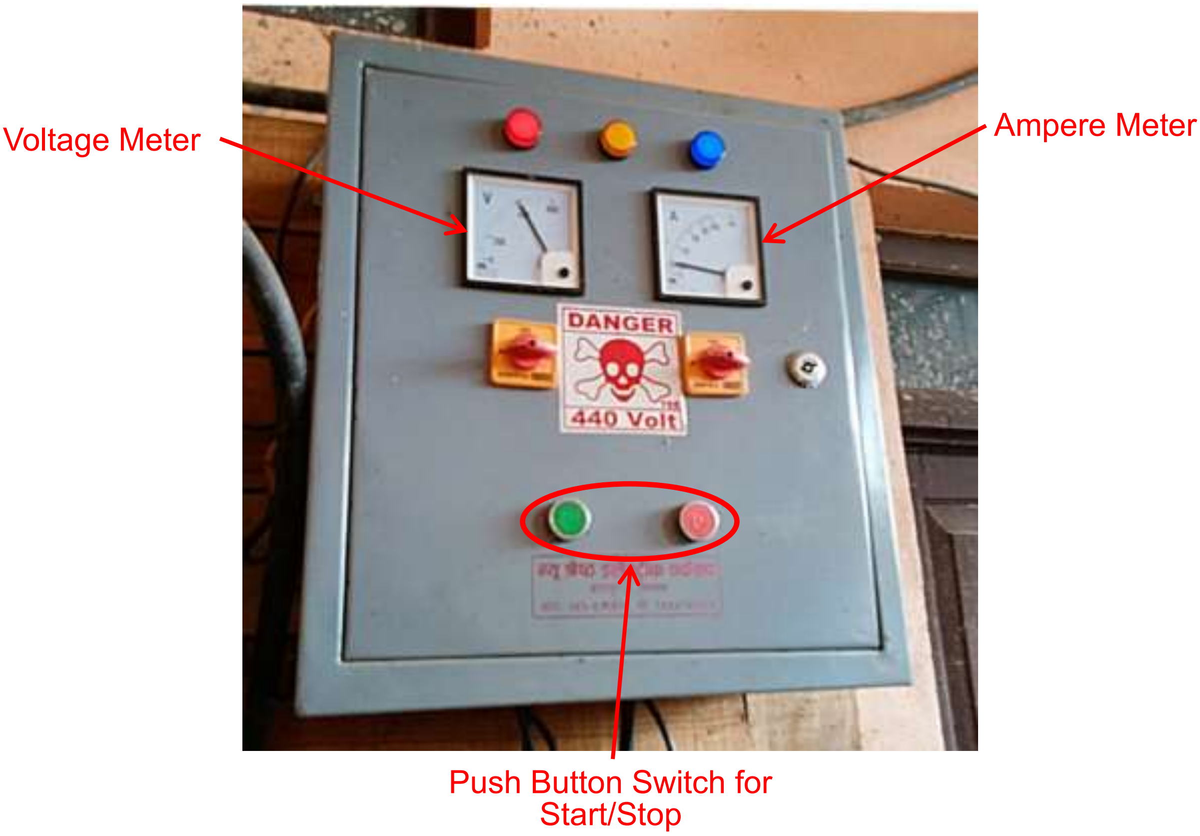


Photo-2. Electrical Panel

< Summary of SOP > 1-4

Daily & Periodic Inspection of Well Pump

The following points shall be checked by daily, monthly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-2** and **Form 3.2-3** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Abnormal noise, vibration and sound	✓ Touch the discharge pipe. ⇒ See **Photo-1**
	✓ Discharge pressure, flow rate, water level of the related tank	✓ Check/read the pressure gauge, flow meter and level meter (if installed). ⇒ See **Photo-2 and 3**
	✓ Voltage and current	✓ Check/read the ampere and voltage meter on the electrical panel. ⇒ See **Photo-4** ✓ It shall be within the rated value or the value of commissioning.
Monthly	✓ Insulation	✓ Measure the insulation resistance value of motor/cable by using insulation meter. ⇒ See **Photo-5** ✓ Acceptance criteria is more than 1.0 MΩ.
Yearly	✓ Condition of protective equipment (thermal protector, immersion detector etc.)	✓ Confirm whether they work properly.
	✓ Appearance, damage and other abnormality	✓ Pull up the well pump by using chain block etc. ✓ Observe the pump.
Every 2-3 Years	✓ Overhaul	✓ Ask supplier or manufacturer for overhaul. ✓ In case stand-by pump is not installed, another pump shall be prepared and installed.

Photo-1. Touching Discharge Pipe

Photo-2. Checking Pressure Gauge

Photo-3. Checking Flow Meter

Photo-4. Checking Ampere/Voltage Meter

Photo-5. Measuring the Insulation Resistance Value

< Summary of SOP > 2-1

Daily & Periodic Inspection of Sedimentation Tank

The following points shall be checked by daily, weekly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Turbidity (Inlet)	✓ Measure the turbidity of inlet water by using turbidity meter. ⇒ see **Photo-1**.
Daily	✓ pH (Inlet)	✓ Measure the pH of inlet water by using Test Kit (ENPHO Kit). ⇒ see **Photo-2** and **Instruction Manual**.
Daily	✓ Oil or other abnormalities	✓ If you find oil, stop inflow. ✓ Remove or drain it manually.
Daily	✓ Scum or Algae	✓ Remove it manually. ⇒ see **Photo-3**.
Weekly	✓ Amount of sediment	✓ Observe the inside of tank.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.
Yearly	✓ Cleaning	✓ Drain the inside water completely. ✓ Carry out cleaning of the tank. ⇒ see **Summary of SOP 2-2**.

Photo-1. Measurement of Turbidity

Photo-2. Measurement of pH

Photo-3. Removing Scum

< Summary of SOP > 2-2

Cleaning Procedure of Sedimentation Tank

i. Close the inlet valve of the tank. ⇒ see **Photo-1**.
ii. Open the drain valve to drain settled sediments with inside water.
iii. Scrape the sediments toward the drainage.
iv. If the amount of settled sediments is too much to drain/wash out, remove it manually by using shovel and bucket. ⇒ see **Photo-2**.
v. Open the inlet valve for wash out.
vi. Clean the inlet chamber, walls and bottom of tank with inlet water. ⇒ see **Photo-3 to 6**.
vii. Close the drain valve
viii. Open the inlet valve and fill the tank with water.
(Once water level is reached to the outlet, treated water will flow into roughing filter.)

Notes;

1. Cleaning shall be performed at least once a year.
2. In case there are two tanks, wash the tanks one by one to keep water supply.
3. In case of one tank only, open the by-pass valve during cleaning to send raw water for the next process.

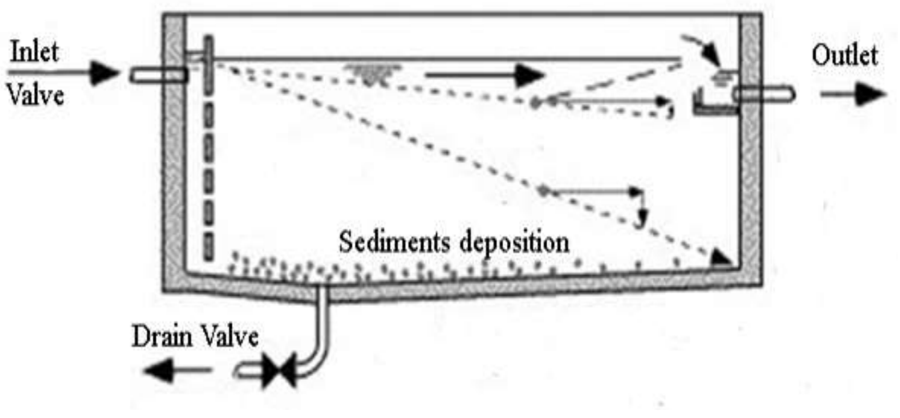


Figure-1. Cross Section of Sedimentation Tank

Photo-1. Operation of Valve

Photo-2. Removing Settled Sludge

Photo-3. Cleaning of Inlet Chamber

Photo-4. Cleaning of Wall

Photo-5. Cleaning of Bottom with Water

Photo-6. Completion of Cleaning

< Summary of SOP > 2-3

Daily & Periodic Inspection of Roughing Filter

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Turbidity (Inlet)	✓ Measure the turbidity of inlet water by using turbidity meter. ⇒ see **Photo-1**.
Daily	✓ Water level (Filtration resistance)	✓ Confirm whether water can be seen on the filter media or not. ✓ If water can be seen, hydraulic cleaning shall be done. ⇒ see **Photo-2**.
Daily (if possible)	✓ Filtration rate (design value: 0.3 – 1.5 m/h)	✓ In case that flow meter or v-notch (see page 3.2-18 of SOP) is installed, measure the filtration rate.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.

Photo-1. Measurement of Turbidity

Normal Condition **High Water Level (Filtration Resistance)**

Photo-2. Observation of Water Level

< Summary of SOP > 2-4

Cleaning of Roughing Filter

a) Procedure of Hydraulic Cleaning

Hydraulic cleaning of RF shall be carried out in case i) turbidity of outlet water is more than 10 NTU, ii) water level reach to the high water level, iii) abnormal condition (clogging, algae growth etc.) is observed. However, it is recommended to perform hydraulic cleaning at least once a month.

i. Close the inlet valve
ii. Open the drain valve of the first compartment (upstream side) quickly in order to drain/wash out accumulated sludge with inside water.
iii. Open the inlet valve and fill the filter with water (Close the inlet valve).
iv. Open the drain valve of the first compartment again quickly.
v. Check the appearance of drained water by observation.
vi. Close the drain valve of the first compartment.
vii. Repeat the procedure from iii to vi until the appearance of drained water is clean enough.
viii. Repeat the procedure from i to vii for the second and third compartment.
ix. Open the inlet valve gradually and fill the filter with water slowly. (Once water level is reached to the outlet, treated water will flow into Slow Sand Filter.)

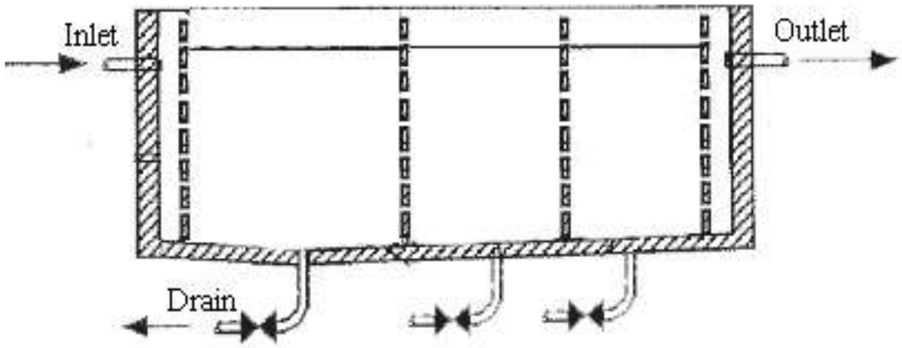


Figure-1. Cross Section of Roughing Filter

b) Procedure of Washing Filter Media (gravel)

Washing of filter media is conducted in case that the above filter cleaning is not sufficient to remove accumulated sludge. Even if the filter cleaning is performed on a regular basis, it is recommended to remove and wash all filter media (gravel) manually <u>once in three years</u>.

- i. Close the inlet valve and drain inside water completely.
- ii. Remove gravel from each compartment and place separately.
  ⇒ see **Photo-1 to 2**.
- iii. Wash gravel separately with sufficient water at the appropriate place.
  ⇒ see **Photo-3**.
- iv. Place the washed gravel in clean area.
- v. Clean the walls and bottom of filter with water.
- vi. Drain all inside water until the appearance of drained water is clean enough.
- vii. Close all drain valves.
- viii. Backfill the washed gravel to the original compartment.
  ⇒ see **Photo-4**.
- ix. Open the inlet valve gradually and fill the filter with water slowly. (Once water level is reached to the outlet, treated water will flow into Slow Sand Filter.)

Photo-1. Excavating Gravel

Photo-2. Removing Gravel

Photo-3. Washing Gravel with Clean Water

Photo-4. Backfilling the Washed Gravel

< Summary of SOP > 2-5

Daily & Periodic Inspection of Slow Sand Filter

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Turbidity (Inlet and outlet)	✓ Measure the turbidity of inlet and outlet water by using turbidity meter. ⇒ see **Photo-1**.
Daily	✓ Water level (Filtration resistance)	✓ Check/measure the water level. ⇒ see **Photo-2**. ✓ If water level is high and treated water amount is less than the design value, sand scraping shall be done.
Daily (if possible)	✓ Filtration rate (Design value: 0.1 - 0.2 m/h)	✓ In case that flow meter or v-notch is installed, measure the filtration rate. ⇒ see **Photo-3**.
Daily	✓ Condition of surface biofilm	✓ Confirm whether color of biofilm is normal or not. ✓ Confirm whether other abnormalities exist or not. ✓ If DO meter is available, measure dissolved oxygen value of treated water. (WHO Guideline: More than 3 mg/L)
In case of sand scraping	✓ Thickness of sand layer	✓ Measure the distance between top of the wall and sand surface. Thickness of sand layer can be calculated based on the as-built drawing. ⇒ see **Photo-4**. ✓ If the thickness is 500 mm or less, re-sanding shall be done.
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.
Every 10 years	✓ Condition of gravel and under drain equipment	✓ Remove sand and/or gravel as required. ✓ Check the condition of gravel and under drain equipment.

Photo-1. Measurement of Turbidity

Photo-2. Measurement of Water Level

Photo-3. Measurement of Filtration Rate at V-notch

Photo-4. Measurement of Sand Layer Thickness

< Summary of SOP > 2-6

Scraping Sand of Slow Sand Filter

a) Procedure of Scraping Sand

Scraping of sand shall be carried out once in three months to six months depending on the water level (filtration resistance) in SSF. It is recommended to carry out the scraping before start of rainy season.

i. Close inlet valve and remove all floating materials.
ii. Close outlet valve and open drain valve. In order to restart quickly, do not drain off inside water completely.
iii. Put on safety items such as gloves, helmet etc. before entering slow sand filter. It is recommended to use stage planks in order to protect sand layer. ⇒ see **Photo-1**.
iv. Wash / clean inside walls of filter. ⇒ see **Photo-2**.
v. Remove algae and remaining scum.
vi. Start scraping approx. 10 mm of surface sand from one edge. ⇒ see **Photo-3**.
vii. Remove scraped sand to storage area.
viii. Check / measure the thickness of sand layer. If it is 500 mm (lower limit) or less, re-sanding must be done.
ix. Level the sand bed.

Photo-1. Preparation of Stage Planks

Photo-2. Cleaning Inside Walls

Photo-3. Scraping Surface Sand

b) Procedure of Restart Filtration

i. If possible, fill the filter with treated water from under drain up to 10-20 mm above sand surface.

ii. Open the inlet valve and fill water slowly in order to avoid unevenness of the sand layer.
⇒ see **Photo-4**.

iii. Drain off filtered water from the drain valve until the bio-film on the sand surface will be formed.*
** It will take from a few days to a few weeks depending on the weather condition and raw water quality.*
Collect sample of treated water and check the turbidity.
⇒ see **Photo-5**.

iv. After the turbidity of treated water is below 5 NTU, close the drain valve and open the outlet valve.

Photo-4. Filling Water to Slow Sand Filter

Photo-5. Collecting Water Sample

< Summary of SOP > 2-7

Daily & Periodic Inspection of Clear Water Reservoir

The following points shall be checked by daily, monthly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** or **Form 3.2-2** attached in SOP)

Frequency	Monitoring / Inspection Points	Methods
Daily	✓ Turbidity (Outlet) ✓ pH (Outlet) ✓ Color (Outlet) *if possible ✓ Taste and Odor (Outlet)	✓ Measure the turbidity of outlet water by using turbidity meter. ⇒ see **Photo-1**. ✓ Measure the pH of outlet water by using Test Kit (ENPHO Kit). ⇒ see **Photo-2** and **Instruction Manual of ENPHO Kit**. ✓ In case color meter is available, measure the color of outlet water. ✓ Check whether abnormal taste and odor are felt or not.
Daily	✓ Residual Chlorine (Outlet)	✓ Measure the residual chlorine of outlet water by using Test Kit (ENPHO Kit). ⇒ see **Instruction Manual of ENPHO Kit**.
Daily	✓ Water level	✓ Check/measure the water level. ⇒ see **Photo-3**.
Monthly	✓ Electrical Conductivity (Outlet) ✓ Ammonia (Outlet) ✓ Nitrate (Outlet) ✓ Total Hardness (Outlet) ✓ Calcium (Outlet) ✓ E.coli (Outlet) ✓ Total Coliform (Outlet)	✓ Basically, outsource the analysis of these parameters. (Ammonia and Nitrate can be measured roughly by ENPHO Kit.)
Yearly	✓ Iron (Outlet) ✓ Manganese (Outlet) ✓ Chromium (Outlet) ✓ Fluoride (Outlet)	✓ Basically, outsource the analysis of these parameters. (Iron can be measured roughly by ENPHO Kit.)

Frequency	Monitoring / Inspection Points	Methods
Yearly	✓ Crack or Leakage on tank body	✓ Check a crack or leakage on concrete body. ✓ If necessary, repair it according to the condition.

Photo-1. Measurement of Turbidity

Photo-2. Measurement of pH

Photo-3. Measurement of Water Level

< Summary of SOP > 2-8

Daily & Periodic Inspection of Chlorination Unit

a) Procedure of Daily & Periodic Inspection of Chlorination Unit

The following points shall be checked by daily, weekly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-1**, **Form 3.2-2** and **Form 3.2-4** attached in SOP)

Type of Chlorination Facility	
 < Pump Type >	 < Gravity Type >

Frequency	**Monitoring /Inspection Points**	**Method**
Daily	✓ Appearance	✓ Observe.
	✓ Abnormal noise and vibration of mixer	✓ Hear and touch the motor cover. ⇒ **See Photo-1**
	✓ Abnormal noise and vibration of pump (for Pump Type)	✓ Hear and touch the motor cover. ⇒ **See Photo-2**
	✓ Heat generation of mixer	✓ Touch the motor cover. ⇒ **See Photo-1**
	✓ Heat generation of pump (for Pump Type)	✓ Touch the motor cover. ⇒ **See Photo-3**
	✓ Leakage or other abnormalities	✓ Observe.

Frequency	Monitoring /Inspection Points	Method
Daily	✓ Liquid Level of Tank	✓ Check the liquid level. ⇒ **See Photo-4** ✓ If the level is low, prepare 1.0 % chlorine solution (once a day, normally). ⇒ **See Summary of SOP C-1.**
	✓ Discharge Pressure (for Pump Type)	✓ Check and read the pressure gauge. ⇒ **See Photo-5**
	✓ Used Amount of Bleaching Powder	✓ Calculate the used amount of bleaching powder.
	✓ Stock of Bleaching Powder	✓ Check the remaining amount of bleaching powder.
Weekly	✓ Dosing Amount	✓ Measure the dosing amount. ⇒ **See Photo-6**
Yearly	✓ Crack or Leakage on tank body	✓ Observe.

Photo-1. Daily Inspection of Mixer

Photo-2. Daily Inspection of Pump (Abnormal noise and vibration)

Photo-3. Daily Inspection of Pump (Heat generation)

Photo-4. Daily Inspection of Tank (Liquid level)

Photo-5. Daily Inspection of Pump (Discharge Pressure)

Photo-6. Weekly Inspection of Pump (Discharge Amount)

b) Procedure to Measure Dosing Amount of the Chlorine Solution

i. Confirm the required dosing amount of chlorine solution (refer to **Table-1**).

ii. Check / measure the actual dosing amount by using measuring cylinder once a week (see **Photo-6**).

iii. If the dosing amount is larger or less than the required amount, adjust the pump stroke by the stroke adjusting screw* (see **Photo-7**). In case of Gravity Type, adjust the opening of discharge valve.

   * *Don't touch the stroke adjusting screw while the pump is stopped.*

iv. Check / measure the dosing amount again.

v. Write down the result on the record sheet.

Table-1. Required Dosing Amount of Chlorine Solution

Distributed Amount (m^3/day)	100		500		1,000	
Chlorin Dosing Rate	Dosing Amount of Chlorine Solution		Dosing Amount of Chlorine Solution		Dosing Amount of Chlorine Solution	
(mg/L)	(mL/min)	(L/hour)	(mL/min)	(L/hour)	(mL/min)	(L/hour)
0.5	3	0.2	17	1.0	35	2.1
1.0	7	0.4	35	2.1	69	4.1
1.5	10	0.6	52	3.1	104	6.2
2.0	14	0.8	69	4.1	139	8.3

Photo-7. Stroke Adjusting Screw

< Summary of SOP > 2-9

Procedure to Prepare Chlorine Solution

Photo-1. Putting Safety Tools

i. Close the drain valve.

ii. Open windows for ventilation.

iii. Put on the safety tools; gloves, protective glasses and mask (see **Photo-1**).

iv. Measure the required amount of bleaching powder by the weighing scale according to **Table-1** (see **Photo-2**).

Table-1. Required Amount of Bleaching Powder (unit: kg, Available chlorine: 35 %)

Tank Volume (L)		1,000	500	300	200	10
Conc. of Solution (w/v %)	0.5	**14.3**	**7.1**	**4.3**	**2.9**	**0.1**
	1.0	**28.6**	**14.3**	**8.6**	**5.7**	**0.3**

Photo-2. Measuring the Required Amount of Bleaching Powder

v. Pour clear water up to half of the tank.

vi. Start mixing (Push the start switch on the control panel).

vii. Add the bleaching powder gradually in order to prevent from generating un-dissolved lumps as shown in **Photo-3**.

Photo-3. Adding Bleaching Powder (Left) and Appearance of Un-dissolved Lumps (Right)

viii. Fill the tank with clear water (see **Photo-4**).

ix. Continue to mix at least 30 minutes and check the condition of solution.

x. If sediments are remaining at the bottom of tank, open the drain valve to discharge it.

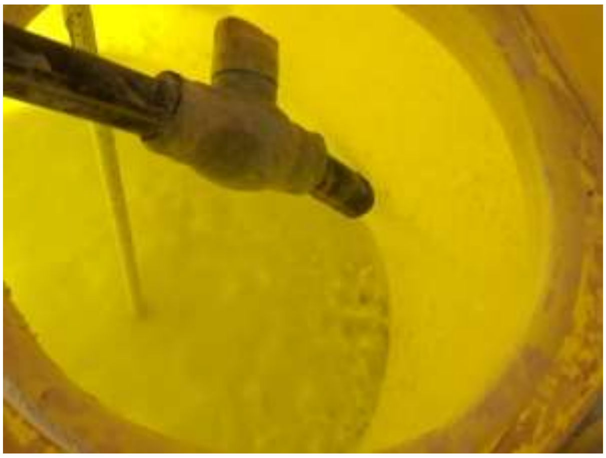


Photo-4. Filling Clear Water

< Summary of SOP > 2-10

Operation Procedure of Volute Pump

a) Preparation Before Operation

i. Check a leakage or the other abnormality at the pump area.
ii. Select the pump to be operated.
iii. Check the related valves are at the proper position (suction valve: open, discharge valve: close).
iv. Check the pressure gauges indicate the original/zero value.
v. Check / record the Voltage, Ampere and Frequency of power incoming on the electrical panel.
vi. Check / record the water level of the related tanks (if necessary).

Photo-1. Typical System of Volute Pump

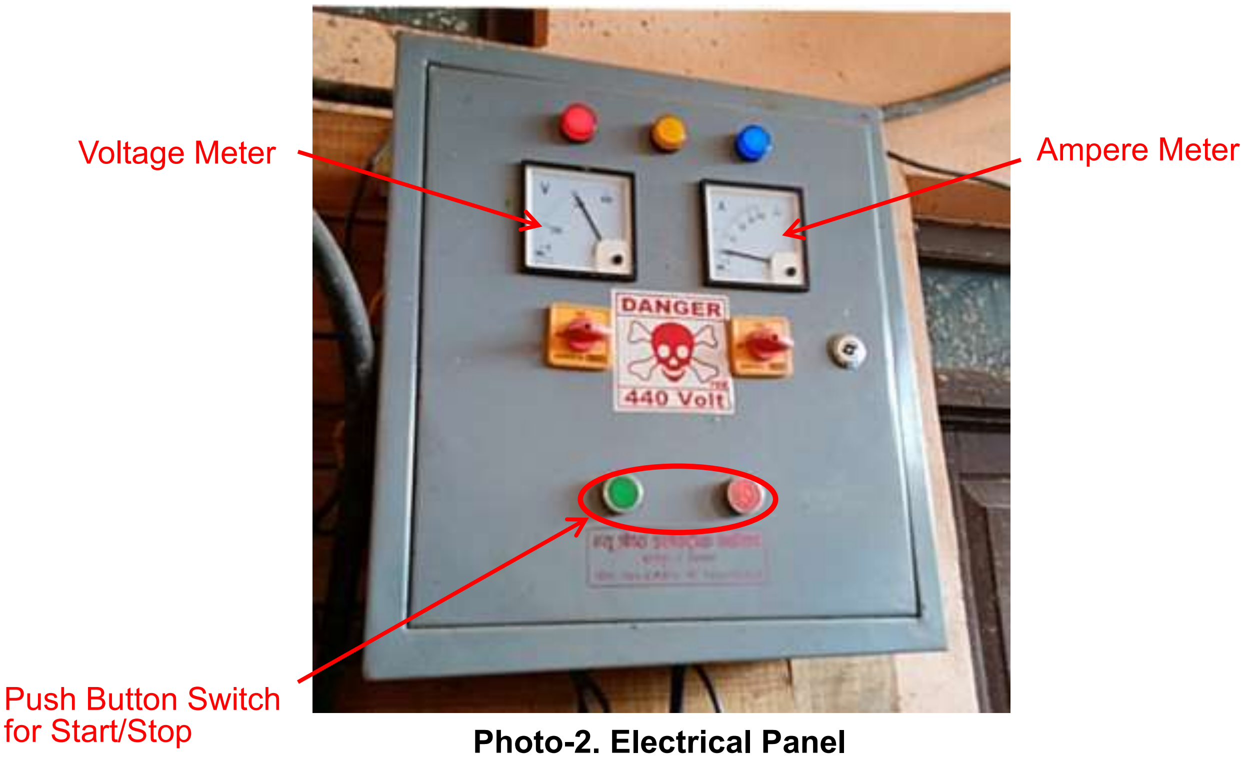


Photo-2. Electrical Panel

b) Start Operation

i. Push the start button at the electrical panel.
ii. Open the discharge valve slowly.
iii. Open the flow control valve slowly. (if it is installed)
iv. Adjust the flow rate and discharge pressure to the design value (indicated in the specification).
v. Check / record the flow rate, discharge / suction pressure, water level of the related tanks, voltage and current periodically.

Notes*; In case the pump is operated frequently, skip the above procedure from ii to iv.*

c) Stop Operation

i. Push the stop button on the electrical panel.
ii. Close the discharge valve and suction valve. (In case the pump is stopped for a long time.)

Notes*; In case the pump is operated frequently, skip the above procedure ii.*

< Summary of SOP > 2-11

Daily & Periodic Inspection of Volute Pump

The following points shall be checked by daily, monthly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-3** and **Form 3.2-4** attached in SOP)

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Appearance, leakage or other abnormalities	✓ Observe.
	✓ Abnormal noise and vibration	✓ Hear and touch the motor cover.
	✓ Lubricant level	✓ Check the lubricant level at the gauge.
	✓ Excessive heat generation of the gland packing	✓ Touch the motor cover.
	✓ Discharge / suction pressure, flow rate, water level of the related tank	✓ Check and read the pressure gauge, flow meter and level meter. ⇒ See **Photo-1**
	✓ Voltage and current	✓ Check and read the voltage / ampere meter on the electrical panel. ⇒ See **Photo-2** ✓ Acceptance criteria is rated value or value of commissioning.
Monthly	✓ Lubrication	✓ Lubricate oil and/or grease in accordance with the manufacturer's instruction manual. ⇒ See **Photo-3**
	✓ Leakage condition of the gland packing	✓ Check / observe water leakage amount. ✓ Proper leakage amount can be calculated by the following formula; q (mL/min) = 0.5×d (mm, shaft dia.)
Yearly	✓ Bearing temperature	✓ Outsource.
	✓ Vibration	✓ Outsource.

Frequency	Monitoring / Inspection Points	Method
	✓ Insulation	✓ Measure by insulation continuity tester. ✓ Acceptance criteria is more than 1.0 MΩ.
Every 1 to 4 years	✓ Replace bearing grease and lubricating oil	✓ Replace oil and/or grease in accordance with the instruction manual.
	✓ Replace gland packing	✓ Outsource depending on the condition.
	✓ Overhaul	✓ Outsource depending on the condition.

Photo-1. Checking Pressure Gauge

Photo-2. Checking Ampere

Photo-3. Lubricating

< Summary of SOP > 2-12

Periodic Inspection of Electrical Panel

The following points shall be checked by weekly, monthly and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-5** attached in SOP)

Frequency	Monitoring / Inspection Points	Method
Weekly	✓ Identifications (Panel Surface)	✓ Check whether all lamps, switches have name tag.
	✓ Status/fault indication lamps (Panel Surface)	✓ Check whether all lamps light up brightly.
	✓ Voltage meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Ampere meter (Panel Surface)	✓ Check whether proper value is shown. ✓ If necessary, zero adjustment shall be done. ✓ Check whether selector switch functions properly.
	✓ Cleanliness (Inside Panel)	✓ Check whether there is no dust, spider's nest, vermin etc. ⇒ See **Photo-1**
	✓ Intrusion path (Inside Panel)	✓ Check whether there is no hole or crack on enclosure.
	✓ Noise (Inside Panel)	✓ Check whether there is no noise from components.
	✓ Cable (Inside Panel)	✓ Check whether there is no cut.
Monthly	✓ Voltage by clamp meter	✓ Measure voltage by using clamp meter. ⇒ See **Photo-2** ✓ Acceptance criteria is ±10% of rating voltage.

Frequency	**Monitoring / Inspection Points**	**Method**
Monthly	✓ Voltage on voltage meter (panel surface)	✓ Check voltage value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Ampere by clamp meter	✓ Measure ampere by using clamp meter. ⇒ **See Photo-3** ✓ Acceptance criteria is less than rating ampere.
	✓ Ampere on ampere meter (panel surface)	✓ Check ampere value shown on the meter. ✓ Acceptance criteria is ±3% of clamp meter value.
	✓ Over/under Voltage Relay	✓ Check whether over-voltage trip test button works properly. ✓ Check whether under-voltage trip test button works properly.
	✓ Thermal Relay	✓ Check whether trip test button works properly.
Yearly	✓ Continuity of Circuit Breaker	✓ Check the continuity by using insulation continuity tester. ⇒ See **Photo-4**
	✓ Continuity of Magnetic Contactor	✓ Check the continuity by using insulation continuity tester.
	✓ Insulation between lines	✓ Measure the insulation by using insulation continuity tester. ✓ Criteria is shown as below; More than 1.0 MΩ: Good, More than 0.4 MΩ: Need to clean up or care, Less than 0.4 MΩ: Repair immediately
	✓ Earth Resistance	✓ Measure the earth resistance by using earth tester. ✓ Acceptance criteria is less than 10Ω.

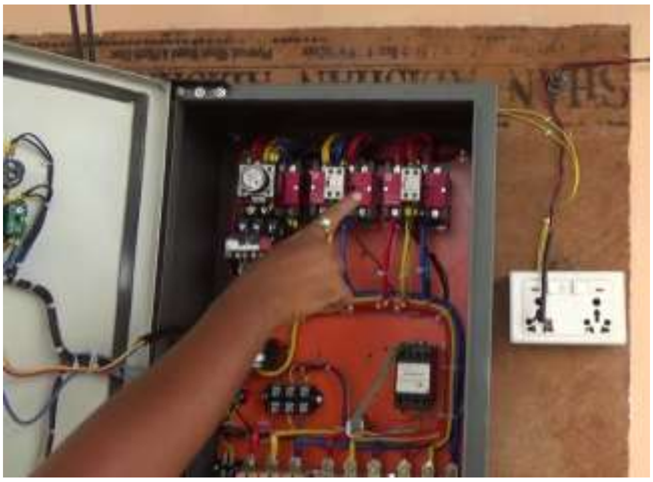


Photo-1. Checking Cleanliness

Photo-2. Measuring Voltage

Photo-3. Measuring Ampere

Photo-4. Checking Continuity

< Summary of SOP > 2-13

Daily & Periodic Inspection of Stand-by Generator

Basically, the Stand-by Generator shall be operated and maintained **in accordance with the manufacturer's instruction manual**.

Typical inspection points are shown below for reference. Inspection results shall be recorded properly. (Refer to **Form 3.2-1** and **Form 3.2-3** attached in SOP)

Frequency	Monitoring / Inspection Points	Method
Daily or Each Operation	✓ Leakage (coolant, oil, fuel), Loose fastenings / fixings, Worn belts, Loose connections etc.	✓ Visual inspection before start-up ⇒ See **Photo-1**
	✓ Level of Fuel, Engine oil and Coolant	✓ Visual inspection before start-up ⇒ See **Photo-2**
	✓ Condition of Battery / Fluid level etc.	✓ Visual inspection before start-up ⇒ See **Photo-3**
	✓ Voltage and current	✓ Check/read the voltage and ampere on the electrical panel. ⇒ See **Photo-4** ✓ Acceptance criteria is rated value or value during commissioning.
Every 2 Weeks	✓ Operational Check for 5 minutes	✓ Start up and check the operation condition in case of long-term stop.
Monthly	✓ Operational Check for 1 hour with 50 % load	✓ Start up and check the operation condition in case of long-term stop.
Every 250 hrs	✓ Replace engine oil, engine oil filter cartridge, fuel filter etc.	✓ Replace them according to manufacturer's instruction manual.
Every 12,000 hrs	✓ Overhaul of engine (Recommended)	✓ Outsource according to manufacturer's instruction manual.

Photo-1. Checking Loose Fastenings

Photo-2. Checking Level of Engine Oil

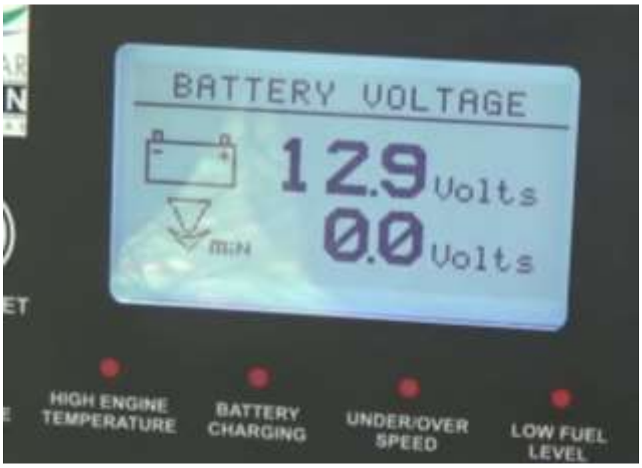


Photo-3. Checking Battery Condition

Photo-4. Checking Voltage and Ampere

< Summary of SOP > 2-14

Daily & Periodic Inspection of Aeration Facility

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-2** attached in SOP)

Frequency	Monitoring / Inspection Points	Method
Daily	✓ Appearance and abnormalities	✓ Observe.
	✓ Flow rate of inlet	✓ Check whether indication value of flow meter is showing the design value. ⇒ See **Photo-1**
	✓ Flow rate / pressure of air	✓ Check whether indication value of flow meter / pressure gauge is showing the design value. ⇒ See **Photo-2**
	✓ Water level	✓ Check water level of level gauge. ⇒ See **Photo-3**
	✓ Pressure	✓ Check whether indication value of pressure gauge is showing the design value. ⇒ See **Photo-4**
Yearly	✓ Leakage from tank body, related piping and valves	✓ Check a leakage or corrosion spot on tank body. ✓ If necessary, repair it according to the condition.
	✓ Condition of media	✓ Stop operation and drain inside water. ✓ Check the amount (level) and condition of media. ⇒ See **Photo-5** ✓ If necessary, refill or replace it according to the condition.

Photo-1. Inlet Flow Meter

Photo-2. Air Pressure Gauge

Photo-3. Level Gauge

Photo-4. Pressure Gauge of Tank

Photo-5. Appearance of Filter Media (Left: Before use, Right: After use)

< Summary of SOP > 2-15

Daily & Periodic Inspection of Pressure Filter

The following points shall be checked by daily and yearly inspection. Inspection results shall be recorded properly. (Refer to **Form 3.2-2** attached in SOP)

Frequency	**Monitoring / Inspection Points**	**Method**
Daily	✓ Appearance and abnormalities	✓ Observe.
	✓ Turbidity (Outlet)	✓ Measure the turbidity of inlet and outlet water by using turbidity meter. ⇒ see **Photo-1**
	✓ Flow rate of inlet	✓ Check whether indication value of flow meter is showing the design value. ⇒ See **Photo-2**
	✓ Pressure of Inlet / Outlet	✓ Check whether indication value of pressure gauge is showing the design value. ⇒ See **Photo-3**
	✓ Flow rate of backwash	✓ Check whether indication value of flow meter is showing the design value.
	✓ Appearance of backwash wastewater	✓ Check whether appearance / color of backwash wastewater is clean enough at the end of backwash.
Yearly	✓ Leakage from tank body, related piping and valves	✓ Check a leakage or corrosion spot on tank body. ✓ If necessary, repair it according to the condition.
	✓ Condition of filter media	✓ Stop operation and drain inside water. ✓ Check the amount (level) and condition of media. ✓ If necessary, refill or replace it according to the condition.

Photo-1. Measurement of Turbidity

Photo-2. Inlet Flow Meter

Photo-3. Pressure Gauge of Tank

< Summary of SOP > 3-1

Procedure for Distribution Flow Management

Procedure to record water distribution flow from a service reservoir is shown below. Precondition of this procedure is that an integrating flow meter is equipped on an outlet pipeline of a service reservoir.

Procedure for Distribution Flow Management

Preparation

(i) Make a plan for bulk meter reading. The plan shall include time schedule of meter reading, staff allocation, transportation, record management, etc.

Daily Work

(ii) Read the meter at the designated time and record meter reading value in **Form 3.3-1**. Then calculate and record daily water distribution flow. If WUSC has plural reservoirs, the record sheets need to be prepared for each reservoir.

(iii) While reading a meter, check the condition of the flow meter.

Monthly Work

(iv) Sum up daily water distribution flow on the **Form 3.3-1** on the last day of every month.

(v) If WUSC has plural reservoirs, sum up the monthly total of distribution flow on the monthly summary sheet attached in **Form 3.3-2** after the procedure (iv).

Yearly Work

(vi) Sum up monthly water distribution flow in **Form 3.3-3** on the last day of every fiscal year.

Form 3.3-1

Daily Water Distribution Flow Record Sheet

Name of the Reservoir		Approved by	
Month/Year		Prepared by	

Day	Time of Meter Reading (hour:minute)	Meter Reading Value (m^3)	Daily Water Distribution Flow (m^3/day)	Remarks
1	10:00	A	B-A	
2	10:00	B	C-A	
3		C		
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	10:00	D	E-D	
31	10:00	E	F-E	
1st day (next Month)		F		
Total				
Daily Average				
Daily Maximum				
Daily Minimum				

Form 3.3-2

Monthly Water Distribution Flow Summary Sheet

Month/Year	
Approved by	
Prepared by	

Day	Daily Water Distribution Flow				
	Reservoir A (m^3/day)	Reservoir B (m^3/day)	Reservoir C (m^3/day)	Reservoir D (m^3/day)	Total (m^3/day)
1					
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					
Total (m^3/month)					
Daily Average					
Daily Maximum					
Daily Minimum					

Form 3.3-3

Annual Water Distribution Flow Summary Sheet

Fiscal Year	
Approved by	
Prepared by	

Month	Monthly Flow (m^3/month)	Daily Average (m^3/day)	Daily Maxmum (m^3/day)	Daily Minimum (m^3/day)
Srawan				
Bhadra				
Asoj				
Kartik				
Mangsir				
Poush				
Magh				
Falgun				
Chaitra				
Baisakh				
Jestha				
Ashadh				
Total				

< Summary of SOP > 3-2

Maintenance for Service Reservoir

a) Procedure for Daily Inspection

Daily patrol and inspection procedure for service reservoir is shown below.

Procedure for Daily Inspection
(i) Make a daily inspection plan for service reservoir(s). The plan shall include staff allocation, transportation, record management, etc.
(ii) Patrol the reservoir site(s) once a day.
(iii) Confirm the condition of the reservoir(s) and related facilities with check sheet (**Form 3.3-4**) by visual inspection.

b) Procedure for Cleaning Inside of the Reservoir

Cleaning procedure of service reservoir is shown below. In case that water contains many alien substances, once-a-year cleaning is recommended.

Procedure for daily inspection
(i) Announce the duration of water supply suspension to customers (if necessary). (ii) Close the inlet valve of the reservoir. (iii) Stop chlorine injection (if necessary). (iv) Close the outlet valve of the reservoir after inside water level is low enough. (v) Open the drain valve of the reservoir, and drain remaining water. (vi) Ventilate to let in fresh air and let out the air containing chlorine. (vii) Wash out inside sediments of the reservoir, and drain from the drain pipe. (viii) Check the condition of walls and roof from inside (concrete cracks, rust of pipes, etc.) visually with check sheet (**Form 3.3-4**). (ix) Close the drain valve. (x) Open the inlet valve and store water. (xi) Open the outlet valve, resume chlorine injection (if necessary) and water supply.

【Supplemental Explanation】

- **Regarding Procedure (v)**: If remaining water contain high concentration of free residual chlorine, water shall be drained after dechlorination with chemicals such as sodium thiosulfate.
- **Regarding Procedure (vii)**: Before entering a reservoir, check whether ladder or steps are corroded or not and a helmet/fall-prevention harness shall be used.

Form 3.3-4

Daily Inspection Record Sheet for Civil Structure

Date (date/month/year)	
Approved by	
Prepared by	

Facility	Strucure	Check Item	Check	Information
WTP	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Service Reservoir	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Pipeline	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		

レ: No Problem, ×: Detection of Problems (If problems are detected, add information such as location and problem outline.)

< Summary of SOP > 3-3

Maintenance for Distribution Pipeline

Patrol inspection procedure for distribution pipelines is shown below. Targets of patrol inspection are not only pipelines but also valves, air valves, wash outs, fire hydrant and valve boxes.

Procedure for daily inspection
(i) Make a patrol inspection plan for distribution pipeline. The plan shall include frequency of patrol, routes of patrol, staff allocation, transportation, record management, etc. (ii) Conduct patrol inspection. Water leakage, damage of valve boxes, inundation of valve boxes are main items of the inspection. Water leakage is mainly occurred at joints. (iii) Confirm the condition of the pipelines with check sheet (**Form 3.3-4** and **Form 3.3-5**) by visual inspection.

【Supplemental Explanation】

- **Regarding Procedure (i)**: Decide the frequency of pipeline patrol based on the situation of pipelines and resources for the patrol. The following table shows the frequency of the patrol as a reference.
- **Regarding Procedure (ii)**: Not only outside but also inside of valve boxes need to be checked. If an inundation of boxes (especially boxes for air valves) is found, drain the water immediately.

Table. Example of Frequency of Pipeline Patrol

Category	Frequency	Remarks
Old pipelines	1 cycle per month	40 years and more after construction
Other pipelines	4 cycle per year	

Form 3.3-4

Daily Inspection Record Sheet for Civil Structure

Date (date/month/year)	
Approved by	
Prepared by	

Facility	Strucure	Check Item	Check	Information
WTP	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Service Reservoir	Fence/Wall	Damage of Fence/Wall		
	Concrete Structure	Hurmful Crack		
		Exposure of Rebar		
		Water Leakage		
		Corrosion of Metal Goods		
		Deterioration of Paint		
		Other Abnormality		
	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		
Pipeline	Pipeline (Pipe and Valves)	Water Leakage		
		Ground Subsidence above Pipelines		
		Crack in the Ground above Pipelines		
		Differencial Settlement above Pipelines		
		Other Abnormality		
	Valve Box, etc.	Damage of the Box		
		Damage of the Cover		
		Inundation of the Box		
		Other Abnormality		

✓: No Problem, ×: Detection of Problems (If problems are detected, add information such as location and problem outline.)

Form 3.3-5

Patrol Inspection Record Sheet for Valve Boxes

(Boxs for Valves, Air Valves, Fire Hydrant)

Date (date/month/year)	
Approved by	
Prepared by	

No.	Valve ID	Pipe Diameter	Appearance, Leakage, Strange Noise, inundation, etc.	Remarks

< Summary of SOP > 4-1

Procedure for Household Connection Facility Management

This shows a management procedure for household connections.

This procedure aims to analyze cause of water meter malfunction, quality of products, quality of manufacturer and life of water meter by maintaining water meter installation records and repair records.

Procedure for Household Connection Facility Management
New Water Meter Installation (i) Make a water meter installation record immediately after new water meters are installed (**Form 3.4-1**). **Water Meter Replacement** (i) Replace water meter if malfunction of water meter is found out. (ii) Carry the replaced water meter back to WUSC's office. Then analyze the causes of malfunction. (iii) Make a water meter replacement record after completion of cause analysis (**Form 3.4-1** and **Form 3.4-2**). (iv) Submit the record sheet to WUSC's manager.

Form 3.4-1

Water Meter Installation/Replacement Record Sheet

Tap Number	User Name	Adress	Installation			1st Replacement				2nd Replacement				3rd Replacement			
			Date (dd/mm/yy)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.	Date (dd/mm/yy)	Meter Life (years)	Meter Dia.	Manufacuturer /Serial No.

Form 3.4-2

Cause Analysis of Water Meter Malfunction Record Sheet

Approved by Prepared by Repair Work Period	

Category	Item	Information
User Information	Tap Number	
	User Name	
	Address	
Meter Problem Information	Replacement Date	
	Life of Water Meter	
	Category of malfunction	☐no proceeding indicator, ☐delay of indicator, ☐inverse rotation of indicator, ☐derangement, ☐leakage from meter, ☐unclearness of meter, ☐ meter damage
	Cause of Malfunction	

Photo (cause of malfunction)	Photo (cause of malfunction)

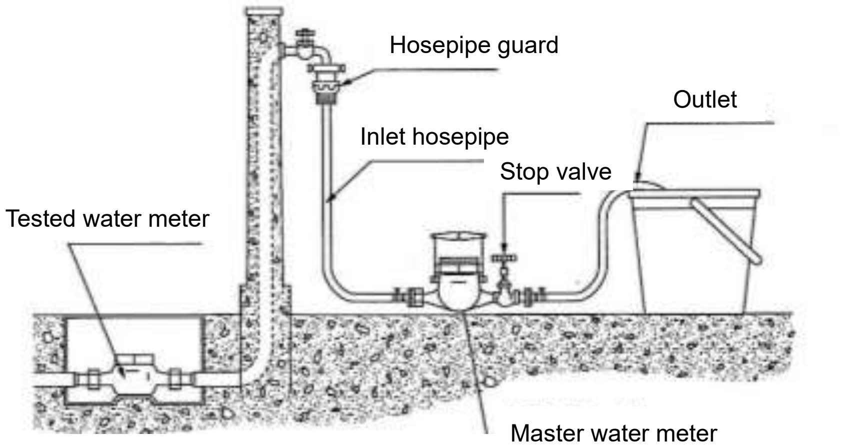
< Summary of SOP > 4-2

Procedure for Use Tolerance Test of Water Meter

This procedure shows a use tolerance test of water meter. This test is conducted in case that a consumer complains the meter reading value if necessary.

Use tolerance means the allowable instrumental error used in periodical inspections. Acceptable use tolerance is ±10.0% for a small flow range and ±4.0% for a high flow range. (Verification tolerance is ±5.0% for a small flow range and ±2.0% for a high flow range.)

Procedure for use tolerance test
(i) Install a master water meter temporary to a household connection. (ii) Exhausts air inside of the meter and pipes by running water. (iii) Fully open the stop valve of the master water meter. (iv) Open the faucet slowly and adjust water flow to test flow. (v) Fully close the stop valve and read values of both water meters. (vi) Remove the master water meter. (vii) Calculate use tolerance by using **Form 3.4-3**. (viii) Submit the record sheet to WUSC's manager.



Measurement Method of Use Tolerance

Calculation method of instrumental error is shown below.

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

E: Instrumental error (%) (It shall be smaller than use tolerance)

I: Measured flow of tested water meter (L)

Q: Measured flow of master water meter (L)

[Example of Calculation]

✧ Case 1

Table 1. Sample of Test Data 1

Water meter	Initial Value	Final Value	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% … OK!

✧ Case 2

Table 2. Sample of Test Data 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% ... N.G! (Replace Tested Meter)

Form 3.4-3

Use Torelance Test Record Sheet

Approved by Prepared by Date of Test	

Category	Item	Information
User Information	Tap Number	
	User Name	
	Address	
Tested Meter	Initial Value	
	Final Value	
	Difference (I)	
Master Meter	Initial Value	
	Final Value	
	Difference (Q)	
Use Tolerance	Cause of Malfunction	E (%) = (I-Q)/Q x 100, E is 10% and less => O.K. / over 10% => N.G.

Photo (Test Situation)	Signature
	User
	WUSC

< Summary of SOP > 5-1

Sampling Point of Water Quality Tests for Surface Water

Figure 1 shows the location to be checked and monitored water quality for surface water treated system.

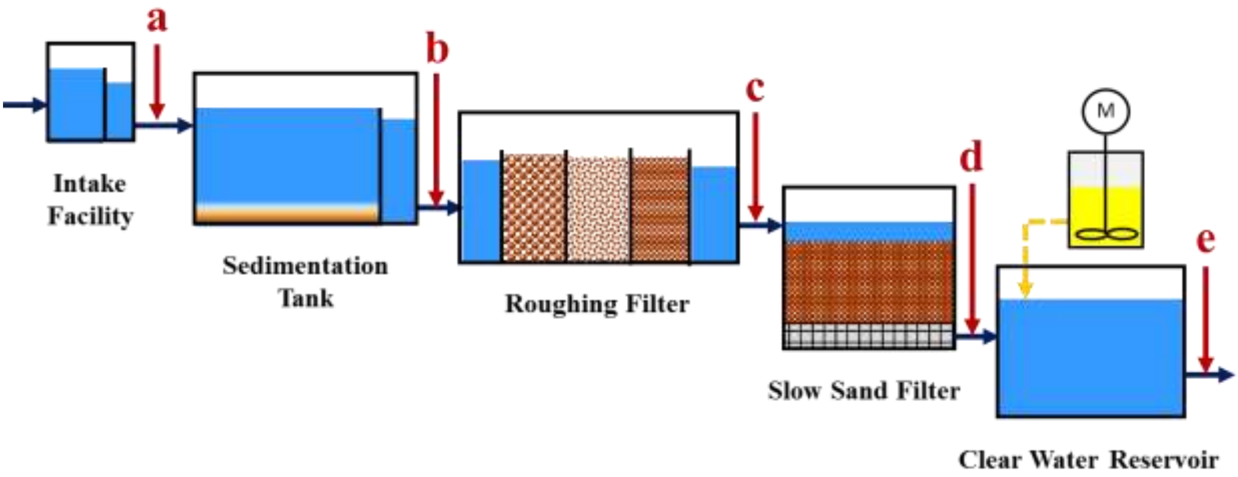


Figure 1. The Location to be Checked and Monitored Water Quality for Surface Water

Basically, sampling point of each suggested location shall be selected by considering human safety.

It is necessary to avoid slip, falling down or unusual positions etc.

Photo-1. Sampling Point in Outlet of Intake Facility

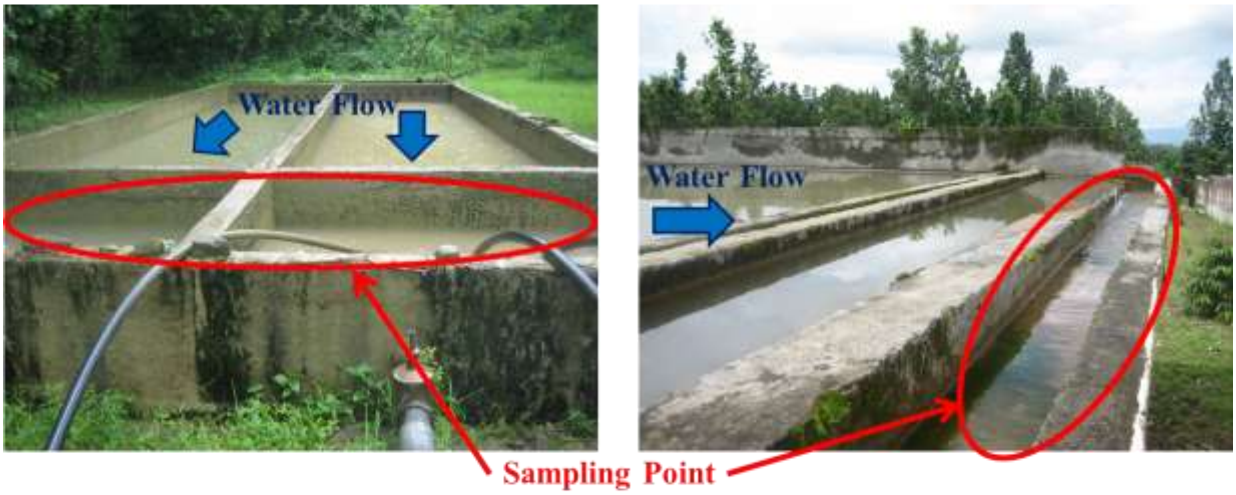


Photo-2. Sampling Points in Outlet of Sedimentation Tank

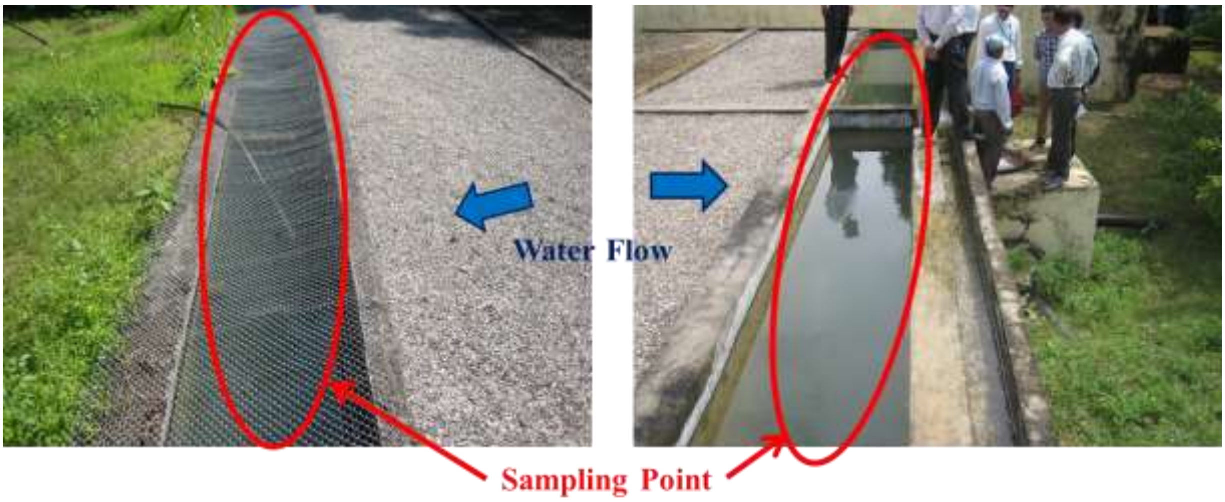


Photo-3. Sampling Points in Outlet of Roughing Filter

Photo-4. Sampling Points in Outlet of Slow Sand Filter

It is necessary to avoid slip, falling down or unusual positions by using water sampler as shown in **Figure 2**.

Figure 2. Water Sampler

Sampling Point
(Manhole)

Photo-5. Sampling Point in Clear Water Reservoir

It is necessary to avoid slip, falling down or unusual positions by using water sampler.

< Summary of SOP > 5-2

Sampling Point of Water Quality Test for Ground Water

Figure 1 shows the location to be checked and monitored water quality for Ground water treated system.

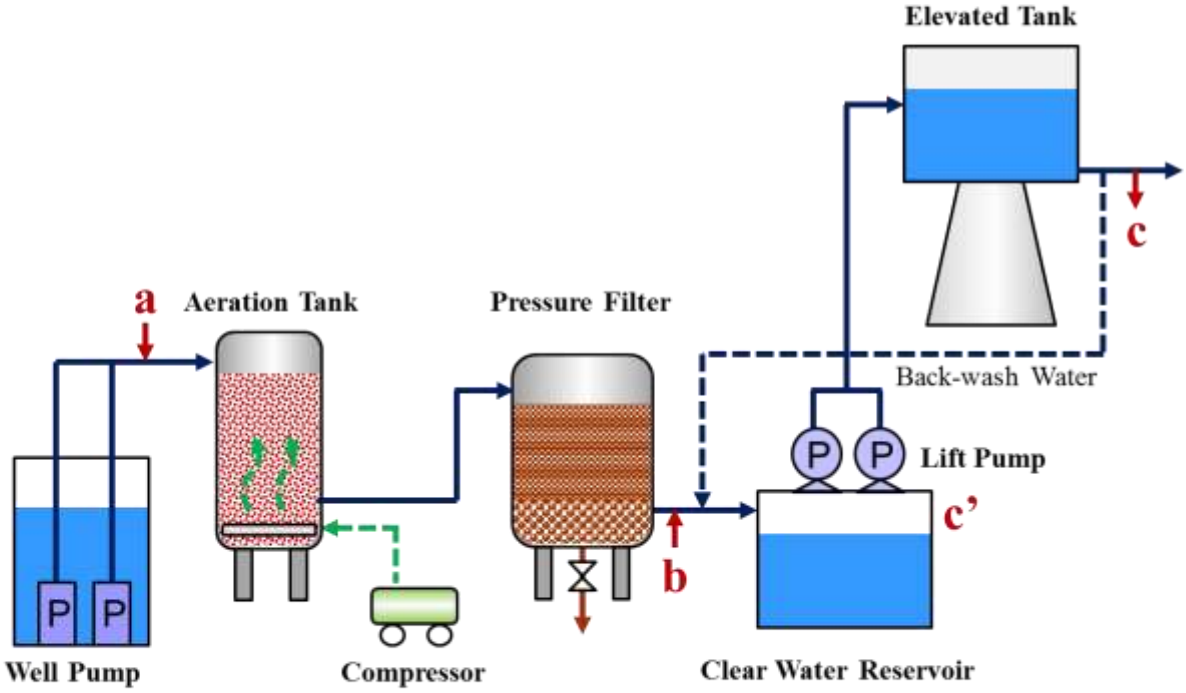


Figure 1. The Location to be Checked and Monitored Water Quality for Ground Water

Sampling point of each suggested location shall be selected by considering human safety.

It is necessary to avoid slip, falling down or unusual positions etc.

Photo 1. Sampling point for Well (Point a)

Wash out is suitable for sampling.

Photo 2. Sampling Point of Pressure Filter

Drainage is suitable sampling point to check the treated water of each Pressure Filter.

In case that the drain valve can't be operated easily due to the problem with accessibility, the inlet of Clear Water Reservoir is also applicable as sampling point.

Photo 3. Sampling Point of Elevated Tank

The following points are suitable for sampling of the Elevated Tank.

- ✓ Wash out installed on the distribution pipe
- ✓ Drainage

In case that the above points can’t be used, the manhole of Clear Water Reservoir is applicable for sampling.

< Summary of SOP > 6-1

Repair Work for Civil Structure

This shows a procedure of repair work for civil structures, such as concrete structure of intake facility, water treatment facility, service reservoir, etc.

If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work and period of the water supply suspension etc. to customers.

Procedure for Repair Work of Civil Structures

(i) Announce the duration of water supply suspension to customers. (if necessary)

(ii) Confirm the situation and take photos before starting the repair work.

(iii) Conduct necessary preparation work including valve operation.

(iv) Conduct repair work.

(v) Take photos after the completion of repair work.

(vi) Conduct cleaning, necessary valve operation and resume water supply operation.

(vii) Prepare a repair work report in **Form 3.6-1**.

Repair Work Record Sheet for Civil Structures

Approved by	
Prepared by	
Date	

Category	Item	Information
Location Information	Site Name	
	Category	☐Fence/Wall, ☐Concrete Structure, ☐Metal Goods, ☐Paint, ☐Others ( )
Facility Information	Problems	☐Water Leakage, ☐Damage of Main Structure, ☐Rust of Metal Goods, ☐Damage of Paint, ☐Others ( )
	Repaired Part	
	Construction Year	
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

< Summary of SOP > 6-2

Repair Work for Pipelines

This shows a procedure of repair work for pipelines.

If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work, period of the water supply suspension and possibility of turbid water at water tap etc. to customers.

Procedure for Repair Work of Pipelines

(i) Announce the duration of water supply suspension to customers. (if necessary)

(ii) Confirm the situation and take photos before starting the repair work.

(iii) Conduct preparation work and necessary valve operation for isolation of water leakage pipeline.

(iv) Conduct repair work.

(v) Take photos after the completion of repair work.

(vi) Conduct cleaning, necessary valve operation and resume water supply operation.

(vii) Prepare a repair work report in **Form 3.6-2**.

Form 3.6-2

Repair Work Record Sheet for Pipelines

Approved by	
Prepared by	
Date	

Category	Item	Information
Location Information	Site Address	
	Category	☐Distribution Pipelines, ☐Valves, ☐Household Connections, ☐Others ( )
Facility Information	Pipe Material	☐DCI Pipe, ☐PVC Pipe, ☐HDPE Pipe, ☐GI Pipe, ☐Others ( )
	Diameter	
	Construction Year	
	Pipe Position	☐Buried Pipeline, ☐River/Canal Crossing Pipeline, ☐Others ( )
	Earth Cover of Pipe	
	Problems	☐Water Leakage, ☐Others ( )
	Leakage Pioint	☐Joint, ☐Pipe Body, ☐Tapping Saddle, ☐Valves, ☐Others ( )
	Leakage Detection	☐Patrol, ☐Call from Customers, ☐Others ( )
	Cause of Water Leakage	☐Slip Out of Joint, ☐Corrosion of Pipe Body, ☐Incident by Third Party, ☐Others ( )
Repair Work Information	Outline of Repair Work	
Cost Information	Repair Cost	

Photo (Before Repair)	Photo (After Repair)

< Summary of SOP > 6-3

Repair Work for Mechanical / Electrical Equipment

This shows a procedure of repair work for mechanical and electrical equipment.

If repair work requires water supply suspension, WUSC has to announce necessary information such as schedule of repair work and period of the water supply suspension etc. to customers.

Procedure for Repair Work of Mechanical / Electrical Equipment

(i) Announce the duration of water supply suspension to customers. (if necessary)

(ii) Confirm the situation and take photos before starting the repair work.

(iii) Conduct necessary preparation work including valve operation and isolation of power supply if necessary.

(iv) Conduct repair work by supplier/manufacturer.

(v) Take photos after the completion of repair work

(vi) Conduct cleaning, necessary valve operation and resume water supply operation.

(vii) Prepare a repair work report in **Form 3.6-3**.

Form 3.6-3

Repair Work Record Sheet for Mechanical/Electrical Equipment

Approved by	
Prepared by	
Date	

Item	Information
Name of Equipment	
Period of Repair Work	
Outline of Repair Work	
Repair Cost (NPR)	

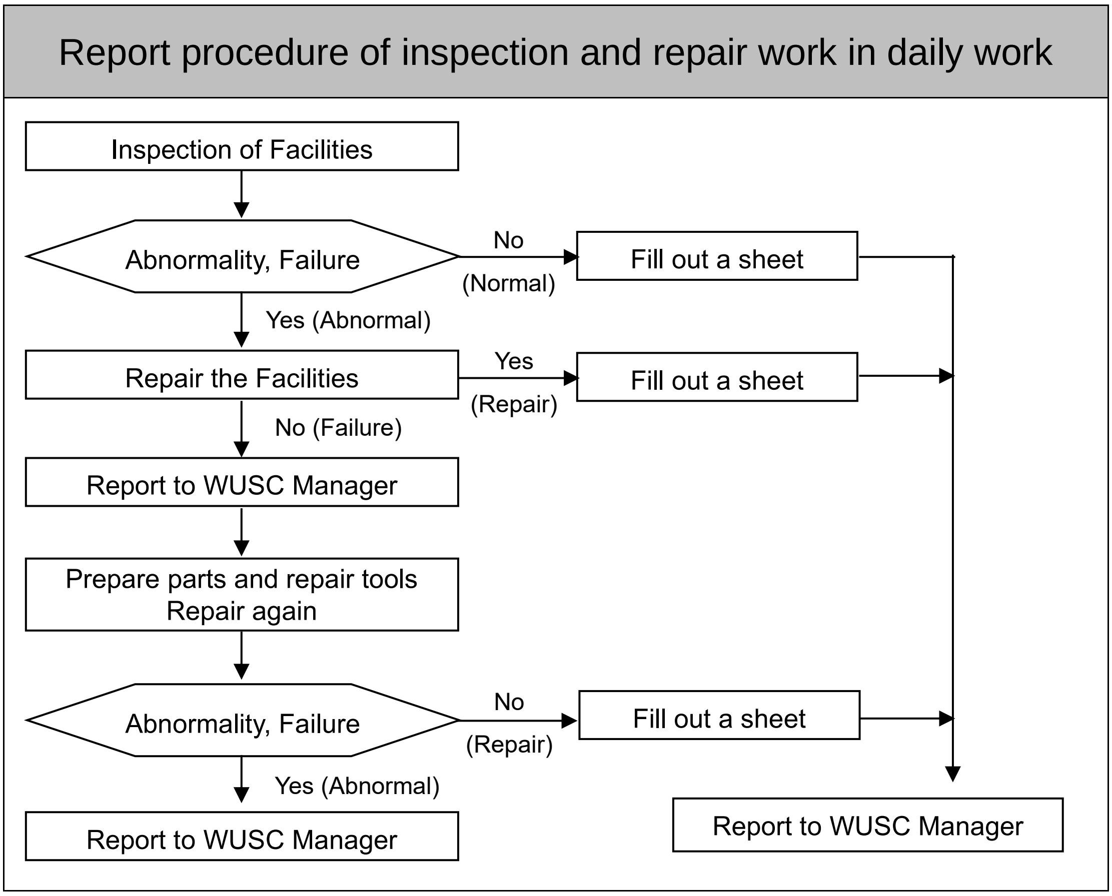
Photo (Before Repair)	Photo (After Repair)

< Summary of SOP > 7-1

Report of Inspection Result

a) Report of Inspection and Repair Work in Daily Work

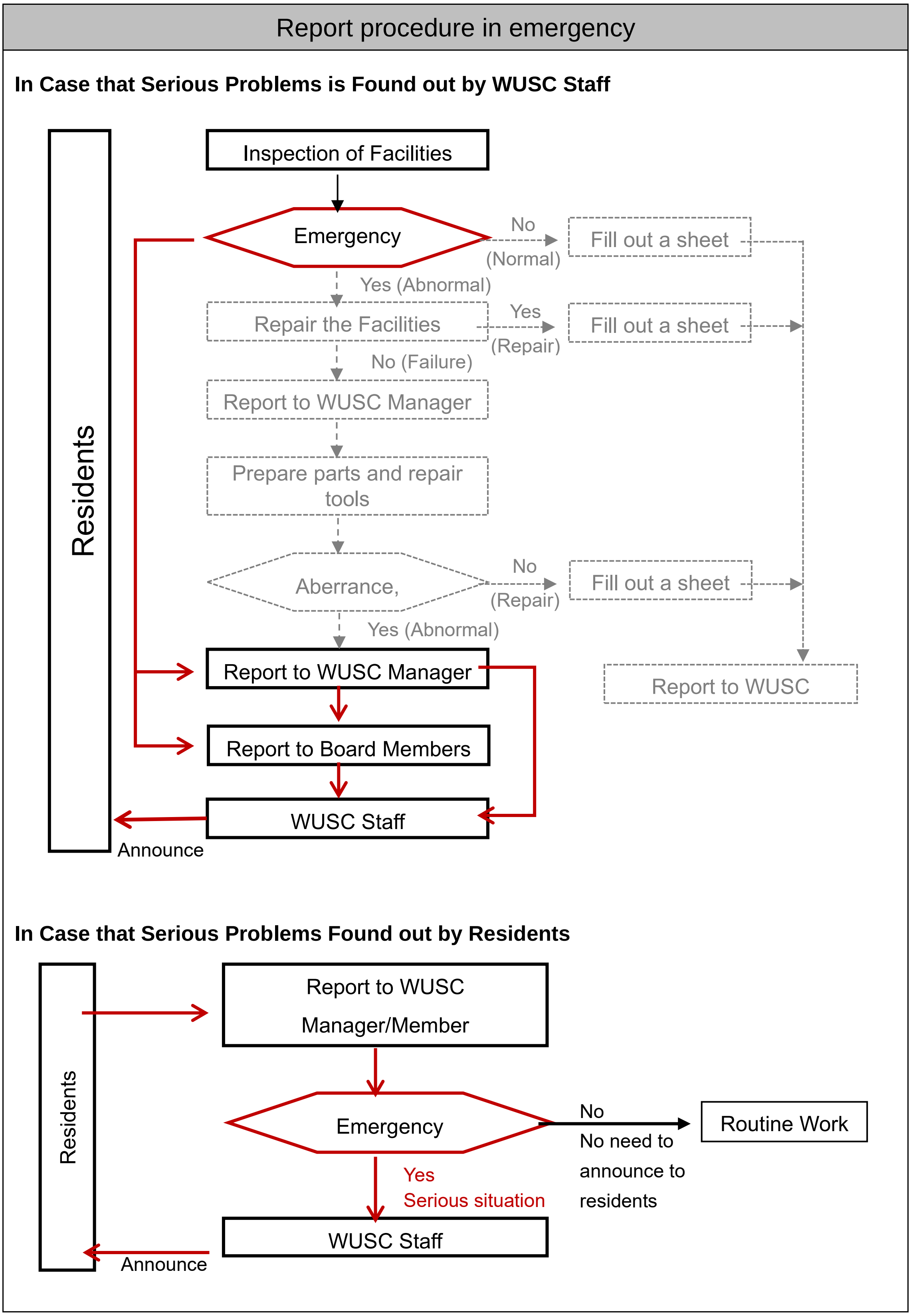
Report of inspection and repair work in daily work shall be made according to the following procedure.



Report procedure of inspection and repair work in daily work

b) Report in case of Emergency

The procedures in case of emergency along with “suspension of water supply” are shown below.



< Summary of SOP > 8-1

Analysis of Water Supply Amount

Report Procedure of Rough Estimation of Water Loss and Loss Ratio

Water Loss in Raw Water Transmission Facility

(i) Calculate monthly water flow (Q1) at water sources.

(ii) Calculate monthly water flow (Q2) at receiving well / reservoir in WTP.

(iii) Water loss in a raw water transmission facility is $\boxed{Q1-Q2}$.

(iv) Water loss rate in a raw water transmission facility is $\boxed{(Q1-Q2)/Q1}$.

Water Loss in Distribution Facility

(i) Calculate monthly water flow (Q3) at a service reservoir.

(ii) Calculate monthly water consumption (Q4) from reading value of customer meter.

(iii) Water loss in water distribution networks is $\boxed{Q3-Q4}$.

(iv) Water loss rate in water distribution networks is $\boxed{(Q3-Q4)/Q3}$.

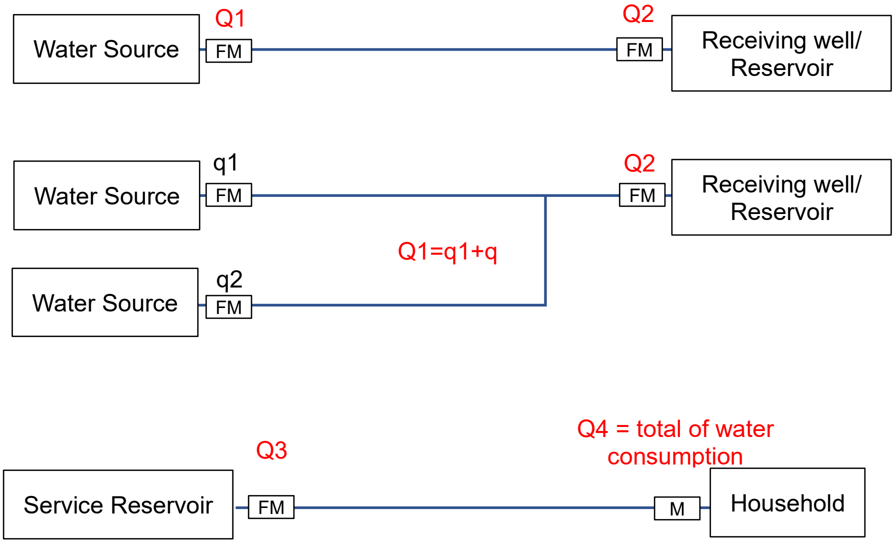


Figure 1. Water Flow Data for Rough Water Loss Estimation