Co-funded by the European Union
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SUSWA

STANDARD OPERATING PROCEDURES FOR THE OPERATION OF RURAL WATER SUPPLY SCHEMES

2026

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1 Introduction

1.1 Background and Rationale

Sustainable WASH for All (SUSWA) is a bilateral, human rights-based Water, Sanitation, and Hygiene (WASH) intervention operating in Nepal, supported by joint financial support of the Government of Nepal, the Government of Finland, and the European Union. SUSWA is scheduled to be completed over a five-and-a-half-year timeframe, building a long-term support mechanism in Nepal's WASH sector. The project is implemented in 28local governments of a total of ten districts in Nepal's Karnali Province, and its primary aim is to enhance the abilities of local governments in providing inclusive, climate-resilient, and sustainable WASH services. SUSWA has a major focus on functionality and sustainability support of rural water supply, quality of water, Gender Equality Disability and Social Inclusion (GEDSI), and long-term service delivery approaches, hence making a direct contribution to Nepal's efforts in achieving the Sustainable Development Goals, especially SDG-6 concerning access to safe drinking water and sanitation facilities.

1.2 Purpose of the SOP

Currently, water supply systems are built and formally hand overed to ~~service providers~~ water users and sanitation committees (WUSCs) for operation and maintenance. Although efforts are made to ensure knowledge and technology transfer during handover, limitations in trained manpower, institutional capacity, and operational resources often constrain effective service delivery. As a result, after the exit of supporting partners many rural water supply schemes' functionality and quality tend to decline over time. With a strong emphasis on maintaining functionality, service quality, and overall system sustainability, this Standard Operating Procedure (SOP) is intended to act as a useful guiding tool for service providers, especially Village Maintenance Workers (VMW), to support the long-term operation of rural water supply schemes.

1.3 Objective of SOP

This Standard Operating Procedure (SOP) is developed to guide Village Maintenance Workers (VMWs) in carrying out routine operation, monitoring, and basic maintenance tasks of rural water supply systems in a safe and standardized manner. The SOP defines the scope of work that can be performed independently by VMWs, while ensuring that tasks beyond their capacity or authority should be timely escalated and supported by the Service Support Unit (SSU) or Municipal WASH Unit.

2 Overview of Rural Water Supply Scheme

2.1 Typical Components of Rural Water Supply Systems

In general, under SUSWA-implemented schemes, spring water is the primary source of supply. Water is abstracted through an intake structure constructed at the spring source, and, where required, conveyed to a treatment unit *(optional in the context of rural water supply depending on source quality)*. Treated water is subsequently dosed through a chlorination unit before being supplied to households through the distribution system.

In some rural water supply schemes, groundwater sources are utilized through pumping systems, while in other cases surface water sources are also pumped to meet demand. The possible configurations of rural water supply schemes in the Nepalese context, considering different source types and conveyance options, are presented in the following diagram.

Figure 1: Water Supply Schemes, Gravity

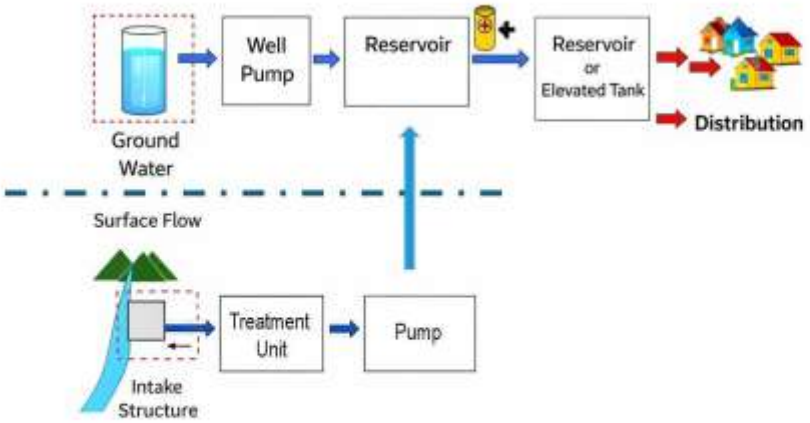

Figure 2: Water Supply Scheme, Pumped

3 Institutional Roles and Service Delivery Framework

3.1 RACI Matrix for Rural Water Supply Operations

The RACI matrix is a valuable tool that helps analyze and clarify the distribution of responsibilities for various activities among stakeholders in a project. By defining who is Responsible, Accountable, Consulted, and Informed for each task, it ensures better coordination and reduces overlaps or gaps in roles. Based on the present structure of operational model of rural water supply schemes RACI matrix has been mased as below

Activity	VMW	WUSCs	Consumers Or Users	Local Governments	Development Partners	Service Support Center
Operational Activities						
Daily operation of water supply (e.g., pumping, distribution)	R	A	I	I	I	I
Stock Management	I	R	I	R	C	I
Routine maintenance and repairs	R	A	C	I	C	C
Water quality testing and treatment	R	A	I	R	C	C
Issues and Intervention Necessary	I	R	I	R	C	C
Billing, Tariff fee collection, and financial management	R	R	C	A	I	I
Monitoring Activities						
Performance monitoring and data collection	R	A	C	C	I	I
Compliance audits and regulatory reporting	C	R	I	A	I	I
User feedback and grievance resolution	C	A	R	C	I	I
Evaluation of scheme sustainability and improvements	C	R	C	A	C	I

R: Responsible (performs the task).

A: Accountable (ensures the task is completed and approves it).

C: Consulted (provides input or expertise).

I: Informed (kept updated on progress or outcomes).

3.2 Process for Rural Water Supply Services

In rural water supply projects, SIPOC (Suppliers, Inputs, Process, Outputs, Customers) acts as a simple tool to map processes and improve the overall system by identifying key elements from beginning to end.

S	I	P	O	C
Suppliers	Input	Process	Output	Customer
• Water source • Service Support Unit (SSU) • Service Provider/WUSCs/VMWs	• Raw water of acceptable quantity • Intake structures and pumps • Pipelines, valves, fittings, meters • Treatment/ chlorination materials • Power supply / fuel • O&M staff (VMWs, technicians) • O&M tools, spares, and funds	• Water abstraction from source • Pumping and conveyance to reservoir • Treatment/ disinfection (chlorination) • Storage in reservoir / elevated tank • Distribution through pipe network • Routine inspection and preventive maintenance • Repair, replacement, and rehabilitation activities • Water quality monitoring and record keeping	•Adequate water flow to service areas • Safe water meeting basic quality standards • Continuous and reliable service • Functional infrastructure components • Reduced water losses and contamination risks • Water quality and O&M records	• Households • Institutions (schools, health posts) • Municipality (performance oversight)

4 Standard Operating Procedure

4.1 Flow Measurement

Flow measurement in water supply projects is particularly critical in rural water supply schemes especially at hilly reason with spring source with very low yield due to frequent variations in source yield caused by climate change, seasonal fluctuations, and increasing human activities around water sources. Regular measurement of flow helps identify seasonal variations, detect losses or blockages, and support informed operational decisions. In rural schemes where flow meters are not installed, simple field-based methods such as volumetric measurement provide practical and reliable data when applied consistently and recorded systematically.

Project/WUSC Name:			
Structure Name/ID:			(e.g., Water Source I)
Location:			
Date of Measurement:			
Method Of Measurement:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.1.1 Equipment

- **Personal Protective Equipment (PPE):** Safety boots, helmets, and heavy-duty gloves for VMW safety.
- **Measuring Tools:** Container with known Volume (2 or 5 lit), Stop watch, Diversion pipe
- **Documentation:** Logbook, pen.

4.1.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- Wear required PPE before approaching the water source.
- Ensure the container volume is known and clean.
- Select a safe and steady flow point (overflow pipe, outlet, or channel).

B. Flow Measurement Procedure

1. **Visual Inspection:** Observe the flow entering the intake and note any visible change compared to previous observations.
2. **Flow Measurement**
    - Place the container under the flowing water.
    - Start the stopwatch as the container begins filling.
    - Stop the timer when the container is completely full.
3. **Flow Calculation**
    - Use the formula:

    Flow (L/s) = Container Volume (L) ÷ Time (seconds)
4. **Repeat Measurement**
    - Repeat the measurement 2–3 times.
    - Calculate and record the average flow value.

5. **Recording**
    - Record date, time, location, container size, time taken, and average flow in the Flow Measurement Logbook.

C. Post-Procedure (Recording & Communication)

- Compare the measured flow with previous records and if significant deviation is observed, inform **WUSC / SSC/ / WASH Unit**.
- Clean and store tools safely.

4.1.3 Flow Management Plan

Where daily measurements are not possible, prepare a measurement schedule in coordination with SSC/WASH Unit (e.g., weekly, monthly, or seasonal). It is also recommended to measure discharge after heavy rain, drought or maintenance works.

4.2 Intake Facility

The intake structure shall be operated by ensuring unobstructed water entry, regulating flow through available gates or valves, and maintaining cleanliness to prevent debris and sediment accumulation. To keep the intake structure functional and reliable, regular periodic inspection and preventive maintenance are essential.

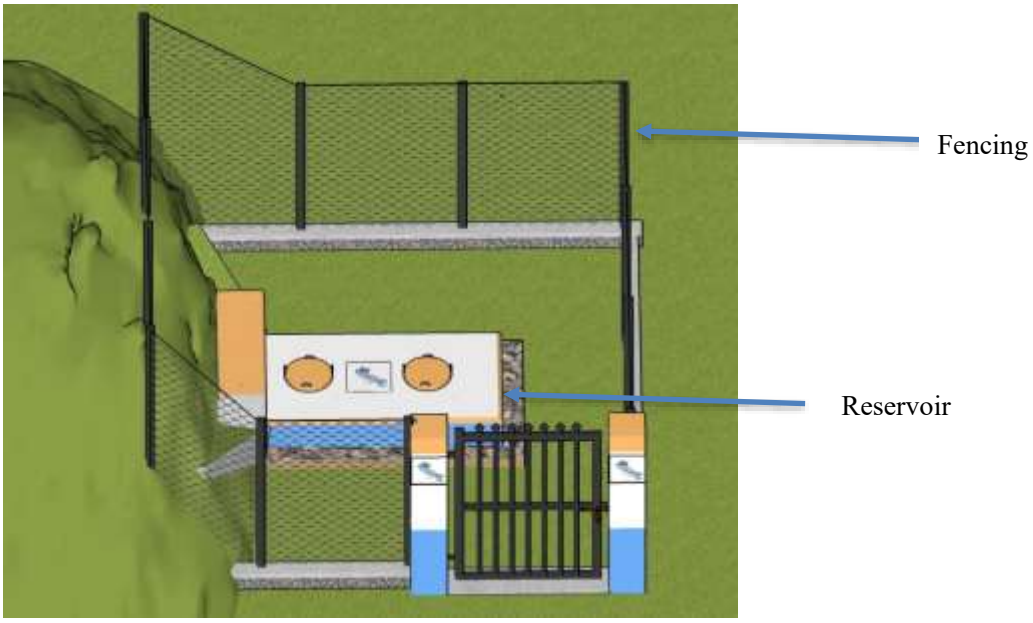

Figure 1: Typical Rural Spring Intake

Figure 2: Rural Spring Intake

Project/WUSC Name:			
Structure Name/ID:	(e.g., Spring Intake A)		
Location:			
Date of Procedure:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.2.1 Equipment

- **Personal Protective Equipment (PPE):** Safety boots, helmets, and heavy-duty gloves for VMW safety.
- **Cleaning Tools:** Brooms, wire brushes, shovels, buckets, rakes for debris removal.
- **Maintenance Supplies[1]:** Non-toxic grease for lubrication of valves/gates, temporary patching materials (e.g., cement-sand mix, sealant tape).
- **Documentation:** Inspection Checklist, Maintenance Logbook, pen.

4.2.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- **Safety Check:** Check for all required Personal Protective Equipment (PPE) (boots, helmet, gloves) before entering the intake area.

[1] In remote schemes, locally available non-toxic lubricants shall be used for valves/gates with consultation with SSC, and environmentally safe local sealants (e.g., red mud paste) can be used.

- **Site Assessment:** Visually scan the surroundings for immediate hazards (e.g., slippery paths, landslides, surface drainage improvements, grazing , blockage due to lime deposition in intake valve chamber , wild animals).
- **Tool Preparation:** Ensure all necessary cleaning tools and maintenance supplies are gathered and in working condition.
- **Baseline Observation:** Before touching anything, observe the current state of the water flow and structure to identify any immediate irregularities (e.g., wet spots indicating new leaks).
- **Notification:** If major maintenance is planned that will interrupt water supply, notify the SSU or community representatives beforehand.

B. During Procedure (Execution & Maintenance)

- **Debris Removal:** Clear leaves, garbage, silt, or branches from the intake screen, weir, and surrounding area to ensure unobstructed water flow.
- **Structural Inspection:**
  - Inspect the intake structure, masonry walls, and fencing for cracks, leakage, or erosion.
  - Check that the inlet is properly submerged (for surface sources) or that overflow pipes are functioning correctly (for springs).
- **Water Quality Check:** Observe the water for unusual changes in clarity (turbidity), colour, or smell.
- **Mechanical Maintenance:**
  - Check all valves and gates for ease of operation, and ensure that opening and closing exercises are carried out during every visit.
  - Apply non-toxic grease to moving parts if they are stiff or dry.
- **Minor Repairs:** Apply temporary patches to small cracks or leaks if materials are available and it is safe to do so.

C. Post-Procedure (Restoration & Reporting)

- **Site Security:** Ensure all inspection covers are closed tightly, and gates/fencing are locked to prevent unauthorized access or livestock entry.
- **Sanitization:** Clean and store all tools properly. Dispose of collected debris away from the water source to prevent re-contamination.
- **Documentation:**
  - Fill out Table 1: Inspection Checklist. Record immediately do not rely on memory
  - Record all maintenance activities, observations, and spare parts used in the Maintenance Logbook.
- **Escalation:** If major issues (structural failure, severe contamination) were found that could not be fixed, report to the Service Support Center (SSC) or WUSC immediately.

4.2.3 Control

This section defines the Critical Control Points (CCPs) and mechanisms required to ensure quality and safety are maintained, preventing failure even when standard procedures are followed.

1. Critical Control Points (CCPs)

- **Turbidity Limit (Go/No-Go):**
  - Control Point: The intake valve.
  - Mechanism: If water is visibly cloudy or muddy, the operator must close the intake valve or open the washout valve.
  - Prevention: Prevents sediment from entering the transmission line and clogging the reservoir.

- **Screen Integrity Check:**
    - *Control Point: The intake mesh/screen.*
    - *Mechanism: Physical inspection for holes >5mm.*
    - *Prevention: Prevents frogs, snakes, or large debris from entering the pipe, which could cause blockages impossible to fix from the outside.*
- **Valve Security:**
    - *Control Point:* Valve handles and inspection covers.
    - *Mechanism:* All valves must be locked in their operating position (Open/Closed) after maintenance.
    - *Prevention:* Prevents unauthorized manipulation or accidental closing by animals/vibration.

2. Error Proofing & Fail-safe

- **Overflow Functionality:** The overflow pipe must always remain open and larger than the inlet capacity. This acts as a failsafe to prevent structural bursting if the inlet is blocked.
- **External Drainage:** Surface water drainage channels (diversion ditches) above the intake must be cleared *before* the intake itself. This prevents surface runoff from contaminating the source during the cleaning process.

3. Verification of Control

- **"Show Me" Verification:** The VMW must record specific values (e.g., "Water Clear: Yes/No", "Valves Locked: Yes/No") rather than just checking a box.
- **Escalation Trigger:** If the intake yield drops below the marked "Normal Level" line on the intake wall, the SSU must be notified immediately, regardless of the cleaning results.

Table 1: Inspection Checklist for Intake

Date of Inspection:

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Water Quality	Inlet water		Clear, odorless, no sediment		Divert water / Close Intake
Screen	Mesh integrity		No holes, no blockage		Repair immediately
Flow	Overflow pipe		Water flowing out (if spring is full)		Check for inlet blockage
Security	Gate/Valve Lock/Fencing		Locked and secure		Replace lock
Hygiene	Intake Interior		No algae, roots, or animal traces		Clean and sanitize
Structure	External Walls		No damp patches (leaks)		Patch/Report
Surrounding	Vegetation/Land Slope		No over growth		Clean

4.2.4 Problems and Troubleshooting

The common problems observed at intake structures, along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Reduced/Low Flow	Low yield or intermittent supply	Clogged screen, siltation, low source level	Clean screen/chamber; remove debris	No improvement after cleaning
No Flow	Complete stoppage	Blocked inlet, damaged pipe	Clear visible blockages; check valves	Persistent blockage or pipe damage
Turbid/Muddy Water	Cloudy water	Upstream erosion, heavy rain	Increase cleaning frequency; wait for settling	Ongoing turbidity
Structural Damage	Leaks, cracks	Floods, erosion, age	Temporary patch (cement/sand)	Major cracks or structural instability
Contamination	Smell, color change, visible waste	Pollution upstream	Divert temporarily; clean area	Recurrent issues or source pollution
Algae/Bio-growth	Green slime on surfaces	Stagnant water, sunlight	Brush off and clean surfaces	Excessive growth returning quickly

4.3 Treatment Facility

Water treatment unit is used to purify raw water obtained from the source to produce quality water to meet the drinking water standards. Thus, based on the quality of raw water treatment unit shall be designed. In rural content of Nepal, the most common treatment units are collection Tank or Sedimentation Tank, roughing filter and Slow Sand filter. This SOP for the treatment facility is limited to the primary treatment unit, specifically the collection tank or sedimentation tank, where water is partially clarified through basic settling processes.

Project/WUSC Name:			
Structure Name/ID:			
Location:			
Date of Procedure:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.3.1 Equipment

- **Personal Protective Equipment (PPE):** Safety boots (non-slip), helmets, and heavy-duty gloves.

- **Cleaning Tools:** wire brushes (for wall scrubbing), buckets, and shovels for sludge removal.
- **Maintenance Supplies:** Disinfectant (bleach/chlorine solution for cleaning), non-toxic grease for valves.
- **Documentation:** Inspection Checklist, Maintenance Logbook, pen.

4.3.2 Procedure

A. Pre-Procedure (Preparation & Safety)

1. **Safety Check:** Wear all PPE. Be careful of surfaces that are slippery inside and around the tank.
2. **Flow Diversion:** Before cleaning, open the **bypass valve** (if available) to ensure the community still receives water from the intake, bypassing the treatment unit temporarily.
3. **Tool Check:** Make sure that your brushes and shovels are clean so that you don't add new dirt to the tank.
4. **Baseline Observation:** Note the level of silt/sludge/sediment at the bottom through the water column before draining.

B. During Procedure (Execution & Maintenance)

1. **Draining:** Open the **washout/drain valve** to empty the tank.
2. **Sludge Removal:** Use shovels and buckets to remove the thick layer of sediment/silt accumulated at the bottom.
3. **Wall Scrubbing:** Use wired brushes to scrub the interior walls to remove algae, or bio-growth.
4. **Flushing:** Use clean water to flush the remaining debris out through the drain valve until the floor is clear.
5. **Structural Check:** While the tank is empty, inspect the floor and walls for cracks or signs of leakage.

C. Post-Procedure (Restoration & Reporting)

1. **Valve Reset:** Close the washout/drain valve tightly. Slowly open the inlet valve to refill the tank.
2. **Disinfection:** After a major cleaning, it is recommended to "shock" the tank with a mild chlorine solution before the water is sent to the distribution line.
3. **Documentation:** Record the volume of sludge removed and the time taken in the Logbook.

4.3.3 Control

This section defines the Critical Control Points (CCPs) and mechanisms required to ensure quality and safety are maintained, preventing failure even when standard procedures are followed.

1. **Critical Control Points**

Control Point	The Trigger (Condition)	The Mechanism (Action)	Prevention (The Goal)
Outlet Quality	Water is visibly cloudy or muddy	Close Outlet Valve; Open Washout Valve	Prevents silt from entering the main reservoir

Sludge Level	Silt reaches the "Max Clean" mark on the wall.	Stop flow and perform Full Tank Cleaning.	Prevents mud from being stirred up into the clean water.
Screen Integrity	Holes found in mesh or gaps	Immediate repair or replacement of mesh	Prevents frogs, snakes, and insects from entering
Valve Security	Valve handles found loose or unlocked.	Lock all valves in the Correct Position	Prevents accidental closing or unauthorized tampering

2. Error Proofing & Fail-safe

- **Overflow Functionality:** The overflow pipe must always remain open and larger than the inlet capacity. This acts as a failsafe to prevent structural bursting if the inlet is blocked.
- **Gravity Logic:** Baffle walls inside the tank must be checked for stability to ensure water is forced to slow down, allowing sediment to fall to the bottom.

3. Verification of Control

- **"Show Me" Verification:** The VMW must record specific values (e.g., "Water Clear: Yes/No", "Sediment Deposit: 5cm") rather than just checking a box.
- **Escalation Trigger:** If the water form outlet less that desired flow or the water is not clear enough, the SSU must be notified immediately, regardless of the cleaning results.

Table 1: Inspection Checklist for Intake

Date of Inspection:

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Water Quality	Tank Outlet		Clear, odorless, no visible sediment		Close outlet / Flush tank
Sludge Level	Tank Floor		Sludge depth below 15cm (or marked line)		Clean and remove silt
Screen	Air Vents/Manhole		No holes >5mm; no insects entering		Repair or replace mesh
Hygiene	Tank Interior		No algae, slime, or bio-growth		Scrub walls and sanitize
Structure	External Walls		No damp patches, leaks, or crack		If cracks with Leakage report to SSU

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Surrounding	Diversion Ditch		No debris; runoff flows away from tank		Clean and clear ditch

4.3.4 Problems and Troubleshooting

The common problems observed at treatment units, along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Reduced Outflow	Low or uneven discharge to transmission line	Sediment accumulation, partially blocked outlet	Remove settled silt; clean outlet pipe	Flow not restored after cleaning
High Turbidity at Outlet	Cloudy water after tank	Excess inflow, short detention time	Reduce inflow temporarily; increase cleaning frequency	Turbidity persists
Structural Leakage	Damp walls, visible leakage	Cracks, joint failure, aging structure	Apply temporary cement-sand patch	Major cracks or leakage continues
Contamination Risk	Smell, debris, animal traces	Open cover, poor hygiene	Clean tank; secure and close cover	Regular contamination
Algae Growth	Green layer on walls or water	Sunlight exposure, stagnant water	Brush and clean interior surfaces	Excessive or recurring growth

For every issue encountered, the VMW must thoroughly document all troubleshooting attempts, observations, and outcomes in the maintenance logbook prior to escalation. Information should be shared to the SSU should occur immediately in cases involving health or safety risks, or within 24 hours for all other non-emergency issues.

4.4 Valves

Valves are essential in water supply systems for controlling flow, pressure, and direction. The general valves used in rural water supply schemes are gate valve and very few butterfly valves and air valves are used.

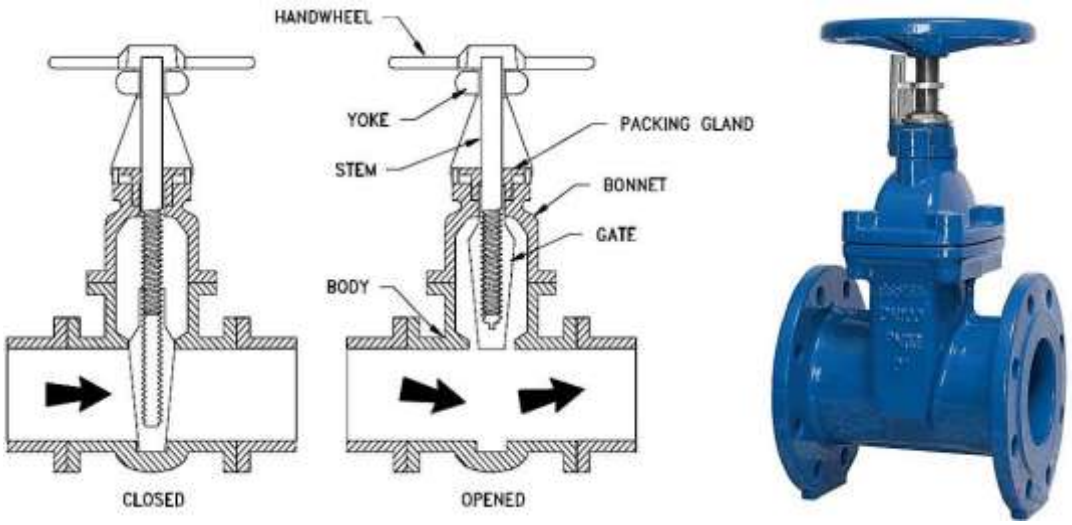

Figure 5: Most Common Gate Valve used at Water Supply Schemes

Project/WUSC Name:			
ValveID:			
Location:			
Date of Procedure:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.4.1 Equipment

- **Personal Protective Equipment (PPE):** Helmets, and heavy-duty gloves for VMW safety.
- **Tools and Supplies:** Valve Key, Wrench, Non-toxic grease for lubrication [2]of valves/gates, temporary patching materials (e.g., cement-sand mix for chamber).
- **Documentation:** Inspection Checklist, Maintenance Logbook, pen.

4.4.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- Wear required PPE before approaching the valve chamber.
- Confirm the purpose of valve operation (flow regulation, isolation for maintenance, or emergency control).
- Inform WUSC / SSC / users if valve operation will interrupt water supply.
- Inspect the valve chamber for hazards such as flooding, loose covers, or unsafe access.

[2] Locally available lubricants can be used with strong guidance from SSC to ensure its non-toxicity

B. During Procedure (Valve Operation)

- Operate the valve slowly and gradually when opening or closing to avoid sudden pressure changes, water hammer, or pipe damage.
- Do not force the valve if resistance is encountered.
- Observe the valve stem, flange, and fittings for leakage during operation.
- If stiffness is observed, apply non-toxic grease to the valve stem if safe to do so.
- Stop operation immediately if abnormal sounds, vibration, or leakage occurs.

C. Post-Procedure (Verification & Reporting)

- Confirm the valve is fully open or closed as intended.
- Recheck for leakage around the valve and connected fittings.
- Ensure valve covers and chambers are securely closed and locked.
- Record the date, time, purpose, valve status, and outcome of the operation in the maintenance logbook.
- Report any abnormalities or incomplete operation to the Service Support Unit.

4.4.3 Control

1. Critical Control Points (CCPs)

- **Valve Operation Integrity (Water Hammer Prevention):**
  - **Control Point:** The valve spindle/handle.
  - **Mechanism:** "Slow-Turn" rule—valves must be opened or closed at a rate of no more than 1 full turn per 10 seconds.
  - **Prevention:** Prevents sudden pressure surges (water hammer) that cause pipe bursts or joint failures in the transmission line.
- **Sealing & Leakage:**
  - **Control Point:** The valve stuffing box.
  - **Mechanism:** Visual inspection for "zero-drip" during operation.
  - **Prevention:** Prevents Non-Revenue Water (NRW) loss and prevents outside contaminants from being sucked into the pipe during low-pressure periods.

2. Error Proofing & Fail-safe

- **Directional Indicators:** All valve chambers must have the "Open" (usually counter-clockwise) and "Close" directions clearly painted on the interior wall or the valve handle itself. This acts as a failsafe against stripping the spindle thread by turning it the wrong way.

3. Verification of Control

- **Escalation Trigger:** If a valve handle spins freely without resistance, or if the "Normal Level" in the downstream reservoir does not rise after opening the valve, the SSU must be notified immediately. This indicates an internal mechanical failure (dropped gate).

4.4.4 Problems and Troubleshooting

The common problems observed at valves (gate/butterfly/washout), along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Valve Hard to Operate	Valve does not turn smoothly	Rust, lack of lubrication, debris	Clean valve stem; apply non-toxic grease; operate slowly	Valve remains stuck or damaged
Valve Not Closing Fully	Continuous flow after closing	Damaged gate, debris inside valve	Open and close valve slowly to flush debris	Leakage persists
Valve Leakage	Water leaking from stem or joints	Loose fittings, damaged seals	Tighten bolts gently; monitor leakage	Leakage increases or joint failure
Valve Breakage	Broken handle or stem	Excessive force, aging	Stop operation; mark valve position	Structural damage to valve
Corrosion	Rust visible on valve body	Exposure, moisture	Clean and protect valve surface	Severe corrosion affecting function

For every issue encountered, the VMW must thoroughly document all troubleshooting attempts, observations, and outcomes in the maintenance logbook prior to escalation. Information should be shared to the SSU should occur immediately in cases involving health or safety risks, or within 24 hours for all other non-emergency issues.

4.5 Pumps

A water pump is used to lift and convey water from a lower elevation to a higher elevation. Pumps are required when abstracting groundwater or when the water source is located below the level of the service area or settlement. The pumps used in water supply schemes are centrifugal pumps and submersible pumps.

Figure 6: Centrifugal Pumps

Figure 7: Submersible Pumps

Project/WUSC Name:			
Structure Name/ID:			
Location:			
Date of Procedure:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.5.1 Equipment

- **Personal Protective Equipment (PPE):** Insulated rubber gloves (for electrical safety), safety boots, helmets, and ear protection (for high-noise pump houses).
- **Tools and Supplies:** Set of spanners, screwdrivers, grease gun, multimeter (to check voltage/current), cleaning rags, High-quality pump grease, spare fuses, gland packing (if applicable), and contact cleaner for electrical panels
- **Documentation:** Inspection Checklist, Maintenance Logbook, pen.

4.5.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- Safety Check: Verify all electrical PPE is worn. Ensure the pump house floor is dry to prevent electric shock hazards.
- Power Assessment: Check the voltage on the control panel before switching the pump "ON" to ensure it is within the safe operating range.
- Prime Check: Ensure the pump casing is filled with water to prevent dry running.

B. During Procedure (Execution & Maintenance)

- Start-up Observation: Listen for unusual grinding, whistling, or vibrating noises immediately after starting.
- Leakage Inspection: Check the pump seal/gland for excessive dripping. A small drip (10 drops per minute) is often normal for cooling, but a steady stream is a failure.
- Temperature Monitor: Carefully check the motor and bearing temperatures (feeling for excessive heat).
- Lubrication: Apply grease to bearings according to the manufacturer's schedule or if moving parts appear stiff.

C. Post-Procedure (Restoration & Reporting)

- Site Security: Ensure the control panel is locked and the pump house door is secured to prevent unauthorized operation.
- Sanitization: Clean the floor of any oil or water spills to prevent slips.
- Documentation: Record the "Time Started," "Time Finished," and total energy units consumed in the Maintenance Logbook.
- Escalation: Immediately report any burnt smells, sparking electrical components, or sudden drops in pressure to the SSC.

4.5.3 Control

This section defines the Critical Control Points (CCPs) to prevent motor burnout or pump damage. and mechanisms required to ensure quality and safety are maintained, preventing failure even when standard procedures are followed.

1. Critical Control Points (CCPs)

- **Voltage Limit (Go/No-Go):**
  - **Control Point:** The electrical starter panel.
  - **Mechanism:** If the voltage is 10% above or below the rated value the pump must not be started.
  - **Prevention:** Prevents motor winding burnout.
- **Dry-Run Prevention:**
  - **Control Point:** Sump/Source water level.
  - **Mechanism:** The pump must be stopped if the water level drops below the foot valve or the "Low Level" mark.
  - **Prevention:** Prevents overheating and destruction of the pump internal impellers.

2. Error Proofing & Fail-safe

- **Overload Relay:** The control panel must have an appropriately set thermal overload relay to automatically trip the power if the motor draws too much current.
- **Phase Preventer:** The system should include a "Single Phase Preventer" to stop the motor if one phase of electricity fails.

3. Verification of Control

- **"Show Me" Verification:** The VMW must record the **Start Voltage:** _____ Volts **Running Amps:** _____ Amps **Pump Runtime:** _____ Hours **Flow Reading (if meter exists):** _____ m^3 during the run, rather than just "Yes/No"

Table 1: Inspection Checklist for Intake

Date of Inspection:

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Power Supply	Voltage (Incomer)		Within ±10% of rated voltage		Stop pump; Notify SSU/Electrician
Current	Amperage (Load)		Steady reading; not exceeding motor rating		Check for blockages or phase loss
Electrical Panel	Indicators & Wiring		All lamps working; no burnt smell or sparking		Tighten connections / Replace fuse
Earthing	Earth Connection		Wires are tight and not corroded		Clean and tighten earth wire
Pump Noise	Pump/Motor Body		Smooth humming; no grinding or rattling		Check for loose bolts or worn bearings
Temperature	Motor Frame		Warm to touch; not painfully hot		Check ventilation; stop to cool down
Lubrication	Bearings		Parts move smoothly; fresh grease visible		Apply non-toxic grease
Valves	Non-Return Valve (NRV)		No water flowing back when pump stops		Clean or repair NRV flap
Pressure	Pressure Gauge		Needle is steady at the "Normal" mark		Check for leaks or pipe blockages

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Priming	Casing/Suction		Pump is full of water before starting		Refill water; check foot valve
Hygiene	Pump House Floor		Dry and clean; no oil or water pools		Mop and clear debris
Ventilation	Motor Fan Cover		No dust or spider webs blocking air flow		Clean with a brush
Security	House/Panel Locks		Doors and control boxes are locked		Replace lock / Secure door

4.5.4 Problems and Troubleshooting

The common problems observed at valves (gate/butterfly/washout), along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Voltage Fluctuation	Pump starts and stops frequently, dim/bright lights, unstable motor sound	Unstable grid supply, loose electrical connections, undersized cables, faulty voltage regulator	Check incoming voltage using voltmeter, inspect connections, ensure proper earthing, verify stabilizer/regulator condition	Voltage remains unstable after basic checks or electrical components appear damaged
Pump Not Starting	No sound or movement	Power failure, loose connection, blown fuse	Check power supply, switch, and visible connections	Power available but pump does not start
Low Pump Discharge	Reduced flow or pressure	Air lock, worn impeller, low water level	Release air; check suction line; clean intake	Flow does not improve
Pump Running but No Water	Pump runs dry	Blocked suction, foot valve failure	Check suction line and foot valve	Repeated dry running
Overheating	Hot motor smell or casing	Continuous operation, low voltage	Stop pump; allow cooling; reduce run time	Overheating continues

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Unusual Noise/Vibration	Knocking or vibration	Loose foundation, bearing wear	Tighten visible bolts; observe operation	Noise persists
Leakage	Water near pump or joints	Seal or gasket failure	Tighten fittings; clean area	Leakage increases
Cavitation	Noise, low output	Low suction head, air leakage	Check suction depth and joints	Cavitation continues
Corrosion	Rust on pump body	Moisture exposure	Clean and protect surface	Structural corrosion observed

For every issue encountered, the VMW must thoroughly document all troubleshooting attempts, observations, and outcomes in the maintenance logbook prior to escalation. Information should be shared to the SSU should occur immediately in cases involving health or safety risks, or within 24 hours for all other non-emergency issues.

In rural water supply schemes, solar pumping can be a sustainable and efficient solution, particularly where tariff collection is low. It reduces dependence on grid electricity and helps avoid recurring electricity costs that are difficult to sustain through user fees.

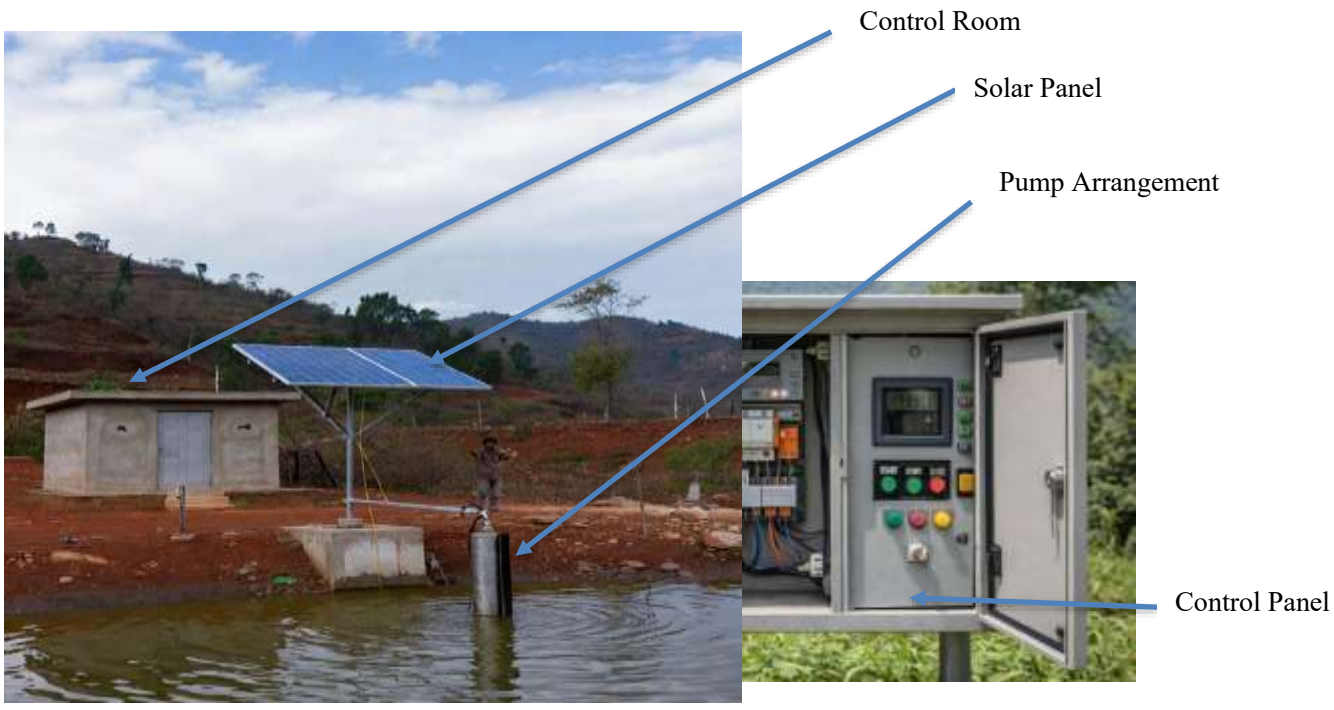

Figure 8: Typical Solar Pumping Scheme

In the case of solar pumping systems, **additional operating and maintenance procedures shall be followed by the Village Maintenance Worker (VMW)**.

- **Solar Panel Assessment:** Visually inspect solar panels for dust, bird droppings, mud, leaves, or shading from trees, structures, or debris. Clean solar panels using clean water and a soft brush or cloth. Do not use abrasive materials. Cleaning is recommended in the morning or late afternoon.
- **Obstruction Removal:** Remove leaves, branches, bird nests, or any temporary objects causing partial shading. Coordinate with the community for trimming trees if permanent shading exists.
- **Electrical Status Check:** Check the DC voltage on the solar pump controller display or using a multimeter to ensure adequate solar input before starting the pump. Start the solar pump and observe the controller indicators to confirm normal operation, with no alarms, flickering lights, or error codes. Inspect all DC and AC cables for signs of cracks, loose connections, or rodent damage. Verify that the earthing connection is secure, intact, and free from corrosion.
- **Documentation:** Record solar voltage, pump run time, panel cleaning date, and observed issues in the Maintenance Logbook.
- **Escalation:** Immediately report controller faults, burnt smells, repeated tripping, damaged panels, or earthing failure to the SSU.

4.6 Reservoir

A reservoir is a structural storage tank that balances constant supply with fluctuating community demand. Its primary functions are to ensure a continuous water supply during peak hours or maintenance, maintain system pressure for gravity flow, and provide essential contact time for water disinfection.

Figure 3: Ground Reservoir

Project/WUSC Name:			
Structure Name/ID:			
Location:			
Date of Procedure:			
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.6.1 Equipment

- **Personal Protective Equipment (PPE):** Safety boots (non-slip), helmets, and heavy-duty gloves for VMW safety.
- **Cleaning Tools:** Brooms, wire brushes, shovels, buckets, and long-handled scrubbers for interior wall cleaning.
- **Maintenance Supplies:** Non-toxic grease for valve lubrication, chlorine for disinfection, and temporary patching materials (cement-sand mix, sealant tape).
- **Documentation:** Inspection Checklist, Maintenance Logbook, and pen.

4.6.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- **Safety Check:** Verify all required PPE before climbing onto or entering the reservoir area.
- **Site Assessment:** Scan for hazards like slippery ladders, unstable ground, or wild animals.
- **Tool Preparation:** Ensure all cleaning and chlorination supplies are gathered and in working condition.
- **Baseline Observation:** Note the current water level and check for any external wet spots indicating new leaks.
- **Notification:** Notify the community if the supply will be interrupted for deep cleaning or major repairs.

B. During Procedure (Execution & Maintenance)

- **Cleaning:** Drain the tank and remove any accumulated silt or sediment from the floor. Scrub interior walls to remove algae or bio-growth.
- **Structural Inspection:**
    - Inspect masonry or concrete walls for cracks, leakage, or erosion.
    - Check that the manhole cover is good and fits tightly.
- **Water Quality Check:** Observe the stored water for changes in clarity, color, or smell. Perform a chlorine residual test if applicable.
- **Mechanical Maintenance:** Check inlet, outlet, and washout valves for ease of movement and apply non-toxic grease if necessary.
- **Minor Repairs:** Apply temporary patches to small cracks on the external structure.

C. Post-Procedure (Restoration & Reporting)

- **Site Security:** Ensure manhole covers are tightly closed and all valve chambers are locked to prevent unauthorized access or contamination.
- **Sanitization:** If the tank was entered, disinfect the interior with a chlorine solution. Clean and store all tools properly.
- **Documentation:** Immediately fill out the Inspection Checklist and record activities in the Maintenance Logbook .
- **Escalation:** Report major structural failures or severe water contamination to the SSU or WUSC immediately

4.6.3 Control

This section defines the mechanisms required to ensure water safety and structural integrity, preventing system failure although the SOP is well followed.

1. Critical Control Points (CCPs)

- **Contamination Barrier (Go/No-Go):**
  - **Control Point:** Manhole cover and air vents.
  - **Mechanism:** Inspection for a tight seal and intact mosquito mesh.
  - **Prevention:** Prevents insects, rodents, or dust from entering the treated water.
- **Water Level Control:**
  - **Control Point:** Overflow pipe , float valve (if present) or leveling equipment's.
  - **Mechanism:** Physical check to ensure the overflow is clear and the float valve stops flow at the marked "Full" line.
  - **Prevention:** Prevents structural stress from over-pressurization and avoids water wastage.
- **Valve Security:**
  - **Control Point:** Distribution and washout valves.
  - **Mechanism:** All valves must be locked in their correct operating position (Open for distribution, Closed for washout).
  - **Prevention:** Prevents unauthorized water diversion or accidental drainage of the entire reservoir.

2. Error Proofing & Fail-safe

- **Overflow Functionality:** The overflow pipe must always remain open and be larger than the inlet pipe to prevent the tank roof from bursting if the inlet valve fails to close.
- **Vent Protection:** All air vents must have fine-mesh screens to allow the tank to "breathe" without letting in contaminants.

3. Verification of Control

- **"Show Me" Verification:** The VMW must record the actual water level (e.g., "Level: 2.5 meters") and confirm "Manhole Locked: Yes" in the logbook.
- **Escalation Trigger:** If the water level drops rapidly overnight without increased demand, the SSU must be notified immediately to check for major underground leaks.

Table 1: Inspection Checklist for Intake

Date of Inspection:

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Water Quality	Stored water		Clear, odorless, no		Drain and clean tank

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
			visible sediment		
Inlet	Inlet pipe & screen		No blockage, proper flow		Clean inlet
Outlet	Outlet pipe		Continuous and controlled outflow		Check blockage/valve
Overflow	Overflow pipe		Free-flowing, directed away from tank		Clean / repair overflow
Structural Condition	Tank walls, floor, roof		No cracks, leakage, or seepage		Patch / report
Cover & Access	Manhole cover & vents		Closed, locked, screened		Secure / replace cover
Hygiene	Tank interior		No algae, slime, insects, or animal traces		Clean and disinfect
Security	Fencing & locks		Locked and secure		Replace lock / repair fence
Surrounding Area	Drainage & vegetation		Clean, no water stagnation		Clear vegetation

4.6.4 Problems and Troubleshooting

The common problems observed at water tanks/reservoirs along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Rapid Emptying	Reservoir drains too fast	Leakage, unauthorized outlet	Inspect visible leaks; check outlet valve	Water level drops abnormally

Turbid Water in Reservoir	Cloudy or dirty water	Sediment entry, poor cleaning	Allow settling; schedule cleaning	Turbidity persists
Contamination	Odor, color change	Open cover, damaged vent	Secure cover; clean surroundings	Repeated contamination
Structural Leakage	Wet patches, seepage	Cracks, joint failure	Mark leakage; apply temporary sealing	Cracks or leakage worsen

For every issue encountered, the VMW must thoroughly document all troubleshooting attempts, observations, and outcomes in the maintenance logbook prior to escalation. Information should be shared to the SSU should occur immediately in cases involving health or safety risks, or within 24 hours for all other non-emergency issues.

4.7 Conveyance (Pipe Network)

The pipe network is classified into transmission mains and distribution networks. In general, transmission mains experience fewer operational issues than distribution networks. Accordingly, the working procedures for addressing different issues have been categorized based on the general issues experienced at pipe network.

Project/WUSC Name:			
Pipe Network	(Transmission/Distribution)		
Location:			
Type of Pipe	(GI/DI/HDPE)		
Time Started:		**Time Finished:**	
Performed By (VMW):			

4.7.1 Procedure

A. New Connection, Repair and Rehabilitation

Any changes or modifications to the distribution system must follow proper planning, material selection, safe handling and installation, site cleanliness, safety measures, and testing procedures. Planning should consider system design, capacity, and existing conditions, while materials must be durable, corrosion-resistant, and suitable for operating pressures and environmental conditions. Proper installation following manufacturer guidelines helps prevent leaks and contamination. The worksite should be kept clean, clearly marked, and safe, with workers using appropriate PPE. Finally, testing and water quality checks are essential to ensure system integrity and the delivery of safe, high-quality water to consumers.

Procedure to add additional pipe

- Prepare a minute describing the need of additional pipe in co-ordinate with WUSC
- Consult with SSU to analyses the impact on the water flow, pressure etc

Procedure for Repair and Rehabilitation

- Notify the users who are likely to be affected by the work (if it is to be done during supply hours) with state date and time, and the expected restoration date and time
- Make sure about the availability of pipe and fitting with store before starting the works.

- Follow the specifications (from O&M manual) of the process considering the proper safety at construction site.
- Isolate the network by closing the valve, so that no water is loss during the process.
- Use the standard procedure like cleaning the pipe before connection etc and experience manpower while conducting the activities.
- Test the leakage or any abnormalities before leaving the site
- Maintain the accurate records of the activities with describing the location, nature of damage, possible cause of the damage etc

B. Network Blockage

Pipe networks become blocked when debris or unwanted materials enter the pipeline, or when air becomes trapped within sections of the network, restricting normal water flow.

Procedure to rectify blockage

- Identify the blockage pipe section examining the water flow in pipe sections
- Close upstream control valve gradually.
- Open downstream valve, washout, or lowest outlet point.
- Flush the pipe to remove debris and sediment.
- In case of blockage due to entrapped air, Open air release valve or nearest tap at high points to release trapped air.
- Allow air to escape until continuous water flow is observed.
- In case of blockage due to entrapped air, consult with SSC to identify critical pint and add air valve in appropriate point to reduce the chance of blockage
- Slowly reopen the upstream valve to restore normal pressure.
- Confirm normal water supply at downstream taps or reservoir.

C. Network Flushing

Controlled flushing of water distribution pipelines involves intentionally releasing water at high velocity through washout valves to remove accumulated sediment and biofilm from pipe walls. The flushing is carried out in a planned sequence and for a defined duration to ensure effective cleaning of the entire distribution system and to maintain water quality.

Flushing can be conducted using either **conventional** or **unidirectional** methods, depending on the network configuration. Conventional flushing is typically used for branch or dead-end systems and involves discharging water until it runs clear, though it requires higher water volumes. Unidirectional flushing (UDF), commonly applied in grid or loop systems, isolates pipe sections to create single-direction, high-velocity flow, achieving more effective cleaning with less water.

Procedure for Network Flushing

- Check the working condition of existing control valves, washout points, and public taps; repair or replace non-functioning valves where feasible.
- Where washout valves are not available, use the nearest downstream tap or pipe end for flushing, ensuring safe disposal of water without causing erosion or damage to property.
- Assess the amount of water available in the reservoir or tank and plan flushing accordingly, prioritizing critical or problem areas.
- Plan flushing from higher elevations or near the tank and proceed towards lower areas or dead ends.
- Inform users in advance about the flushing schedule and possible temporary interruption of supply using local means (word of mouth, ward notice, or WUSC members).
- Open the washout point or downstream tap and allow water to flow at the highest practical velocity to remove sediment and debris.
- Slowly open upstream valves to allow flushing water to pass through the entire section.
- Close the washout point or tap once flushing is completed.
- Restore all closed valves and service connections to resume normal supply.
- Record the flushing activity in the O&M or logbook, noting the date, section flushed, issues observed, and actions taken.

4.7.2 Control

1. Critical Control Points (CCPs)

- **Material Suitability:**
  - **Control Point:** Pipe and fitting selection.
  - **Mechanism:** Verify materials are durable, corrosion-resistant, and rated for the specific operating pressure.
  - **Prevention:** Prevents premature pipe bursts and material degradation.
- **Joint Integrity:**
  - **Control Point:** Pipe connections.
  - **Mechanism:** Physical inspection and "dry-check" before final burial.
  - **Prevention:** Prevents Non-Revenue Water (NRW) loss and soil erosion around joints.
- **Contamination Control:**
  - **Control Point:** Pipe interior during installation.
  - **Mechanism:** Ensure all pipes are capped or cleaned before being joined.
  - **Prevention:** Prevents the entry of soil or debris that can cause blockages or health risks.

2. Error Proofing & Fail-safe

- **Pressure Management:** Gradually open upstream valves after a repair to avoid "water hammer," which can snap newly installed fittings.
- **Specification Compliance:** Cross-reference every fitting with the O&M manual to ensure no "improvised" or non-standard parts are used.

3. Verification of Control

- **"Show Me" Verification:** The VMW must record the specific result of the leak test (e.g., "Pressure Test Passed: Yes/No") and the "Time Pressure Restored" in the logbook.
- **Escalation Trigger:** If a leak persists after three repair attempts or if the flow to downstream users does not return to normal levels, the SSU must be notified immediately.

4.7.3 Problems and Troubleshooting

The common problems observed at water tanks/reservoirs along with their symptoms, likely causes, and rectification steps, are summarized below. Village Maintenance Workers (VMWs) should attempt initial troubleshooting and repairs as outlined.

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
New Connection, Repair and rehabilitation				
New Pipe Connection		New Demand Creation		Before adding new Pipe
Leakage at Joint	Water seepage around joints	Improper jointing, loose fittings	Tighten joint; apply temporary sealing (rubber/cloth)	Leakage continues or joint fails
Pipe Burst / Crack	Sudden loss of pressure, other municipal works like road construction	Excess pressure, weak or old pipe	Isolate section; temporarily block flow	Major burst or repeated failures
Backflow / Contamination Risk	Dirty water after repair	Open pipe ends, poor hygiene	Flush and disinfect pipe section	Water quality not improved
Repeated Minor Leaks	Frequent small leakages	Aging or corroded pipes	Record locations; apply temporary repair	Multiple leaks in same section
Pipe Blockage related				
Debris / Sediment Blockage	Low or no water flow	Entry of sand, silt, waste during repair or intake failure	Isolate section; flush through washout or downstream valve	Flow not restored after flushing

Problem	Symptoms	Likely Causes	VMW Troubleshooting Steps	Escalate to SSU If
Air Lock in Pipe	Intermittent flow, gurgling sound	Trapped air at high points, improper valve operation	Open air release point or tap at high elevation	Air lock recurs frequently
Sudden Blockage After Repair	No supply immediately after works	Debris left inside pipe, air trapped or faulty joining	Flush line and release air	Supply not restored
Network Flushing Related				
Ineffective Flushing	Water remains dirty during flushing	Insufficient flow/pressure, short flushing duration	Continue flushing; increase discharge if possible	Water not cleared
Low Flushing Velocity	Sediment not removed	Low tank level, partially closed valves	Fully open valves; flush smaller pipe section	Velocity cannot be increased
Air Entry During Flushing	Irregular flow, splashing	Rapid valve operation, empty pipe	Operate valves slowly; keep pipe full open	Air locking continues

4.8 Water Quality

The quality of supplied drinking water shall comply with the National Drinking Water Quality Standards (NDWQS), 2079, and the parameters specified in the standard must be regularly tested. In rural water supply schemes, water quality testing is carried out using field test kits provided by the Government or supporting agencies such as development partners and I/NGOs. Commonly used kits include Wagtech and ENPHO water testing kits. The parameters that can be measured through these kits can be summarized as:

Figure 9: WagTech Kit

Figure 10: ENPHO Kit

Table 8: Parameters measured by each Kits

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 (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 $CaCO_3$)	500	mg/L			

21		Calcium	200	mg/L			
22		Nitrites	3	mg/L			
23		Zinc	3	mg/L			
24		Mercury	0.001	mg/L			
25		Aluminum	0.2	mg/L			
26		Residual Chlorine	0.1-0.5	mg/L			
27	Micro biological	*E.Coli* (MPN/100mL)	0				
28		Total Coliform (MPN/100mL)	0 in 95%samples				
29	Others	Temperature	℃				
30		Phosphate	mg/L				

The Village Maintenance Workers (VMWs) of each water supply scheme are responsible for water sampling, testing, and maintaining records of the measured water quality. For rural water supply schemes, water quality testing shall be conducted at the recommended sampling points, following the prescribed procedures and testing frequencies as specified in the National Drinking Water Quality Standards (NDWQS), 2079.

1. **Intake:** To measure the quality of water at source
2. **After Chlorination:** To measure the quality of Supplied Water
3. **Household level:** To measure Quality as Consumers level

4.8.1 Equipment

- **Personal Protective Equipment (PPE):** Gloves, mask, sanitizer for VMW
- **Tools:** Water Quality Test kit, Reagents
- **Documentation:** Inspection Checklist, Maintenance Logbook, and pen.

4.8.2 Procedure

Procedure for water Sampling and testing

- Ensure all required personal protective equipment (PPE) before sampling and testing.
- Use clean, contamination-free sampling bottles only.
- Collect samples carefully without disturbing sediments or introducing any foreign matter.
- Do not store samples; conduct testing immediately after collection.
- Follow the standard procedures for handling reagents and test kits while measuring each parameter.
- Record all test results accurately in the water quality logbook.
- If any parameter deviates from the standard, repeat the test for confirmation and promptly inform the Service Support Center (SSC) if non-compliance persists.

Calibration

Portable water quality test kits shall be regularly calibrated to ensure accuracy and reliability of test results. The responsibility for calibration of all provided kits shall rest with the Service Support Center (SSC). As Village Maintenance Workers (VMWs) are not technically equipped to carry out calibration, they shall not attempt to calibrate the kits on their own. The SSC shall plan, coordinate, and arrange calibration through

qualified technicians or authorized laboratories at required intervals, and ensure that calibrated kits are returned to the schemes with proper records and certification.

Table 1: Inspection Checklist for Intake

Date of Inspection:

Item	Control Point (What to check)	Frequency	Standard (The "Right" Way)	Status (Yes/No)	Action Taken if 'No'
Residual Chlorine			0.1 mg/L to 0.5 mg/L		Adjust Chlorinator dose
Turbidity			Clear water (< 5 NTU)		Stop supply/Flush tank
pH Level			6.5 to 8.5 (Neutral)		Report to SSU
Bacterial Risk			No H2S color change (No Coliform)		Shock chlorination
Reagent Stock	Tool Kit / Store		Not expired; dry storage		Order new DPD/Reagents
Equipment	Digital Meters		Calibrated and clean probes		Replace batteries/Clean
Hygiene	Sampling Point		No waste or stagnant water nearby		Clean the surroundings
Taste/Odour	Consumer Tap		No foul smell or metallic taste		Check for contamination

4.9 Chlorine Dosing

4.9.1 Equipment

- **Personal Protective Equipment (PPE):** Rubber gloves, face mask, safety goggles, apron/overall.
- **Tools and Supplies:** Bleaching powder (≈33–35% available chlorine) , clean plastic bucket (10–20 L), measuring cup/scale, wooden or plastic stirring stick, funnel, clean cloth, Free Residual Chlorine (FRC) test kit (DPD method).
- **Documentation:** Chlorination Logbook, Inspection Checklist, pen.

4.9.2 Procedure

A. Pre-Procedure (Preparation & Safety)

- **Safety Check:** Ensure PPE is worn before handling chlorine. Prepare chlorine solution in a well-ventilated area and avoid direct contact or inhalation.
- **Water Quality Check:** Visually inspect water turbidity. If water is highly turbid, allow settling or filtration before chlorination, as high turbidity increases chlorine demand.
- **Tank Assessment:** Confirm the volume of the reservoir/tank to be chlorinated and ensure it is operational and free from visible contamination.

B. During Procedure (Preparation & Dosing)

- **Preparation of Chlorine Solution:** Measure the required quantity of chlorine powder based on tank volume and target dose. Dissolve the chlorine powder in a small quantity of clean water and mix thoroughly. Using Thumb rule initially 3gm bleaching power can be used per 1000 liters of water

Table 1: Required amount of Leaching 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**

- **Settling:** Allow the solution to stand for 5–10 minutes so that insoluble material settles. Use only the clear solution and discard sediment safely.
- **Manual Dosing:** Pour the prepared chlorine solution slowly into the reservoir or tank inlet to ensure proper mixing. Avoid pouring at a single point.
- **Contact Time:** Allow a minimum contact time of **30 minutes** before supplying water to consumers.

C. Post-Procedure (Monitoring & Reporting)

- **Residual Chlorine Testing:** Measure Free Residual Chlorine (FRC) at the tank outlet and at the farthest tap using test kit.
- **Adjustment:** If FRC is below **0.1 mg/L**, slightly increase the dose in the next cycle. If FRC exceeds **0.5 mg/L**, reduce the dose accordingly.
- **Documentation:** Record date, time, type and quantity of chlorine used, tank volume, FRC results, and name/signature of the VMW in the logbook.
- **Reporting:** Immediately report abnormal results, repeated low residuals, or strong chlorine taste/odour complaints to the SSC.

4.9.3 Control

This section defines **Critical Control Points (CCPs)** to ensure effective disinfection and prevent under- or over-chlorination.

1. Critical Control Points (CCPs)

- **Chlorine Dose Control:**

- **Control Point:** Chlorine preparation and dosing
- **Mechanism:** Dose must be sufficient to achieve ≥0.1 mg/L residual chlorine at consumer points
- **Prevention:** Prevents microbiological contamination

- **Contact Time Control:**

- **Control Point:** Reservoir/tank detention time
- **Mechanism:** Minimum 30 minutes contact time before supply
- **Prevention:** Ensures effective disinfection

2. Error Proofing & Fail-safe

- **Standard Dose Reference:** Use fixed dose charts approved by SSC for common tank sizes to avoid calculation errors.
- **Stepwise Adjustment:** Any change in chlorine dose shall be made gradually, not abruptly.

3. Verification of Control

"Show Me" Verification: The VMW shall record actual values, not just Yes/No:

- Tank Volume: _____ L
- Chlorine Type & Quantity: _____ g
- Contact Time: _____ min
- FRC at Tank Outlet: _____ mg/L
- FRC at Farthest Tap: _____ mg/L

- **Table : Manual Chlorination Inspection Checklist**

Item	Control Point	Frequency	Standard (Right Way)	Status (Yes/No)	Action if 'No'
Chlorine Stock	Storage condition	Monthly	Dry, sealed, labeled		Replace stock

Item	Control Point	Frequency	Standard (Right Way)	Status (Yes/No)	Action if 'No'
PPE	Availability	Daily	All PPE available		Arrange PPE
Mixing	Solution clarity	Every dosing	Clear solution only		Re-mix
Contact Time	Detention	Every dosing	≥30 minutes		Delay supply
Residual Chlorine	FRC at tap	Daily	0.1–0.2 mg/L		Adjust dose
Logbook	Record keeping	Daily	Fully filled		Update record

Table Problems and Troubleshooting

Problem	Symptoms	Likely Causes	VMW Action	Escalate to SSC If
No residual chlorine	FRC = 0	Underdosing, high demand	Increase dose slightly	Continues for more than 2 days
Strong chlorine taste	Consumer complaints	Overdosing	Reduce dose	Complaints continue
Cloudy water	Poor disinfection	High turbidity	Pre-settle water	Turbidity remains
Inconsistent results	Variable FRC	Poor mixing	Improve mixing	Issue repeats

4.9.4 Mandatory Reporting

All chlorination activities, test results, and corrective actions must be recorded. Issues posing public health risks must be reported immediately, and all other issues within 24 hours to the SSC.

4.10 Continuous Improvement

Monitoring & Compliance The Service Support Center (SSC) or designated regulating body (e.g., Municipality, WUSC) shall establish a formal audit mechanism. This audit process is required to verify the quality, consistency, and strict adherence to protocols of all activities performed by Village Maintenance Workers (VMWs).

Capacity Building The SSC shall conduct periodic needs-based assessments of VMWs to develop targeted training plans. Training curricula must prioritize:

- Strict adherence to this SOP.
- Safe handling and operation of maintenance equipment.
- Compliance with correct reporting and escalation protocols.

SOP Review Cycle This Standard Operating Procedure shall be reviewed annually. Revisions must incorporate field feedback, documented incident reports, and seasonal operational data to ensure that equipment lists