CLAVERIA WATER DISTRICT

Operations Manual

Technical Services

Revised 2020

OPERATING PROCEDURE

Management procedures are documented manuals of actions to be taken when the system is operating under normal conditions and incident situations. Operational procedures are usually step-by-step actions to be applied as standard operating procedures in any circumstances or events. It is also routine good practices aimed to improved present set-ups in order to achieve a more reliable, efficient and economy-wise solutions to persistent problems in the water system.

This chapter provides reference on the daily operations of the water district. Basically, the daily operation of the Claveria Water District is consisting of Water Production and Distribution, Administrative and Financial Aspects and Commercial Operations.

1. Water Production and Distribution

The Claveria Water District (CWD primary concern is the operation and maintenance of the pump equipment, repair of pipe service connections, leakages, defective meters, installation of service connections and the maintenance of water sources and reservoir tank.

The pump motors are mostly operating 24hours. The water is pumped directly into the water distribution system and excess goes directly to the reservoir tank. The CWD personnel conducts cleaning operations of the distribution and transmission lines, as well as the flushing of water through the hydrants, blow-off valves and flushing points to remove undesirable elements that are accumulated during low pressure and power interruption.

A. Wells

1. Pumping Tests

A pumping test is a field experiment in which a well is pumped at a controlled rate and water-level response (drawdown) is measured in one or more surrounding observation wells and optionally in the pumped well (control well) itself; response data from pumping tests are used to estimate the hydraulic properties of aquifers, evaluate well performance and identify aquifer boundaries. Aquifer test and aquifer performance test (APT) are alternate designations for a pumping test. Pumping tests are a practical way of obtaining an idea of the borehole's efficiency and its optimal production yield.

The pumping test is actually done by the well drilling contractors who are knowledgeable and who possess the required tools and equipment for the tests. It only becomes necessary for the water district to conduct the test for monitoring purposes. Once the pumping level is established, it should be compared with the design pump curves of the equipment to be used. This will guide the operational parameters for pumping water from well. *The importance and vital nature of the work of professional well drillers is underscored by the NWRB, which imposes standards for their activities, regulating and requiring registering with it.*

24 Hours Constant Rate Pumping Test Procedure

I. Required Tools and Equipment

- Pumping unit (submersible pump with a capacity greater than the yield requirement by at least 20%)
- Water Level Indicator
- Stopwatch
- Containers for volumetric measurement of discharge

II. Terminologies

Static Water Level- The vertical distance from ground level (or known measuring point) to the water surface point in the well during pumping

Pumping Water Level- The vertical distance from ground level (or known measuring point) to the water surface in the well during pumping

Drawdown- The difference between the pumping water level and the static water level

Well Yield- The volume of water per unit time that could be pumped from the well as determined by the pumping test.

III. Discharge Measurements

Discharge measurements are usually measured by a flow meter. If there is no device to measure the flow, then volumetric measurements will be resorted to.

The volumetric method consists of noting down the time required to fill a container (bucket or a drum). Better results are obtained with a larger container. For more accurate results, several trial measurements should be done and the average of these trials taken.

IV. Procedure

1. Prior to starting pump, measure and record the static water level.
2. After starting the pump, measure the corresponding water levels. Discharge should be greater than the required yield and should be maintained at a constant rate during the entire duration of the test for 24 hours.

   Measurement intervals should be as follows:

Time from start of pumping (min)	Time intervals between measurements (min)
0-15	0.5-1
10-15	1
15-60	5
60-300	30
300- end of test	60

3. Simultaneous with the water level measurements, take measurements of discharged.
4. Monitor nearby wells to determine effects during pumping.
5. Right after the end of the pumping test, measure the water level recovery
6. Plot data obtained from the test on a semi-logarithmic paper showing the time in the abscissa (x-axis) and the drawdown in the ordinate axis (y axis).

2. Major Causes of deteriorating Well Performance

At the outset, in designing and constructing a well, care should be taken to prevent the major causes of eventual well deterioration. Following are five of the main causes of deterioration in well performance. Consider that the first four of these major causes of well deterioration are greatly influenced by the care taken in constructing the well.

2.1 Well yield reduction due to the incrustation and growth of iron bacteria;

2.2 Plugging of well screen due to buildup of fine particles;

2.3 Sand Pumping;

2.4 Structural collapse of the well casing and screen; and

2.5 Condition of the pump.

3. Prevention and Remedial Causes

a. *Prevention and Treatment of Iron Bacteria*

1. Care should be taken to avoid introducing iron bacteria into the well during drilling and repair work. For this purpose, equipment and materials (drill rods, filter pack) should be chlorinated prior to drilling or repair;
2. Chemical treatment (application of strong oxidizing agent such as chlorine and chlorine compounds) to clear contaminating bacteria; and
3. Physical treatment (jetting, air or surge block surging, air lift pumping) to clear blockages.

B. Pump in General

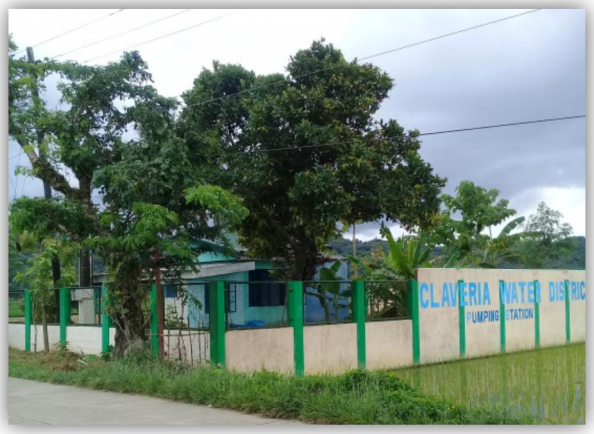
1. Manufacturers Recommendations

Pump manufacturers always provide a manual for the operation and maintenance of their pumps. The instructions in these manuals, including the recommended maintenance schedule, should be followed. The instructions include greasing, oil inspection, checking of voltage at power source, adjustment and repairs.

If during inspection a defect is found, it should be repaired immediately. The operator should pay attention even to small defects, and not wait for them to worsen, as these could cause other parts or units to fail, resulting in larger damage and more costly repairs.

2. *Pump Station Data*

The CWD has two (2) existing Deep Well water sources.



Pump Station 1
Malasin East, Centro 7, Claveria,
Cagayan

Pump Station 2
Sitio Cabanuangan, Centro 8,
Claveria, Cagayan

3. Pump Log

A pump log should be maintained to record the daily pressure and flow readings of the pump. The time of the day when these readings are made should also be reflected.

The schedule for operating and stopping the well pumps should relate the pump capacity to the data on daily water demand and the water levels of the reservoir.

4. Pump Operations

It is simple to operate the intake pumps used for water wells or surface water. They are automatically started by the low level pressure and shut down by the high level pressure switches installed in the water storage or receiving tank. These pumps may set for manual operation by turning the control switch mounted on the pump base from the

"Auto" to "Manual" setting, and using the start/stop buttons for the pump motor. However, care must be observed in stopping pump operation.

Pump Operation Procedure

1. The Pump Operator-in-Charge must be familiar with the Locations, Functionalities, and Operations of Electrical Devices (Circuit Breakers, Relays, Switches, and pressure Transmitter), Mechanical Devices (Discharge Valve, Blow-off Valve, Check Valve Flow Meter, and Pressure Gauge), Motor Control Equipment (VFD, RVAT,IVFD)
2. Before starting the Pump/Motor, check the physical conditions of all electrical components and wires for the signs of overheating, loosed or detached wires and burnt components that can cause further damage to the control system.
3. Always refer to the recent data in the Operators logbook. Early warning or notice can be helpful.
4. Make sure that the selector switch is in "OFF" position before turning on the Main Circuit Breaker.
5. Be aware of the specified operating voltage and current of the submersible motor.
6. Check the Line Voltage. Never attempt to start the motor with a single-phase power supply if the motor is a three-phase. (It may cause damage to the motor)
7. Fully Close the Discharge Valve and open the Blow off Valve before starting the motor.
8. Start the Pump/Motor by setting the selector switch to manual mode, and then press the start Button.
9. After starting the Pump/motor, immediately checks the Line current of the motor, it should not exceed the Rated Current.
10. If the Operator encounters problem, press the STOP Button and shut off the Main Circuit Breaker and fix it.
11. Divert the pump discharge to the Distribution Line by gradually opening the Distribution Valve and fully closing the Blow-off Valve. (Blow-Off Flushing is already Done)
12. Turn On the dosing pump and make sure that is working properly.
13. Round the Clock monitor and inspection of Voltage, Ammeter Water Discharge Pressure, and Flow Meter Reading to determine if the pump is functioning normally.
14. Frequent and accurate recording of Line Voltage, Line Current, KWHR Reading, Discharged Capacity , pressure and Flow Meter Reading. Always examine and analyze if these valves are in accordance with normal operation.
15. Record in the logbook all the important and events relevant to the smooth and efficient operation to b endorse to the next operator.
16. Operators are duty-bound to maintain cleanliness and orderliness inside and outside water pumping station premises.
17. Stop the Pump Operation as per required pump schedule.
18. Press the STOP Button to stop the Pump/Motor.
19. Fully Close the Discharge Valve right after the Pump/Motor stops.
20. Record all the important Data, Time, KWHR Reading, Flow Meter Reading, Motor Running Hour, and Engine Hour and pressure Reading when the Pump/Motor stops.
21. Turn OFF the Main Circuit Breaker at the Main Control Panel.
22. On-Time Submission of Reports (Monthly Production and Flushing Report).

Standard Operating Procedures for Standby Generator Sets

Standby generator sets are used specifically during power outages and interruptions; therefore proper handling and maintenance are required in every operator to ensure that generator sets are always in running conditions as follows:

1. Before starting the generator set, be sure to check the following:
    a. Engine Oil Level
    b. Radiator Fluid (Coolant/ Water)
    c. Fuel Level
    d. Battery Condition
    e. Air Cleaner
2. Upon starting the generator set, observe the sound that produce by the generator set during "No load" condition, immediately report to the authorized mechanic if you hear unusual sound, like "cranking" sound.
3. Before shifting the power to generator set, measure or read the following:
    a. Line Voltage Output
    b. Frequency
4. Regular warm-up (5minutes) for at least twice a week is also necessary to prevent clogging to the fuel and also re-charge the battery.
5. Record the latest change oil date which serve as reference to the next one (every 500 running-hours for brand new gen-set and 300 running –hours for others).
6. Always maintain minimum fifty percent (50% fuel levels of fuel tank.

5. Pump Trouble Checklist

The manufacturer or supplier of the pump always provides the pump design curve which is the basic reference for evaluating actual performance. In addition to the comparison of actual performance against the design curve, the operator should be alert to the following indications of pump problems:

1. Excessive heating of the motor;
2. Change in the bearing noise level;
3. Change in the pattern of oil consumption of the motor;
4. Excessive vibration;
5. Change in amperage or voltage load;
6. Cavitation noise or other unusual noise; and

7. Presence of cracks or uneven settlement of the pad or ground around the pump.

Repair and Maintenance of Dosing Pump

1. The Water Resources Operator B will verify and check the brand, date of purchased (CWD Property Sticker) and operation condition of the dosing pump.
2. Check every day if the whole system is working from the current source to the dosing pump to the injection point.
3. Monitor the design strokes of the dosing pump.
4. Check if there is leak and clogging in the system (pump, hose and injector).
5. Referring to previous records of cleaning of pumps, injector valve, and replacement of delivery tube must be adopted in that pumping station depending of what kind of disinfectant being used.
6. Always provide a stock of spare dosing pump, repair kit and delivery tube to avoid any stoppage of operation.

Repair and Maintenance of Pump House and Security Fence

1. Inspect all structure in the pumping station and record all defects to be address.
2. Repair all deteriorating parts of the structure to ensure its soundness and beauty.
3. Repaint the structure if necessary
4. Restore immediately of any damage after calamities.
5. Maintain cleanliness of surroundings and beautify the area

Security Measures of Pumping Station Facilities

1. Secure all gates and equipment rooms with heavy-duty padlocks and overhead barbwires to all perimeter fences.
2. Ensure all perimeter lights “On” during night time.
3. Daily checking and inventory of all pumping station facilities and equipment.
4. Secure all well opening with threaded caps to prevent contamination from all sorts (physical, chemical and bacteriological).
5. Every site, visit, inspection and educational trips should be properly documented and coordinated with concerned personnel.
6. Secure all maintenance tools, materials and machine use during and after preventive maintenance activities.
7. Only authorized personnel are allowed to enter Water Pumping Stations and premises.

8. Always use protective gear during and after preventive maintenance activities and during preparation of chlorine solution and during disinfection.

C. Chlorine Disinfection

This section details the procedures for using chlorine safely as a disinfectant and the methods of calculating the chlorine dosages required in the water system.

1. General

Disinfection is necessary to ensure that drinking water is free from disease-causing microorganisms. Water disinfection means the removal, deactivation or killing of pathogenic (Disease causing microorganisms, such as bacteria, fungi and viruses) microorganisms. Disinfection is often universally employed by water distribution systems, even when water at the source is deemed already potable- as precautionary measure to control the spread of waterborne diseases. In Local Water Districts, this precautionary is particularly important because of the risk of contamination due to breaks and other types of seepages anywhere throughout the extensive pipe network, and the magnified impact of this risk due to the number of users.

2. Chlorination

Chlorination is the process of adding the element chlorine to water to make it safe for human consumption as drinking water. Chlorine (and its compound) is the most widely used disinfectant for water systems because of its effectiveness, cheap cost and availability.

Chlorination has the advantage of oxidizing bacteria and viruses even after the point of application due to its residual action. Hence any bacteria introduced to the system after the point of chlorination can still be eliminated by the residual chlorine in the water.

Chlorinating Procedures for CWD Production Wells passing the PNSDW Limits:

c. Chlorine Dioxide Disinfectant

1. 500 grams (1 pack) of Dioxide is dissolved in a fifty (50) liters container of clean water.
2. Prepared solution must stir thoroughly until particulates are dissolved.
3. Dosing pump foot-valve must have to be suspended a few inches from the bottom of the container.

4. Dosing pump strokes and adjustments varies on each particular well based on chlorine residual measurements taken from starting point, midpoints and endpoints of distribution lines.

d. Calcium Hypochlorite

1. 750 grams of Calcium Hypochlorite is poured in 10liter pail of clean water and stirred vigorously and letting particulates settled at the bottom.
2. The cleared aqueous solution is to be transferred to a 50 liter container and filled for until partly full.
3. Dosing pump foot-valve must have to be suspended a few inches from the bottom of the container.
4. Dosing pump strokes and adjustments varies on each particular well based on chlorine residual measurements taken from starting point, midpoints and endpoints of distribution lines.
5. Decanted calcium hypochlorite un-dissolved particulates are to be dispose properly.

3. Determinants of Chlorine Effectiveness

1. *Contact Time (CT & Dosage)* - refers to the period of time allowed for the disinfectant to react with the microorganisms that may be in the water. Dosage refers to the amount of chlorine in relation to the volume of the water being treated.

2. *The Type of Microorganism* – Chlorine is quite effective in destroying the most significant pathogenic organisms that are dangerous to humans and are commonly borne in water. Different pathogens and parasites, however, have different levels of resistance to it. Thus the dosages, the CT, and other conditions of the water that intensify or inhibit the oxidizing action of chlorine such as temperature and pH (acidity or alkalinity) need to be considered in order to be sure that the harmful organisms and undesirable substances are eliminated.

3. *Characteristics of the Source Water* – The nature of the water that requires treatment influences the disinfection. Materials in the water, for example, iron, manganese, hydrogen sulfide and nitrates often react with disinfectants, effectively increasing the chlorine demand. Turbidity of the water also reduces the effectiveness of disinfection. Usually, the tests on the water from new source are the basis for prescribing the dosage and CT needed to eliminate the harmful and undesirable substances. Additional tests on the water at source need to be conducted when there are indications that the source water have changed. The possibility of contaminants (whether pathogens or minerals that change its acidity or turbidity) in the path of the water or in the proximity of the spring box or reservoir needed to be checked.

4. *Temperature of Water* – Higher temperatures usually increase the speed of reactions and of disinfection.

4. Terminology and Definitions

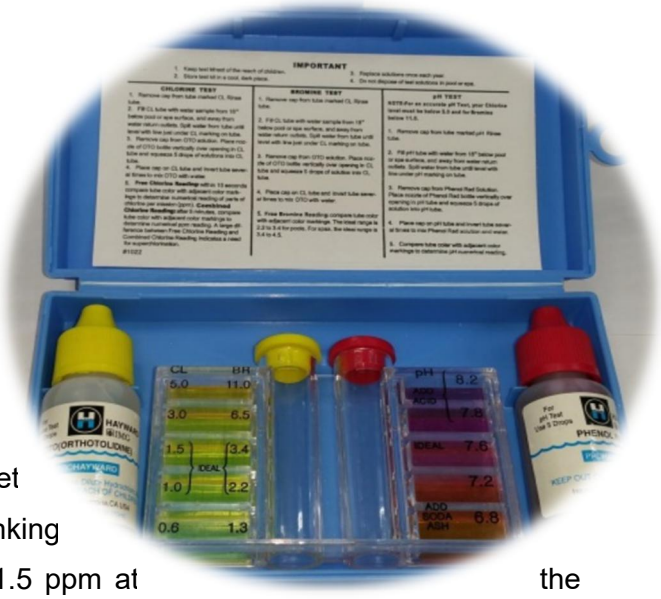
1. *Available Chlorine Content* – is amount of chlorine in a chlorine compound, which determines its potential disinfecting power.
2. *Chlorine Demand* – is the total amount of chlorine needed to oxidize all the materials in the water that react with chlorine within a given period. After all the reactions within that period are completed, the pathogens and undesirable organic substances, as well as the soluble iron, manganese and hydrogen sulfides are deemed to have been destroyed, neutralized, or eliminated. Chlorine demand is the difference between the amount of chlorine added to water and the amount of residual (remaining) chlorine at the end of a specific contact period. If no residual chlorine is detected, it means that the chlorine demand was so great it exhausted the chlorine; thus the chlorine infused into the water (dosage) was insufficient.
3. *Chlorine Residual* - the total amount of chlorine (combined and free available chlorine) remaining in water at the end of a specific contact period following the infusion of chlorine. The chlorine residual is an important indicator of safe water because as long as the residual chlorine is present in the water disinfection is continuing process.
4. *Dosage of Chlorine* – the quantity of chlorine applied to a specific quantity of water. Dosage is expressed in milligrams per liter (mg/l) of chlorine.
5. *Dosage Rate* – is the amount of chlorine applied per unit time. It is usually in grams/day or kg/day.
6. *Super chlorination* –this means applying the chlorine at very higher than the usual dosages. If a system design or requirements do not allow adequate contact time for the normal dosages of chlorine to eliminate the pathogens and undesirable substances in the water, super chlorination could be resorted to. Super chlorination provides a chlorine residual of 3.0-5.0 mg/l, which is 10 times the recommended minimum breakpoint chlorine concentration. (Breakpoint chlorination uses the continual addition of chlorine to the water to the point where chlorine demand is met and all ammonia is oxidized, so that only free chlorine remains) Retention time for super chlorination is approximately 5 minutes.
7. *Dechlorination* – removes excessive levels of chlorine from the water. Dechlorination is considered necessary phase after super chlorination in order to remove the odor, taste and the other objectionable traces of excess chlorine in the water. Dechlorination commonly involves the use of an activated carbon filter.

8. *Shock Chlorination* (dosage of 200 mg/l for 3-4 hours) is recommended whenever a well, reservoir or pipeline is new, repaired, or found to be contaminated. This treatment introduces high levels of chlorine to the water. Unlike super chlorination, shock chlorination is one time only occurrence, and chlorine is depleted as water flows or is flushed through the system.

5. Chlorine Dosages

The commonly used dosages for various disinfection requirements are as follows:

1. For disinfection of water supplies:
    - Dosage: 0.5 – 2.0 mg/l
    - Contact Time: 24-30 minutes
2. For disinfection of newly constructed/ repaired wells, storage tanks, pipelines:
    - Dosage: 50 mg/l
    - Contact Time: 24 hours or



6. Measuring Chlorine Residual

CWD checks and maintains chlorine residuals throughout its water system to ensure that any microorganism entering the system through cross connection will be killed automatically. The water district maintains chlorine residuals set in the Philippine National Standards of Drinking Water (PNSDW) with values ranging from 1.5 ppm at the pump station to 0.3 ppm at critical points in the distribution system such as but not limited to dead-end. As part of the routine water quality maintenance procedures, the CWD takes readings of chlorine residuals at different distribution points using the Comparator Test Kit.

Measuring Chlorine Residual using Comparator Test Kit

1. Fill a viewing tube with 5 ml sample water and place this tube in the top left opening of the comparator;
2. Fill a second viewing tube with 5 ml sample water;
3. Add 5 drops of the Orthotolidine Solution (yellow cover) to the yellow test tube;
4. Place the tube to the comparator, and hold up to a light source (sky, window or lamp);
5. Compare the color of the water to the provided test points (the comparison must be done one within one minute after adding the solution)
6. If the result is above or below the set (as per DOH Administrative Order No. 2017-0010), it is needed to lessen or add Chlorine to the water.

7. Water Quality

One of the standards established by Local Water Utilities Administration (LWUA) for compliance by Local Water Districts, pursuant to Section 62 of PD 198, as amended, is the regular monitoring of the water quality in terms of bacteriological, chemical and physical parameters including uniform testing procedures and submission of water analysis result. It is mandatory for this water to meet at least the minimum standards specified by the PNSDW. The CWD is doing the best to perform the regular monitoring to maintain water quality conforming to standards.

a. Bacteriological Water Analysis

It is a method of analyzing water to estimate the numbers of bacteria present and, if needed, to find out what sort of bacteria they are.

Water samples from various water sources are examined in the laboratory facilities of Metro Tuguegarao Water District (MTWD) or Ilocos Norte Water District (INWD). When a sample test positive for coli forms, immediately a re-sampling is done and, without waiting for the results, take the actions needed to determine the possible source of contamination in order to eliminate the cause.

Sampling points include the pumping stations, reservoir and concessionaires taps. Sampling is done based on the population served by the District:

Population Served	Minimum Frequency of Sampling for Total Coliform and Thermotolerant Coliform/ E. coli	Minimum Frequency of Sampling for Heterotrophic Plate Count
Less than 5,000	2 samples monthly	2 samples monthly
5,000 – 100,000	1 sample per 5, 000 population +2 additional samples monthly	1 sample per 5, 000 population +2 additional samples monthly
More than 100, 000	1 sample per 100, 000 population + 12 additional samples monthly	Required at least 40% of the sampling points

Methods of Detection and Standard Values Being Observed

Parameters	Method of Determination	PNSDW Limit
Total Coliform	Multiple Tube Fermentation Technique	<1.1 mpn / 100mL
Fecal Coliform	Multiple Tube Fermentation Technique	<1.1 mpn / 100mL

Heterotrophic Plate Count	Pour Plate Method	<500 CFU/ mL

Water Sample Collection for Bacteriological Test

1. The sampling bottle should be kept unopened until the moment it is filled. Care must be exercised to take samples that will we representative of the water being used and tested and to avoid contamination of the sample at the time of collection and in the period before examination;
2. Flame the tap for 2 to 3 months;
3. Open the tap fully allow the water to run to waste for 2 to 3 minutes;
4. Restrict the flow from the tap to one that will permit filling the bottle without splashing;
5. Hold the bottle near the base, remove the cover and head as a unit, taking care to avoid soiling;
6. Do not rinse the bottle. Fill it just below the neck to provide ample air space for mixing purposes;
7. Replace the cap immediately and secure the hood around the neck of the bottle;
8. Submit the water sample immediately after collection to MTWD or INWD within six (6) hours accompanied by complete and accurate identifying and descriptive data.
9. The use of iced coolers for storage of water samples during transport to laboratory is must. The bottles with water sample for testing should not have a direct contact to the water of the storage box.

b. *Physical and Chemical Quality Analysis*

The Physical and Chemical Analysis is administered annually by the Platinum Research Laboratory Inc. Although water samples shows presence of manganese, iron and problems in color, odor and turbidity, it is still within the permissible limits by the PNSDW.

The required water to be analysed is one (1) liter in every pump station. Sample containers must be carefully cleaned to remove all extraneous surface dirt, thoroughly rinsed with distilled water and drained before use. Date and Time of Sampling, Source of Sample and Name of collector must be provided in the container.

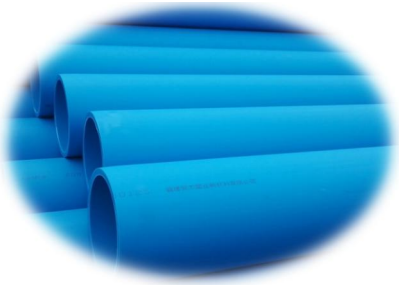
D. Distribution System

The purpose of distribution system is to deliver water to consumer with appropriate quality, quantity and pressure. Distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage. The distribution system is directed at the following general objectives:

- To ensure adequate pressure in the system 24/7
- To minimize Non-Revenue Water (NRW);

- To ensure that the delivered water is potable

The Distribution System consists of four (4) components, whose operation and maintenance are based on their unique characteristics as well as their function and contribution to the total system. They are:



a. Distribution Pipelines

- A water pipe is any pipe or tube designed to transport treated drinking water to consumers. The varieties include large diameter main pipes, which supply entire towns, smaller branch lines that supply a street or group of buildings, or small diameter pipes located within individual buildings.

The distribution pipeline of CWD has about 17.417km of piping with pipe diameters ranging 50mm to 200mm. The pipe materials are Cast Iron (CI) and Unplastic Poly Vinyl Chloride (uPVC) pipe class 100 and High Density Poly Ethylene (HDPE) SDR 11.

Water Distribution Lines per Kilometer per Pipe Diameter Size

Pipe Diameter	Pipe Material	Length
50mm	uPVC Pipe	8.231 km
75mm	uPVC Pipe	4.944 km
100mm	uPVC Pipe	1.519 km
150mm	uPVC Pipe	1.548 km
200mm	Steel Coated	1.175 KM

Transmission and Distribution Lines Leak Repair

1. Verify and inspect the service request received from the commercial division its truthfulness and its condition.
2. Prepare the necessary tools or equipment needed to address the repair.
3. If the site condition is a concrete road/sidewalk, prepare the concrete saw for square holing, jackhammer with compressor for concrete breaking and dewatering pump for water draining; if it is an ordinary soil use common excavation tools.
4. Inform the public before closing the gate valves of the affected area. Provide necessary early warning device to avoid accident.
5. In the excavation process, it needs care to avoid damage in the pipeline and continuous dewatering to avoid intrusion of contaminants inside the pipeline.
6. After repair work is done, open gate valves and proceed to flushing activity to the nearest flushing point until the water clears.

7. Upon build-up of pressure in the system, observe the repaired portion of the pipeline if there is a leak. If none, restore the affected area to its original condition. In backfilling, use other backfill materials if necessary and always compact layer by layer about 20 cm thick.
8. Fix the warning devices before leaving the area.

Operation and Maintenance of Distribution System (Fire Hydrant, Blow-Off Assembly, Pipelines and Valves)

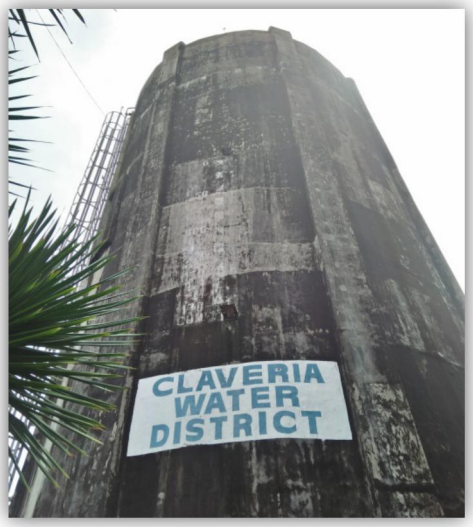
1. Only designated personnel (Pump Operators) and BFP (Bureau of Fire Protection) are authorized for the usage of fire hydrants and blow-off points during flushing activities and fire events, respectively.
2. Limit or suspend all flushing activities during low water pressure situations, especially during power outages and interruptions.
3. Conduct flushing activities right after the commercial power resumes eliminating effects or varying water pressure.
4. Strictly follow all regulars flushing intervals and schedules for every area.
5. Do not leave valve fully open or fully close, but back of 1 ½ turns.
6. Clean valve box and clear hydrant surroundings.
7. Inspect operability of air release valves, special valves.
8. All exposed pipes and mechanical fittings should be inspected for deterioration due to corrosion or rusting.
9. Replace all malfunction/leaking valves and repaint all exposed pipes and fittings to weather once a year to avoid rusting.

Fire Fighting Facilities

Hydrant Type	Number	Location	Status
Angle Hydrant-150mm	3	Centro 2, Centro 4	Operational
Angle Hydrant-100mm	8	Centro 1, Centro 2, Centro 3, Centro 4, Centro 5, Centro 6, Centro 7, Centro 8	Operational

b. Storage Tank or Reservoir

Water for distribution is pumped from the water source to the system's water tank or reservoir, from which it is delivered to the consumers through the pipelines. The reservoir is designed, based on the requirements of the system, to distribute the water by pumping.



Operation and Maintenance of Elevated Water Reservoir

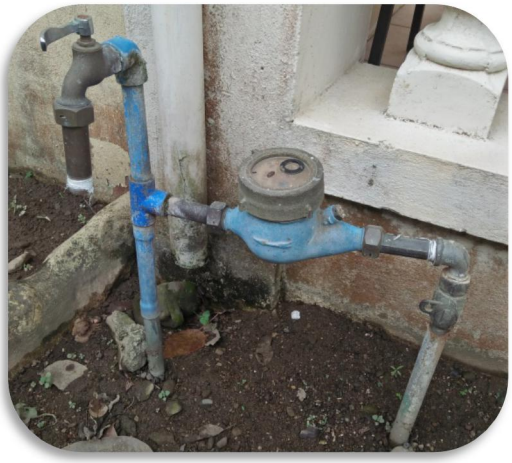
1. Ensure security of the utility entry point and opening of reservoir.
2. Daily checking of water level of reservoirs.
3. Weekly collection of raw and treated water samples for presence/absence of coliforms and chlorine residual analysis.
4. Observe for crack/leaks and implement repair the soonest
5. Strictly implement periodic cleaning and maintenance of reservoir inner chamber as per schedule.
6. Keep reservoir roof ladders free of dirt, debris or grease to prevent slipping contamination.
7. Never enter a closed reservoir alone without someone standing by to help you in trouble.
8. Complete cleaning and disinfection are recommended.

Cleaning of Reservoir

The quality of water coming from the reservoir must be maintained within the standards for potable water. To ensure the quality of water supply, the reservoir of the District is annually cleaned and disinfected to avoid accumulation of solids and proliferation of bacteria in the tank, making unsafe for drinking.

1. Scheduling of date of Cleaning. Coordination with the CAGELCO II regarding their schedules of power interruption to avoid same day of service interruption, communicating to schools and cooperatives if they had programs and activities in the tentative dates of cleaning.
2. Preparation of water service interruption advisory, and distribution of notices, posting at the District's Website (claveriacagayanwaterdistrict.gov.ph), Facebook Page (https://www.facebook.com/Claveria-Water-District-Cagayan-Valley-Region-02), and airing at Claveria Radio Station, and TV (via Agri-based Cable TV).
3. Preparation of materials to be used.
4. Hiring of laborers to do the cleaning.
5. Stoppage of pumping operations and draining the reservoir.
6. The cleaning proper.
7. Filling up of the tank then flushing twice to wash the cleaned reservoir.
8. Flushing of distribution end points.
9. Back to normal operation.

c. Service Connections

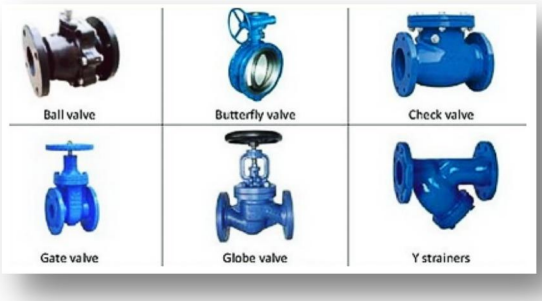


A pipeline or lateral tap at the Water District mains leading to an individual household with provisions of water meter, outlet valve and meter stand. The systematic inspection and replacement of consumption meters is an important aspect of routine maintenance. Representative pothole checking of service connections within 5 years of service (avoid leaks due to deterioration) should also be done. The water service connection is a small water pipe connecting the distribution water main to residential, commercial or industrial buildings. The District takes responsibility of leakages from the main lines up to the water meter while concessionaires is from the "after the meter" up to inside of his house.

Operation and Maintenance of Service Connections and Meters

1.	Follow established installation procedure for new connection
2.	All service connection pipes should be embedded to prevent potential damage due to exposure
3.	Repair of all service connections leaks should be accomplished immediately to minimize NRW (Non-Revenue Water) and increase Water System Pressure
4.	Maintain accuracy of all water meters by regular maintenance and periodic cleaning
5.	Replacement of water meters should be done every five years

d. Valves and Other Appurtenances

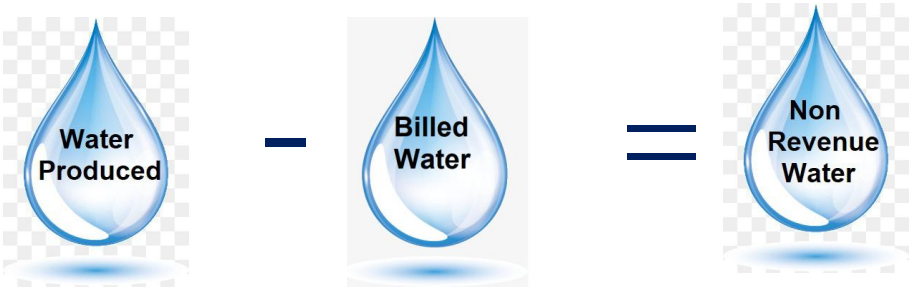


Valves and faucets are flow control devices in the water distribution system. Their useful life depends to a large extent on the manner they are operated and maintained. Valves are used in water supply systems to start and stop flow, to throttle or control the quantity of water, to regulate pressures within the system, and to prevent backflow.

Gate Valves with different sizes are installed the different barangays served by the District:

Barangay	Size	Quantity	Barangay	Size	Quantity
Centro 1	2”	2	Centro 7	3”	1
	3”	4		4”	2
	4”	2		6”	1
Centro 2	2”	1	Sta. Maria	2”	1
	3”	1		4”	1
Centro 3	2”	1	Taggat Sur	2”	3
	3”	1		3”	1
Centro 4	2”	1	Taggat Norte	2”	2
	3”	2	Centro 8	2”	1
	4”	1	Centro 6	2”	1

e. *Reducing Non-Revenue Water*



Non-Revenue Water (NRW) is water that has been produced but does not result in revenue for the District. NRW is a result of leaks and wastage, meter inaccuracies an sometimes theft. NRW is typically measured as the volume of water “lost” as a share of net water produced.

NRW can be analyzed on whether they are physical or actual losses due to commercial policies or deficiencies:

a. Physical Losses

- Leaks/ Breaks
- Illegal Connections
- Water Usage by the District (Flushing, etc.)

b. Commercial Losses

- Non-metered connections
- Under-registration of meters
- Poor collection performance

Performance audit to water meters being used by customers to ensure accuracy is being done; defective water meters are immediately attended to

minimize revenue losses; and distribution Pipes/Lines are being monitored. These routines are conducted periodically to maintain and even decrease the percentage of the Non-Revenue Water.

The percentage of NRW can be determined by the formula:

$$NRW\ (\%) = \left[\frac{Production\ (m^3) - Billed\ Consumption\ (m^3)}{Production\ (m^3)} \right] x\ 100$$

FABRICATION SHOP

The CWD has different kinds of Maintenance equipment which usually they fabricate it in our store room which is under our reservoir tanks. List of maintenance equipment to wit:

Hand Tools
Welding Machine
Air Compressor
Battery Charger
Portable Grinder
Electric Grill

The Agency acquired different units of equipment generator sets and 1 motor service vehicle that are used for the operation of the district, to wit;

TMX Single Motor
40 KVA Generator Set: Isuzu (4JB1)
25KVA Generator Set: Denyo
Portable Generator Set
Submersible Pump Motor
Portable Motor Pump