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Planning of Clean Water Distribution System to the Needs of the Community with the Utilization of Water Sources of Artesic Water Sources, Way Hula Hamlet, Liang Village, Salahutu District

Edison Hukom, Rudi Serang

Ambon State Polytechnic, Indonesia

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***Keywords*— Discharge, Distribution and Demand for Clean Water**

***Abstract*— *The need for clean water is one of the necessities that cannot be separated from the life of living things on earth, especially humans, animals and plants. In general, clean water is an important component for the life processes of creatures on earth. Water is one of the village needs for living creatures which is very vital, which if managed properly will bring many benefits to living things. With regard to the results of research, surveys, interviews and observations with both village officials and local communities, the source of the spring has not been utilized because there is no piping network and reservoir tank in the construction process so that it is used daily for washing cars, washing clothes and people using buckets / buckets. gene to take water for daily needs in Way Hula Hamlet. The author aims to determine the availability of clean water discharge that enters the reservoir and is distributed to the community, the diameter of the pipe and the distribution system that will be used for the next 5 years projection for the people of Way Hula Hamlet, Liang Village. Then a research study was carried out through the analysis stage, the results obtained were that the water discharge entering the reservoir was 0.26 m3/second and channeled to the public faucets of the Way Hula Hamlet 0.015 m3/second, the diameter of the galvanized pipe according to the planning and calculations is a galvanized pipe diameter 6 inches is used from the well/source to the reservoir, galvanized pipes with a diameter of 2 inches, 1 inch and 1/2 inch are used from the reservoir to the public faucet for the clean water needs of Way Hula Hamlet for the next 5 years from 2020 to 2025 of 0.01m3/ seconds can be met.*

I. INTRODUCTION

The need for clean water is one of the necessities that cannot be separated from the life of living things on earth, especially humans, animals and plants. In general, clean water is an important component for the life processes of creatures on earth. Another definition of clean water is water that is used for daily needs. The physical requirements that must be met for drinking water are that it must be clear, odorless, tasteless and colorless from the development of public interest in the need for clean water in Way Hula Hamlet, Liang Village, Salahutu District, with available artesian eye sources.

In accordance with the results of research, surveys, interviews and observations both with village officials and local communities, what the authors did was that the springs had not been utilized because there was no piping network and reservoir tanks in the construction process so that they were used daily for washing cars, washing clothes and the community. using buckets or genes to fetch water for daily needs. In Way Hula Hamlet and Tanjung Dusun headed by a Hamlet Head, the population of Way Hula Hamlet in 2019 = 337 people or 65 family heads (KK) with an elevation of 79 m above sea level. Based on the above background, the authors took the research with the title "Planning a clean water distribution system for the needs of the community by utilizing Artesian Water Sources, Way Hula Hamlet, Liang Village, Salahutu District.

II. LITERATURE REVIEW

2.1. Definition of Clean Water

Clean water is one type of water-based resource of good quality and can be used by humans for consumption or in carrying out their daily activities including sanitation. For drinking water consumption according to the Ministry of Health, the requirements for drinking water are tasteless, odorless, colorless, and does not contain heavy metals. Although water from natural sources can be drunk by humans, there is a risk that this water has been contaminated by bacteria (eg *Escherichia coli*) or harmful substances. Although bacteria can be killed by boiling water to 100 °C, many harmful substances, especially metals, cannot be removed this way. There are several sources of clean water that are commonly used , including rivers. Rivers average more than 40,000 cubic kilometers of fresh water obtained from rivers in the world. Because of the importance of the need for clean water, it is only natural that the clean water sector should receive the main priority for handling because it involves the lives of many people.

Law No. 5 of 1962 is closely related to Law No. 7 of 2004 concerning Water Resources. In this case, the discussion is more focused on the clean water pipe distribution system. An extensive distribution system is needed to deliver water to each customer with the required amount of pressure. Distribution systems are often the main investment in a city 's water network . A distribution system such as a tree with many dead end points is not good, because water can stop at the ends of the system .. A single pipe system is a system with one pipe serving both sides of a road. A double pipe system has a on each side of the road. The main advantage of this two-pipe system is that repairs can be carried out without disturbing traffic and without damaging the road cover. In the planning of a water pipe distribution network system pressure requirements must be considered.

The planning of a clean water distribution network system requires a detailed map of the city in question, which includes contour lines (or all determining elevations) as well as existing and future roads and plots. After examining the topographical conditions and determining the source of clean water for distribution, the city can be divided into areas, each of which must be served by a separate distribution system. The pipelines must be large enough to carry the estimated demand with adequate pressure. The effect of flow in the auxiliary pipes is initially ignored, but can be calculated later. The flow in the pipeline network is analyzed to meet the needs in different areas. In selecting the pipelines, future capacity requirements must be considered.

2.2. Service Area Division

The aims and objectives of the division of service areas are to:

1. Facilitate the determination of the magnitude of the load in the water demand service network system.
2. Simplify the calculation of clean water needs, both for domestic and non-domestic needs.

Things that need to be considered in the distribution of clean water service blocks are:

a. Population density
b. Service area boundaries
c. Present and future land use.

2.3. Artesian Well

An artesian well is one way to get groundwater from compressed groundwater. As a result of this pressure, if the pressure from the inside exceeds the amount of outside air pressure, the water from within cannot reach the ground surface. Water resources are one of the most important resources for human life in carrying out various activities, including development activities. The increasing population and development activities have resulted in an increase in the need for water resources. On the other hand, the availability of water resources is increasingly limited, even in some places it can be said to be in critical condition. This is caused by various factors such as pollution, deforestation, agricultural activities that ignore environmental sustainability, and changes in the function of water catchment areas. There are various types of water resources that are generally used by the community, such as rainwater, ground water, and surface water. Of these types of water, so far surface water is the largest source of fresh water used by the community.

2.4. Surface water

Surface water is water that is on the ground surface and can be easily seen by our eyes, is a container of water

found on the earth's surface. Surface water can be divided into two types , namely:
is in critical condition. This is caused by various factors such as pollution, deforestation, agricultural activities that ignore environmental sustainability, and changes in the function of water catchment areas. There are various types of water resources that are generally used by the community, such as rainwater, ground water, and surface water. Of these types of water, so far surface water is the largest source of fresh water used by the community.

For this reason, surface water which is generally found in rivers, Surface water is water that is on the ground surface and can be easily seen by our eyes, is a container of water found on the earth's surface. Surface water can be divided into two types , namely:
First, inland waters; Land waters are surface water that is above land, for example, such as lakes, rivers, and so on
Second, a lake is a large basin on the earth's surface which is surrounded by land and is inundated with fresh or salt water.

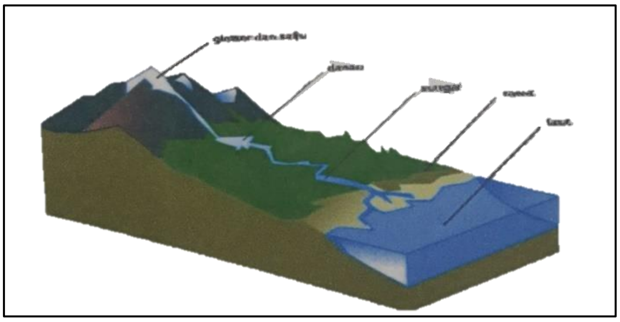

Fig.1: Surface Flow Schematic

2.5. Artesian Groundwater

Artesian groundwater or deep groundwater is located very deep in the soil and is between two impermeable layers. The layer between the two impermeable layers is called the aquifer layer. This layer holds a lot of water. If the waterproofing layer is cracked, water will naturally escape to the surface. Water gushing to the surface is called an artesian spring. Artesian water can be obtained through drilling. Drilling wells are called artesian wells **.**

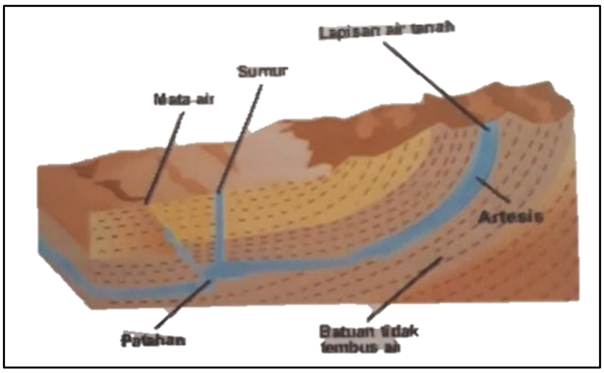

Fig.2: Groundwater Schematic (Deep-Shallow)

2.6. Clean Water System

a) Clean Water Quality

Because the use of drinking water is very wide in all human life and activities, a water supply for a community must:

- Safe in terms of hygiene.
- Available in sufficient quantities.
- Quite cheap or economical.

Given the existence of such a requirement, basically two aspects are important to be considered and must be fulfilled by a drinking water supply , namely:

- In terms of Quality
  Fulfillment of quality requirements so that it can be used safely without worrying about being infected by disease germs.
- Quantity
  Availability in sufficient quantities and can be used at any time. To ensure that clean water is hygienically safe and can be drunk without the possibility of being infected for drinking water users, certain quality requirements must be met. Clean water, apart from being free from health hazardous substances, must also be attractive in taste and smell.

b) Clean Water Quantity

Provision of sufficient quantities for other needs or activities does not only mean meeting the demand and need for water itself, but further than that, it will support the possibility of people living in a healthy manner, the amount of water needed by the community depends on:

1. Water Usage

The use of water starts from the amount of water used from the existing system regardless of the circumstances. Water use can vary from one community to another due to factors including: Depending on the level of life, education, economic level of the community.

2. Water Needs

Demand is the amount of water that is needed reasonably for basic human needs and other activities that require water.

3. Factors affecting water use
   Social and economic factors, including:
   - Population
   - Size of the city/village
   - Climate
   - Life level
   - Education
4. Population _

The level of water demand in a building depends on the number of different people in the building and the level of use / consumption of clean water per person per day, for domestic purposes. Table 1 below shows the average water usage per person per day.

2.7. Domestic Needs

Represents the need for clean water for households and public faucet connections. The number of needs is based on the number of residents, the percentage given water and the way the water is distributed, namely by house connections or through public faucets. The number of house connections is calculated from the number of new customers, which is 5 people per connection, while the number of faucets is generally based on 100 general taps. The water requirement per person per day is adjusted to the standards commonly used and the service criteria are based on the city category. It includes different categories of water needs per person per day.

Table . 1 : Standard of Clean Water Needs

CATEGORY CITY	CLEAN WATER NEED (LITERS/PERSON/DAY)
METROPOLIS	190
BIG CITY	170
MEDIUM CITY	150
SMALL TOWN	150
VILLAGE	60

Source: Husein .SK Mater and Sanitari Engineering 1978

2.8. Non-domestic needs

Non-domestic needs are the need for clean water other than for household purposes and for connecting public faucets, such as providing clean water for offices, trade and social facilities such as places of worship, schools, hotels, health centers, military and other public services . abel 2 following :

Table .2: non-domestic needs according to international standards

Category		Debit
General	Mosque	25-40 liters/person/day
	church	5-15 liters/person/day
	Terminal	25-40 liters/person/day
	School	15-30 liters/person/day
	Hospital	220-300 liters/person/day
	Office	25-40 liters/person/day
Commercial	Cinema	10-15 liters/person/day
	Hotel	80-120 liters/person/day
	Restaurant	65-95 liters/person/day
	Market/store	5-10 liters/person/day
Industry	farm	10-35 liters/person/day
	Industry	40-400 liters/person/day

Source : Raswari, Plumbing System Planning and Maintenance

2.9. Population Calculation

The thing that is very decisive in planning a clean water supply system is knowing the number of people who will be served for the present and in the future according to the planning grace period, it needs to be determined, considering that for a certain period of time the needs will change due to population growth and regional development so that the distribution network system will change, the method of estimating population growth can be calculated by Calculation with the Geometric method

1. Calculation with Geometric method

This method is based on the assumption that population development will experience growth by itself. This has a relationship with the analogue of multiple interest, therefore the formula used is the double interest formula ,

Calculation of the population by geometrically using the formula:

$P_n = P_0 (1 + Ig)^n$ 2.1

Where :

P_n = Total population calculated after n years from the base year

P_0 = Current population

Ig = Percentage of population growth every year

This method is suitable for calculating population growth in developing areas.

2.10. Clean Water Needs

Water demand can be defined as the amount of water needed for household, industrial, urban management and others. Priority for water needs includes water needs including domestic water needs, water needs to replace leaks. The need for clean water differs from one city to another . The factors that affect the use of clean water are:

1. Climate

In hot areas the average water consumption per person will be more than in cold areas.

2. Population Characteristics

The high and low standard of living of the population and the habits of daily living also greatly affect the use of water.

3. Industrial Presence

The existence of industry can affect the amount of water demand per capita of a city .

4. Water quality

The better the water quality, the more its use will increase and vice versa. Water that is not of good quality will cause people's reluctance to use it so that the average usage per person per day will also decrease.

5. Water Price

The higher the price of water, the more people use it sparingly, so that the average consumption per person per day will also decrease, although in general this is not too big of an impact. To project the amount of clean water needs, it can be done based on the estimated water demand for various purposes plus the estimated water loss. The water needs for various purposes can generally be divided into:

a. Domestic needs
 - home connection
 - common faucet connection
b. Non-domestic needs
 - Social facilities (mosque, orphanage, hospital and so on)
 - Trading/industry facilities
 - Office facilities and others

While water loss can be caused by two things, namely:

- Loss of water due to technical factors, for example leakage from distribution pipes
- Loss of water due to non-technical factors, including unregistered connections. water meter malfunction, for fire and others

Table . 3 : Clean water consumption per capita according to international standards

Total population (liters/person/day)	**home connection (liters/person/day)**	**Common faucet/public hydrant (liters/person/day)**
Over 1 million	190	30
500,000 – 1,000,000	170	30
1,000,000 - 500,000	150	30
20,000 – 100,000	130	30
Under 20,000	100 – 130	30

Source: Husein SK Mater and Sanitari Engineering 1978

Water use for households is set at 135 liters/person/day. Details of water use for households can be seen in the following table:

Table . 4 : Details of water use for households

Utility	**Liters/person/day**
Bath	55
Wash clothes	20
Glontor WC	30
House cleaner	10
Sink	10
Cook	5
Drink	5
Amount	135

Source: Husein SK Mater and Sanitari Engineering 1978

Water loss is the amount of water lost. The loss needed for maintaining the purpose of providing clean water, namely the sufficiency of its quality, quantity, and continuity and caused by water use and treatment activities. This loss is determined by multiplying a certain factor (15-20%) by the total water production.

Water loss can be divided into 3 categories , namely:

a. Loss of planned water (*unacounted for water*)

 The planned water loss is specifically allocated for smooth operation and

 maintenance , facility component imperfection factors and other planned costs.

b. *Incidental* water loss

 The use of water that is incidental in nature, for example the use of water that is not specifically allocated, such as firefighting.

c. Administrative water loss

 Administrative water loss can be caused by:

 - Meter recording error
 - Loss of water due to illegal connection
 - Loss due to leakage and illegal theft

Planning for safe clean water needs usually takes into account conditions at the time of maximum demand (peak). For the safety of planning transmission lines and treatment plants, peak days are used, while for reservoir and distribution design safety, peak hours are used.

2.10.1 Fluctuations in water demand

Water requirements are not always the same at all times but will fluctuate. The fluctuations that occur depend on an activity in the daily use of water by the community.

1. In general, water needs are divided into three groups Average demand
2. Maximum daily requirement
3. Needs at peak hours

Maximum daily demand and peak hours are very necessary in calculating the amount of raw water demand , because this involves the demand on certain days and at peak hours of service. So it is important to consider a coefficient value for this purpose. Maximum daily water requirements and peak hours are calculated based on basic needs and leakage vsalues with the following approach:

1. Maximum daily requirement = 1.15 x Average water requirement
2. Need at peak hour = 1.56 x Maximum daily requirement

2.10.2 Water sources

The source of raw water for a clean water supply is very important, because in addition to quantity, it must also be sufficient in terms of quality, it will affect the processing process. Besides, the location of the water source can affect the shape of the transmission network, distribution and so on. In general, water sources can be categorized as follows:

1. RainwaterWater
   Rain is water vapor that has condensed, then falls to the earth in the form of water
2. Surface water
   Surface water can come from rivers, lakes and groundwater that flows out of the earth (springs).
3. Groundwater
   Groundwater is rainwater or surface water that seeps into the soil and joins in the pores of the soil found in the soil layer which is usually called an aquifer. In determining the source of raw water for a clean water supply system, certain considerations are needed, so that the selected raw water in addition to meeting the quantity and quality requirements is also easier to obtain, both from a technical and economic point of view.

2.11. Distribution System and Water Supply System

2.11.1. Clean Water Distribution System

The distribution system is a system that is directly related to consumers, which has the main function of distributing water that has met the requirements throughout the service area. This system includes elements of the piping system and its equipment, fire hydrants, available pressure, pumping system (if needed), and distribution reservoir. . The drinking water distribution system consists of pipes, valves, and pumps that carry treated water from the treatment plant to residential, office and industrial areas that consume water. Also included in this system are treated water storage facilities (distribution reservoirs), which are used when the water demand is greater than the installation supply, water meters to determine the amount of water used, and fire taps. Two important things that must be considered in the distribution system are the availability of an adequate amount of water and sufficient pressure (continuity of service), as well as maintaining the security of water quality coming from the treatment plant. The main task of the clean water distribution system is to deliver clean water to the customers to be served, while taking into account the factors of quality, quantity and water pressure in accordance with the initial planning. The factor coveted by customers is the availability of water at all times. The water supply through the main pipe has two types of systems:

a. Continuous system

In this system, drinking water supplied to consumers flows continuously for 24 hours. The advantage of this system is that consumers can get clean water at any time from the distribution pipe network at any pipe position. The disadvantage is that the use of water will tend to be more wasteful and if there is only a slight leak, then the amount of water lost will be very large.

b. intermittent system

In this system clean water is supplied 2-4 hours in the morning and 2-4 hours in the afternoon. The disadvantage is that water customers cannot get water all the time and need to provide a water storage area and if a leak occurs, water for *fire fighters* will be difficult to obtain. The dimensions of the pipes used will be larger because the water needs for 24 hours is only supplied in a few hours. The advantage is that water waste can be avoided and this system is also suitable for areas with limited water sources.

2.11.2. Clean Water Dispensing System

To distribute drinking water to consumers with sufficient quantity, quality and pressure requires a good piping system, reservoir, pump and other equipment. The method of water distribution depends on the topography of the water source and the position of the consumers. The flow system used is the Gravity Method. The gravity flow method is used if the elevation of the water source has a large enough difference with the elevation of the service area, so that the required pressure can be maintained. This method is considered quite economical, because it only takes advantage of the difference in altitude of the location.

2.12. Flow Hydraulics in Piping

2.12.1. Pressure Pipe

A pressure pipe is a pipe that flows full. This kind of pipe is often less expensive than an open line or gutter, because it generally takes a shorter path. When scarce water is obtained, pressure pipes can be used to avoid water loss from seepage that occurs in open channels. Pressurized pipes are preferred for drinking water supply services, because there is less chance of contamination. Because water engineers are almost exclusively dealing with turbulent flow problems in pipes.

2.12.2. Fluid Flow Rate and Capacity

Determination of velocity at a number of points on a cross section allows to assist in determining the amount of flow capacity so that velocity measurement is a very important phase in analyzing a fluid flow. Velocity can be obtained by measuring the time it takes a recognized particle to move along a predetermined distance. determined. The magnitude of the fluid flow velocity in a pipe approaches zero at the wall and reaches a maximum at the center of the pipe. The velocity is usually sufficient to place minor errors in fluid flow problems so that the actual velocity is used in the flow section. The velocity form used in fluid flow generally indicates

speed if no other details are mentioned.

The amount of velocity will affect the amount of fluid flowing in a pipe. The amount of flow may be expressed as the volume , weight or mass of the fluid with each flow rate shown as the volume flow rate (m3/s). weight flow rate (N/s) and mass flow rate (kg/s). The flow capacity (Q) for an incompressible fluid is:

$Q = AV$ ……………………………………………..... 2.2

Where Q = Volume flow rate (m3/s)

A = cross-sectional area of flow (m2)

V = fluid flow velocity (m/s)

2.12.3. Laminar and Turbulent Flow

The fluid flow that flows in the pipe can be classified into two types of flow, namely "laminar" and "turbulent". The flow is said to be laminar if the moving fluid particles follow a straight line parallel to the pipe and move with the same velocity . The flow is said to be turbulent if each fluid particle moves along an arbitrary path along the pipe and only the average movement follows the pipe axis. From the experimental results it is found that friction for a cylindrical pipe is a function of Reynolds number (Re). When closed, it is very important to know the type of flow that flows in the pipe the flow will be laminar if the Reynolds number is less than 2100 and will be turbulent if the Reynolds number is greater than 3000. If the Reynolds number lies between 2100-3000 then the flow is called transitional flow.

2.12.4. Loss of compressive height

Headloss or pressure loss due to friction between the liquid and the pipe wall is calculated using the Darcy-Weisbach or Hazen William formula. A pressure pipe is a pipe that is flowing with water in a full state, a pressurized pipe can be used to avoid loss of brush water seepage and evaporation that occurs in the channel. Open pressure pipes are preferred for drinking water services, because there are fewer possibilities. In each pipe network there are 2 conditions that must be met:

1. The algebraic sum of the pressure drops around each closed loop must be equal to 0.
2. The flow entering a meeting point must be equal to the flow leaving that point.

The first condition states that there must be no unsustainable pressure, meaning that the pressure drop on any path between 2 (two) meeting points must be the same . The second condition is a statement about the law of continuity. The pipeline problem is solved by successive approximation methods, because each analysis solution will require the use of multiple equations at once, some of which are non-linear. A procedure suggested by Hardy Cross *(Analysis of flow in Networks of conduits orConductors)* requires that the flow in each pipe be considered such that the principle of continuity is satisfied at each node. A correction to the magnitude of the reliable flow must be calculated. successively for each pipe rotation in the network concerned, so that the correction is reduced to an acceptable magnitude. Water is distributed to consumers in several ways , depending on local conditions or certain considerations, these methods include:

1. Gravity system
2. Pump system with sump
3. Pump system without sump

The distribution system in the pipeline includes :

1. The distribution system is a tree or closed end system *(tree or deadend system)*

2. Circle or ring system
3. *Iron grid system*
4. Radial system

2.12.5. Calculating Debit Distribution

It is assumed that the pipe characteristics in the flow entering and leaving the pipeline network are known and will be calculated in each element of the network. If the pressure on the entire network is also calculated, the pressure height at a point must also be known. In the network layout, not all of them meet the requirements for analysis using the Hardy-Cross method, so there are several networks that are categorized by the equation continuity . For this reason, the network calculation is divided into several segments with the calculation method adjusted to the type of network.

Often a pipe system connects three points. The flow of each pipe connecting three points will be sought. That is if the length, diameter, type of pipe set up, density and viscosity of the liquid are known. The pipe flow discharge is determined by the friction coefficient of each pipe, the continuity equation at the branch point, namely the flow to other branch points can be done with the continuity equation as follows:

Q1 = Q2 + Q3 ………………………….................... 2.3

Q = Water discharge (m3/s)

2.13. Calculation of Debir A liran

1. Determining the Gravity Transmission System

The transmission system is a system consisting of a long pipe that carries water from a reservoir or reservoir to a distribution network at the location of the consumer. The equations used for the gravity transmission system are: $h_o = Z_0 - Z_1$ ………………… …………………….......... 2.4

$Q = -0{,}956.\,D^2 \left[\frac{g.D.hf}{L}\right] \ln\left(\frac{\epsilon}{3.7\,.D} + \frac{1{,}78*v}{D}\left[\frac{L}{g*D*hf}\right]^5\right)$..... 2.5

Where :

D = Diameter of pipe (m)

g = gravity

L = pipe length (m)

T = temperature

v = pressure determined by temperature

ϵ= roughness in a m pipe

Z_0= elevation of shelter (m)

Z_1= elevation tit i k view (m)

2. Calculating the flow velocity in the pipe
   Can be calculated using the equation:

v = Q/A……..……………………………………….. 2.6

Where : Q = Design water discharge(m^3/det)

v = flow rate (m/s)

A = Cross-sectional area (m)

3. Calculating the cross-sectional area of the pipe
   Can be calculated using the equation:

$A = \frac{1}{4}\,.\,\pi.\,D^2$.. 2.7

4. Calculating the pressure in the pipe Can be calculated using the equation:

$P = \frac{F}{A}$... 2.8

Where :

P = Pressure (N/ m^2)

F = 9810 N

A = Cross-sectional area (m)

5. Calculating the Force due to pressure in the pipe

F = M . A ………..………………………….......... 2. 9

Where :

F = Force = Newtons (kg /cm)

M = Mass of liquid = 1000 kg /cm

A = Cross-sectional area m ^{2}

Table .5 : (∈)Coefficient of Absolute Hardness _

Ingredient	Value ∈in (mm)
• Brass, Tin, Glass, Centrifugally stirred Cement, Coal seam	0.0015
• Traded steel or wrought iron or welded steel pipe	0.046
• Polyvinyl Chloride (PVC)	0.05
• Asphalt cast iron	0.12
• Senk plated iron (galvanized)	0.15
• Cast iron	0.26
• wooden board	0.18 – 0.9
• Concrete	0.3 -3
• Riveted steel	9

Source : Dua KYS 2009

2.13.1. In-Pipe Energy Calculation

In planning a clean water distribution network, the flow in a pipe that is flowing in full will make the pipe pressurized and as a result, the pipe will lose energy. Calculating the energy loss in the pipe

1. Calculating big height loss

It can be calculated using the Darcy-Weisbach equation, and the basic equation is as follows:

$hf = \frac{8.f.L.Q^2}{\pi.g.D^5}\left(1 + \frac{q.L}{2.Q}\right)^2$ ……………………………..… 2. 10

Where : hf = energy loss in the pipe

D = Diameter of pipe

Q = Incoming debit

q = Outgoing debit

T = Su hu

g = Gravity

∈= pipe roughness

2. Calculating the loss at one turn in the pipe

Can be calculated using the equation:

$h_m = K_m \frac{v^2}{2.g}$... 2.11

Where : K_m= coefficient of loss at the turn

v = flow velocity

g = Gravity

Table.6: Coefficient K_m of P Pressure Loss on Bends ( )

Wall	∂	∂	∂	∂	∂
	15°	30°	45°	60°	90°
Fine	0.042	0.130	0.236	0.471	1,129
Rough	0.062	0.165	0.320	0.684	1,265

Source ; Two KYS 2009

In addition, *Swamee* describes the value of v with its correlation with temperature, as follows:

$V = 1.792 \times 10^{-6}(1 + [\frac{T}{25}]^{1,165})^{-1}$...................... 2.12

While Reynolds, explained the Reynolds number, as follows:

$$R = \frac{V.D}{v}$$

$R = \frac{4(Q-0,5.\ q.L)}{\pi.v.D}$... 2.13

Where :

D = Diameter of pipe

v = flow velocity

T = Temperature

v = Kinematic viscosity

2.13.2. Clean water distribution

To distribute water through the piping system, there are two types of pipes that will be calculated based on the discharge of tapped water at the water source.

1. Transmission Pipe

Q = A . V 2.14

A = . . D ^{2} 2.15

Where :

Q = flow rate (m ^{3}/s)

A = pipe area (m ^{2})

= 3 ,14

V = velocity of flow in the pipe (m/s)

D = pipe diameter (m)

2. Distribution pipe

The distribution pipe dimension calculation uses maximum hourly discharge data, because the distribution system is designed to distribute water at peak hours.

The allowable flow velocity in the pipe for the pipe is:

- Transmission = 0.6 – 3.0 m/s
- Distribution = 0.3 – 2.0 m/s

III. METHODOLOGY

3.1 Research sites

The research location is in Way Hula Hamlet, Liang Village, Salahutu District.

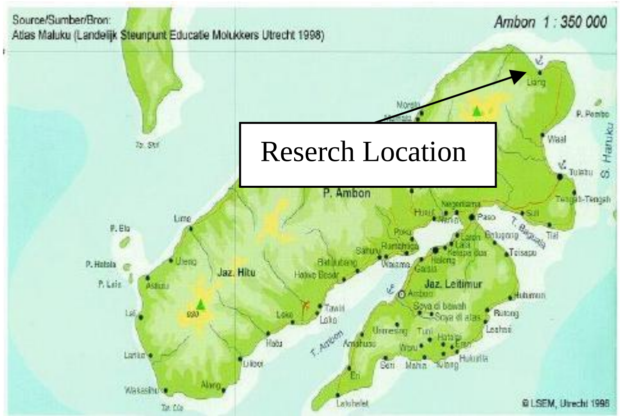

Fig.3: Research Location

3.2 Method of collecting data

used in this research are:

1. Population data
   a. In accordance with the results of a survey in Way Hula Hamlet, Liang Village, Salahutu District .
   b. Sources of data that can be obtained are: District Office Way Hula Hamlet, Liang Village Salahutu District .

2. The data collection techniques used in this research include:

a. Primary data
   1. Observation Techniques : the author directly conducted a field survey to obtain supporting data in this study.
   2. Literature Technique : namely a library approach that is used to obtain information through relevant books and journals.

b. Secondary Data

1. Water discharge data, map of the location of population data.
2. Data from Way Hula Hamlet, Liang Village, Salahutu District, geographic data and other facilities and infrastructure data related to research.

4.1. Research Flowchart

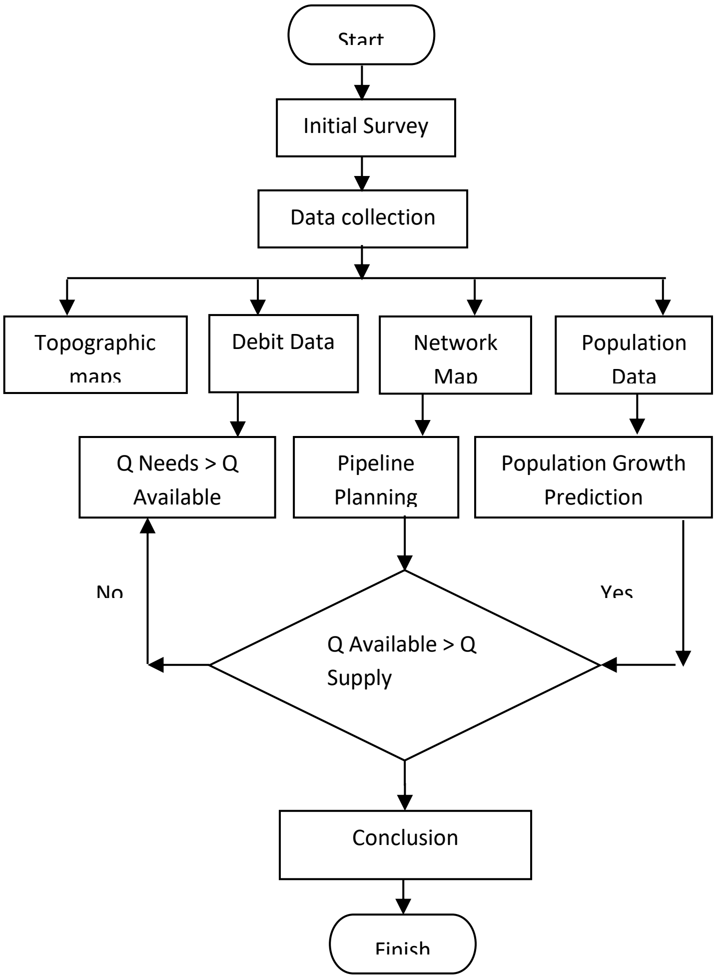

Fig.4: Research Flowchart

IV. ANALYSIS AND DISCUSSION

4.1. Calculation of Broncapt Tub/Artesian Well Capacity

Diameter = 6.03 m
Well height = 2.0 m
Volume V = πd^2
V = 3.14×6.03^2 m^3
V = 114.173 m^3
V = 114.17 liters

4.2. Calculation of Reservoir Planning Volume.

Known = Length = 4.0 m
Wide = 3.0 m
Height = 2.0 m
Volume = 4.0 x 3.0 x 2.0
= 24 m^3
= 24,000 liters

4.3. Predicting the Population of the Way Hula Hamlet

5 years ahead.

No	Year	Total Population	Soul Growth	% Growth
1	2	3	4	5
1	2015	298	-	-
2	2016	305	7	0.023
3	2017	310	5	0.016
4	2018	321	11	0.034
5	2019	337	16	0.048
Amount			39	0.121
R Average			7.8	0.024

Source: Analysis Results

To predict the population (number population) for the next few years can use the geometric method as follows:

$Pn = Po\ (1 + Ig\%)^n$ 3.1

Where :

Pn = Total population after 5 years
Po = Current population (2019) = 337 inhabitants
Ig = Percentage of population increase = 0.024 %
n = Number of years planned = 5 years

Then $P_5 = 337\ (1 + 0.024\%)^5$
$P5 = \_\ 337\ (1.024)^5$
= 337 (1.1259)
= 38 0 soul

So the population of Way Hula Hamlet after the next 5 years is 3.890 people.

4.4. Calculating the Amount of Clean Water Needs for the People of Way Hula Hamlet

1. Residents ' water needs

The amount of clean water needed for the Way Hula Hamlet community:

The population of Way Hula Hamlet in 2025 = 3 80 person

Clean water needs per person = 130 liters/person/day

So = 3 80 x 130 liters/person/day = 49 . 400 liters/day

Total water requirement = 49400 liters/day

2. Domestic water needs

a. Water needs for places of worship
Mosque building area = 400 m^2
Water needs for worship = 40 liters/person/day
So = 400 x 40 liters/person/day = 1600 liters/day
Total water requirement = 1600 liters/day

b. Total Water Needs for Office Infrastructure
Number of Public Health Center employees = 7 0rang
Water needs for health centers = 300 liters/person/day
So = 7 x 300 liters/person/day = 2 100 liters/day
Total water requirement = 2 100 liters/day

c. Amount the need for clean water for educational infrastructure

<u>Needs for Liang 2Th Public Elementary School</u>
Number of Students, Teachers and Employees = 155 people
Water requirement for schools = 30 liters/person/day
So = 155 x 30 liters/person/day = 4,650 liters/day
Total water requirement = 4,650 liters/day

<u>The need for Liang 3Th State Elementary School</u>
Number of Students, Teachers and Employees = 140 people
Water needs for schools = 30 liters/person/day
So = 140 x 30 liters/person/day = 4200 liters/day
Total water requirement = 4200 liters/day

<u>Needs for Salahutu 4Th State Junior High School</u>
Number of Students, Teachers and Employees = 230 people
Water needs for schools = 30 liters/person/day
So = 230 x 30 liters/person/ day = 6900 liters/day
Total water requirement = 6900 liters/day

<u>Need for 4Th Salahutu Senior High School</u>
Number of Students, Teachers and Employees = 228 people
Water requirement for schools = 30 liters/person/day
So = 228 x 30 liters/person/day = 6840 liters/day
Total water requirement = 6840 liters/day

So the total need for clean water for the Way Hula Hamlet community is:

(49400 + 1600 + 2 100 + 4650 + 4200 + 6900 + 6840) = 75 . 690 liters/day

Because there is a leak in the pipeline, it must be multiplied by a factor of X, according to Hazem William , which is 1.12 to compensate for the leak.

So the water needs for the people of Way Hula Hamlet every day are:

= 1.12 x 75690 liters/day

= 2 89,038 liters / day x 24 hours

= 6.89 6.912 / 36000 seconds liter/day

= 1,926 liters/second / 1000 m^3

= 1.926 m^3/second

Water is flowed during busy hours in Way Hula Hamlet for 8 hours every day where breaks are those that require a lot of clean water. So the planned water capacity is to use the formula :

$$Q = \frac{289.038 \text{ liter}}{8 \text{ jam}}$$

= 36,130 liters/hour / 3600

= 10 .04 liters/second / 1000

= 0.0 1 m 3 / second

4.5 Water Discharge Calculation

No	Time	Volume
1	2.00 seconds	10 liters
2	2.01 seconds	10 liters
3	2.00 seconds	10 liters
4	2.02 seconds	10 liters
5	2.01 seconds	10 liters
6	2.04 seconds	10 liters
7	2.03 seconds	10 liters
8	1.99 seconds	10 liters
9	2.01 seconds	10 liters
10	1.98 seconds	10 liters
Amount	**22.24**	**100 liters**

Source: Analysis Results

Information :

1. No, field testing
2. Test time/(seconds)
3. Volume of water/liter

Average = 22.24 / 10 = 2.22 m 3 / sec

Volume = 100/10 = 10 liters = 1.0

$$Q = \frac{\text{Volume}}{\text{Waktu}}$$

$$Q = \frac{1{,}0}{22{,}24} = 0{,}04 \text{ second}$$

4.5.1. Calculating water discharge from Bronkap to Reservoir tub

- Cross-sectional area of 6 inches pipe = 15.24 cm = 0.1524 m

  $A = \pi . r^2$

  $= 3.14 (\frac{0,1524}{2})^2$

  $= 3.14 (0.0762)^2$

  $= 0.02 \ m^2$

- Flow Velocity $V = \frac{Q}{A} = \frac{0,04}{0,02} = 2 \ m^3$/second

- Calculating h e ad losser major for pipe diameter 6 inches :

  $H_f = f + \frac{L . V2}{D \ x \ 2 . g}$

  $H_f = 0,017 + \frac{6,00 \ x \ 2}{0,1524 \ x \ 9,18}$

  $= 0.017 + \frac{12}{2,80}$

  $= 4.3$ m

4.5.2. Calculating the water discharge from the reservoir to the community

- Cross-sectional area of 2 inch pipe = 5.08 cm = 0.0508 m

  $A = \pi . r^2$

  $= 3.14 (\frac{0,0508}{2})^2$

  $= 3.14 (0.0508)^2$

  $= 0.32 \ m^2$

- Flow Velocity $V = \frac{Q}{A} = \frac{0,04}{0,32} = 0.13 \ m^3$/second

- Calculating h e ad losser major for diameter 2 inch pipe :

  $H_f = f + \frac{L . V2}{D \ x \ 2 . g}$

  $H_f = 0,017 + \frac{20,00 \ x \ 0,13}{0,0508 \ x \ 9,18}$

  $= 0.017 + \frac{2,6}{0,466}$

  $= 5,60$ m

  - The cross-sectional area of 1 inch pipe = 2.54 cm = 0.0254 m

    $A = \pi . r^2$

    $= 3,14 (\frac{0,0254}{2})^2$

    $= 3 .14 (0.0127)^2$

    $= 0.08 \ m^2$

  - Flow Velocity $V = \frac{Q}{A} = \frac{0,20}{0,08} = 2.5 \ m^3$/second

  - Calculating h e ad losser major for 1 inch pipe diameter :

    $H_f = f + \frac{L . V2}{D \ x \ 2 . g}$

    $H_f = 0,017 + \frac{6,00 \ x \ 2,5}{0,0254 \ x \ 9,18} = 0.017 + \frac{15}{0,025}$

    $= 312$ m

- The cross-sectional area of 1/2 inch pipe = 1.27 cm = 0.0127 m

  $A = \pi . r^2$

  $= 3,14 (\frac{0,0127}{2})^2$

  $= 3.14 (0.00635)^2$

  $= 0.04 \ m^2$

- Flow Velocity $V = \frac{Q}{A} = \frac{0,20}{0,040} = 5.00 \ m^3$/second

- Calculating head losser major for 1/2 inch pipe diameter :

  $H_f = f + \frac{L . V2}{D \ x \ 2 . g}$

  $H_f = 0,017 + \frac{126,00 \ x \ 5,00}{0,0127 \ x \ 9,18}$

  $= 0.017 + \frac{630}{0,117}$

  $= 10.76$ m

4.5.3. Calculating the discharge of water that is flowed by the reservoir to the community

- Analyzing Water Discharge With Gravity

  Known :

Galvanized pipe diameter = Ø2 = 5.08 cm = 0.0508 m

$g = 9, 81$

$V = 2 \ m^3$ (Bronkap Volume)

$T = 25^0$

$Z_0 = 40$ m (Elevation Source from sea level)

$Z_1 = 2 \ 7$ m (Elevation like reservoir from sea level)

$v = 1.792 \ x10^{-6} (1 + [\frac{T}{25}]^{1,165})^{-1}$

$= 1,792 \ x10^{-6} (1 + [\frac{25}{25}]^{1,165})^{-1}$

$= 1.792 \ x \ 10^{-6} x \ 0.5$

$= 8,96^{-07}$

$\in = 0.55 = 5 \ x \ 10^{-5}$

Asked ?

Water Discharge (Q) .... ?

Answer :

Biggest loss value:

$Hf = Z_0 - Z_1 = 40 - 2 \ 7 = 13$

$$Q = -0,956 . D^2 \left[\frac{g.D.hf}{L}\right]^{0,5} ln \left(\frac{\epsilon}{3.7 . D} + \frac{1,78 * v}{D} \left[\frac{L}{g * D * hf}\right]^{0,5}\right)$$

$$Q = -0,956 \ x \ 0,0508^2 \left[\frac{9,81 \ x \ 0,0508 \ x \ 13}{380}\right]^{0,5} ln \left(\frac{5x10^{-5}}{3,7 \ x \ 0,0508} + \frac{1,78 \ x \ 8,96^{-07}}{0,0508} \left[\frac{380}{9,81 \ x \ 0,0508 \ x \ 13}\right]^{0,5}\right)$$

$= 0.20 m^3/det$

The flow of water that enters from the catcher or bronkap to the reservoir is 0.20 m3 / second

❖ Check the flow type again:

a. Calculating the cross-sectional area of the pipe

By using the formula:

$A = \frac{1}{4}.\pi.D^2$

$A = \frac{1}{4}.3.14.(0,0508)^2 = 0.00456m^2$

b. Calculate the speed of water flow in the pipe

$v = Q/A$

$v = \frac{0,0021}{0,00456}$

v = 0.46 m/s

Cross-sectional area of 1 inch pipe = 2.54 cm = 0.0254 m

$A = \pi.r^2$

$= 3.14\ (\frac{0,0254}{2})^2$

$= 3.14\ (0.01905)^2$

$= 0.002\ m^2$

➢ Flow Velocity $V = \frac{Q}{A} = \frac{0,51}{0,002} = 1.5\ m^3/second$

➢ Calculating head losser major for 1 inch pipe diameter:

$H_f = f + \frac{L.V2}{D \times 2.g}$

$H_f = 0,017 + \frac{580 \times 0,17}{0,0254 \times 9,18}$

$= 0.017 + \frac{19,89}{0,199}$

= 19.95 m

➢ Calculating the flow of water flowing from the reservoir to the public faucet :

Analyzing Water Discharge With Gravity

Known

Pipe diameter Ø 1/2 = 1.27 cm = 0.0127 m

g = 9, 8

V = 50 m^3 (Reservoir Volume)

T = 25 ^{0}

Z_0= 30 m (Elevation Source from sea level)

Z_1= 20 m (Elevation like reservoir from sea level)

$v = 1.792\ x10^{-6}(1 + [\frac{T}{25}]^{1,165})^{-1}$

$= 1,792\ x10^{-6}(1 + [\frac{25}{25}]^{1,165})^{-1}$

$= 1.792\ x\ 10^{-6} x\ 0.5$

$= 8,96^{-07}$

$\in = 0.55 = 5\ x\ 10^{-5}$

Asked = Water Discharge (Q) .... ?

Answer =

Biggest loss value:

$Hf = Z_0 - Z_1 = 30 - 20 = 10$

$Q = -0,956.D^2 \left[\frac{g.D.hf}{L}\right]^{0,5} ln\left(\frac{\epsilon}{3.7.D} + \frac{1,78*v}{D}\left[\frac{L}{g*D*hf}\right]^{0,5}\right)$

$Q = -0,956\ x\ 0,0127\ ^2 \left[\frac{9,81\ x\ 0,0127\ x\ 10}{580}\right]^{0,5} ln\left(\frac{5x10^{-5}}{3,7x0,0127} + \frac{1,78\ x\ 8,96^{-07}}{0,0127}\left[\frac{580}{9,81x\ 0,0127\ x\ 10}\right]^{0,5}\right)$

$= 0.015m^3/det$

The flow of water flowing from the reservoir to the public faucet is 0.015 m3 / second.

❖ Check the flow type again:

a. Calculating the cross-sectional area of the pipe

By using the formula:

$A = \frac{1}{4}.\pi.D^2$

$A = \frac{1}{4}.3.14.(0,0127)^2 = 0.00364m^2$

b. Calculate the speed of water flow in the pipe

$v = Q/A$

$v = \frac{0,0020}{0,00364}$

v = 0.5 0 m /s

4.5.4. Calculating Friction Loss Head in Straight Pipe

According to *Barnouli's Theorem* to calculate the friction loss head for a straight pipe take the highest elevation and lowest elevation"

Q Reservoir = $0.20m^3/det$

q Common faucet = $0.015m^3/det$

Known ;

$D_1 = 0.1524$ m

$D_2 = 0.1524$ m

$L_1 = 20$ m

$L_2 = 20$ m

Q Reservoir = $0.20m^3/det$

q Common faucet = $0.015m^3/det$

T = 25 ^{0}

g = 9, 81

$\in = 0.55 = 5\ x\ 10^{-5}$

Asked : . hf =........... ??

Servant:

So : $\sum L = L_1 + L_2$

= 20 + 20 = 40 m

$$D_e = \left[\frac{\sum L}{\frac{L_1}{{D_1}^5} + \frac{L_2}{{D_2}^5}}\right]^{0,2}$$

$$D_e = \left[\frac{40}{\frac{20}{0,0762^5} + \frac{20}{0,0762^5}}\right]^{0,2}$$

= 0.665 m

- Kinematic Viscosity:

V = $1.792 \text{ x}10^{-6}(1 + [\frac{T}{25}]^{1,165})^{-1}$

= $1,792 \text{ x}10^{-6}(1 + [\frac{20}{25}]^{1,165})^{-1}$

= $1.792 \text{ x } 10^{-6}\text{x } 0.5$

= $8,96^{-07} m^3/det$

= 0.00 896 m^3/det

- Reynolds number

$$R = \frac{4(Q - 0,5.\ q.L)}{\pi.v.D}$$

$$R = \frac{4(0,0281 - 0,5\ x\ 0,20\ x\ 40)}{3,14\ x\ 8,96^{-07}\ x\ \ 40}$$

= 10148.25

Al i ran type, because R > 4000

- Friction Factor:

$$f = \left\{\left(\frac{64}{R}\right)^8 + 9,5\left[\ln\left(\frac{E}{3,7\ .D}\right) + \frac{5,74}{R^{0,9}} - \left(\frac{2500}{R}\right)^6\right]^{-16}\right\}$$

$$f = \left\{\left(\frac{64}{10148,25}\right)^8 + 9,5\left[\ln\left(\frac{5x10^{-5}}{3,7\ x\ 0,1524}\right) + \frac{5,74}{10148,25^{\ 0,9}} - \left(\frac{2500}{10148,25}\right)^6\right]^{-16}\right\}$$

= 2 , 1523 m

a. Calculating the cross-sectional area of the pipe

$$A = \frac{1}{4}.\pi.D^2$$

$$A = \frac{1}{4}.3.14.(0,1524)^2 = 0.0182m^2$$

b. Calculate the speed of water flow in the pipe

v $= Q/A$

v $= \frac{0,015}{0,0182}$

v = 0.0181 m/s

c. Calculating the Force in the pipe

F = M . A

Where :

F = Force = Newton (kg /cm)

M = Mass of liquid = 1000 kg /cm

A = Cross-sectional area (m)

So F = 1000 x 9.81 = 9810 N

d. Calculating the pressure in the pipe

$$P = \frac{F}{A}$$

Where :

P = Pressure (N/ m^2)

F = 9810 N

A = 0.0182 m

Then: $P = \frac{9,81}{0,0182}$

P =538000 (N/ m^2)

e. Calculating losses for a 30 turn°

$$h_m = K_m \frac{v^2}{2.g}$$

Where :

K_m= loss coefficient on turn

v = flow velocity

g = Gravity

Known :

K_m= 0, 0 130

v = 0.0181

g = 9.81

Asked : h_m=.............. ??

Solution : $h_m = 0,0130\ \frac{0,0186^{\ 2}}{2\ x\ 9,81}$

= $2.16 \text{ x } 10^{-8}$m

f. Calculating losses for a 90 turn°

$$h_m = K_m \frac{v^2}{2.g}$$

Where :

K_m= coefficient of loss in turns

v = flow velocity

g = Gravity

Known :

K_m= 1.129

v = 0, 1806

g = 9.81

Asked : h_m=................ ??

Solution:

$$h_m = 1,129\ \frac{0,0181^2}{2\text{ x }9,81}$$

= 1.88 x 10 ^{3} m

V. CONCLUSIONS AND SUGGESTION

5.1. Conclusion

The conclusions obtained from this research are as follows:

1. Availability of clean water discharge entering the reservoir is 0.26 m3 / second and channeled to the public faucets of Way Hula Hamlet is 0.015 m3 / second
2. The diameter of the galvanized pipe that is in accordance with the planning and calculations is a 6

inch diameter galvanized pipe used from the well or source to the reservoir and a 2 inch diameter, 1 inch diameter and 1/2 inch diameter galvanized pipe used from the reservoir to the public faucet.

3. The need for clean water in Way Hula Hamlet for the next 5 years from 2020 to 2025 which is planned for s is 0.01 m3 / second.

5.2. Suggestion

The author recommends that:

1. In every planning it must be calculated accurately so that in the flow of water discharge so that it can serve all people.
2. For the next researcher, whether or not the quality of the water consumed by the local community is feasible or not.

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