

Analysis of Raw Water Availability for Clean Water Needs of Podomoro City Housing Tenjo, Bogor Regency

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ABSTRACT

The availability of clean water in Tenjo Subdistrict, Bogor Regency, is still considered unable to meet the needs of the community. Tenjo Sub-district residents utilize Cidurian River water for various activities and daily needs, such as drinking water, irrigation of rice fields, and ponds. However, the Cidurian River often experiences bad water. Based on this, Perumda Air Minum Tirta Kahuripan Bogor Regency wants to meet the need for clean water by planning the construction of a Water Treatment Plant (IPA) in the Tenjo District area, especially Podomoro City Housing Tenjo Bogor Regency. The purpose of this research is to analyze the availability of raw water for clean water needs and planning of the clean water system of Kota Podomoro Tenjo Housing in Bogor Regency. This research uses methods with primary data collection, secondary data, and data processing with Epanet 2.0 and Excel Application programs. Then an analysis of raw water availability and clean water system planning data was carried out. The results of the analysis of raw water system planning show that the potential raw water of the Cidurian River using flo mate measuring instruments is 14,455 l / s, in stage I there are 829 SR, stage II there are 2737 SR, stage III 4555 SR are served, and the water demand from stage I to stage III reaches 31.63 l / s so that the Cidurian River can be utilized as a source of raw water for clean water services and can meet the clean water needs of Podomoro City Housing Tenjo Bogor Regency only by using 20% of Cidurian River water. The results of the hydraulic calculation analysis of piping using Epanet 2.2 obtained that each node/junction has met the hydraulic criteria.

Keywords: raw water, clean water system, clean water pipe network, epanet 2.2.

INTRODUCTION

Efforts to fulfill clean water needs in an area should pay attention to the availability of existing water sources. In order to improve the welfare of the community and anticipate regional development, adequate availability of clean water is needed, in terms of quantity, quality and continuity in accordance with community expectations. Until now, the availability of clean water in Tenjo Sub-district, Bogor Regency, is still considered unable to meet the needs of the community. Tenjo Sub-district residents utilize Cidurian River water for various activities and daily needs, such as drinking water, irrigation of rice fields, and ponds. However, the water quality in the Cidurian River is poor. In fact, the acidity level can reach PH 8 - 9.

Based on this, Perumda Air Minum Tirta Kahuripan Bogor Regency wants to meet the needs of clean water by planning the construction of a Water Treatment Plant (IPA) in the Tenjo District area, especially Kota Podomoro Tenjo Housing in Bogor Regency which is realized in 2030 as many as 18,158 House Connections (SR) served. Based on this, a study of the clean water system is needed to support the achievement of the service coverage target of 18,158 SR

The drinking water supply system must be able to provide sufficient water for the required needs. The water supply system must be able to provide sufficient water for the required needs.

Clean Water

Clean water can be defined as water that is utilized by humans to meet their daily needs. For further needs as drinking water, the clean water is cooked first to meet the permissible requirements in terms of physical, chemical, biological and radiological parameters. This clean water can come from a variety of raw water sources available around the human environment itself, including: from surface water, such as river water, lake water, ponds, reservoirs and other puddles on the earth's surface, rainwater, shallow groundwater and deep groundwater and springs. To determine alternative raw water sources that will be used to produce clean water, it is necessary to consider aspects of quality, quantity and continuity of the raw water source itself [1]-[3].

Clean Water Supply Requirements and Criteria

In a clean water supply system, the quality aspect is a description of the quality of the clean water itself which includes physical parameters, chemical, bacteriological and radioactive parameters, and all of these parameters must be met in the community water supply system. Meanwhile, the quantity aspect or the flow rate distributed to the community is a description of the amount of clean water availability itself in meeting the needs of the community in an area. In another sense, the raw water selected to meet the community's clean water needs must be in accordance with the level of service that will be planned in an area [4]. The clean water demand referred to in this study is the amount of clean water needed by an area for household activities or also known as domestic needs, and non-domestic needs that must be met at all times. The amount of clean water demand for household or domestic purposes in an area is presented [5]. While the standard of water demand for purposes outside household activities or also known as non-domestic in an area, is the need for clean water for purposes outside non-domestic purposes in an area, such as: activities in educational infrastructure facilities, offices, business centers, markets and shops, and other activities contained in an area [6], [7]. For the continuity aspect, the water supply system in an area must be continuous and available all the time. The nature of continuity reflects that raw water for clean water needs can certainly be taken all the time with relatively constant flow fluctuations, during the dry season or rainy season. As for the hydraulic conditions in the service area, the available water pressure in the main network pipe does not exceed 10-80 m with a flow velocity in the pipe of 0.6 - 3m/s. Clean water planning criteria can be seen in Table 1.

Table 1. Clean Water Planning Criteria based [8]

No.	Description	Category of Cities by Population (Population)				
		< 1.000.000	500.000- 1.000.000	100.000- 500.000	20.000- 100.000	< 20.000
1	House Connection Unit (SR) Consumption	190	170	150	130	30
2	General Hydrant Unit (HU) Consumption l/org/day	30	30	30	30	30
3	Non-domestic unit consumption	20-30	20-30	20-30	20-30	10-20
4	Water Loss (%)	20-30	20-30	20-30	20-30	20
5	Maximum Factor Per Day	1,1	1,1	1,1	1,1	1,1
6	Peak Hour Factor	1,5	1,5	1,5	1,5	1,5
7	Number of people per SR	5	5	6	6	10
8	Number of people per HU	100	100	100	100-200	200
9	Remaining Network Pressure in Distribution (meter)	10	10	10	10	10
10	Operating Hours (Hours)	24	24	24	24	24
11	Reservoir Volume (%)	20	20	20	20	20
12	SR: HU	50:50 to 80:20	50:50 to 80:20	80:20	70:30	70:30

No.	Description	Category of Cities by Population (Population)				
		< 1.000.000	500.000- 1.000.000	100.000- 500.000	20.000- 100.000	< 20.000
13	Service Coverage	90	90	90	90	70

Based on the group of water consumption or basic needs for clean water purposes, it can be divided into 2 groups, namely:

1. Water use for domestic needs
2. Water use for non-domestic needs

The amount of clean water demand for domestic use, calculated based on the percentage of the population to be served with the criteria:

1. House Connection (SR)
Faucets are provided only up to the yard, in one unit serving 8 people with water service of 150 liters / person / day
2. General Connection (SU)
In the form of public taps or water tanks shared by house/building connections (100 people) with a service of 60 liters/life/day.

Government Regulation 16 of 2005 on Drinking Water Development System states that the drinking water supply system consists of:

1. Raw Water Unit
2. Production Unit
3. Distribution Unit
4. Service Unit

RESEARCH METHODS

The research was conducted in Kota Podomoro Tenjo Housing, Singabraja Village, Tenjo District, Bogor Regency. Tenjo sub-district is astronomically located between 6.3393° south latitude and 106.4408° east longitude. Tenjo Sub-district is a lowland located at approximately 61.9 meters above sea level. Tenjo sub-district has an area of 72.18 km². The implementation time starts from February 2024 - June 2024.

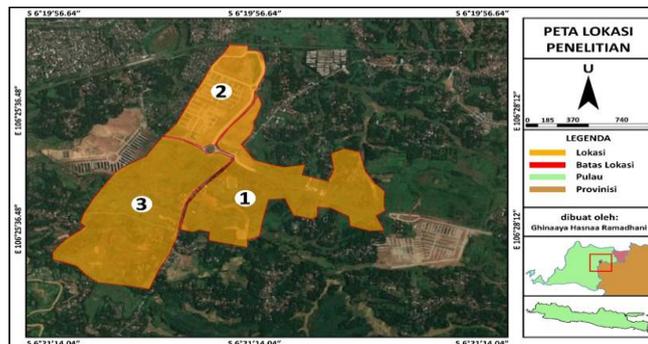


Figure 1. Location plan

The research flow chart can be seen in Figure 2 below.

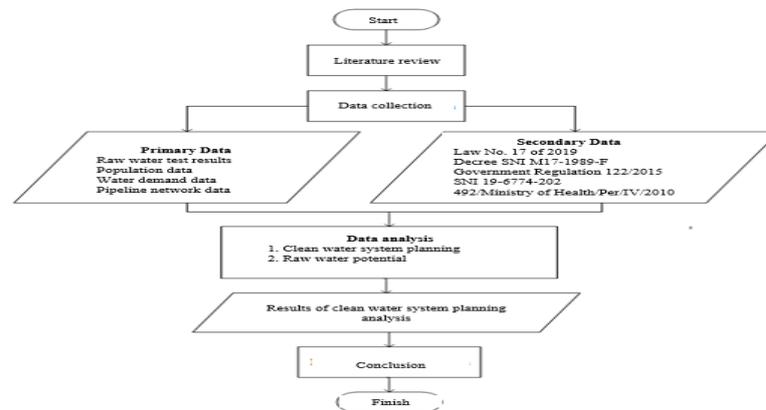


Figure 2. Flow chart [9]-[15]

First, in starting the research all the needs both for field surveys and all kinds that support the research are prepared, then conduct observation and data collection related to research in journals and literature books that support the applicable standards in connection with the planning of clean water systems [16]. After that, primary data collection will be used in the analysis stage in the form of raw water test results, population, water demand, rainfall data so as to get the results of clean water system planning [17]-[18].

Clean water is essential for the healthy development and sustainability of any area, whether rural or urban. It plays a fundamental role in supporting human life, economic activities, and environmental balance. Access to clean water ensures that people can safely drink, cook, bathe, and maintain personal hygiene without the risk of waterborne diseases such as cholera, dysentery, and typhoid. When a community has a reliable supply of safe water, public health improves significantly, reducing medical expenses and increasing productivity [19]. In residential areas, clean water is necessary for daily household tasks including washing clothes, cleaning homes, and preparing food. Schools and healthcare facilities especially depend on safe water to maintain sanitation standards and protect students and patients. Without clean water, sanitation systems cannot function properly, leading to contamination and the spread of illness [20].

RESULTS AND DISCUSSION

Based on the data from the results of the research conducted, it is necessary to pay attention to several aspects of the existing Clean Water System Planning, namely, including:

Raw Water Potential

The initial step taken for planning a clean water system is to analyze the potential of raw water. The raw water source for clean water services for Kota Podomoro Tenjo Housing comes from the Ciduran River. Measurement of raw water discharge in the Cidurian River is carried out with the Flo Mate measuring instrument shown in table 2 below.

Table 2. Results of raw water potential analysis

Sample Point-	Test Distance Interval	Total River Stretch	Height/Depth (m)	Speed (m/sec)	Water Discharge (l/sec)
1	0 m	19 m	0.7	0.17	2,261.00
2	5 m		1.5	0.25	7,125.00
3	10 m		2.0	0.78	29,640.00
4	15 m		2.1	0.66	26,334.00
5	19 m		1.3	0.28	6,916.00
Average			1.5	0.43	14,455.20

Water discharge is obtained after the results of data analysis in the field, namely the total stretch of the river multiplied by height / depth and speed. Based on table 2 using the Flo Mate measuring

instrument, the average discharge of the potential raw water of the Cidurian River is 14.455 l / s. With this, the Cidurian River can be utilized as a source of raw water for clean water services. With this the Cidurian River can be utilized as a source of raw water for clean water services for Podomoro City Housing Tenjo, Bogor Regency.

Calculation of population

Before analyzing water demand, what must be done to support the analysis of water demand is to analyze the population because future water demand is calculated based on population. The total population in the planning year is shown in table 3.

Table 3. Results of population analysis

No.	Year	Accumulated Number of SRs or Units	Total Population (P)	Population Increase (r)
1	2022	829	4.145	-
2	2023	2737	13.685	9.540
3	2024	4555	22.775	9.090

The number of residents is obtained by assuming in 1 SR there are 5 people, so the results obtained the number of SR Podomoro City Housing Tenjo Bogor Regency based on table 3 in Phase I to III to be served is 4555 SR which is 22,775 residents.

Calculation of water demand

After analyzing the population, the calculation of water demand analysis can be carried out. The first thing to do to analyze water demand is to calculate the daily water demand, which can be obtained from the population of each stage multiplied by the assumption of 100 l/person/day, after which it is divided to get the water demand per second and summed up with water loss (20% of the water demand per second) so as to obtain the average water demand. The results of the water demand analysis are shown in Table 4.

Table 4. Results of water demand analysis

Development Stage	Year	Requirement (100 l/Person/Day)		Water Loss (20%)	QR	QPEAK	QMAX
		(l/Day)	(l/det)	(l/det)	(l/det)	(l/det)	(l/det)
Stage 1	2022	414.500	4,80	0,96	5,76	8,64	6,91
Stage 2	2023	1.368.500	15,84	3,17	19,01	28,51	22,81
Stage 3	2024	2.277.500	26,36	5,27	31,63	47,45	37,96

Based on table 4, the results of the Analysis of Water Needs required by residents of Podomoro City Housing Tenjo Bogor Regency in Phase I required 5.76 l / sec (414,500 l / day), Phase II as much as 19.01 l / sec (1,368,500 l / day), Phase III as much as 31.63 l / sec (2,277,500 l / day). A comparison of raw water availability with water demand is shown in Figure 3.

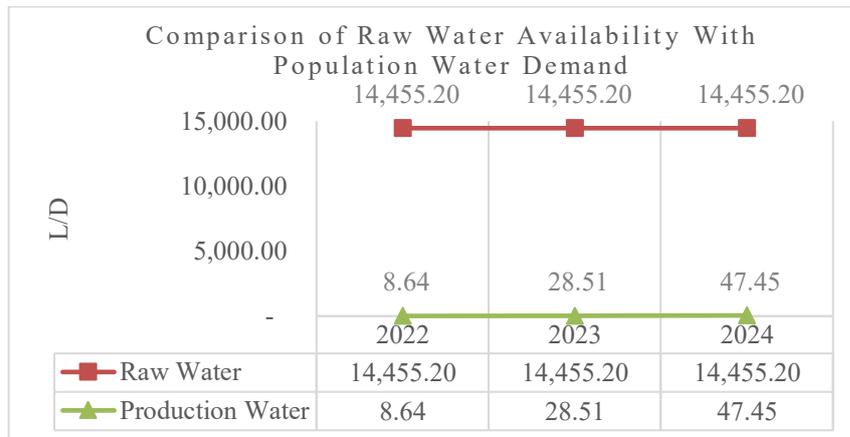


Figure 3. Comparison diagram of raw water availability with population water demand

Analyze the hydraulic calculation of the fountain using the Epanet 2.2 application

The results of the headloss value or water loss, pressure value or pressure and velocity value or speed are shown in Figures 4 and 5.

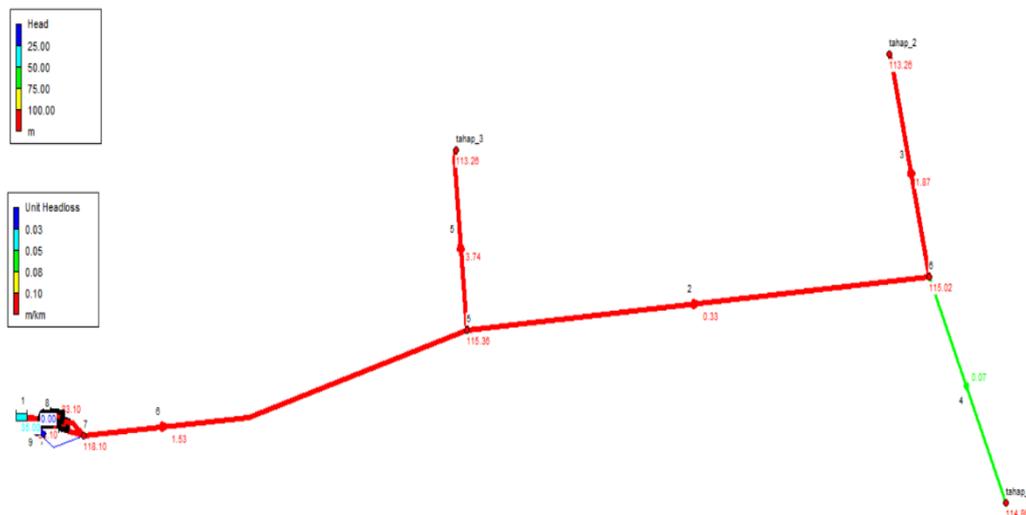


Figure 4. Headloss value results

This headloss value is said to meet the criteria if it does not exceed 10m/km, based on the figure above the headloss value in Kota Podomoro Tenjo Housing meets the hydraulic criteria because none of them exceeds 10m/km.

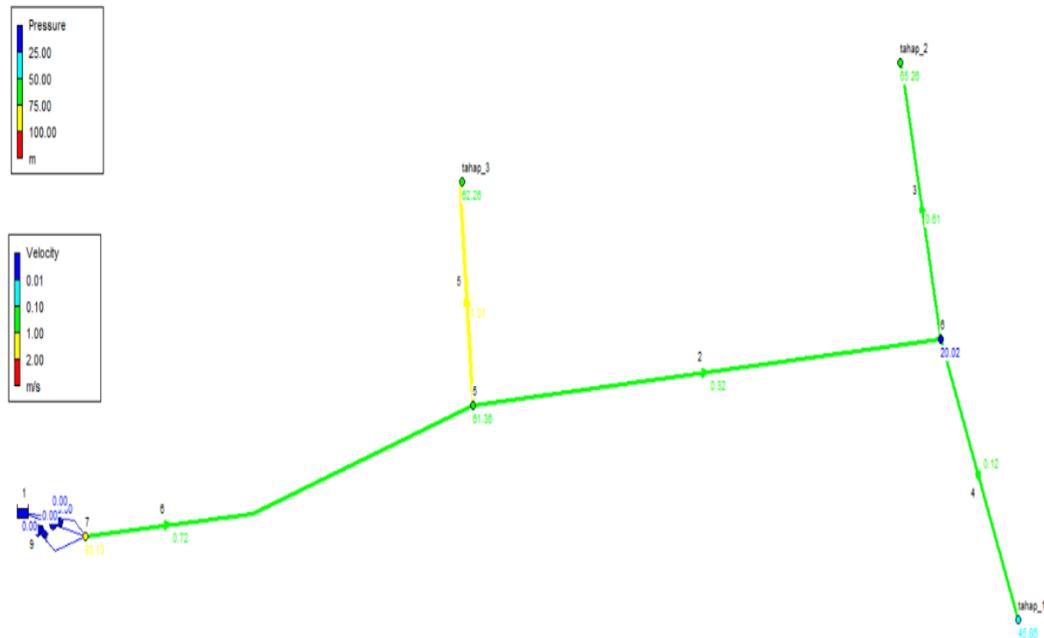


Figure 5. Results of pressure value and velocity value

The pressure value and velocity value meet the criteria if the pressure in the pipe is at least 0.6 bar / 6m and the speed in the pipe is a maximum of 3m / second. Based on the picture above, the pressure value and velocity value at Kota Podomoro Tenjo Housing meet the hydraulic criteria.

CONCLUSION

Based on the results of the discussion of the research on Drinking Water System Planning for Podomoro City Housing Tenjo, Bogor Regency, it can be concluded that clean water services to meet clean water needs in stages I, II, and III in Podomoro City Housing Tenjo can be served very well because as follows: 1) the results of the analysis of the raw water potential of the Cidurian River obtained an average discharge of 14,455.20 l / sec based on this, the Cidurian River can be utilized as a source of raw water for clean water services and can meet the clean water needs of Podomoro City Housing Tenjo Bogor Regency by using only 20% of the Cidurian River water, 2) based on the results of the analysis using the EPANET 2.2 program, each node has met the hydraulic criteria. The hydraulic criteria that must be met are the maximum water loss of 10m/km, the pressure in the pipe is at least 0.6 bar or 6m. In addition, the velocity in the pipe must be 0.3 - 3 m/sec.

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