Development of the Mata Penida Source in the Drinking Water Supply System on the Island of Nusa Penida

I Gusti Ngurah Kerta Arsana[1], Sagung Putri Chandra Astiti[2], Anak Agung Gede Ngurah Kurnia Teja Dharma[2]

[1]Civil Engineering, Faculty of Engineering, Udayana University, Badung Regency, INDONESIA
[2]Environmental Engineering, Faculty of Engineering, Udayana University, Badung Regency, INDONESIA

E-mail: kerta.arsana@unud.ac.id

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ABSTRACT

The need for inadequate water can have a negative impact on health and social conditions. This is also accompanied by an increase in problems related to the quality, quantity and continuity of raw water that can be used as clean water. One area that requires special attention in terms of providing raw water is Nusa Penida Island. The method used in research is quantitative. For the basis of taking drinking water needs based on the increase in existing drinking water needs and hydraulic analysis using the Epanet application. For this reason, optimization needs to be carried out to meet the demand for raw water which continues to increase along with the increasing population in Nusa Penida District. Optimizing water supply can be done by increasing the production capacity of the Penida-spring water source by considering a more strategic location. Network optimization design is carried out using manual calculations and the help of the Epanet application to run simulations. Based on the analysis results, in 2038 water demand in Nusa Penida District will reach 138.15 liters/second. Production capacity is currently still experiencing a deficit of 22.52 liters/second so optimization is needed in the Drinking Water Supply System network. The addition of a pump with a capacity of 25 liters/second to the Penida-spring, supported by adjustments to pipe dimensions and accessories, could be a solution to overcome the existing deficit. Rejuvenation and realignment of distribution pipes to service areas must also be carried out so that water is distributed evenly throughout the village.

Keywords: development; springs; raw water; drinking water supply systems; epanet.

INTRODUCTION

Water is a basic need for human life and other living creatures. The uneven distribution of water on the earth causes its availability in one place to vary greatly [1]. Geographic conditions, population and socio-economic conditions greatly influence the fulfillment of clean water needs, which include the quantity and quality of clean water in an area [2]. The need for inadequate water can have a negative impact on health and social conditions. This is also accompanied by an increase in problems related to the quality of raw water that can be used as clean water. One area that requires special attention in terms of providing raw water is Nusa Penida Island.

Nusa Penida District is located in Klungkung Regency and consists of three main islands, namely Nusa Penida Island, Nusa Lembongan Island and Nusa Ceningan Island. Based on the Central Statistics Agency [19], Nusa Penida District has an area of 202.84 km^2 with a population of 62,082 people. Nusa Penida is a dry area with hilly topography and karst rocks that cover almost the entire island with a slope of between 15% to 45% and consists of dry valleys that only have water during the rainy season [3], [4].

Based on the Bali Province SPAM and Jakstrada SPAM planning report (2018), the management of clean water supply is carried out by the Regional Drinking Water Company (PDAM) and Rural Drinking Water Supply (PAM Des)/community-based drinking water supply (Pamsimas). The provision of rural drinking water in Bali Province, known as PAM Des, is currently being maintained to provide rural drinking water services that cannot be reached by PDAM (Regional Drinking Water

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Company) at the sub-district level. Management of rural drinking water supply (PAM Des) is carried out independently by the community.

Currently on Nusa Penida Island there are nine springs, namely Penida-spring, Guyangan, Tembeling, Seganing, Tabuanan, Aceng/Sekartaji, Wates Water, Angkal Water, and Toya Pakeh. Among the nine springs, six of them have not been managed in an optimal system by the government because the location of the springs is in a steep and steep area. Meanwhile, the three springs that have been managed are the Penida Springs (discharge ± 200 liters/second), the Guyangan Springs (discharge ± 178 liters/second), and the Tembeling Springs (discharge ± 26.4 liters/second). seconds) [16]. These spring sources have not yet been utilized optimally. This can be seen from PDAM service coverage based on PDAM Technical Report data on Nusa Penida Island, which has only reached 41.35% of the population of the administrative area. One of the drinking water supply systems carried out by community self-management (PAMDES) in Klungkung Regency is in Nusa Penida by utilizing the Tabuanan Spring. Currently, the Tabuanan Spring has been utilized independently by the local community to meet the needs of the surrounding area, namely Sekar Taji Village and parts of Tanglad Village.

Along with regional development on the island of Nusa Penida, it must be accompanied by the development of a drinking water supply system to be able to improve drinking water services to meet technical aspects. This research focuses on developing the Penida-spring water source in the drinking water supply system on the island of Nusa Penida.

RESEARCH METHODS

Materials

This research begins by identifying problems at a predetermined location. Based on the problems obtained, research objectives were determined with the support of the literature study carried out. In order to fulfill these objectives, it is necessary to search for primary and secondary data which will later be analyzed in the results and discussion. The results will then be summarized and suggestions added. Systematically, the research stages to be carried out are described through the following research framework:

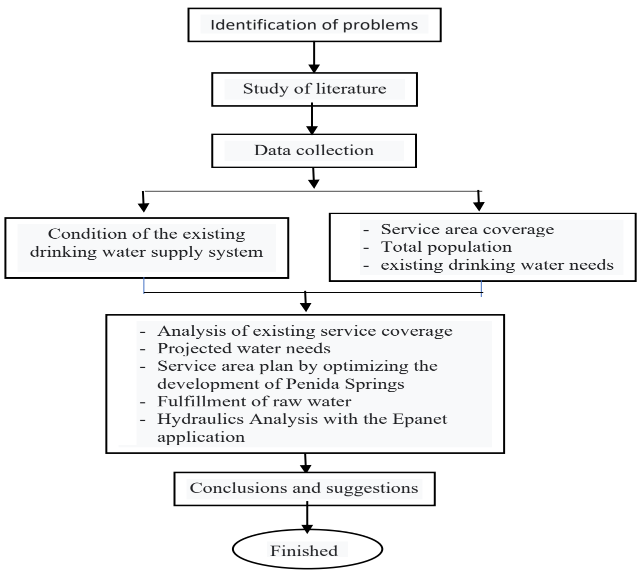

Figure 1. Research flow framework

Methods

Data analysis was carried out through four stages, namely:

- The method used in this research is quantitative [17].

- Analysis of the condition of the area around the water source with data on the water source, topography of the area, as well as the existing conditions of PDAM Nusa Penida services which will be used as a basis for designing unit optimization needed to meet raw water needs.
- Calculation of the projected population of Nusa Penida District for the next 15 years until 2038, where this projection will be used as a basis for calculating water needs in the planning year
- Calculation of existing water consumption through PDAM customer water payment data, where the amount of water consumption needs will refer to real conditions in the field. This data will also be used as a basis for calculating water needs in the planning year [5] - [8].
- Analysis of raw water requirements based on the development of water sources with the nearest service area. For Nusa Penida Island, supply of raw water will utilize the Penida-spring and Guyangan spring. The villages around the two springs will be the main focus before being distributed to other villages at a greater distance. The analysis process is carried out to determine flow velocity, pipe dimensions, pressure loss and pump capacity [9] - [11]. This analysis will also utilize EPANET software to get an overview of the water distribution simulation based on the calculations that have been carried out [12], [13].

Clean water management is crucial to ensuring the availability of safe water for residents. Water consumed must be free from physical, chemical, and biological contaminants that can harm health. Management efforts can be implemented from the source, through distribution, and through utilization. At the source level, protecting catchment areas, managing upstream rivers, and monitoring water quality are priorities. Treatment processes include filtration, sedimentation, coagulation, and disinfection with chlorine or environmentally friendly technologies to ensure water quality meets health standards. Distribution systems must be well-maintained to prevent leaks and recontamination. Public education on clean water use and hygienic storage is also crucial. Local governments need to conduct regular monitoring and develop programs to provide safe and sustainable drinking water facilities. With integrated management, the community's need for safe water can be met while simultaneously supporting improved health and well-being [18].

RESULT AND DISCUSSION

To meet the water needs of the Nusa Penida District Community, the Nusa Penida Regional Drinking Water Company (PDAM) currently only utilizes two main springs, namely Penida Springs and Guyangan Springs because only these two springs have the potential to be used on a large scale. Currently, clean water service coverage from PDAM Nusa Penida has served 14 villages with service coverage reaching 59.44%. For two other villages located in Nusa Ceningan and Nusa Lembongan, namely Jungutbatu and Lembongan Villages, the water used to meet daily needs comes from sea water using Sea Water Reverse Osmosis (SWRO) technology. SWRO is a technology for distilling seawater into clean fresh water using a membrane to separate water from unwanted minerals and microorganisms through a molecular filtration process or what is known as molecular scale [14], [15]. According to [16], [17] it is still very difficult for people who live in coastal areas to obtain clean water facilities or drinking water. Therefore, the use of SWRO technology can be the answer to this problem. SWRO Nusa Ceningan currently has a production capacity of 5 liters/second. For SWRO Nusa Lembongan, it is currently still under construction and is planned to have a production capacity of 42 liters/second.

The Penida Raw Water Supply System utilizes the Penida Springs located in Sakti Village, in the form of springs that come out on the surface near Nusa Penida's Cristal Bay Beach. Penida Springs currently serves the water needs of 6 villages, namely Sakti Village, Toyapakeh, Ped, Kutampi Kaler, Batununggul, and Suana. SPAB Penida's transmission delivery system uses a combination pump and gravity system. The discharge that can be produced at the Penida-spring currently reaches 70 liters/second. The drainage scheme at SPAB Penida can be seen in Figure 2 below.

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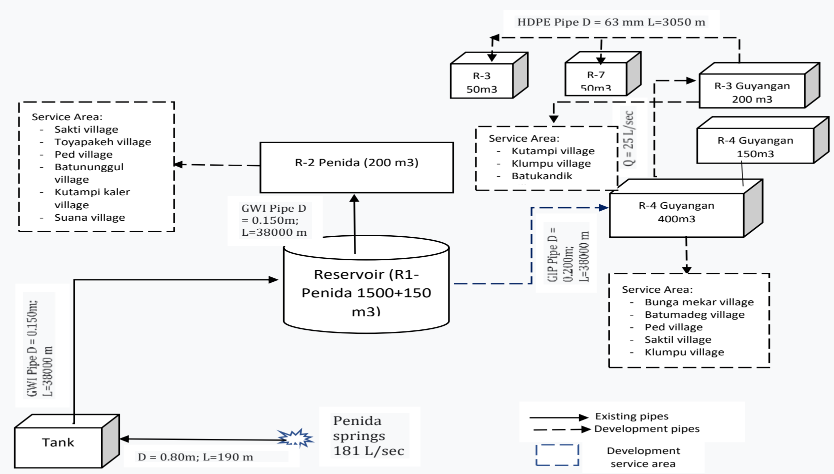

Figure 2. Scheme of the SPAB MA Penida Pipeline Network

The Guyangan Raw Water Supply System utilizes the Guyangan Spring located in Batukandik Village. Guyangan Spring is a spring that comes out on the edge of a steep cliff adjacent to Segara Kidul Temple. The transmission delivery system in this spring uses a multistage pumping system. The discharge that can be produced at the Guyangan spring currently reaches 40 liters/second. Guyangan Springs itself serves 8 villages, namely Bungamekar Village, Batumadeg, Batukandik, Klumpu, Kutampi, Pejukutan, Sekartaji, and Tanglad. However, until now the villages of Tanglad and Pejukutan still do not have access to water. The drainage scheme at SPAB Nusa Penida can be seen in Figure 3 below

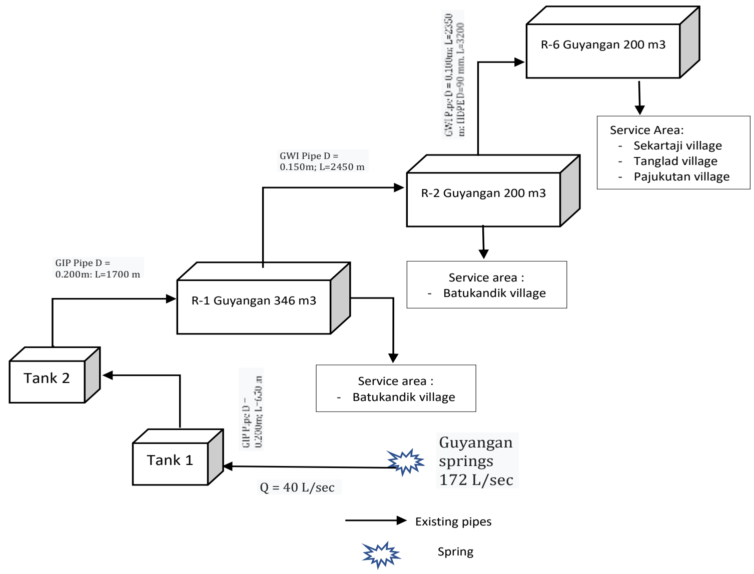

Figure 3. Scheme of SPAB MA Guyangan Pipe Network

Based on the existing service area, there are still two villages that have not been reached by PDAM water, namely Tanglad and Pejukutan Villages, which shows that services in these areas are not yet optimal. This can be seen from the less efficient distribution of service areas where the utilization of the Penida-spring is still less than optimal when compared to the utilization of the Guyangan spring. In this planning, optimization is carried out by changing the service area, where the Penida-spring is planned to serve 10 villages, namely Sakti Village, Toyapakeh, Ped, Kutampi Kaler, Batununggul, Suana, Bungamekar, Batumadeg, Kutampi, and Klumpu. Meanwhile, the Guyangan spring will serve 4 villages, namely Batukandik, Sekartaji, Tanglad and Pejukutan villages. Calculations regarding water requirements in each service area can be seen in Table 1 and 2 below.

The use of Penida springs needs to be optimized because of the advantage of the springs' location being easier to reach compared to Guyangan springs. At the Guyangan spring, several pump stages are needed to channel the water to the reservoir. The pumping stage requires greater electrical energy so it will have an impact on the water costs that will be set by the PDAM

Table 1. Penida Service Area Water Needs

No	Information	Unit	Year 2038
A	**Population**		
1	Total population	souls	48.179
2	Service level	%	80
3	Underserved population	souls	38.543
B	**Domestic needs**		
1	Home connection	liters/person/day	120
2	Home connection water needs	liters/day	4.625.184
3	Domestic needs	liters/day	4.625.184
C	**Non-domestic needs**		
	20% of domestic needs	liters/day	925.037
D	**Total requirement**	liters/day	5.550.221
		liters/second	64,24
E	**Water loss**		
	% water loss	%	20
	Amount of water loss	liters/second	12.85
F	**Average water requirement**	liters/second	77.09
G	**Maximum water requirement**		
1	Coefficient factor	_	1,20
2	Water requirement	liters/second	92,52
H	**Peak hour needs**		
1	Coefficient factor	_	2
2	Water requirement	liters/second	154,17

Table 2. Water Needs in the Guyangan Service Area

No	Information	Unit	Year 2038
A	**Population**		
1	Total population	souls	16.131
2	Service level	%	80
3	Underserved population	souls	12.905
B	**Domestic needs**		
1	Home connection	liters/person/day	120
2	Home connection water needs	liters/day	1.548.576
3	Domestic needs	liters/day	1.548.576
C	**Non-domestic needs**		
	20% of domestic needs	liters/day	309.715
D	**Total requirement**	liters/day	1.858.291
		liters/second	21,51
E	**Water loss**		
	% water loss	%	20
	Amount of water loss	liters/second	4,3
F	**Average water requirement**	liters/second	25,81
G	**Maximum water requirement**		
1	Coefficient factor	_	1,2
2	Water requirement	liters/second	30,97

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No	Information	Unit	Year 2038
H	**Peak hour needs**		
1	Coefficient factor	_	2
2	Water requirement	liters/second	51,62

The water need that will be used in the calculation is the maximum water need, where the need from the Penida service area is 92.52 liters/second while the need from the Guyangan service area is 30.97 liters/second. Water needs in the Guyangan service area can still be met in the plan year, but water needs in the Penida service area are still experiencing a deficit of 22.52 liters/second. With changes in service areas, the water distribution scheme also changes. Optimization of the drainage scheme can be seen in Figure 4 and Figure 5 below.

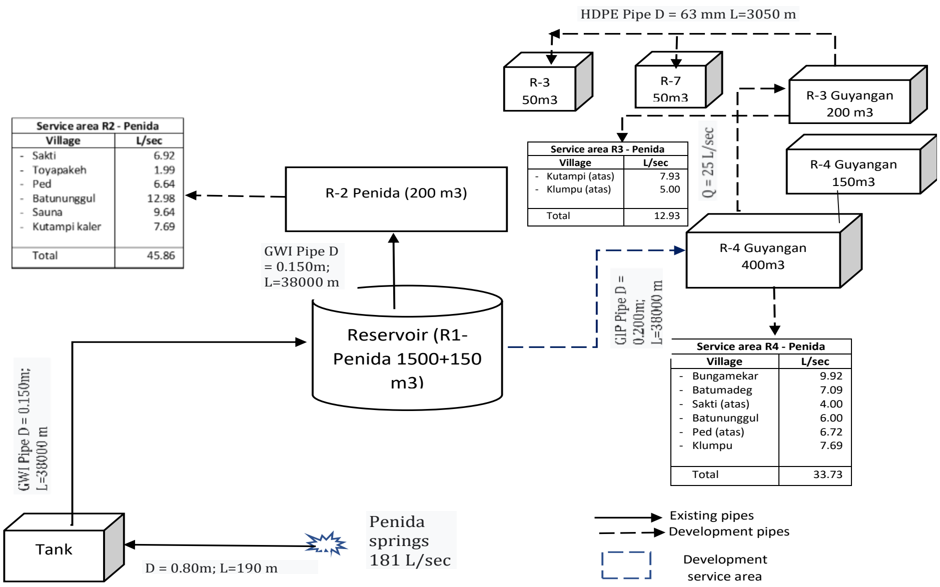

Figure 4. Optimization of the Penida Regional Service Network

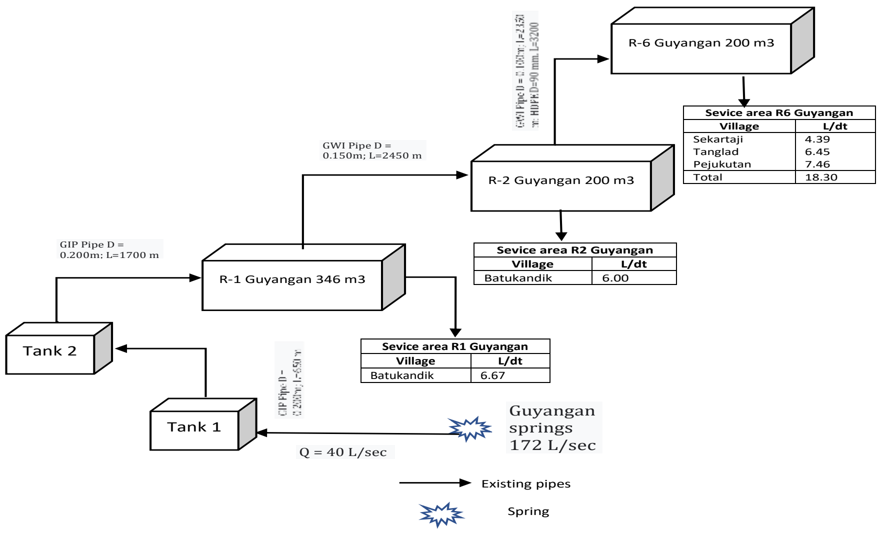

Figure 5. Optimization of the Guyangan Service Area Network

Hydraulic analysis is needed so that the flow rate and amount of water can be achieved as expected. The water need that will be used in the calculation is the maximum water need, where the need from the Penida service area is 92.52 liters/second while the need from the Guyangan service area is 30.97

liters/second. The Penida service area, which will experience a deficit of 22.52 liters/second in the plan year, is a problem that requires optimization of the transmission network. The production capacity of Guyangan spring water currently reaches 40 liters/second, the needs in the Guyangan service area can still be met until the planning year. There is a need for a solution to overcome this condition so that water needs in the Penida service area can be met until the end of the planning year. Analysis of the dimensions of the transmission pipeline network for the development of the Penida and Guyangan springs can be seen in tables 3 and 4.

Table 3. Analysis of transmission pipe dimensions in the development of Penida springs

No	Pipe Segment	Elevation		Length (m)	Discharge (Q) (m^3/dt)	Flow Rate(V) m/dt		Inner Diameter (D) m		(Hf)	(Hm)
		Sta 0	Sta 0+1			Calculate	Use	Calculate	Use		
1	SMA - R1 Penida	3	164	3790	0,09252	2,83	1,150	0,20	0,32	17,966	3,103
2	R1 Penida - R2 Penida	164	147	300	0,04586	2,69	0,934	0,15	0,25	1,290	0,291
3	R1 Penida - R4 Guyangan	164	348	7800	0,04666	1,89	0,951	0,18	0,25	34,638	3,661
4	R4 Guyangan - R3 Guyangan	348	493	4900	0,01293	1,52	0,263	0,10	0,25	2,026	0,182
5	R3 Guyangan - R5 Guyangan	493	512	2950	0,01293	1,08	0,412	0,12	0,20	3,612	0,254
6	R3 Guyangan - R7 Guyangan	493	492	1600	0,01293	1,08	0,412	0,12	0,20	1,959	0,278

Table 4. Analysis of transmission pipe dimensions in the development of Guyangan springs

No	Pipe Segment	Discharge (Q) (m3/s)	Pump Head	Used Head	Used Power (Hp)
1	SMA - Bak 2 Guyangan	0.03097	165.352	170	93,6
2	Bak 2 Guyangan - R1 Guyangan	0.03097	100.433	105	57,81
3	R1 Guyangan - R2 Guyangan	0.02597	68.680	70	32,32
4	R2 Guyangan - R6 Guyangan	0.01830	132.385	155	50,43

The planned reservoir capacity will be used to accommodate water production capacity which has been adjusted to the projected water needs in accordance with the planning year. Reservoir capacity is calculated based on the maximum daily demand in the villages in the planning area. The existing drinking water supply system that utilizes the Penida-spring has two reservoirs that are operational, namely the round reservoir with a capacity of 1500 m3 and R-2 Penida with a capacity of 200 m3. These two reservoirs have met the reservoir needs for the Penida service area.

The drinking water supply system that utilizes Guyangan springs has seven operational reservoirs, namely R-1 with a capacity of 346 m^3, R-2 with a capacity of 200 m3, R-3 with a capacity of 200 m^3, R-4 with a capacity of 400 m3, R-5 with a capacity of 50 m3, R-6 with a capacity of 50 m3, and R-7 with a capacity of 200 m^3. If the seven reservoirs are combined, the total volume is 1,246 m3, thus meeting the reservoir needs for the Guyangan service area according to the projection year. The flow of the Penida and Guyangan springs to the reservoir uses a pump. Calculation of pump flow and head requirements according to tables 5 and 6.

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Table 5. Penida Network Pump Head and Power

No	Pipe Segment	Discharge (Q) (m3/s)	Pump Head	Used Head	Used Power (Hp)
1	SMA - R1 Penida	0.09252	182,069	185	304,29
2	R1 Penida - R4 Guyangan	0.04666	222,299	225	186,64
3	R4 Guyangan - R3 Guyangan	0.01293	147,207	170	39,08
4	R3 Guyangan - R5 Guyangan	0.01293	22,865	30	6,9

Table 6. Head and Pump Power of the Guyangan Network

No	Pipe Segment	Discharge (Q) (m3/s)	Pump Head	Used Head	Used Power (Hp)
1	SMA - Bak 2 Guyangan	0.03097	165.352	170	93,6
2	Bak 2 Guyangan - R1 Guyangan	0.03097	100.433	105	57,81
3	R1 Guyangan - R2 Guyangan	0.02597	68.680	70	32,32
4	R2 Guyangan - R6 Guyangan	0.01830	132.385	155	50,43

The data input process on Epanet is carried out after calculating the amount of water needed for each service area, reservoir capacity, and segmentation of pipe and pump dimensions. The water requirement in the Penida service area is 90.52 liters/second, while for the Guyangan service area the water requirement is 30.97 liters/second. These two discharges will be used in this modeling scheme. The modeling scheme is drawn by drawing the objects that make up the pipe network model in Epanet which include reservoirs, junctions, pumps and tanks, followed by drawing the pipes that connect these nodes/junctions. The running results on Epanet show that the running process has been successful.

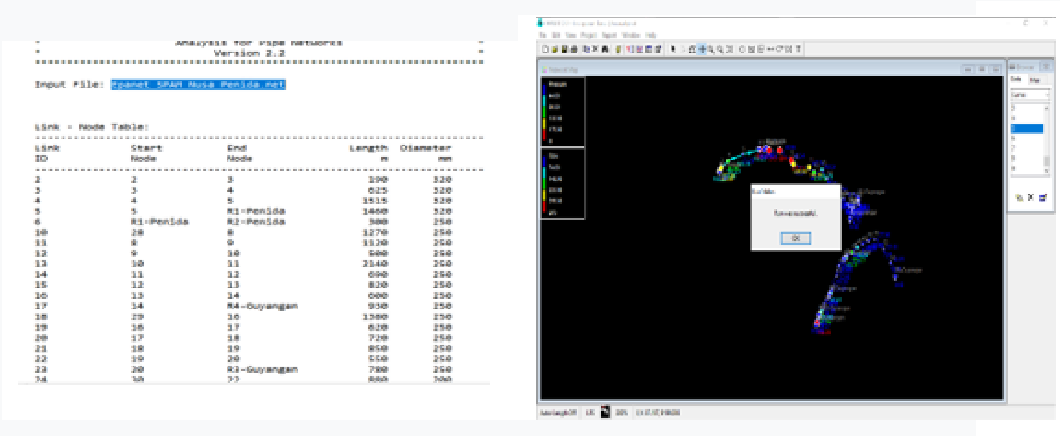

Figure 6. Result of Epanet Analysis

CONCLUSION

Based on the discussion and analysis that has been carried out, it can be concluded as follows: 1) the Drinking Water Supply System (SPAM) on Nusa Penida Island utilizes the two springs Penida and Guyangan as the main source to meet the community's raw water needs. The production capacity for the Penida-spring is 70 liters/second, while for the Guyangan spring it is 40 liters/second. The raw water requirement at the Nusa Penida SPAM for the 2038 planning year is 123.49 liters/second for Nusa Penida Island, which is divided into 92.52 liters/second for the Penida service area and 30.97 liters/second for the Guyangan service area, 2) the Penida service area is still experiencing a deficit of 22.52 liters/second for the 2038 planning year. The addition of a pump with a flow rate of 25 liters/second as well as adjusting the dimensions and pipe accessories at the Penida springs could be a solution to overcome this deficit condition.

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REFERENCES

[1] Kornita, S. E. (2020). Strategi Pemenuhan kebutuhan masyarakat terhadap air bersih di kabupaten Bengkalis. *Jurnal Samudra Ekonomi Dan Bisnis*, *11*(2), 166–181.

[2] Kameo, T. B., Taryana, D., & Astuti, I. S. (2023). Evaluasi potensi mata air dalam pemenuhan kebutuhan air bersih Desa Baumata Kecamatan Taebenu, Kabupaten Kupang. *Jurnal Integrasi Dan Harmoni Inovatif Ilmu-Ilmu Sosial*, *3*(7), 784–794.

[3] Sudipa, N. (2024). Strategi Pengelolaan Sistem Penyediaan Air Minum (SPAM) yang Berkelanjutan di Pulau Nusa Penida: Drinking Water Supply System Management Strategy (SPAM) Sustainable development on Nusa Penida Island. *Jurnal Alam Lestari*, *9*(1), 39–51.

[4] Sudipa, N., & Ariantana, K. (2023). DAMPAK SISTEM PENGELOLAAN AIR MINUM TERHADAP SOSIAL BUDAYA MASYARAKAT DI PULAU NUSA PENIDA. *PARIWISATA BUDAYA: JURNAL ILMIAH AGAMA DAN BUDAYA*, *8*(2), 205–213.

[5] Hajia, M. C., Binilang, A., & Wuisan, E. M. (2015). Perencanaan sistem penyediaan air bersih Di desa taratara kecamatan tomohon barat. *TEKNO*, *13*(64).

[6] Kurniawan, A., Priyanto, A., Suripin, S., & Salamun, S. (2014). Perencanaan sistem penyediaan air bersih PDAM kota salatiga. *Jurnal Karya Teknik Sipil*, *3*(4), 985–994.

[7] P[l], I. P. G. S., Arsana[l], I. G. N. K., & Sanjaya, I. P. Y. (2014). Perencanaan Sistem Jaringan Distribusi Penyediaan Air Minum Pedesaan Di Desa Kubu Kecamatan Kubu. *Jurnal Ilmiah Teknik Sipil Vol*, *18*(2).

[8] Singal, R. Z., & Jamal, N. A. (2022). Perencanaan sistem jaringan distribusi air bersih (Studi kasus Desa Panca Agung Kabupaten Bulungan). *Selodang Mayang: Jurnal Ilmiah Badan Perencanaan Pembangunan Daerah Kabupaten Indragiri Hilir*, *8*(2), 108–119.

[9] Arsana, I., Yekti, M. I., & Parwita, I. G. L. M. (2024). *Buku Ajar Mekanika Fluida dan Hidraulika*. Kaizen Media Publishing.

[10] Kerta, D. R. I. I. G. N., Arsana, M. T., & Astiti, S. P. C. (2023). *Buku Ajar Penyediaan Air Minum Berbasis Masyarakat*. Kaizen Media Publishing.

[11] Radianta, T. (2009). Hidraulika Sistem Jaringan Perpipaan Air Minum. *Yogyakarta: Fakultas Teknik. Univeritas Gajah Mada*.

[12] Agunwamba, J. C., Ekwule, O. R., & Nnaji, C. C. (2018). Performance evaluation of a municipal water distribution system using Water CAD and Epanet. *Journal of Water, Sanitation and Hygiene for Development*, *8*(3), 459–467.

[13] Menapace, A., Avesani, D., Righetti, M., Bellin, A., & Pisaturo, G. (2018). Uniformly distributed demand EPANET extension. *Water Resources Management*, *32*, 2165–2180.

[14] Irwanto, B., Musthofa, M. Y., Kumalasari, A. D., Rahayu, D. P., Fauzia, Y., Maulidin, A. A., Rahayu, L., Mufarrochah, M., & Azizah, Z. (2023). PEMANFAATAN TEKNOLOGI MEMBRAN REVERSE OSMOSIS (RO) UNTUK PENGOLAHAN AIR BERSIH DI

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KAMPUNG NELAYAN, DESA KEDUNGPANDAN, KECAMATAN JABON, KABUPATEN SIDOARJO. Jurnal Terapan Abdimas, 8(2), 203–208.

[15] Sefentry, A. (2020). Pemanfaatan teknologi membran reverse osmosis (RO) pada proses pengolahan air laut menjadi air bersih. *Jurnal Redoks*, *5*(1), 58–64.

[16] Harmayani, K. D., Konsukartha, G. M., & Arsana, I. G. N. K. (2017). Analisis Potensi Sumber Daya Air Di Nusa Penida. *Seminar Nasional Sains Dan Teknologi*, 1–8.

[17] Sugiyono, S., & Lestari, P. (2021). *Metode penelitian komunikasi (Kuantitatif, kualitatif, dan cara mudah menulis artikel pada jurnal internasional)*. Alvabeta Bandung, CV.

[18] S Syaiful, AA Hasanah, DM Lestari. (2024). PERENCANAAN BANGUNAN PENAMPUNG AIR SEDERHANA UNTUK KEBUTUHAN MASYARAKAT DI KAMPUNG SINAR HARAPAN. Jurnal Pengabdian Masyarakat UIKA Jaya SINKRON 2 (3), 224-236

[19] BPS. 2022.