The International Conference on Geo-Informatics for Spatial-Infrastructure Development in Earth & Allied Sciences (GIS-IDEAS), Thailand, Sep 2 - 4 2021

STUDY ON EXTENDING THE SUPPLY WATER PIPE NETWORK AT BINH THUY DISTRICT, CAN THO CITY

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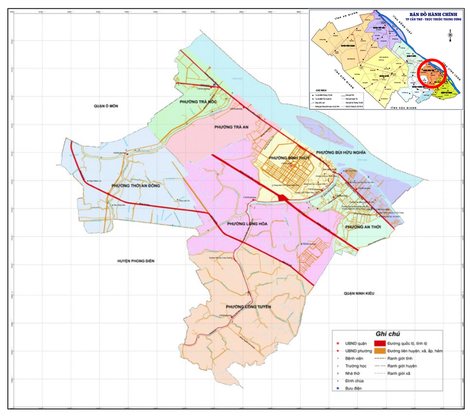
1. BACKGROUND

Binh Thuy has total 32,611 households, but only 27,487 households reach to tap water 84.3%.

There are 3 water suppliers (Tra Noc, Long Hoa, Can Tho 2) took water from Hau and Binh Thuy rivers, treated and supply 64.416 m^3 tap water per day. The water consumption of 130 - 150 L/person per day lower than the national standard of 300 - 400 L/person per day according to the national standard for construction TCXDVN 33:2006.



For water pressures, it is 4 - 5 kg/cm^2 (40 - 50 mH_2O) at the pipes' head, 0,7 - 2,0 kg/cm^2 (7 - 20 mH_2O) along pipeline, 0,3 kg/cm^2 (3 mH_2O) at the pipes' end that need to expand to supplied an sufficient quantity of water at the desired pressure. The leakage water of 24% is in the middle ranking of water suppliers.

By the water supply master plan to 2030, 100% household reach to tap water, the lost water rate is 15%. This study aimed to evaluate the current water supply system in relation to present and future water demand.

2. METHODOLOGY

The design and necessary data of water distribution system, the length and diameter of pipeline was collected.

The demand of nodes was estimated through field investigation, the elevations of the nodes were found by using ArcGIS 10.4 and Google Earth Pro.

The map of existing water distribution layout includes length and diameter of the pipe network with their relative positions. AutoCAD 2014 is used to replicate the layout and to prepare the background of the design outline. Then the raw file of the AutoCAD was exported to EPANET 2.0. Using AutoCAD file as backdrop the pipe network was drawn and the nodes were placed in the EPANET 2.0.

Multiple new structures are expected to be constructed as per future master plan. After assigning all necessary data, the model was completely prepared. The model was simulated, at first for present water demand, and then for future water demand. The diameter of the pipes was changed to find out the required diameter that results in pressure between the acceptable ranges if necessary. Finally, the reliability of the water distribution system was checked for the future demand as per future master plan.

3. RESULTS

According to collected data at study site, the maximum water supply flow rate to the network is 506,292.3 m^3/month and 17,683 m^3/day. The highest water flow rate appears at 9:00 AM (Fig. 1).

Water supply network has been found as tree system. After assigning all the necessary data of nodes and pipes, the final simulation has been run. EPANET 2.0 has provided pressure at different nodes and flow rate in the pipes.

Existing water supply network

Table 1. Water flow transfer in the max month

Day	Flow (m^3/day)	Day	Flow (m^3/day)
1	12,815.1	17	15,906.8
2	15,212.4	18	17,493.7
3	17,453.5	19	16,180.9
4	17,270.5	20	15,072.9
5	15,631.6	21	16,116.2
6	17,309.4	22	15,842.7
7	14,980.3	23	15,625.2
8	16,621.3	24	16,469.3
9	16,651.9	25	17,010.8
10	16,781.3	26	17,117.4
11	17,448.2	27	**17,683.0**
12	16,679.9	28	16,703.1
13	16,087.7	29	15,296.3
14	15,752.3	30	17,555.5
15	16,226.5	31	16,855.5
16	16,437.3	**Total**	**506,292.3**

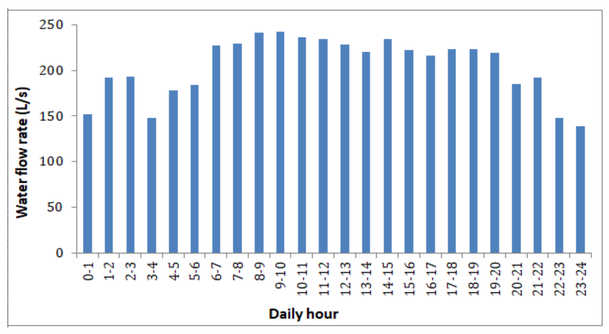


Fig 1. Water flow in hour

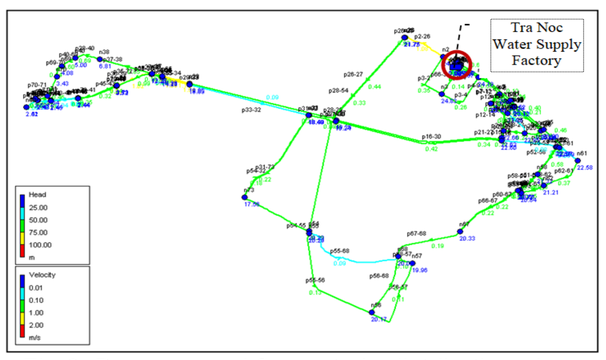
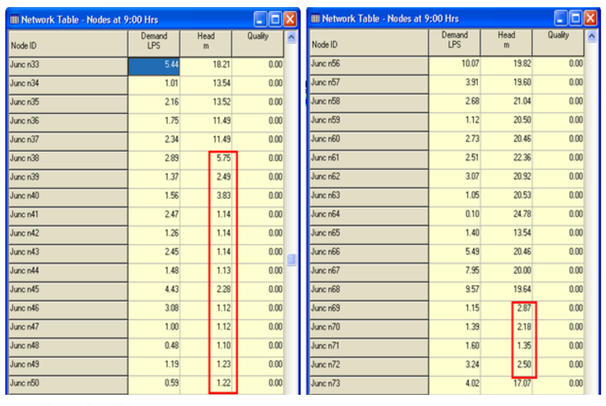


Fig 2. Pressure and flow rate in distribution pipes



Network Table - Nodes at 9:00 Hrs

Node ID	Demand LPS	Head m	Quality
Junc n33	5.44	18.21	0.00
Junc n34	1.01	13.54	0.00
Junc n35	2.16	13.52	0.00
Junc n36	1.75	11.49	0.00
Junc n37	2.34	11.49	0.00
Junc n38	2.89	5.75	0.00
Junc n39	1.37	2.49	0.00
Junc n40	1.56	3.83	0.00
Junc n41	2.47	1.14	0.00
Junc n42	1.26	1.14	0.00
Junc n43	2.45	1.14	0.00
Junc n44	1.48	1.13	0.00
Junc n45	4.43	2.28	0.00
Junc n46	3.08	1.12	0.00
Junc n47	1.00	1.12	0.00
Junc n48	0.48	1.10	0.00
Junc n49	1.19	1.23	0.00
Junc n50	0.59	1.22	0.00

Network Table - Nodes at 9:00 Hrs

Node ID	Demand LPS	Head m	Quality
Junc n56	10.07	19.82	0.00
Junc n57	3.91	19.60	0.00
Junc n58	2.68	21.04	0.00
Junc n59	1.12	20.50	0.00
Junc n60	2.73	20.46	0.00
Junc n61	2.51	22.36	0.00
Junc n62	3.07	20.92	0.00
Junc n63	1.05	20.53	0.00
Junc n64	0.10	24.78	0.00
Junc n65	1.40	13.54	0.00
Junc n66	5.49	20.46	0.00
Junc n67	7.95	20.00	0.00
Junc n68	9.57	19.64	0.00
Junc n69	1.15	2.87	0.00
Junc n70	1.39	2.18	0.00
Junc n71	1.60	1.35	0.00
Junc n72	3.24	2.50	0.00
Junc n73	4.02	17.07	0.00

Fig 3. The nodes' pressures at max water use

Fig. 2 shown that all the nodes at the head of water distribution system have proper pressure (≥ 10 mH_2O) in them to fulfill the demand by the supply of water, but not for nodes at the end of pipeline. There are 17/73 nodes (23.3%) located at the end of pipes have pressure less than 10 mH_2O which need to improve to satisfy the water demand at these nodes (Fig. 3).

It see that the flow rate in the pipeline differ to the water pressure in the nodes. To increase the pressure at the nodes, the velocity in the pipes will decrease. It is require a larger pipe diameter comparing to current diameter.

Future water supply network

After simulating water supply network at new water demand, new water flow rate, but kept the former pressure, EPANET model gave no results (Fig. 4). It could be said that insufficiency of pumping capacity caused of this result.

By increase the pumping capacity at the pipes' head, all nodes have high pressure (> 10 mH_20) to supply an sufficient water to all household (Fig. 5).

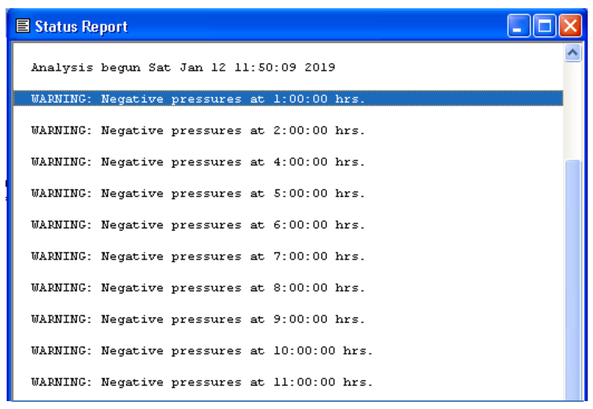


Fig 4. Result in new water demand, old pressure

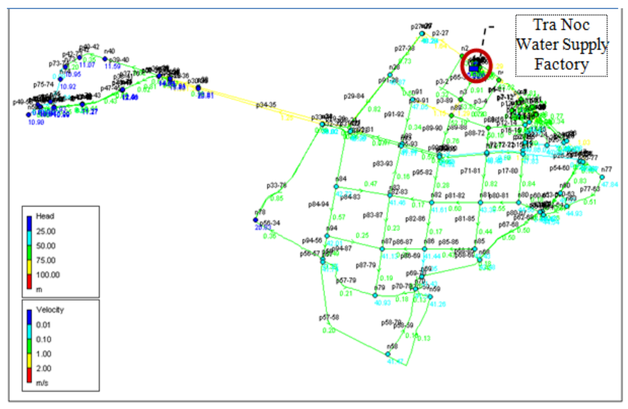


Fig 5. Water supply network as master plan

Table 2. Budget to improve the water supply network as master plan

Code	Item	Unit	Quantity	Price (VND)	Amount (VND)
AB.11614	Dig the ditch for piping works	m^3	4,302	690.813	2.972.340.371
BB.19113	Install the pipe ϕ300 mm	100 m	3.530	75.748.362	267.391.718
BB.19111	Install the pipe ϕ200 mm	100 m	193.989	32.267.242	6.259.490.008
BB.19108	Install the pipe ϕ100 mm	100 m	11.170	10.541.436	117.747.840
AB.13122	Backfill K = 0,90	m^3	3,659	149.455	546.980.401
TT	Install pumping	pack	2	122.171.928	244.343.856
	Total				10.408.294.194

Solutions for water leakage

- Well performing the system of the flow record meter, the flow adjust valve, and optimizing working mode of the pipeline;
- Upgrade or replace the old pipeline;
- Quick assessment and repair the water leakage;
- Install flow meter to all customer;
- Capacity building to staff of water supply factory;
- Apply 4.0 to water consumption record;
- Take control of the network pressure;
- Monitor network activities;
- Divide the water network into sections;
- Create more awareness on water saving to customers.

4. CONCLUSIONS

Apply EPANET 2.0 model running the hydraulic simulation for water supply network in Binh Thuy district at the existing and future conditions obtained the results are:

- A model has been developed for the current water distribution system. The existing water distribution system could not supply sufficient water to all nodes as 17/73 nodes have low pressure.
- Different scenarios has been developed to evaluate the future water distribution demand as master plan.
- A management system in relation to the different scenarios has also been developed. It has been found that if install a pumping station at the head of pipes, and increase the diameter of pipes, then all the nodes have sufficient pressure.

Acknowledgement: The authors gratefully acknowledge the fund support from the Erasmus+ programme of the European Commission on this study under the project INOW-ASIA (Ref. 619225-EPP-1-2020-1-ES-EPPKA2-CBHE-JP).