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Research Article

Flood Management in the Babon River Watershed, Semarang City

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Abstract.
Floods are natural disasters that often occur during the rainy season, Apart from that, there are also tidal floods which are caused by global warming. This problem occurs in the city of Semarang, especially northern Semarang, specifically the northern coast floods that occurred in 2021 in the city of Semarang including Genuk, Kaligawe, Tawang Station, Tanjungmas, and Karangayu. Flood disasters are caused by high rainfall, while tidal floods are caused by high tides and inundate the roads and houses of residents on the north coast of Semarang city. To handle this problem, the current government has built embankments in the Sringin River, which is equipped with a ponpa, Tenggang River, Babon River, Semarang River, Banger River, and others. The embankment is equipped with a pump so that when the water from upstream to downstream is high, the water is pumped into the sea. The aim is to determine one of the annual discharges of the Baboon river, as well as to determine the capacity of the Baboon river's longstorage capacity. Apart from that, there is a method for dealing with tidal floods, namely using Baboon River Longstorage which is equipped with a pump. If high tide floods roads and houses, the pump is turned on, whereas if the water recedes and does not inundate residential areas, the pump is turned off. Flood control analysis was calculated using the HEC-RAS program simulation using a return period of 50 years. Based on calculations using the HEC-RAS program, the flood discharge is 2,529 m^3/sec. The high tide elevation is + 1.67 m, while the normal water level is -0.5 m. The implication of the results of this research is to provide input to local governments when discussing flood management meetings in the city of Semarang.

Keywords: babon, longstorage, hec-ras

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1. Introduction

Floods are natural disasters that we often encounter during the rainy season, apart from tidal floods which are caused by global warming. This problem occurs in the city of Semarang, especially North Semarang, specifically the north coast of the Java Sea Floods that occurred in 2021 in the city of Semarang include Genuk, Kaligawe, Tawang Station, Tanjungmas, Karangayu, The flood disaster was caused by high rainfall, while

tidal floods were caused by high tides and inundated the roads and houses of residents on the north coast of Semarang city[1].

To handle this problem, the current government has built embankments including the Sringin River which is equipped with a ponpa, the Tenggang River, the Babon River, the Semarang River, the Banger River, and others.The embankment is equipped with a pump so that when the water from upstream to downstream is high, the water is pumped into the sea. Floods in the city of Semarang are caused by:

1. The geographical condition of the city of Semarang has potential flood areas, because there are areas located in high areas and areas located in lowland areas, causing flooding originating from the southern area of Semarang City and Semarang district.
2. there is a change in land use from rubber forests to housing in the Mijen sub-district area
3. pressing of hills in several places results in changes in water flow patterns, erosion, As well as non-technical problems, namely the behavior of people who do not care about environmental maintenance, such as throwing rubbish in waterways and anywhere and blocking drainage channels.[2][3]

There are also high tides and land subsidence which are the main threats in the city of Semarang. Land subsidence is basically a change (deformation) of the land surface vertically downwards from a high reference plane[4][5] Climate change has resulted in changes in the characteristics of rainfall in the East Flood Canal watershed, namely that annual rainfall levels and maximum daily rainfall tend to increase, while the number of rainy days tends to decrease, so that annual rainfall increases by an average of 22.64 mm/year while maximum daily rainfall increased by an average of 2.56 mm/year, and the number of rainy days decreased by an average of 4 days/year [6][7].

The research objectives are: To determine the discharge of the Babon River and to determine the longstorage capacity of the Babon River.

2. Method

The location of this research was carried out in the Babon Watershed, Genuk District, Semarang City. The location is as shown in Figure 1.

The research method uses qualitative methods, namely according to conditions in the field, which consist of: Rainfall Data, Topographic Data, long storage capacity, pump

Figure 1: Research location (source Googleeth, 2023).

capacity, using references from the Karangroto Rain Station. The analytical methods used include:

2.1. Hydrological Analysis

Determine the location of the rain station closest to the babon watershed, namely the Karangroto Rain Station The data used is rainfall data and catchment area, In the hydrological analysis, we will discuss the steps to determine the planned flood discharge. The steps to determine the planned flood discharge are to calculate the average regional rainfall carry out alignment tests to determine the method that meets the distribution test, calculate rain intensity and planned flood discharge. Calculation of Regional Average Rainfall Using the Thiessen Method[8]

2.2. Hydraulic Analysis

The aim is to determine the potential river discharge which is calculated based on the results of the difference between the return flood discharge and the discharge capacity of each river section The return period flood discharge is related to the peak flood time This means that rainfall that falls into the watershed area with high rainfall intensity from the starting point to the destination point causes normal times to change to peak flood times. The duration of the flood peak is the basis for analyzing the longstorage volume so that the amount of flowing river discharge can be accommodated with the planned longstorage volume dimensions.[9][10]

2.3. Analysis of Planned Flood Discharge

Calculation planning and methods for improving flood discharge using HEC-RAS 5.0.1 modeling[11][12].

3. Result and Discussion

Results The hydrological analysis in this study uses annual rainfall data from the closest station to the Babon watershed, namely the Karangroto rainfall station for 10 years from 2001 to 2020. From this data, an analysis was carried out to calculate the maximum average rainfall statistical parameter analysis and distribution testing to select 1 (one) type of distribution used in hydrological calculations. Based on the analysis carried out, the Gumbel distribution was selected which met the requirements for statistical parameters and distribution testing Furthermore, the Gumbel distribution is used to analyze rainfall for return periods of 2, 5, 10, 25 and 50 years. The results of the planned return period rainfall calculation can be seen in **Table 1.**

TABLE 1: Return Period (years).

Return period (years)	Average rainfall (mm)	Standard Deviation	Variable Reduction	Yn	Sn	Precipitation Plan (mm)
2	113.100	22.196	0.367	0.5236	1.062	109.817
5	113.100	22.196	1.500	0.5236	1.062	133.506
10	113.100	22.196	2.250	0.5236	1.062	149.190
25	113.100	22.196	3.199	0.5236	1.062	169.007
50	113.100	22.196	3.902	0.5236	1.062	183.709

Source: Analysis Results, 2023

Based on return period rainfall values, drainage coefficient, river length and catchment area The Babon River was analyzed to calculate the planned flood discharge using the Nakayasu Synthetic Unit Hydrograph method. This planned flood discharge calculation is used as an estimate of the magnitude of the peak discharge in the next few years that will be accommodated by the Babon River, which will then be carried out by hydraulic analysis. [13][14]The results of the analysis of planned flood discharge with return periods of 2, 5, 10, 25 and 50 years using the Nakayasu Synthetic Unit Hydrograph method can be seen in **Table 2.**

Based on the return period flood analysis as in table 2 above, the data used for the analysis is planned flood discharge data Next, the condition of the Babon River in accommodating flood discharge was modeled using the HEC-RAS version 5.0.7

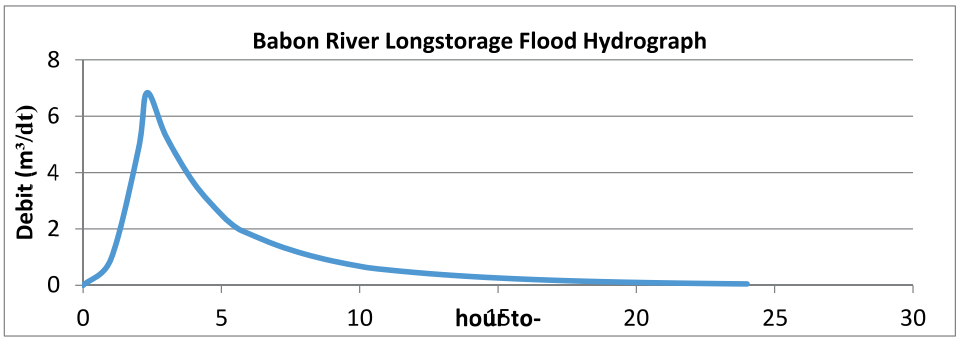

Figure 2: Babon River Flood Discharge hydrograph.

TABLE 2: Babon River Planned Flood Discharge Using the Nakayasu Method.

Return period (years)		Debit (m^3/sec)
2		155.573
5		189.132
10		211.352
25		239.426
50		260.252

Source: Analysis Results, 2023

program. Modeling using the HEC-RAS program uses several data, such as modeling this river scheme using image data of the existing conditions of the cross section, lengthwise and the situation of the Babon rive[15]

Then, in analyzing the flood water level, the modeling uses the planned flood discharge and the Manning coefficient of each section or station (Sta). The modeling results were obtained after selecting the flow type, entering boundary condition parameters that correspond to the original conditions and running the HEC-RAS program, as can be seen in **Figure 3**.

Based on running HEC-RAS 5.0.7 using planned flood discharge for 2, 5, 10, 25 and 50 years it was found that the condition of the Babon River in general is no longer able to accommodate water at all stations, which is calculated on average, the water will overflow over the embankments.The condition of the Babon River water which overflows over the embankment has varying heights of runoff on the left and right embankments of the river. The highest runoff in the 2 year return period was 1,874 m at Sta 13+25, in the 5 year return period it was 2,099 m in Sta 13+25, in the 10 year return period it was 2,240 m in Sta 13+25, in the 25 year return period it was 2,409 m at Sta 13+25 and at the 50 year return period of 2,529 m at Sta 13+25. Flood conditions that occur from the HEC-RAS simulation results at all Sta can be seen in **Figure 4.**

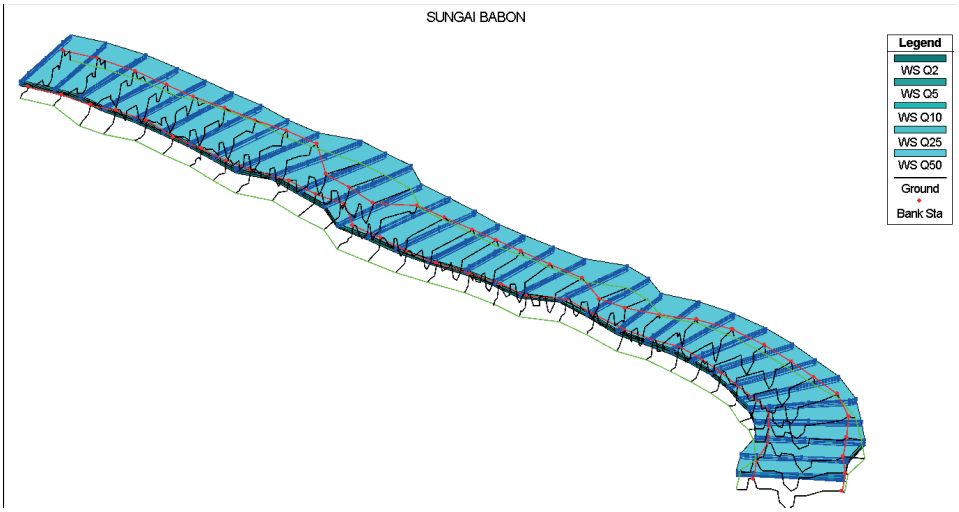

Figure 3: The direction of the Babon River water flow.

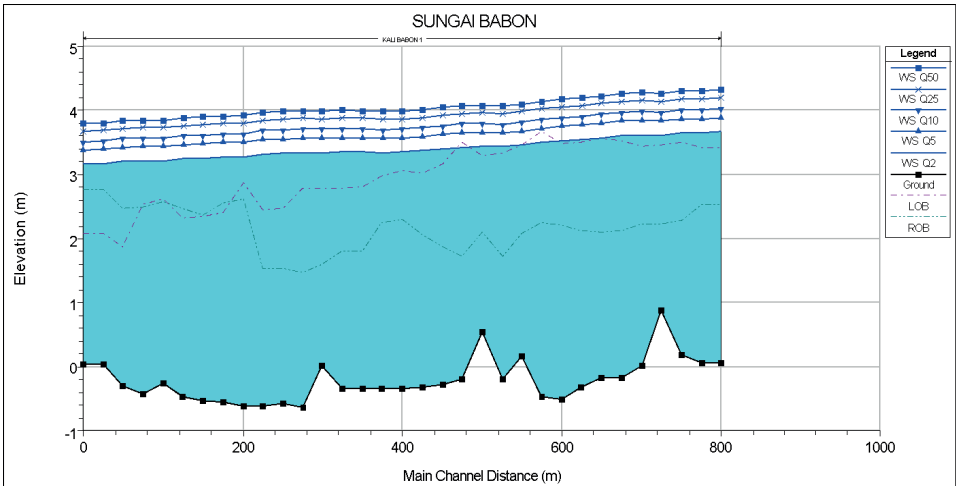

Figure 4: Longitudinal Section of the Babon River.

4. Conclusion

The problem of flood disasters is a problem that is generally known by many people through social and electronic media, through cyberspace, through observations in the field and others.The floods that occurred in Semarang several years ago were caused by high rainfall according to observations, flooding in Semarang is an annual cycle based on an analysis of flooding problems in the Baboon watershed area and from the results of the analysis of annual planned discharge for a 50 year return period and the rain intensity was 183,708 mm meanwhile, in the simulation using HEC-RAS software, the peak flood discharge entering Longstorage was 260,525 m3/sec.For the lonstorage capacity of the Babon River, when the flood level is 50, the embankment must be raised by 2.529 meters because according to the analysis of the annual cycle with a return

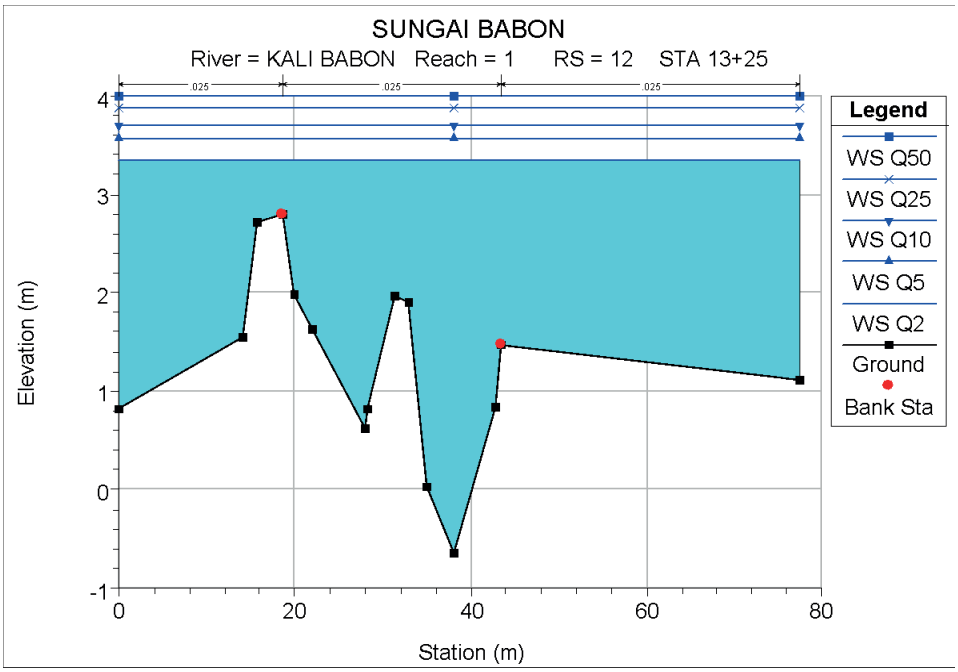

Figure 5: Cross Section Condition Sta 13+25.

period of 50 years, the Babon River cannot accommodate water, so the Babon River embankment must be raised by 0.56 m.

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References

[1] Ikhwanudin SI. Wahyudi, eta Soedarsono, «Methods for Handling Rob Floods in the Banger River Basin in Semarang City», J. Phys. Conf. Ser., libk. 1625, zenb. 1, 2020, https://doi.org/10.1088/1742-6596/1625/1/012041...

[2] Suliyati T. «Penataan Drainase Perkotaan Berbasis Budaya Dalam Upaya Penanganan Banjir Di Kota Semarang», Humanika, libk. 19, zenb. 1, or. 59, 2016, https://doi.org/10.14710/humanika.19.1.59-69...

[3] M. Perkiraan Laju Aliran Puncak Sebagai Dasar Analisis Sistem Drainase di Daerah Aliran Sungai Wilayah Semarang Berbantuan SIG, T. Wismarini, eta D. Handayani Untari Ningsih dan Fatkhul Amin, «Metode Perkiraan Laju Aliran Puncak (Debit Air)

sebagai Dasar Analisis Sistem Drainase di Daerah Aliran Sungai Wilayah Semarang Berbantuan SIG», J. Teknol. Inf. Din., libk. 16, zenb. 2, or. 124–132, 2011.

[4] Wahyudi SI, Faiqun M, Le Bras G. «Problems, Causes and Handling Analysis of Tidal Flood, Erosion and Sedimentation in Northern Coast of Central Java: Review and Recommendation», zenb. 04, or. 65–69, 2012.

[5] Adi HP, Wahyudi SI. «Study of Institutional Evaluation in Drainage System Management of Semarang as Delta City», Proc. Int. Conf. "Issue, Manag. Eng. Sustain. Dev. Delta Areas, UNISSULA Semarang, libk. 1, zenb. 2, or. 1–7, 2015.

[6] Suripin S, Kurniani D. «Pengaruh Perubahan Iklim terhadap Hidrograf Banjir di Kanal Banjir Timur Kota Semarang», Media Komun. Tek. Sipil, libk. 22, zenb. 2, or. 119, 2016, https://doi.org/10.14710/mkts.v22i2.12881...

[7] Budinetro HS, Rahayu S, Praja TA, Taufiq A, Junarsa D. «Semarang City Flood Control Strategy», J. Sumber Daya Air, libk. 8, zenb. 2, or. 141–156, 2012.

[8] Diya SG, et al., «Flood simulation model using XP-SWMM along Terengganu River, Malaysia», J. Fundam. Appl. Sci., libk. 9, zenb. 2S, or. 66, 2018, https://doi.org/10.4314/jfas.v9i2s.5...

[9] C. E. Departement, U. Islam, S. Agung, eta J. R. Kaligawe, «Banger Watershed Management in», libk. 11, zenb. 4, or. 106–114, 2020.

[10] Ikhwanudin AR, Yudnangrum F, Hidayah N. «Penanggulangan banjir di jalan brigjen s. sudiarto kota semarang sta. 0.00 – 8.00», libk. 10, zenb. 2, or. 168–174, 2022.

[11] Udin I, Yudaningrum F, Rossid A. «PENANGGULANGAN BANJIR DI Jl. BRIGJEN S. SUDIARTO, KOTA SEMARANG Sta 0.00-8.00», Matriks Tek. Sipil, libk. 10, zenb. 2, or. 168, 2022, https://doi.org/10.20961/mateksi.v10i2.61219...

[12] I. Artikel, «Pengendalian Banjir Sungai Banger Kota Semarag Dengan Analisa Hec-Ras», libk. 17, zenb. 2, or. 71–79, 2022.

[13] Zhang L, Oyake Y, Morimoto Y, Niwa H, Shibata S. «Flood mitigation function of rain gardens for management of urban storm runoff in Japan», Landsc. Ecol. Eng., libk. 16, zenb. 3, or. 223–232, 2020, https://doi.org/10.1007/s11355-020-00409-8...

[14] Harjanto I, Yudaningrum F, Budiman AK. «Flood Analysis of Babon River (Kang Roto – Banjardowo) Semarang City Indonesia», libk. 65, zenb. 01, or. 8135–8141, 2023.

[15] Wigati R. «Model Analisis Efektivitas Saluran Drainase Menggunakan Software Hec-Ras», Researchgate.Net, zenb. October 2017, 2020.