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Submission date: 07-Jul-2022 09:36AM (UTC+0700)
Submission ID: 1867531740
File name: IJPSAT_Article_M._Faisal_Novriansyah.docx (1.71M)
Word count: 2685
Character count: 13988

Analysis of Water Level Changes on The Lambidaro River For Predicting Involution/Flood

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***Abstract*— Lambidaro River is a water flow that flows with the shape and flow pattern which is influenced by geological factors, soil texture, rocks, soil contours, slope level, and so on. Looking at the flow pattern, the Lambidaro River is a river with a parallel flow pattern or a parallel pattern following the morphology of the river forming which most of the water comes from upstream (2) the Sekanak River and the Musi River. From the morphology of the river forming, most of this river should be a catchment and final disposal area for water flows from the Sekanak river. At this time the area which has become commensurate with the flow in the Lambidaro river area has changed a lot, from what was once a swamp area, now it has turned into a residential area, so that at some points the flow has been narrowing the wet cross section of the river due to the large amount of garbage and aquatic plants that grow and do not grow. maintained. The high intensity of rainfall with a long duration in addition to the periodic ebb and flow of the Musi River (3) is the main thing that causes inundation in the area along the Lambidaro river. With the changes in function that occur in the flow of the Lambidaro River, at several points, puddles or floods often occur with the height and duration of inundation varying according to the contours of the area.**

Based on the division of river areas in the city of Palembang, there are 21 sub-watersheds, but only 18 sub-watersheds that lead directly to the Musi river, namely the Rengas Lacak, Gandus, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang sub-watersheds. , Sei Lively, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju.
This research was conducted to obtain a movement pattern at the station under review, namely the main channel of Jakabaring Sport City (JSC) using the HEC-RAS ver 4.1.0 program with rainfall data for a 5-year return period (R_5) and Q_5 flood discharge of 40.87 m^3/sec.
The results showed that the pattern of water flow movement in the main channel of JSC segment 3, especially in the return period of 5 years of rain at Sta. 0 + 000 (P14) there is an overflow as high as 1.50 m both in the return period (R_2, R_5, R_{10}, R_{20} and R_{50}). Meanwhile, over flow height for Sta. 0 + 100 - Sta. 0 + 500 or channel P15-P19 ranges from 0.50 m to 1.00 m and at Sta. 0 + 600 or P_{20} with a return period of R_2, R_5, R_{10}, R_{20} and R_{50} there is no overflow.

***Keywords*—The Lambidaro river; Flood discharge; IDF curve; HEC-RAS program; Water flow**

I. INTRODUCTION

Topographically of Palembang city located at the position of 1040 37' – 1040 52' East Longitude and 20 52' - 30 05 South Latitude is the provincial capital of South Sumatra which is currently developing so rapidly, but in the midst of its development, it is often faced with flooding problems. The southern part of the city of Palembang has a land elevation that tends to be flatter, while the higher location is in the northern part of the city of Palembang. (PUPR Palembang city, 2019)

Palembang city has 108 tributaries, with 4 major rivers crossing the city of Palembang, namely the Musi River, Komering River, Ogan River, and Keramasan River. From the 4 major rivers above, the Musi river is the largest river with an average width of 504 meters and a maximum width of 1,350 meters around Kemaro Island. (Syarifudin, A, 2018)

Based on the division of river areas, there are 21 sub-watersheds, but only 18 sub-watersheds in the city of Palembang which empties directly into the Musi river in the city of Palembang, namely the Rengas Lacak, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang, Sei Selincah, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju. The drainage network system of the city of Palembang is divided into 19 sub-watersheds.(Syarifudin A, 2018)

Due to the relatively flat condition of the Palembang city area, in certain locations it often experiences puddles (floods) caused by the flow of rainwater (run off) which the canal cannot accommodate. In addition, at certain locations, puddles (floods) are also caused by the runoff of the Musi River. Floods that occurred in the city of Palembang caused problems for the Government to evaluate the existing drainage channels. The rainwater drainage channels have been built but need to be reviewed and evaluated to function properly. (Syarifudin A, 2022).

One channel that has an important role in the city of Palembang is the Lambidaro River which is located in the Gandus area, being a river whose part of its flow is run-off from the Sekanak river. With the morphological conditions of natural rivers and artificial rivers which are relatively straight, it does not necessarily make the Lambidaro river flow able to accommodate direct runoff from the Sekanak river, especially when there is heavy rain that coincides with the periodic tidal cycle of the Musi river resulting in overflow at several points on Lambidaro the river. (Edward, R M, 2019)

II. RESEARCH METHODS

This research was carried out in the Lambidaro sub-catchment (Water Catchment Area) which is part of the Sekanak river as shown in the following figure 1 below:

Figure 1. Research location

A. *Materials and tools*

Rainfall data from BMKG Kenten, 2019 as secondary data were analyzed statistically in the form of rainfall analysis using the norm, log-normal, log-pearson type 3 and gumbel method approaches. Based on a certain return period includes a return period of 2 years, 5 years, and 10 years, after that the rainfall intensity is calculated for the first time the concentration time is calculated. Then the rainfall intensity intensity (IDF) curve is made and calculate the planned discharge for each certain return period. HEC-RAS software program ver. 4.1.0 is used to predict the overflow of water in the channel/river at each cross-sectional station based on the results of the topographic survey.

B. *Research methods*

This research was conducted for the first time using empirical methods, including hydrological analysis and hydraulics analysis, then simulation was carried out using the HEC-RAS ver. 4.1.0 program. Hydrological analysis to determine the design rain with a certain return period and get an overview of the IDF (Intensity Duration Curve) curve as well as channel hydraulics analysis to calculate flood discharge and then a simulation is carried out with the help of the HEC-RAS ver. 4.1.0 software program. In the hydraulic analysis, the water level profile is calculated using some data on the design flood discharge and Lambidaro river to obtain a water level profile. In this analysis also used the application program HEC-RAS 4.1.0. After getting the direct runoff discharge, the calculation results are simulated on the existing channel using HEC-RAS 4.1.0. (Istiarto, 2012).

C. Stages, Process and Data Analysis

After the data is collected, it is processed as follows:

a) Rainfall analysis

Rainfall data analysis with frquency analysis, then the selection of frequency distribution with the normal distribution method, normal log, pearson type III log, and gumbel. Then the suitability test to determine the difference in discharge from the calculation results. Conformity test using chi-squared and rainfall intensity with smirnov-kolmogorov.

b) Design Flood Discharge Analysis

Calculating the design flood discharge using the rational equation method previously determined the intensity of rain, time of concentration and runoff.

c) Hydraulic Analysis

This analysis is carried out by calculating the planned flood discharge using the rational formula.

d) Numerical modeling

The HEC-RAS program ver 4.1.0 (open source) is used for modeling the Jakabaring Sport City (JSC) Main Channel to determine the ability of the trough/channel body to accommodate flood discharge within a certain return period.

III. RESULTS AND DISCUSSION

The results of the calculation of the intensity of rain for each return period in a span of 10 minutes. So that IDF curves can be made with the help of Ms. Excel. The following is the shape of the IDF curve from the rain intensity data that has been obtained which is shown in Figure 1.

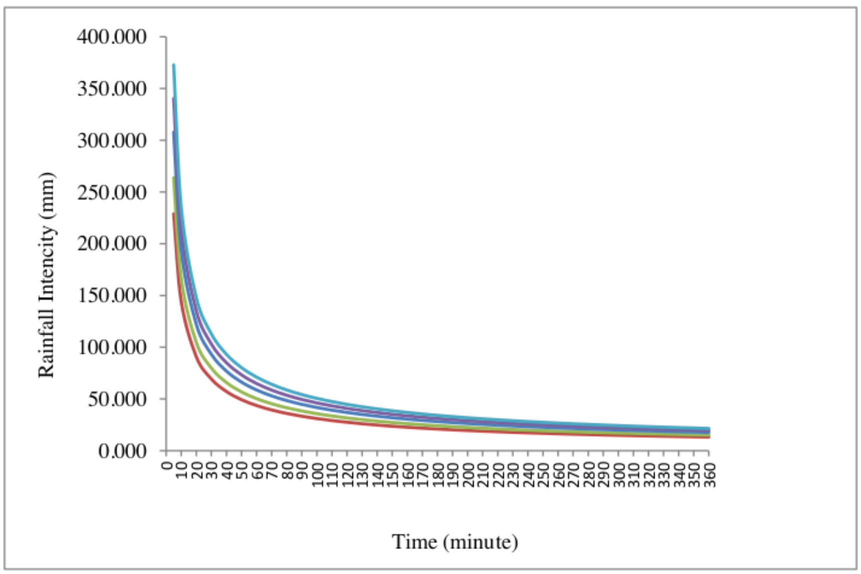

Fig 1. IDF curve graph (Intensity Duration Frequency)

A. Lambidaro debit

To calculate the runoff discharge (Run Off) using the Rational Formula. The results are as in table 1.

TABLE I. THE RESULTS OF THE CALUCULATION OF RUNOFF DISCHARGE

Return Period (Year)	**C**	**I (mm/jam)**	**A (km^2)**	**Q (m^3/det)**
2	0,5864	257,1460	52,09	2,170
5	0,5864	296,2446	52,09	9,005
10	0,5864	345,6414	52,09	11,68
20	0,5864	382,2866	52,09	11,78
50	0,5864	418,6661	52,09	12,79

B. Simulation Results

After inputting data in the HEC-RAS program, then running a test, the simulation results are obtained in the form of a graph of fluctuations in water level changes in each cross section of the Lambidaro river.
The pattern of water flow movement in Lambidari river for the 2 year rain return period (PF2) can be seen as shown below:

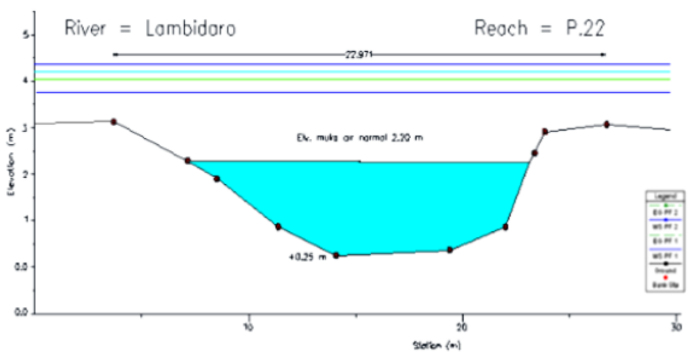

Fig 2. Pattern of water flow movement in the lambidaro river (P.22) with flood discharge return period 2 years(Q2)

In the 2-year return period (R_2) with a planned flood discharge (Q_2) of 2.17 m^3/second, the flow of water along the Lambidaro river does not occur inundation, or the increase in the design flood water level is only 30 cm (+2.50m) from the ground. existing normal water (2.20 m)

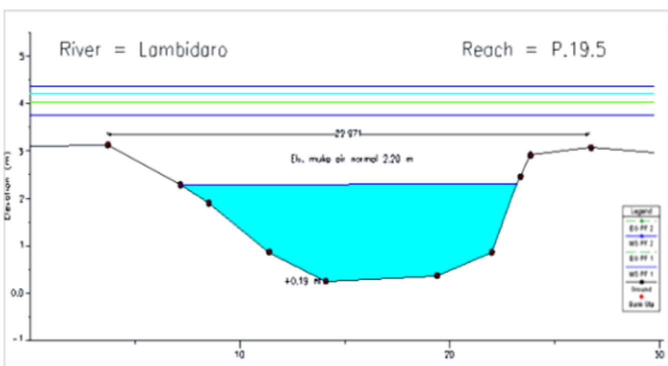

Fig 3. Pattern of water flow movement in the lambidaro river (P.19.5) with flood discharge return period 2 years(Q2)

In the 2-year return period (R_2) with a planned flood discharge (Q_2) of 2.17 m^3/second, the flow of water along the Lambidaro River does not occur inundation, or the increase in the design flood water level is only 30 cm (+2.50m) from the ground. existing normal water (2.20 m)

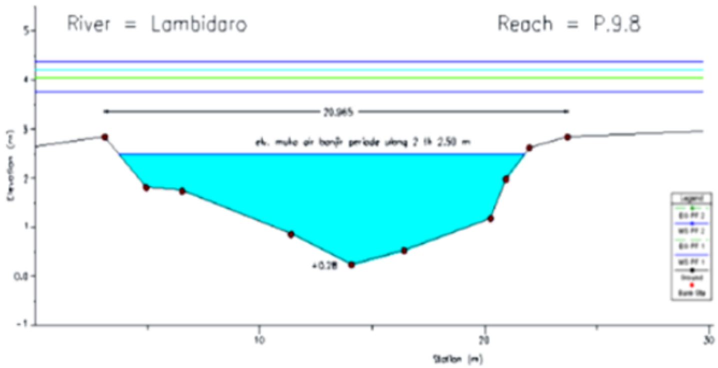

Fig 4. Pattern of water flow movement in the lambidaro river (P.9.8) with flood discharge return period 2 years(Q2)

In the 2-year return period (R_2) with a planned flood discharge (Q_2) of 2.17 m^3/second, the flow of water along the Lambidaro River does not occur inundation, or the increase in the design flood water level is only 30 cm (+2.50m) from the ground. existing normal water (2.20 m)

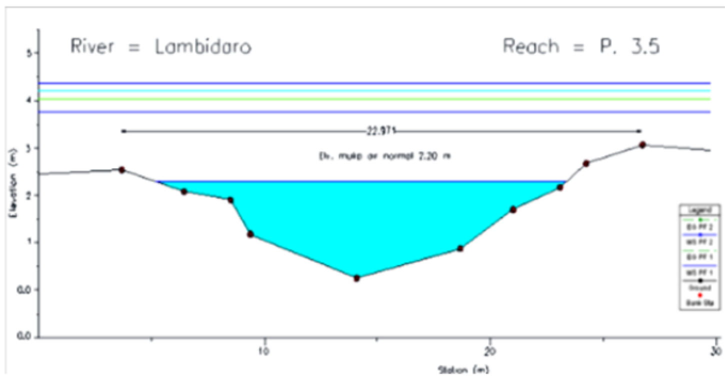

Fig 4. Pattern of water flow movement in the lambidaro river (P.3.5) with flood discharge return period 2 years(Q2)

For the discharge return period (Q2), Q5, Q10, Q25 and Q50 all sections of the Lambidaro river overflowed, as shown in the picture below

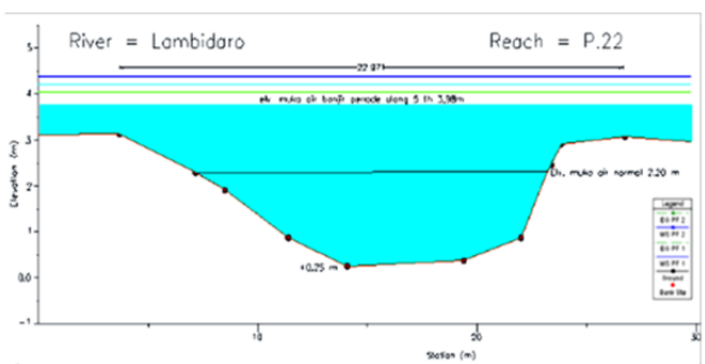

Fig 5. Pattern of water flow movement in the lambidaro river (P.22) with flood discharge return period 5 years(Q5)

In the 5-year return period (R_5) with a planned flood discharge (Q_5) of 9.05m^3/second , the flow of water along the Lambidaro River does not occur inundation, or the increase in the design flood water level is only 30 cm (+1,78m) from the ground. existing normal water (2.20 m)

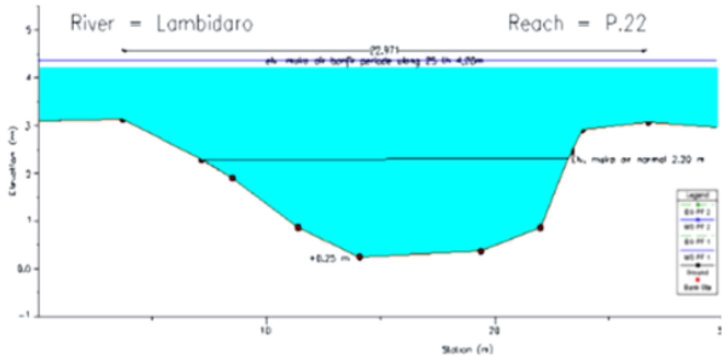

Fig 2. Pattern of water flow movement in the lambidaro river (P.22) with flood discharge return period 25 years(Q25)

In the 25-year return period (R_{25}) with a planned flood discharge (Q_2) of, the flow of water along the Lambidaro River does not occur inundation, or the increase in the design flood water level is only 30 cm (+2.50m) from the ground. existing normal water (2.20 m)

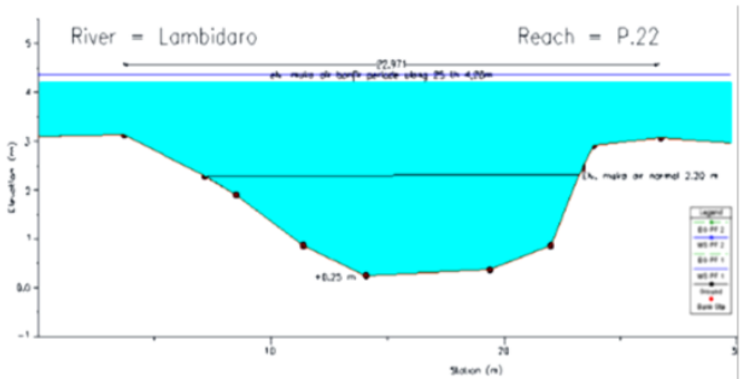

Fig 2. Pattern of water flow movement in the lambidaro river (P.22) with flood discharge return period 50 years(Q50)

In the 2-year return period (R_2) with a planned flood discharge (Q_2) of 2.17 m^3/second, the flow of water along the Lambidaro River does not occur inundation, or the increase in the design flood water level is only 30 cm (+2.50m) from the ground. existing normal water (2.20 m)

IV. Conclusion

1. Based on the design flood discharge (Q_2) of 2.17 m^3/s with a return period of 2 years (R_2) and the flow coefficient value (C) 0.5864, the planned rainfall intensity is 257.1460 mm in the Lambidaro catchment area of 52.09 km^2 there is no increase in water level of 30 cm from the normal water level and this does not cause flooding/inundation in the Lambidaro river.
2. The design discharge (Q_5) of 9.05m^3/second and rainfall intensity of 296.2446 mm, there was an increase from the normal water level of 1.78 m which resulted in overflow in Lambidaro river.
3. The design discharge (Q_{10}) of 11.68 m^3/second and a planned rainfall intensity of 345.6414 mm, there was an increase from the normal water level of 1.94 m which resulted in overflow in Lambidaro river
4. The design discharge (Q_{25}) of 11.78m^3/second and a planned rainfall intensity of 382.2866 mm, an increase from the normal water level of 2.06m resulted in overflow in the Lambidaro river.

5. The design discharge (Q_{50}) of 12.79 m^3/second and a planned rainfall intensity of 418.6661 mm, an increase from the normal water level of 2.21 m resulted in overflow in the river Lambidaro.

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