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Flood Routing Analysis of Arafuru Ii Retention Pond in Buah Sub Watershed, Palembang City

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Abstract
This research aims to determine the magnitude of the influence of flow from the outlet of the Arafuru I retention pond o and changes in flow at the inlet to the Arafuru II retention pond in the Buah sub-watershed of Palembang city. rainfall data, also carried out a field survey to obtain Arafuru II retention pond data as input data in the HEC-RAS ver. 6.1.0. The results obtained from this research are that there is a significant influence on rainfall intensity in the Buah Sub-watershed where there is an increase in changes in flow from the outlet of the Arafuru I retention pond to the inlet flow into the Arafuru II retention pond based on Gumbel distribution frequency analysis. with a flow discharge Q2 of 17.34 m3/sec with concentration time (tc) to retention ponds of 0.4227 hours and changes in flow at the inlet to the Arafuru II retention pond as a flood and inundation control function based on tracing floods occur at flow discharge with a 2-year rainfall return period of between 4 - 5 m. For annual rainfall return periods of 5 and 10 years there is also an increase in average flow of 5 m

***Keywords**: Retention Pond, flow capacity, HEC-RAS, flow changes*

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I. INTRODUCTION

Most of the floods that occur in Indonesia are caused by, among others: high rainfall that lasts for a long duration, causing a lot of waterlogging in urban areas. In addition, flooding is caused by the overflow of the main rivers that pass through residential and urban areas, due to the high intensity of rainfall in the upstream area or often referred to as flash floods or floods. (Syarifudin, A. et al 2018)

In the study of hydrology, fluctuations and the journey of flow discharge waves from one point upstream to the next point downstream can be known/estimated the pattern and time of travel. This method is commonly known as the flood routing method. According to Soemarto (1987) Flood tracing is a hydrograph forecast at a point in a flow or part of a river based on observations of hydrographs at other points. Flood hydrographs can be traced through riverbeds or through reservoirs/retention ponds. Based on the division of river basins, there are 21 Sub-DAS, but only 18 Sub-DAS in the city of Palembang flow directly into the Musi River in the city of Palembang, namely the Rengas Lacak, Gandus, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang, Sei Lincah, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju Sub-DAS. (Palembang City PUPR Service, 2018).

The floods that occurred in the city of Palembang caused problems for the Government to evaluate the existing drainage channels and retention ponds as flood/inundation control.

In recent years, the Buah River has often overflowed because it is no longer able to accommodate the water discharge during the rainy season. In addition, the water discharge of the Musi River enters the Buah River when the tide is high. This is one of the causes of the area around the Buah River.

Simulations using programs with different conditions, namely existing conditions, river channel normalization, diversion, combined retention ponds accompanied by pumping systems and embankment construction, show that in existing conditions there are seven areas that are inundated.

II. MATERIAL AND METHODS

This research was located in the Arafuru II retention pond adjacent to the Arafuru I retention pond with secondary data collection and primary data obtained directly from field surveys, namely at the inlet channel of the Arafuru II retention pond in the Buah Sub Watershedas shown in Figure 1.

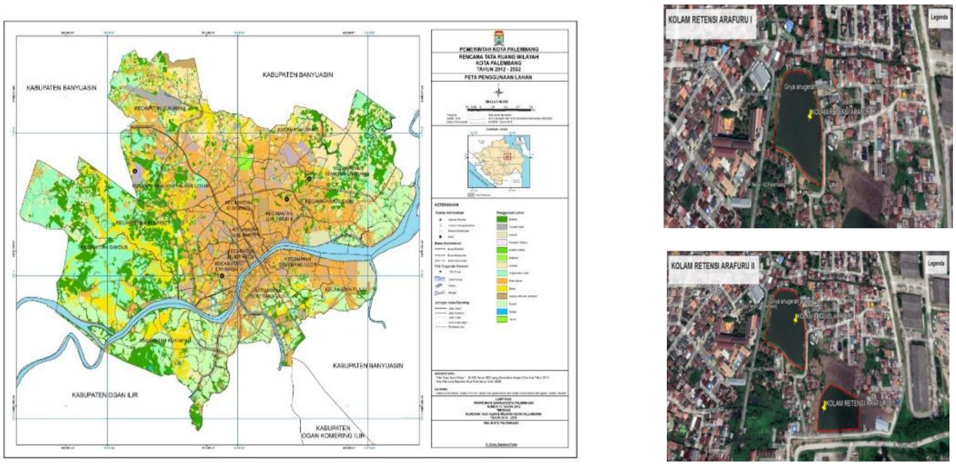

Figure 1: The research location is in Ilir Timur II sub-district, Palembang city

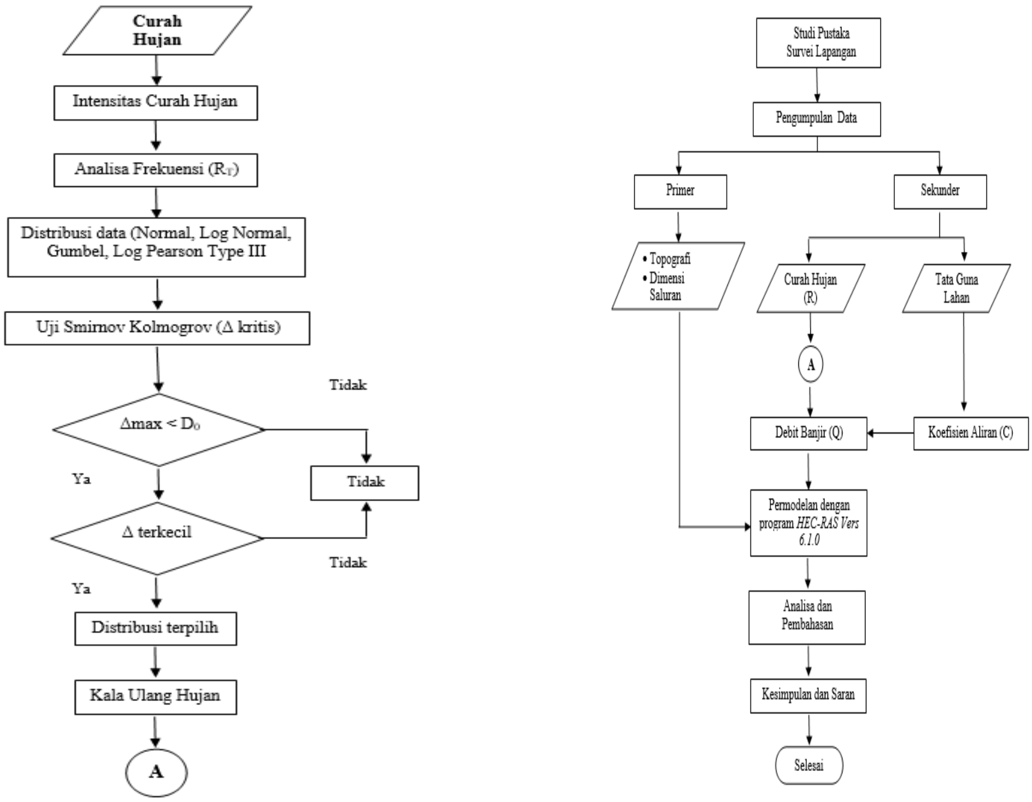

Figure 2: Research Flowchart

The research flow diagram as shown in Figure 2 can be described as follows: Based on data from the BMKG rainfall station in South Sumatra province for 19 years, a rainfall frequency analysis was carried out with a return period of 2, 5, 25, 50 and 100 years with the results as in Table 1.

Table 1: Recapitulation of Planned Rainfall Distribution

	Method			
Return Period	**Normal (mm)**	**Log Normal (mm)**	**Log Pearson type III (mm)**	**Gumbel (mm)**
5	117.613	139.711	43.783	120.761
10	128.465	153.019	50.529	138.901
25	138.824	166.901	61.078	161.817
50	147.456	179.428	70.488	178.818
100	154.362	190.123	81.348	195.696

A recapitulation of the Smirnov-Kolmogorove goodness-of-fit test calculations for the four probability distributions can be seen in Table 2.

Table 2: Smirnov-Kolmogorov Test Recapitulation

No	Selisih Untuk Nilai Kritis 5 %			
	Normal	Log Normal	Log Pearson III	Gumbel
1	0,0359	0,0500	0,0500	0,0293
2	0,0524	0,1000	0,1000	0,0609
3	0,0838	0,1500	0,1500	0,1091
4	0,0314	0,2000	0,2000	0,0532
5	0,0124	0,2500	0,2500	0,1111
6	0,0634	0,3000	0,3000	0,0734
7	0,0366	0,3500	0,3500	0,1158
8	0,1237	0,4000	0,4000	0,0451
9	0,0800	0,4500	0,4500	0,1007
10	0,1165	0,4999	0,5000	0,0540
11	0,0914	0,5499	0,5500	0,0766
12	0,0602	0,5998	0,6000	0,1028
13	0,0102	0,6498	0,6500	0,1653
14	0,0279	0,6998	0,7000	0,1992
15	0,0689	0,7498	0,7500	0,2334
Selisih Maks	**0,1237**	0,7498	0,7500	**0,2334**
Di Kritik	0,3380	0,3380	0,3380	0,3380
Uji Kecocokan	**Diterima**	Ditolak	Ditolak	**Diterima**

Table 3: Rekapitulasi Uji Kecocokan Chi-Square dan Smirnov-Kolmogorov

Distribusi Frekuensi	Uji Kecocokan			
	Uji Chi-Square		Uji Smirnov-Kolmogorov	
	$\sum X^2$	X^2 kritik	Δmaks	Δkritik
Normal	8,2526	14,067	**0,1237**	**0,338**
Log-Normal	6,5684	14,067	0,7498	0,338
Log-Pearson Tipe III	5,5158	14,067	0,7500	0,338
Gumbel	8,2526	14,067	**0,2334**	**0,338**

Table 4: Rainfall Intensity and Duration with Return Period

t		Periode Ulang				
Menit	Jam	5	10	25	50	100
5	0.083	228.928	263.736	307.713	340.337	372.724
10	0.167	144.216	166.143	193.847	214.399	234.801
20	0.333	90.850	104.664	122.116	135.063	147.916
30	0.500	69.332	79.873	93.192	103.072	112.881
40	0.667	57.232	65.934	76.928	85.084	93.181
50	0.833	49.321	56.820	66.295	73.323	80.301
60	1.000	43.676	50.317	58.707	64.931	71.110
70	1.167	39.411	45.403	52.974	58.590	64.166
80	1.333	36.054	41.536	48.462	53.600	58.700
90	1.500	33.331	38.399	44.802	49.552	54.267
100	1.667	31.070	35.795	41.763	46.191	50.586
110	1.833	29.158	33.591	39.192	43.347	47.472
120	2.000	27.514	31.698	36.983	40.904	44.797
130	2.167	26.085	30.051	35.061	38.779	42.469
140	2.333	24.827	28.602	33.371	36.909	40.422
150	2.500	23.711	27.316	31.871	35.250	38.605
160	2.667	22.713	26.166	30.529	33.766	36.979
170	2.833	21.813	25.130	29.320	32.428	35.514
180	3.000	20.997	24.190	28.223	31.216	34.186
190	3.167	20.254	23.334	27.224	30.111	32.976
200	3.333	19.573	22.549	26.309	29.098	31.867
210	3.500	18.947	21.827	25.467	28.167	30.848
220	3.667	18.368	21.161	24.689	27.307	29.906
230	3.833	17.832	20.543	23.968	26.510	29.032
240	4.000	17.333	19.968	23.298	25.768	28.220
250	4.167	16.868	19.432	22.672	25.076	27.463
260	4.333	16.432	18.931	22.087	24.429	26.754
270	4.500	16.024	18.460	21.539	23.822	26.089
280	4.667	15.640	18.018	21.023	23.251	25.464
290	4.833	15.278	17.602	20.537	22.714	24.875
300	5.000	14.937	17.208	20.078	22.206	24.319
310	5.167	14.614	16.836	19.643	21.726	23.794
320	5.333	14.308	16.484	19.232	21.271	23.295
330	5.500	14.017	16.149	18.842	20.839	22.822
340	5.667	13.741	15.831	18.470	20.428	22.373
350	5.833	13.478	15.528	18.117	20.037	21.944
360	6.000	13.227	15.239	17.780	19.665	21.536

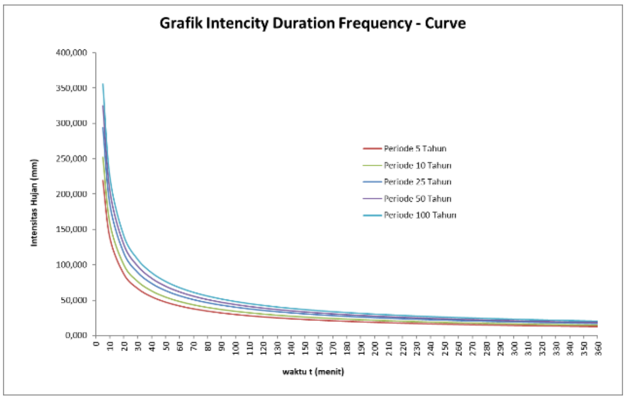

Figure 3: IDF curve (Intensity Duration Frequency-curve)

For return periods of 2, 5, 10, 20 and 50 can be seen in the following table 5.

Table 5: Results of runoff discharge calculations

Return Period (Year)	C	I (mm/hour)	A (km2)	Q (m3/sec)
2	0.8689	120.761	5,950	17.34
5	0.8689	138.901	5,950	71.81
10	0.8689	161.817	5,950	83.65
25	0.8689	178.818	5,950	92.45
50	0.8689	195.696	5,950	101.17

III. RESULTSAND DISCUSSION

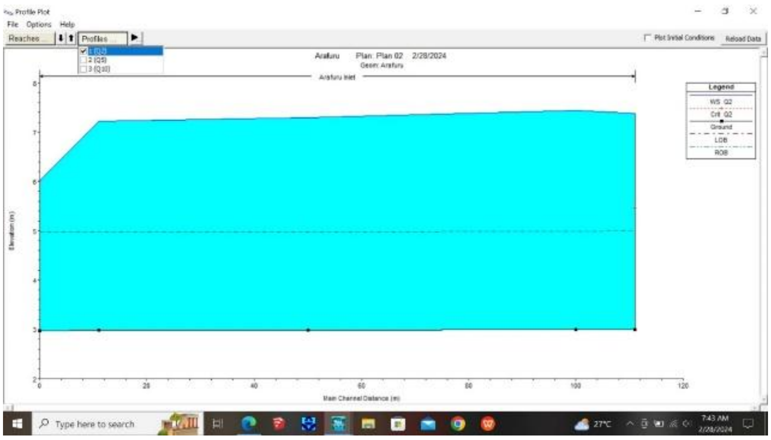

Figure 4: Longitudinal section of the simulation results of the inlet flow to the Arafuru II Retention Pond with a 2-year flood return period (Q2)

Figure 4 shows a change in flow from sta 0 +00 to 0+10 and continues to increase in flow up to 0+120 with a 2-year return period.

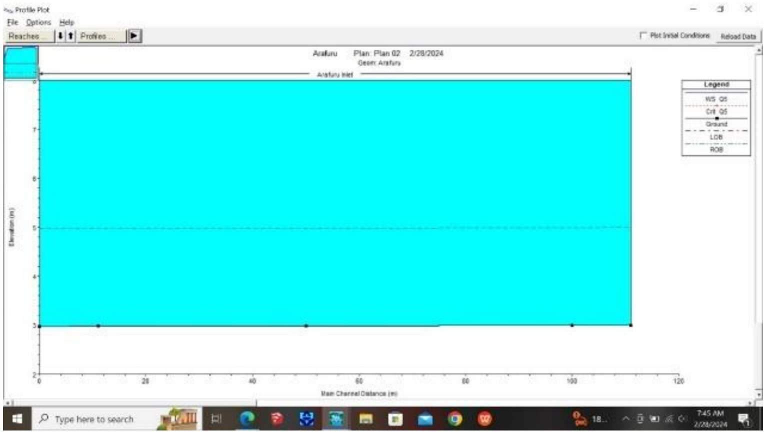

Figure 5: Longitudinal section of the simulation results of the inlet flow to the Arafuru II Retention Pond with a 5-year flood return period discharge (Q5).

Likewise in Figure 5, it was found that there was a change in flow from sta 0 +00 to sta 0 +120, there was an increase in flow with a 5-year return period of 5 m.

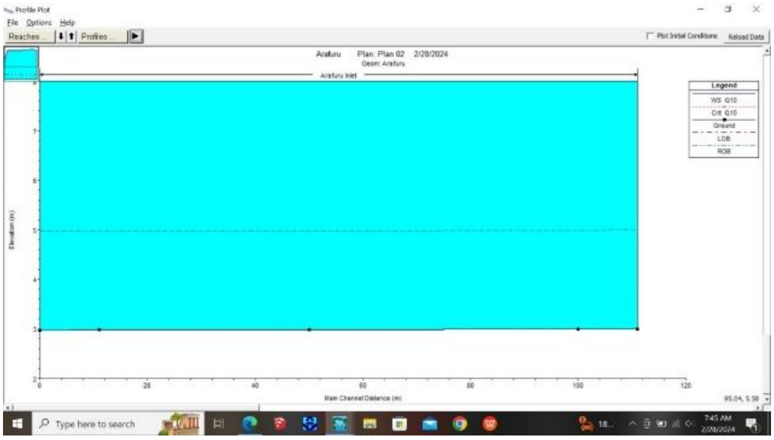

Figure 6: Longitudinal section of the simulation results of the inlet flow to the Arafuru II Retention Pond with a 10-year flood return period discharge (Q10).

In the same 10-year return period as the 5-year return period, there was also a 5-meter rise in the water level.

IV. CONCLUSION

This study resulted in the following conclusions:

1. There is a significant effect of rainfall intensity on the Buah Sub-watershed on the increase in changes in flow from the outlet of the Arafuru I retention pond to the inlet flow to the Arafuru II retention pond based on Gumbel distribution frequency analysis with a Q2 flow rate of 17.34 m3/sec with a concentration time (tc) to retention ponds I and II for 0.4227 hours.
2. Changes in flow at the inlet to the Arafuru II retention pond as a function of controlling flooding and inundation based on flood routing in the Buah Sub-watershed occurred at a flow rate with a 2-year rainfall return period of between 4 - 5 m. For annual rainfall return periods of 5 and 10 years, there was also an increase in average flow of 5 m.

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