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Batang bayang river flood modeling based on rain return period

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Abstract: West Pasaman Regency is one of the regencies in West Sumatra that experiences flooding the most. In 2020, in April and September, floods occurred in the West Pasaman district, more precisely around the Nagari Ujung Gading area, Lembah Melintang District. Floods most often inundate the Jorong Lombok and Jorong Irian areas. The flood that occurred was caused by the overflow of the Batang Bayang river. Puddles of water inundated at least 150 residents' houses until the water level reached a height of 1 meter. The problem of flooding almost every year is felt by residents who live near the location of the Batang Bayang river. This study aims to determine the flood discharge of the Batang Bayang river with return periods of 2, 5, 10 and 25 years. Then this study also aims to determine the ability of the Bayang Bayang River to flow flood discharge for 2, 5, 10 and 25 years return periods. The results show that the 2-year return period produces a maximum flood discharge of 47.2 m/s3. In the 5-year return period it produces a flood discharge of 110 m/s3, in the 10-year return period it produces a flood discharge of 143.6 m/s3 and at the return period of 25 years resulted in a flood discharge of 189.2 m3/s. The cross section modeling in the 2 year return period resulted in a water elevation of 21.07 meters. The 5-year return period modeling results in a water level elevation of 22.4 meters. The 10-year return period models the water at an elevation of 23.01 meters and the 25-year return period produces a water level of 23.72 meters.

Keywords*:* Flood; River; Rain Period;Batang Bayang

1. Introduction

A river is a water flow system that originates from a spring to an estuary or from a higher upstream to a lower downstream and can lead to other rivers, lakes and the sea (Mawardi, 2007). Rivers are a vital element for humans, but rivers can also bring disasters such as floods. Floods are a condition where water can no longer be accommodated by drain channels (river troughs) or the flow of water is hampered so that it overflows which inundates the surrounding area (plains) (Suripin, 2003). Floods are natural disasters from ancient times and are often found in various parts of the world, usually floods often occur in low-lying areas adjacent to rivers and seas. In Indonesia alone, almost all regions face the danger of floods, losses caused by floods almost reach two-thirds of all natural disasters that occur in Indonesia (Dirjen Pengairan, 1994). Natural conditions that affect flooding in West Sumatra are the pattern of rain in the waters, the pattern of temperature at sea level and the pattern of whirlpools in the Indian Ocean that affect the weather and flooding in West Sumatra (Arif M, 2019).

Batang Bayang River is one of the rivers in West Pasaman Regency. Batang Bayang River has flooding problems that occur almost every year caused by high rainfall intensity and overflow of the Batang Bayang River. HEC-RAS is an application designed to model the hydraulic behavior of water in all types of river flows. This program is the Next generation program from HEC

(Hydraulic Engineering Center). HEC itself has developed a lot of software to analyze various models involving hydrology and hydraulics problems. The software designed by HEC are HEC-HMS, HEC-Ressim and HEC-FDA. Departing from the above problems, research related to flood modeling in the Batang Shadow River was carried out.

2. Methods

This study uses quantitative research which presents numbers for static analysis. Quantitative research is research whose research instruments have been predetermined and well-organized so as not to give room for flexibility. While qualitative research is research that requires researchers to be instruments, follow cultural assumptions and follow data (Mulyadi M, 2011). The data needed in this study is divided into two, namely. Primary data, data obtained from the research location. In this study, primary data can be in the form of measurements of the cross section and length of the river. Secondary data, data obtained indirectly. These data are obtained from literature studies and references related to research. In this study secondary data in the form of rainfall data, geometric data and geodetic data, then the data is processed using the Hec-Ras program to get an overview of the flooding that occurred.

3. Results

After processing the data, the following results were found:

Period of 2, 5, 10 and 25 years

Return the results of processing rainfall data found the amount of rainfall in the return period as in the following table 1.

Table 1. Rainfall return period

Method Log Pearson type III return		
Period	**KTR**	**Rainfall Plan**
2	-0.191	90
5	0.736	141
10	1.34	176
25	2.081	230

Hourly rainfall calculation

After finding the rainfall in the rainfall return period, the calculation of the rainfall intensity in hours is carried out using the monobe method.

Table 2. Intensity rain

t	Repeat Period				t	Repeat Period			
	2	5	10	25		2	5	10	25
1	31.23	57.26	69.76	86.41	13	5.64	10.35	12.61	15.62
2	19.67	36.07	43.93	54.43	14	5.37	9.85	12.00	14.86
3	15.01	27.52	33.52	41.53	15	5.13	9.41	11.46	14.20
4	12.39	22.71	27.67	34.28	16	4.91	9.01	10.98	13.60

5	10.68	19.57	23.84	29.54	**17**	4.72	8.65	10.54	13.06
6	9.45	17.33	21.11	26.16	**18**	4.54	8.33	10.15	12.57
7	8.53	15.64	19.05	23.60	**19**	4.38	8.03	9.79	12.12
8	7.80	14.31	17.43	21.59	**20**	4.23	7.76	9.46	11.72
9	7.21	13.22	16.11	19.96	**21**	4.10	7.52	9.16	11.34
10	6.72	12.33	15.02	18.60	**22**	3.97	7.29	8.88	10.99
11	6.31	11.57	14.09	17.46	**23**	3.86	7.07	8.62	10.67
12	5.95	10.92	13.30	16.47	**24**	3.75	6.88	8.38	10.38

Calculation of planned debit

After getting the value of rainfall intensity within 24 hours using the monobe method. the calculation of the planned flood discharge is calculated using HEC-HMS which is then found to be the following graph.

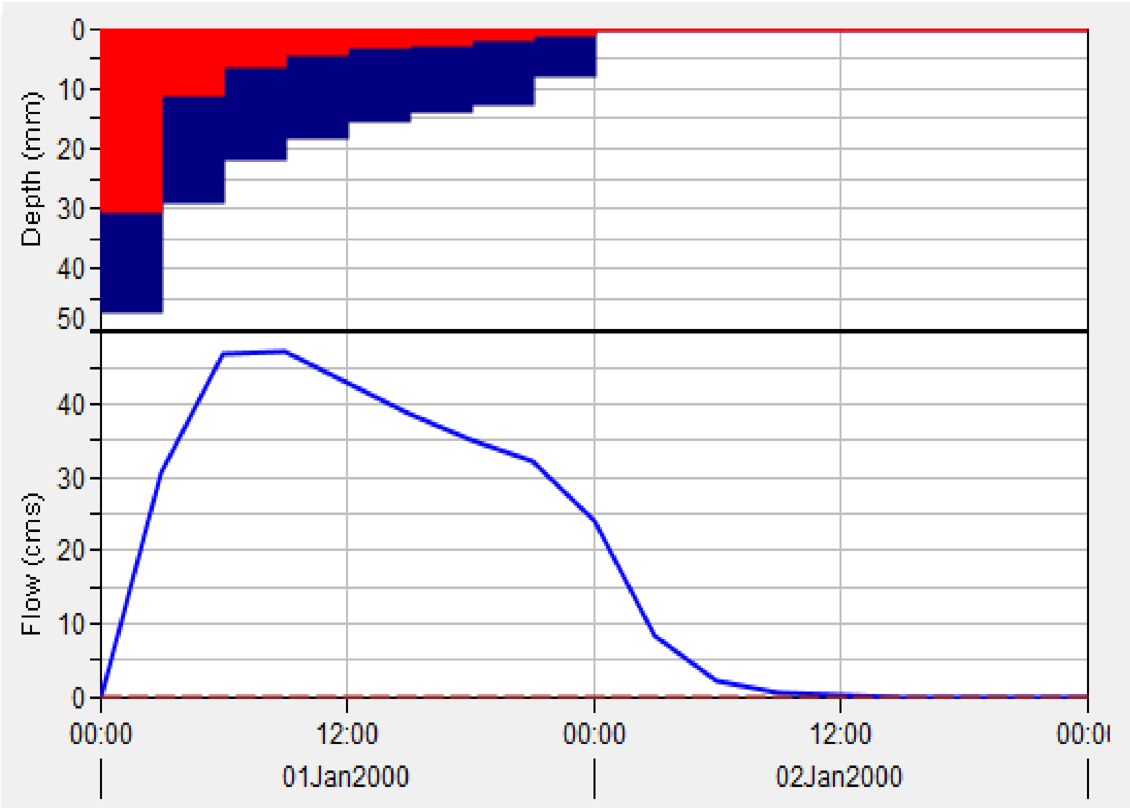

Figure 1. Graph of flood discharge for 2 year return period

Based on data processing using the HEC-HMS program, it can be seen that the maximum flood discharge in the 2-year return period occurs between 09:00 and is 47.2 m^3/s.

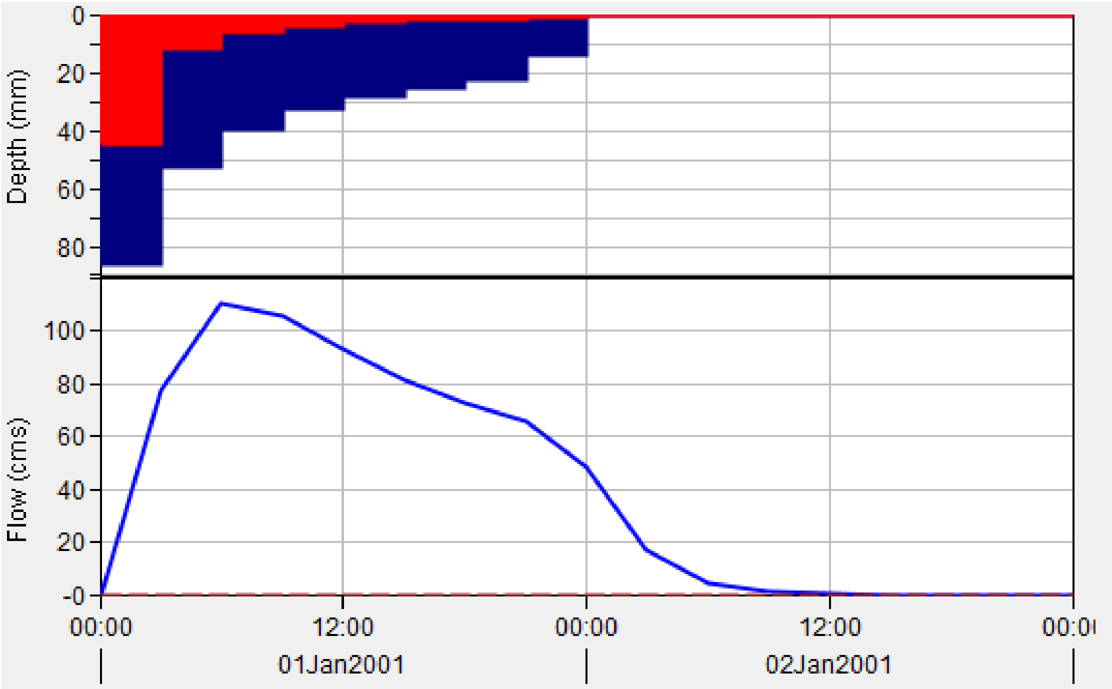

Figure 2. Graph of flood discharge for 5 years return period

Data processing using the HEC-HMS program can be seen that the maximum flood discharge in the 5-year return period occurs between 09:00 and is 110.5 m^3/s.

Cross section of batang bayang river

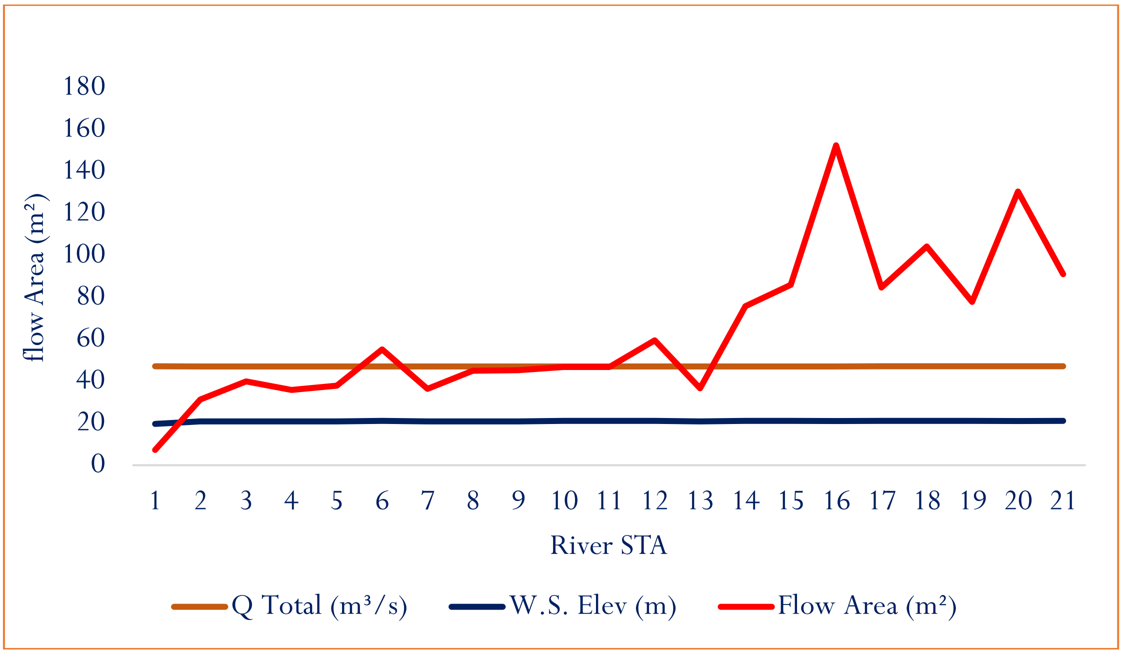

Figure 5. HEC-RAS modeling cross section modeling 2 years return period

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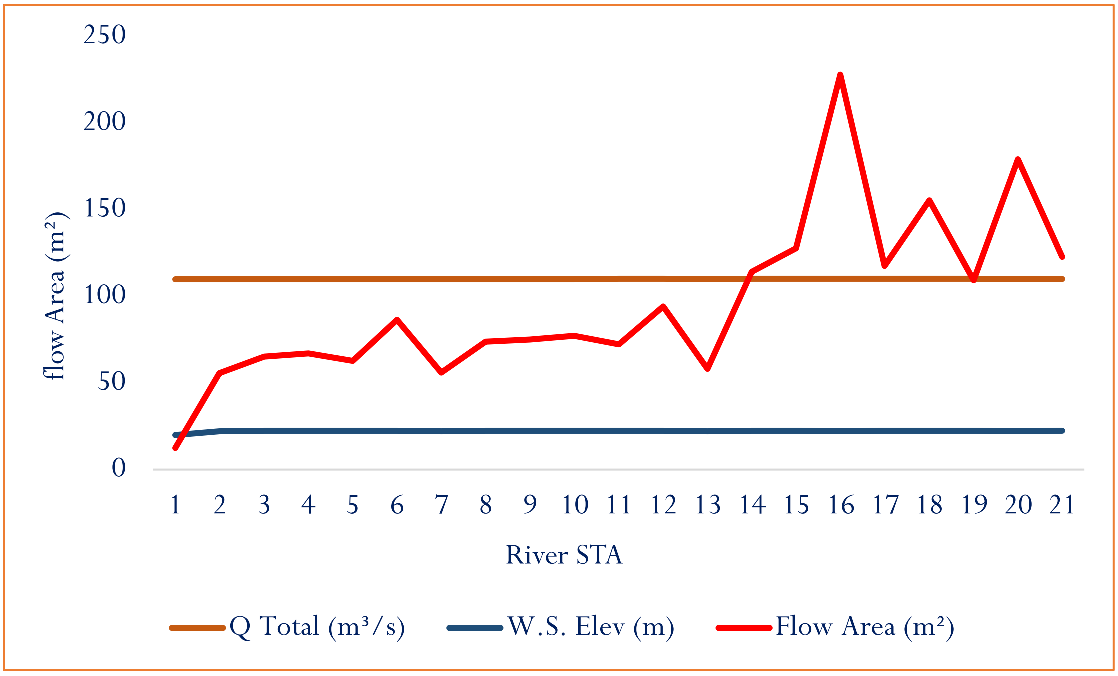

Figure 6. HEC-RAS Modeling Cross Section Modeling 5 Years Return Period

The results of the 5-year return period modeling resulted in the water level being at an altitude of 22.4 meters which made the river water flow mostly overflow.

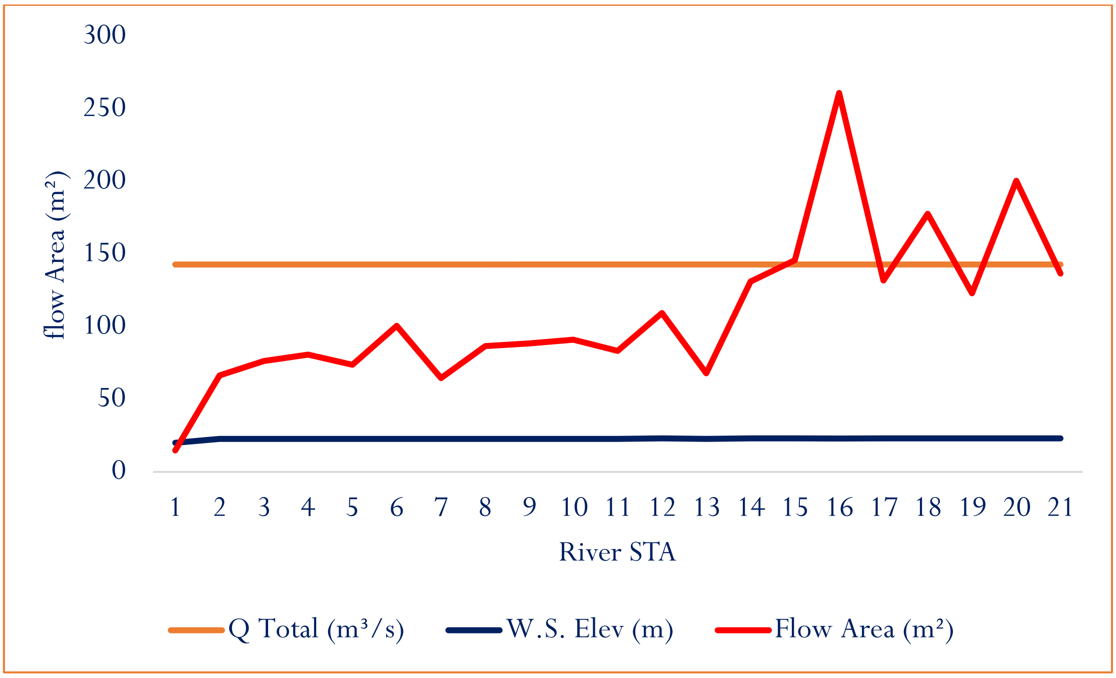

Figure 7. HEC-RAS modeling cross section modeling 10 years return period

The modeling of the 10-year return period resulted in the water level being at an altitude of 22.98 meters where the river flow overflowed in almost all cross-sections.

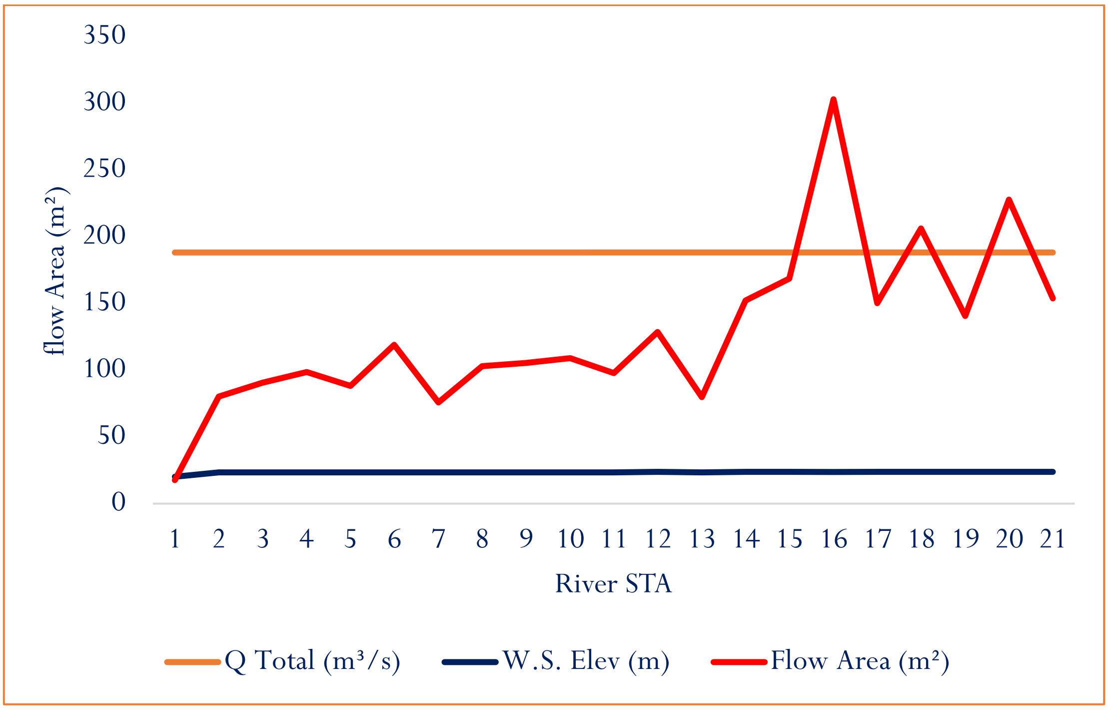

Figure 8. HEC-RAS modeling cross section modeling 25 years return period

The modeling of the 25 year return period results in the water level being at an altitude of 23.72 meters where the river overflows in almost all cross-sections.

4. Discussion

The flood map was obtained through HEC-RAS modeling using DEMdata (Digital Elevation Model).

Figure 9. River overflow area 2 year return period

In the 2 year return period, it can be seen that the river has overflowed where the water has inundated the bank area and entered the Madura road. In the 5 year return period The overflow of the river begins to thicken in the area around the bank and extends towards Jorong Koto Pinang.

Figure 10. River overflow area 5 year return period

In the 10-year return period the river overflow area has inundated the Kampung Air Bayang soccer field area. In 25 years, the area that was most flooded was the area around Jalan Madura or more precisely around Jorong Koto Pinang, Air Bayang Village, Koto Village and Simpang Empat Saba Village.

Figure 11. River overflow area 10 year return period

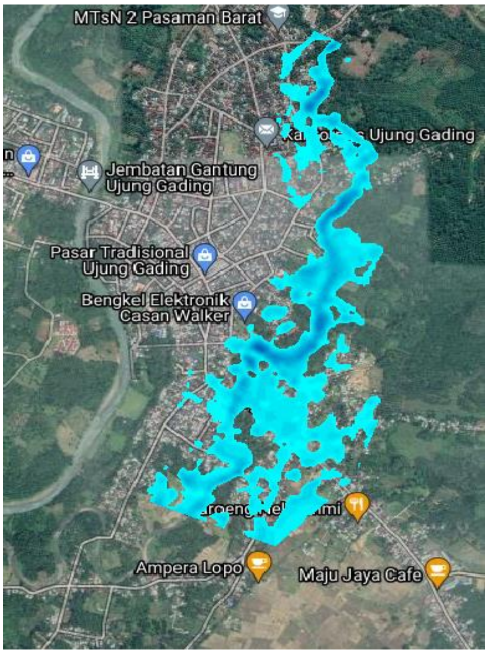

Figure 12. River overflow area 25 year return period

5. Conclusion

The results of the synthetic unit hydrograph modeling using the HEC-HMS modeling show that the maximum flood discharge in each return period, the resulting flood discharge is a 2 year return period of 47.2 m3/s. Return period 5 years 110.5 m3/s. Return period 10 years 143.6 m3/s. Return period 25 years 189.2 m3/s. Hydraulic modeling using HEC-RAS shows the Batang Bayang river is not able to drain the water discharge generated by the calculation of return periods of 2, 5, 10 and 25 years.

References

Mawardi Erman. 2007. *Desain Hidrolik Bangunan Irigasi*. Bandung: Alfabeta Bandung

Suripin. 2003. *Sistem Drainase Perkotaan Berkelanjutan*. Yogyakarta: ANDI

Direktorat Sungai, Ditjen Pengairan, Departemen Perkerjaan Umum. 1994. *Teknologi Pengendalian Banjir Di Indonesia*. Departemen Perkerjaan Umum

Arif Muhammad. 2019. *Analisis Wilayah Berpotensi Banjir Daerah Sumatera Barat Untuk Pelaksanaan Pembelajaran Geografi Berorientasi Bencana Alam*. Jurnal Kepemimpinan dan Kepengurusan Sekolah

Mulyadi Muhammad. 2011. *Penelitian Kuantitatif dan Kualitatif dan Pemikiran dasa menggabungkannya*. Jurnal Studi Komunikasi dan Media.

Natakusuma Dantje. 2011. *Prosedur Umum Perhitungan Hidrograf Satuan Sintetis dengan Cara ITB dan Beberapa Contoh Penerapannya.* Jurnal Teknik Sipil.

Kodoatie Robert. 2009. *Hidrolika Terapan Aliran Pada Saluran Terbuka Dan Pipa*.Yogyakarta: Andi

Basuki dkk. 2009. *Analisis Periode Ulang Hujan Maksimum Dengan Berbagai Metode.* J.Agromet 23 (2): 76-92

Palar dkk. 2013. *Studi Perbandingan Antara Hidrograf Scs (Soil Conservation Service) Dan Metode Rasional Pada Das Tikala.* Jurnal Sipil Statik Vol 1. No.3

Sari, Irawan. 2021. *Penerapan Metode Empiris Di Das Batang Lembang Untuk Perhitungan Debit Banjir Rancangan.* Akselerasi: Jurnal ilmiah Teknik Sipil Vol.2 No.2.

Siby, Halim. 2013. *Studi Perbandingan Hidrograf Satuan Sintetik Pada Daerah Aliran Sungai Ranoyapo.* Jurnal Sipil Statik Vol.1 No.4

Triatmodjo, Bambang. 2015. *Hidrologi Terapan*. Yogyakarta: Beta Offset Yogyakarta.

Haan Charles. 1977. *Statistical Methods In Hydrology*. Iowa: The Iowa State University Press.

HEC, 2002, HEC RAS Application Guide, US Army Corps of Engineer, Davis, California.

HEC, 2002, HEC RAS Hydroulic Reference Manual, US Army Corps of Engineer, Davis, California.

Soewarno. 1995. *Hidrologi Aplikasi Metode Statistik Untuk Analisa Data*. Bandung: Nova

Soedarsono, Takeda. 2003. *Hidrologi Untuk Pengairan*. Jakarta: Paradnya Paramita.

Syarifudin. 2017. *Hidrologi Terapan.* Yogyakarta: Andi.