

BAB VI

KESIMPULAN DAN SARAN

VI.1. Kesimpulan

Pembandingan hasil yang didapat oleh setiap metode terhadap satu sama lain bertujuan untuk mengetahui besarnya perbedaan yang ada. Dengan melihat nilai kesalahan relatif dari satu metoda terhadap metoda yang lain, tampak bahwa setiap hasil yang didapat memberikan penyimpangan yang cukup besar satu dengan yang lain. Akan tetapi ini bukan merupakan nilai kesalahan absolut karena ketiadaan data hasil yang dapat dijadikan sebagai acuan.

Dengan berpegang pada hasil pembandingan dalam bentuk kesalahan relatif masing-masing metoda terhadap metoda yang lain, penulis menarik kesimpulan sebagai berikut.

1. Metoda Analisis Hidrograf Satuan merupakan metoda yang cukup terpercaya untuk menentukan besarnya debit rencana karena mempertimbangkan karakteristik DAS dan alirannya.
2. Metoda Analisis Frekuensi merupakan metoda penentuan debit rencana yang hanya memperhitungkan sifat statistik data yang digunakan. Metoda ini sama sekali tidak memperhitungkan sifat-sifat klimatologis dan hidrologis DAS yang selalu berubah. Metoda ini memberikan hasil yang terpercaya apabila seri data yang digunakan memiliki penyimpangan yang kecil.

3. Dalam analisis Hidrograf Satuan diperlukan data fluktuasi debit yang terjadi pada kejadian banjir sedangkan umumnya sedikit sekali dilakukan observasi pada saat tersebut. Untuk itu para ahli telah mengemukakan metoda Hidrograf Satuan Sintetis untuk membuat Hidrograf Satuan suatu sungai tanpa data debit saat banjir.
4. Untuk mengetahui besarnya debit rencana dengan kala ulang tertentu dengan menggunakan Hidrograf Satuan Sintetis diperlukan curah hujan rencana dengan kala ulang tertentu pula. Dengan demikian metoda penentuan curah hujan rencana berpengaruh besar pada hasil yang didapat dengan metoda Hidrograf Satuan Sintetis (HSS).
5. Dari hasil perhitungan dengan metoda MAF terlihat bahwa masing-masing nilai debit rencana yang diperoleh memiliki simpangan yang besar dimana besarnya simpangan tersebut sesuai dengan besarnya kala ulang. Dengan kata lain semakin besar kala ulang yang diinginkan maka semakin besar pula simpangannya.
6. Besarnya simpangan pada hasil metoda MAF menyebabkan semakin panjangnya batas nilai untuk masing-masing debit banjir rencana. Sehingga ketika dibandingkan dengan hasil perhitungan metoda Analisis Hidrograf dan Analisis Frekuensi hampir semua hasilnya tidak melampaui batas yang diperoleh dari metoda MAF tersebut. Kecuali untuk kala ulang 2 dan 5 tahun.

7. Dari Grafik analisis hasil terlihat bahwa hasil metoda Regresi memberikan batasan yang relatif lebih lebar dibandingkan dengan hasil metoda MAF seri data tahunan terbesar.
8. Dari hasil Analisis Hidrograf dipergunakan debit rencana dari HSS Nakayasu karena nilainya lebih mendekati nilai debit rencana hasil perhitungan metoda MAF daripada kedua Hidrograf Satuan Sintetik lainnya.
9. Dari Grafik Analisis Hasil terlihat bahwa hasil metoda Analisis Hidrograf lebih masuk ke dalam batas yang diberikan oleh metoda MAF bila dibandingkan dengan hasil Analisis Frekuensi debit.

VI.2. Saran

Berdasarkan pengalaman selama penyusunan tulisan ini, penulis mengemukakan sara-saran sebagai berikut :

1. Dalam mengumpulkan data hidrologi yang diperlukan sebaiknya berhati-hati agar tidak ada data yang tidak terpakai ataupun terlewatkan sehingga penulisan/penelitian dapat berjalan lancar.
2. Dalam menentukan debit banjir rencana untuk kepentingan perencanaan bangunan hidrolis, ada baiknya dengan menggunakan beberapa metoda agar hasil yang didapat dapat lebih bervariasi. Dengan demikian pihak perencana akan memiliki alternatif besaran debit banjir rencana yang lebih banyak. Selanjutnya untuk memilih debit banjir rencana yang akan digunakan dapat didasarkan pada pertimbangan-pertimbangan khusus

seperti perbedaan hasil yang didapat dari beberapa metoda, debit banjir rencana yang minimum demi kepentingan ekonomis ataupun nilai yang terbesar demi kepentingan keamanan bangunan.



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ANALISIS FREKUENSI CURAH HUJAN

m	X (mm)	(100.m) (n+1)	X ²	(X-Xrt)	(X-Xrt) ²	(X-Xrt) ³	(X-Xrt) ⁴
1	36,85	7,6923077	1357,9225	-19,18583	368,096073	-7062,229	135494,7
2	43,67	15,384615	1907,0689	-12,36583	152,913752	-1890,905	23382,62
3	45,47	23,076923	2067,5209	-10,56583	111,636764	-1179,535	12462,77
4	46,73	30,769231	2183,6929	-9,30583	86,598472	-805,8707	7499,295
5	50,34	38,461538	2534,1156	-5,69583	32,4424794	-184,7868	1052,514
6	50,44	46,153846	2544,1936	-5,59583	31,3133134	-175,224	980,5236
7	52,13	53,846154	2717,5369	-3,90583	15,255508	-59,58542	232,7305
8	56,23	61,538462	3161,8129	0,19417	0,03770199	0,0073206	0,001421
9	63,57	69,230769	4041,1449	7,53417	56,7637176	427,6675	3222,12
10	65,93	76,923077	4346,7649	9,89417	97,8946	968,58581	9583,353
11	79,41	84,615385	6305,9481	23,37417	546,351823	12770,52	298500,3
12	81,66	92,307692	6668,3556	25,62417	656,598088	16824,781	431121
	672,43		39836,0777	4E-05	2155,90229	19633,426	923532

56,035833

$$s = 13,99968276$$

$$Cs = 0,780602731$$

$$Ck = 3,49708726$$

$$Cv = 0,249834471$$

$$Cs/Cv = 3,124479695$$

Pemilihan jenis sebaran

No	Sebaran	Syarat	Hasil hitungan	Keterangan
1	Normal	$Cs \approx 0$	0,780602731	tidak dipilih
2	Log Normal	$Cs \approx 3 Cv$ atau $Cs \approx 3$ Cv	3,124479695	dicoba
3	Gumbel Tipe I	$Cs = 1,1396$ $Ck = 5,4$	$Cs = 0,780602731$ $Ck = 3,4970602731$	tidak dipilih
4	Log Pearson III	Tidak termasuk di atas $Cs < 0$	$Cs = 0,780602731$	dicoba

Analisa Distribusi Curah Hujan metode Log Normal 2 parameter

n = 12
X_{rt} = 56,035833
σ = 13,99968276
Persamaan : X_t = X_{rt} + K.σ

T	K	X _t
2	-0,1194	54,36427088
5	-0,7746	66,87998727
10	1,3209	74,52801396
20	1,8183	81,49145616
50	2,4318	90,08026154
100	2,8805	96,36191919

Analisa distribusi Debit metode Log Normal 3 parameter

Persamaan : X_t = X_{rt} + α.S_x

T (thn)	α	X _t
2	-0,12127554	54,33801391
5	0,77221267	66,8465654
10	1,320002145	74,51544427
20	1,8201521	81,51738497
50	2,4404952	90,20199158
100	2,8908724	96,5071295

Penggambaran pada kertas probabilitas log normal

1. Plotting pada kertas probabilitas log normal dengan menggunakan absis =

$\frac{100.m}{n+1}$ dan ordinatnya = data hujan (X) seperti yang terlihat dalam

lampiran.

2. (a) Untuk Log Normal

Persamaan garis teoritis = $X_T = \bar{X} + K.\sigma$

dengan : X_T = besarnya variabel dengan jangka waktu ulang T tahun

\bar{X} = harga tengah (mean)

K = faktor frekuensi

σ = penyimpangan standar

Pengujian Distribusi Curah Hujan (Untuk Distribusi Log Normal)

A. Uji Chi-Kuadrat

Tabel Hitungan Pengujian Chi Kuadrat untuk sebaran Log Normal

Kls	Teoritis		Pengamatan		Ef-Of	$\frac{(Ef - Of)^2}{Ef}$
	Jangkauan	Ef	Jangkauan	Of		
1	$P \leq 0,2$	2,4	$P \leq 43,67$	2	0,4	0,0667
2	$0,2 < P \leq 0,4$	2,4	$43,67 < P \leq 50,34$	3	-0,6	0,15
3	$0,4 < P \leq 0,6$	2,4	$50,34 < P \leq 52,13$	2	0,4	0,0667
4	$0,6 < P \leq 0,8$	2,4	$52,13 < P \leq 65,93$	3	-0,6	0,15
5	$0,8 < P \leq 1$	2,4	$65,93 < P \leq 81,66$	2	0,4	0,0667
		12		12		$\Sigma = 0,5001$

$$DK = K - (P + 1) = 5 - (2 + 1) = 2$$

α diambil 5%, maka didapat X^2 kritis = 5,991 (dari tabel nilai X^2)

$$X^2 = 0,5001 < 5,991 \text{ (Distribusi sesuai)}$$

B. Uji Smirnov- Kolmogorov

$$n = 12$$

$\alpha = 0,05$ maka Δ kritis yang didapat dari tabel (tabel nilai Δ untuk uji Smirnov-Kolmogorov sampel tunggal) = 0,375

Dari gambar plotting didapat Δ maks = 0,115 = 11,5% < 0,375 maka distribusi memenuhi syarat.

Metode Log Pearson III

m	X (mm)	Peluang (%)	Log X	(Log X) ²	(Log X - Log Xrt)	(Log X - Log Xrt) ²	(Log X - Log Xrt) ³
1	36,85	7,692307692	1,5664375	2,453726417	-0,18202834	0,033134317	-0,006031385
2	43,67	15,38461538	1,6401832	2,690200903	-0,10828264	0,01172513	-0,001269628
3	45,47	23,07692308	1,657725	2,748052024	-0,090740878	0,008233907	-0,000747152
4	46,73	30,76923077	1,6695958	2,787550072	-0,078870051	0,006220485	-0,00049061
5	50,34	38,46153846	1,7019132	2,896508578	-0,046552621	0,002167147	-0,000100886
6	50,44	46,15384615	1,7027751	2,899442966	-0,045690754	0,002087645	-9,53861E-05
7	52,13	53,84615385	1,7170877	2,948390255	-0,031378107	0,000984586	-3,08944E-05
8	56,23	61,53846154	1,7499681	3,062388293	0,001502251	2,25676E-06	3,39022E-09
9	63,57	69,23076923	1,8032522	3,251718538	0,054786379	0,003001547	0,000164444
10	65,93	76,92307692	1,8190831	3,309063236	0,070617243	0,004986795	0,000352154
11	79,41	84,61538462	1,8998752	3,60952576	0,151409364	0,022924795	0,003471029
12	81,66	92,30769231	1,9120094	3,655779852	0,163543543	0,026746491	0,004374216
	672,43		20,839905	36,3123469	-0,141684612	0,122215101	-0,000404096

Rerata Log X = 1,736658781
 Slog X = 0,105420705

Rerata Log X = 1,736658781
 Slog X = 0,105420705
 Cs = 0,780602731

Persamaan Log Xt = rerata Log X + K.Slog X
 Log Xt = 1,736658781 + (K. 0,105420705)

T (tahun)	K	Slog X	K.Slog X	Log Xt	Xt
1,0101	-1,7476	0,105420705	-0,184233224	1,552425557	35,68005843
1,0526	-1,402	0,105420705	-0,147799828	1,588858953	38,80243254
1,1111	-1,1694	0,105420705	-0,123278972	1,613379809	41,05630004
1,25	-0,8562	0,105420705	-0,090261208	1,646397573	44,29937239
2	-0,1288	0,105420705	-0,013578187	1,723080594	52,85433271
5	0,782	0,105420705	0,082438991	1,819097772	65,93223112
10	1,3354	0,105420705	0,140778809	1,87743759	75,41150193
25	1,9878	0,105420705	0,209555277	1,946214058	88,35152669
50	2,4438	0,105420705	0,257627119	1,9942859	98,69289759
100	2,8776	0,105420705	0,303358621	2,040017402	109,6522132
200	3,2942	0,105420705	0,347276886	2,083935667	121,3209123

Penggambaran pada kertas probabilitas Log Normal

1. Plotting pada kertas probabilitas Log Normal dengan menggunakan absis =

$$\frac{100.m}{n+1} \text{ dan ordinatnya = data hujan (X).}$$

2. Persamaan garis teoritis = $\text{Log } X_t = \text{rerata Log } X + K \cdot \text{Slog } X$

$$\text{Log } X_t = 1,736658781 + (K \cdot 0,105420705)$$

A. Uji Chi-Kuadrat

Kls	Teoritis		Pengamatan		Ef-Of	$\frac{(Ef - Of)^2}{Ef}$
	Jangkauan	Ef	Jangkauan	Of		
1	$P \leq 0,18$	2,4	$P \leq 43,67$	2	0,4	0,0667
2	$0,18 < P \leq 0,36$	2,4	$43,67 < P \leq 46,73$	2	0,4	0,0667
3	$0,36 < P \leq 0,64$	2,4	$46,73 < P \leq 56,23$	4	-1,6	1,0667
4	$0,64 < P \leq 0,82$	2,4	$56,23 < P \leq 65,93$	2	0,4	0,0667
5	$0,82 < P \leq 1$	2,4	$65,93 < P \leq 81,66$	2	0,4	0,0667
		12		12		$\Sigma = 1,3335$

$$DK = K - (P + 1) = 5 - (2 + 1) = 2$$

α diambil 5%, maka didapat X^2 kritik = 5,991 (dari tabel nilai X^2)

$$X^2 = 1,3335 < 5,991 \text{ (Distribusi sesuai)}$$

C. Uji Smirnov-Kolmogorov

$$n = 12$$

$\alpha = 0,05$ maka Δ kritik yang didapat dari tabel (tabel nilai Δ untuk uji

Smirnov-Kolmogorov sampel tunggal) = 0,375

Dari gambar plotting didapat Δ maks = 0,1138 = 11,38% < 0,375 maka distribusi memenuhi syarat.

Tabel : Hasil Analisa Frekuensi Data Hujan Harian Maksimum DPS Oyo Dengan Berbagai Metoda dan Kala Ulang

Kala Ulang (Tahun)	Log Normal 2 Parameter (mm)	Log Normal 3 Parameter (mm)	Log Pearson III (mm)
2	54,36427088	54,33801391	52,85433271
5	66,87998727	66,84656540	65,93223112
10	74,52801396	74,51544427	75,41150193
20	81,49145616	81,51738497	
25			88,35152669
50	90,08026154	90,20199158	98,69289759
100	96,36191919	96,50712950	109,6522132
200			121,3209123

Tabel : Hasil Uji Kesesuaian Distribusi

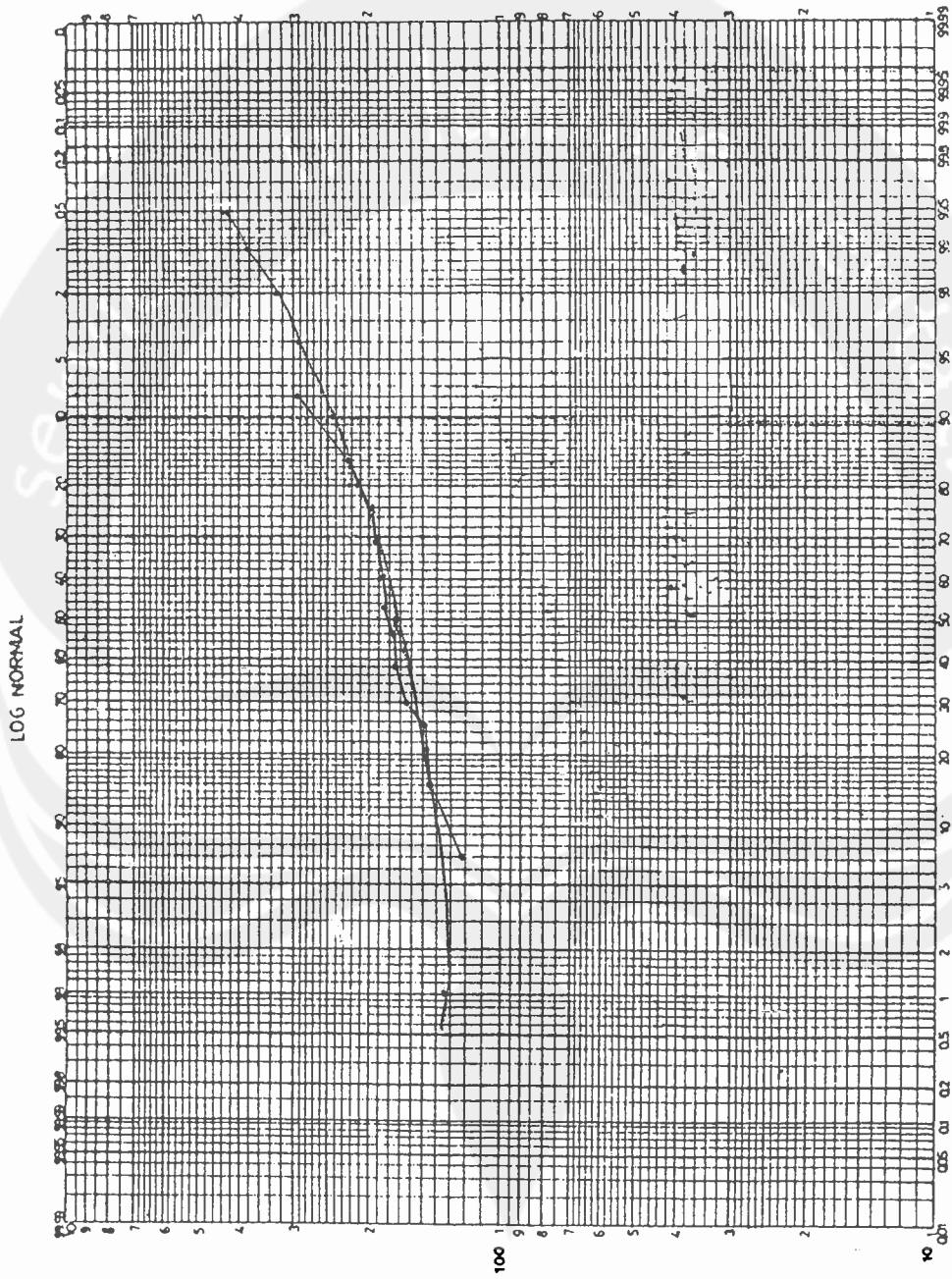
Metoda	Log Normal 2 Parameter	Log Normal 3 Parameter	Log Pearson III
Chi-Kuadrat	0,5001%	0,5001%	1,3335%
Smirnov- Kolmogorov	11,5%	15,84%	11,38%

Chi-Kuadrat kritis = 5,991%

Delta P mak (Smirnov-Kolmogorov) = 37,5%

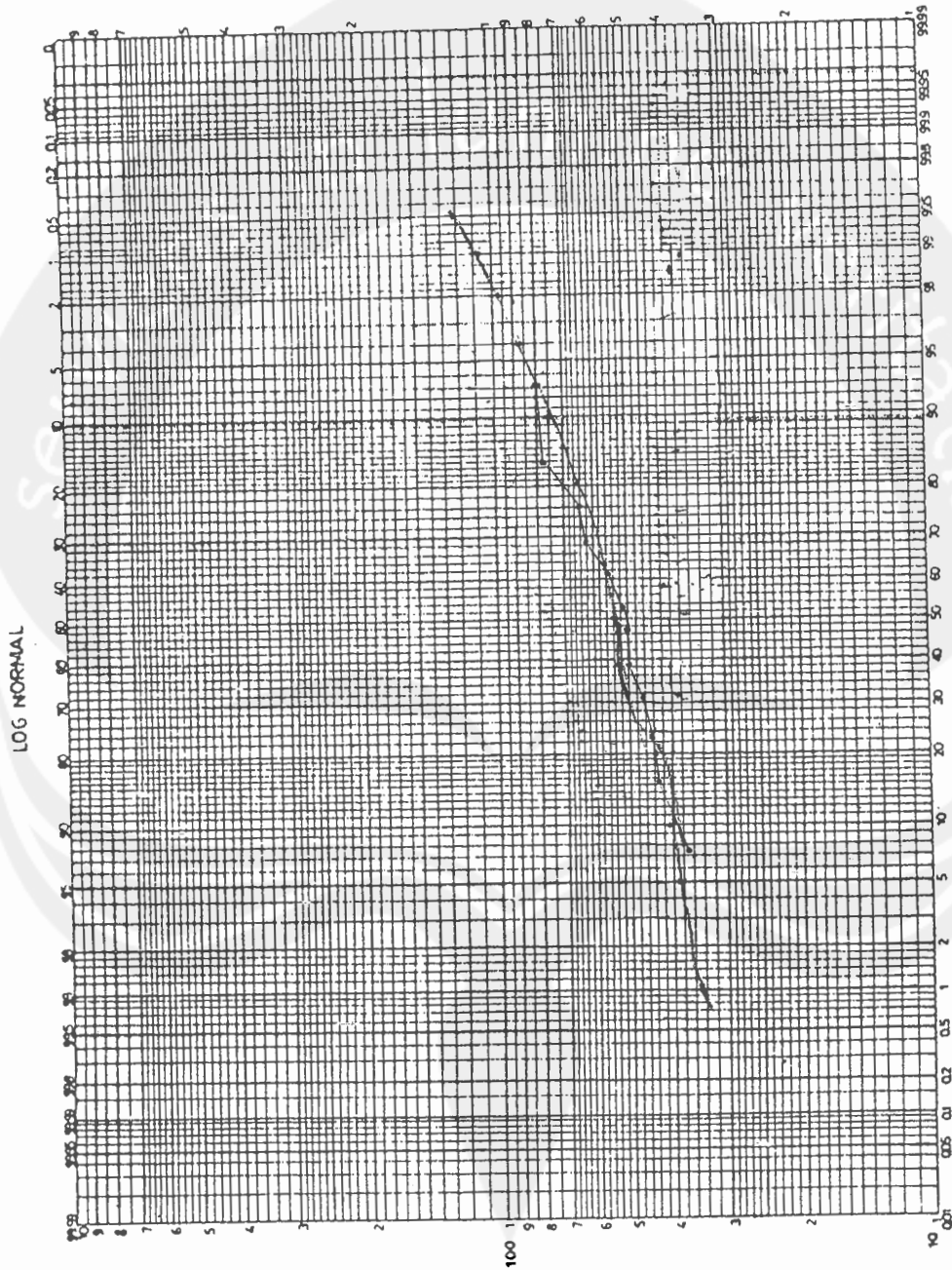
Jadi, yang memiliki simpangan terkecil terhadap simpangan yang diperkenankan adalah analisa frekuensi dengan metoda Log Normal 2 Parameter. Sehingga yang digunakan dalam perhitungan selanjutnya yaitu hasil curah hujan rancangan dengan metode Log Normal 2 Parameter.

Plotting data curah hujan pada sebaran
Log Normal 2 Parameter



Plotting data curah hujan pada sebaran

Log Normal 3 Parameter



ANALISIS FREKUENSI DEBIT

no	X	(100.m) (n + 1)	X ²	(X- Xrt)	(X- Xrt) ²	(X- Xrt) ³	(X- Xrt) ⁴
1	121,75	7,6923077	14823,063	-63,7675	4066,29406	-259297,406	16534747,35
2	146,37	15,384615	21424,177	-39,15	1532,7225	-60006,0859	2349238,262
3	150,25	23,076923	22575,063	-35,27	1243,9729	-43874,9242	1547468,576
4	164,9	30,769231	27192,01	-20,62	425,1844	-8767,30233	180781,774
5	178,9	38,461538	32005,21	-6,62	43,8244	-290,117528	1920,578035
6	179,3	46,153846	32148,49	-6,22	38,6884	-240,641848	1496,792295
7	181,7	53,846154	33014,89	-3,82	14,5924	-55,742968	212,9381378
8	187,4	61,538462	35118,76	1,88	3,5344	6,644672	12,49198336
9	193,64	69,230769	37496,45	8,12	65,9344	535,387328	4347,345103
10	199	76,923077	39601	13,48	181,7104	2449,45619	33018,66947
11	224	84,615385	50176	38,48	1480,7104	56977,7362	2192503,289
12	299	92,307692	89401	113,48	12877,7104	1461362,58	165835425,1
	2226,21		434976,11	-0,0275	21974,8791	1148799,58	188681173,2

$$X_{rt} = 185,5175$$

$$s = 44,696144$$

$$C_s = 1,4035331$$

$$C_k = 6,8766299$$

$$C_v = 0,2409268$$

$$C_s/C_v = 5,825557532$$

Pemilihan Jenis Sebaran

No	Sebaran	Syarat	Hasil hitungan	Keterangan
1	Normal	$C_s \approx 0$	1,4035331	Tidak dipilih
2	Log Normal	$C_s \approx 3 C_v$ $C_s \approx 3$ C_v	$C_s = 5,825557532$ C_v	Tidak dipilih
3	Gumbel Tipe I	$C_s = 1,1396$ $C_k = 5,4$	$C_s = 1,4035331$ $C_k = 6,8766299$	Dicoba
4	Log Pearson III	Tidak termasuk di atas $C_s < 0$	$C_s = 1,4035331$	Dicoba

Analisa Distribusi Debit metode Log Pearson III dan Gumbel

No	X	Peluang(%)	Log X	Log Xrt	(Log X-Log Xrt) ²	(Log X-Log Xrt) ³
1	121,75	7,6923077	2,085469	2,268385	0,03345823	-0,00612004
2	146,37	15,384615	2,165452	2,268385	0,01059516	-0,00109059
3	150,25	23,076923	2,176814	2,268385	0,00838514	-0,00076783
4	164,9	30,769231	2,217221	2,268385	0,00261778	-0,00013394
5	178,9	38,461538	2,25261	2,268385	0,00024884	-3,9253E-06
6	179,3	46,153846	2,25358	2,268385	0,00021918	-3,2448E-06
7	181,7	53,846154	2,259355	2,268385	8,154E-05	-7,363E-07
8	187,4	61,538462	2,27277	2,268385	1,9226E-05	8,42987E-08
9	193,64	69,230769	2,286995	2,268385	0,00034634	6,44544E-06
10	199	76,923077	2,298853	2,268385	0,00092831	2,8284E-05
11	224	84,615385	2,350248	2,268385	0,00670157	0,000548612
12	299	92,307692	2,475671	2,268385	0,04296761	0,008906598
	2226,21		27,09504		0,10656892	0,001369717

Metode Log Pearson III

Rerata Log X = 27,09504

Slogx = 0.0983753

Cs = 0.1569499

Persamaan : Log Xt = Rerata Log X + K.SlogX

$$\text{Log Xt} = 27,09504 + (K.0.0983753)$$

Tr (tahun)	K	SLogx	K.Slogx	Log Xt	Xt
1,01	-1,31581	0,0983753	-0,129443203	2,128476697	134,423964
2	-0,2255	0,0983753	-0,02218363	2,23573627	172,082327
5	0,70447	0,0983753	0,069302448	2,327222348	212,433179
10	1,33686	0,0983753	0,131514004	2,389433904	245,151132
25	2,0933	0,0983753	0,205929015	2,463848915	290,97047
50	2,7073	0,0983753	0,26633145	2,52425135	334,388513
100	3,27308	0,0983753	0,321990227	2,579910127	380,110728
200	3,8308	0,0983753	0,376856099	2,634775999	431,296565

Penggambaran dan Pengujian untuk metoda Log Pearson III

Penggambaran pada kertas probabilitas Log Normal

1. Plotting pada kertas probabilitas Log Normal dengan menggunakan absis =

$$\frac{100.m}{n+1} \text{ dan ordinatnya = data hujan (X).}$$

2. Persamaan garis teoritis = Log Xt = rerata Log X + K.Slog X

$$\text{Log Xt} = 27,09504 + (K.0,0983753)$$

A. Uji Chi-Kuadrat

Kl s	Teoritis		Pengamatan		Ef-Of	$(Ef - Of)^2$ Ef
	Jangkauan	Ef	Jangkauan	Of		
1	$P \leq 0,18$	2,4	$P < 146,37$	2	0,4	0,0667
2	$0,18 < P \leq 0,36$	2,4	$146,37 < P \leq 164,9$	2	0,4	0,0667
3	$0,36 < P \leq 0,64$	2,4	$164,9 < P \leq 187,4$	4	-1,6	1,0667
4	$0,64 < P \leq 0,82$	2,4	$187,4 < P \leq 199$	2	0,4	0,0667
5	$0,82 < P \leq 1$	2,4	$199 < P \leq 299$	2	0,4	0,0667
		12		12		$\Sigma = 1,3335$

$$DK = K - (P + 1) = 5 - (2 + 1) = 2$$

α diambil 5%, maka didapat X^2 kritik = 5,991 (dari tabel nilai X^2)

$$X^2 = 1,335 < 5,991 \text{ (Distribusi sesuai)}$$

A. Uji Smirnov-Kolmogorov

$$n = 12$$

$\alpha = 0,05$ maka Δ kritik yang didapat dari tabel (tabel nilai Δ untuk uji Smirnov-Kolmogorov sampel tunggal) = 0,375

Dari gambar plotting didapat Δ maks = 0,16 = 16% < 0,375 maka distribusi memenuhi syarat.

Metode Gumbel

$$n = 12$$

$$X_{rt} = 185,5175$$

$$S_x = 44,696144$$

$$K = \frac{Y_t - Y_n}{S_n}$$

$$S_n$$

$$\text{Persamaan : } X_t = X_{rt} + K \cdot S_x$$

Tr (tahun)	Yt	Yn	Sn	K	Xt
2	0,3665	0,5053	0,9833	-0,1411573	179,208312
5	1,4999	0,5053	0,9833	1,0114919	230,727288
10	2,2504	0,5053	0,9833	1,7747381	264,841451
20	2,9702	0,5053	0,9833	2,5067629	297,560137
25	3,1985	0,5053	0,9833	2,7389403	307,93757
50	3,9019	0,5053	0,9833	3,4542866	339,910791
100	4,6001	0,5053	0,9833	4,1643446	371,647644
200	5,2958	0,5053	0,9833	4,8718601	403,270859
1000	6,9072	0,5053	0,9833	6,5106275	476,517443

Penggambaran dan Pengujian untuk metoda Gumbel tipe I

Penggambaran pada kertas probabilitas Gumbel

1. Plotting pada kertas probabilitas Gumbel dengan menggunakan absis =

$$\frac{100.m}{n+1} \text{ dan ordinatnya = data hujan (X).}$$

2. Persamaan garis teoritis = $X_t = X_{rt} + K.S_x$

$$K = \frac{Y_t - Y_n}{S_n}$$

A. Uji Chi-Kuadrat

Kl s	Teoritis		Pengamatan		Ef-Of	$\frac{(Ef - Of)^2}{Ef}$
	Jangkauan	Ef	Jangkauan	Of		
1	$P \leq 0,27$	2,4	$P \leq 150,25$	3	-0,6	0,15
2	$0,27 < P \leq 0,46$	2,4	$150,25 < P \leq 178,9$	2	0,4	0,0667
3	$0,46 < P \leq 0,64$	2,4	$178,9 < P \leq 187,4$	3	-0,6	0,15
4	$0,64 < P \leq 0,82$	2,4	$187,4 < P \leq 199$	2	0,4	0,0667
5	$0,82 < P \leq 1$	2,4	$199 < P \leq 299$	2	0,4	0,0667
		12		12		$\Sigma = 0,5001$

$$DK = K - (P + 1) = 5 - (2 + 1) = 2$$

α diambil 5%, maka didapat X^2 kritik = 5,991 (dari tabel nilai X^2)

$$X^2 = 0,5001 < 5,991 \text{ (Distribusi sesuai)}$$

B. Uji Smirnov-Kolmogorov

$$n = 12$$

$\alpha = 0,05$ maka Δ kritik yang didapat dari tabel (tabel nilai Δ untuk uji

Smirnov-Kolmogorov sampel tunggal) = 0,375

Dari gambar plotting didapat Δ maks = 0,18 = 18% < 0,375 maka distribusi memenuhi syarat.

Hasil Analisa Frekuensi debit Maksimum DPS Oyo dengan berbagai metode dan kala ulang

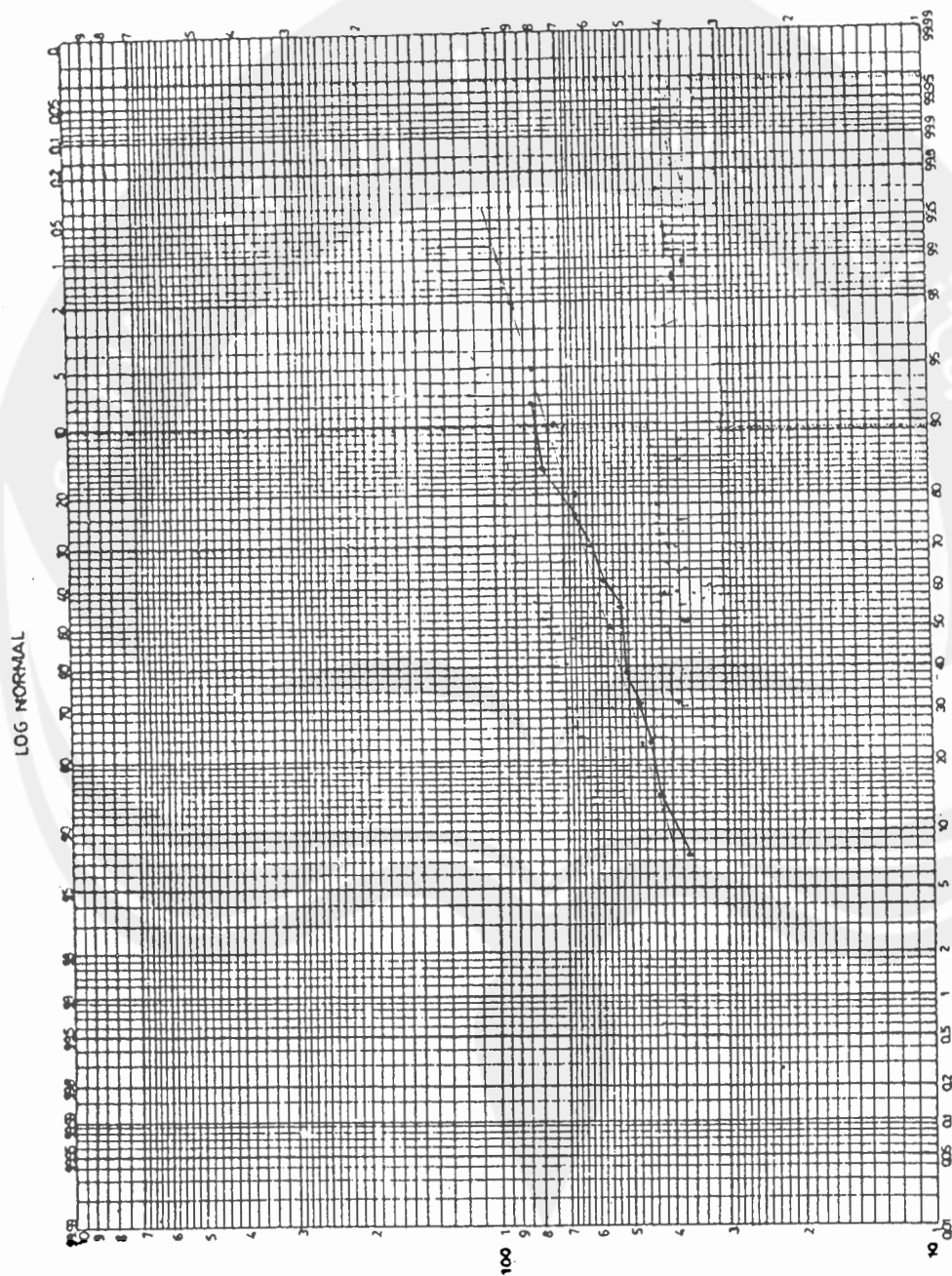
No	Kala Ulang (tahun)	Log Pearson III (m ³ /det)	Gumbel I (m ³ /det)
1	2	172,082327	179,208312
2	5	212,433179	230,727288
3	10	245,151132	264,841451
4	25	290,97047	307,93757
5	50	334,388513	339,910791
6	100	380,110728	371,647644
7	200	431,296565	403,270859

Hasil uji distribusi

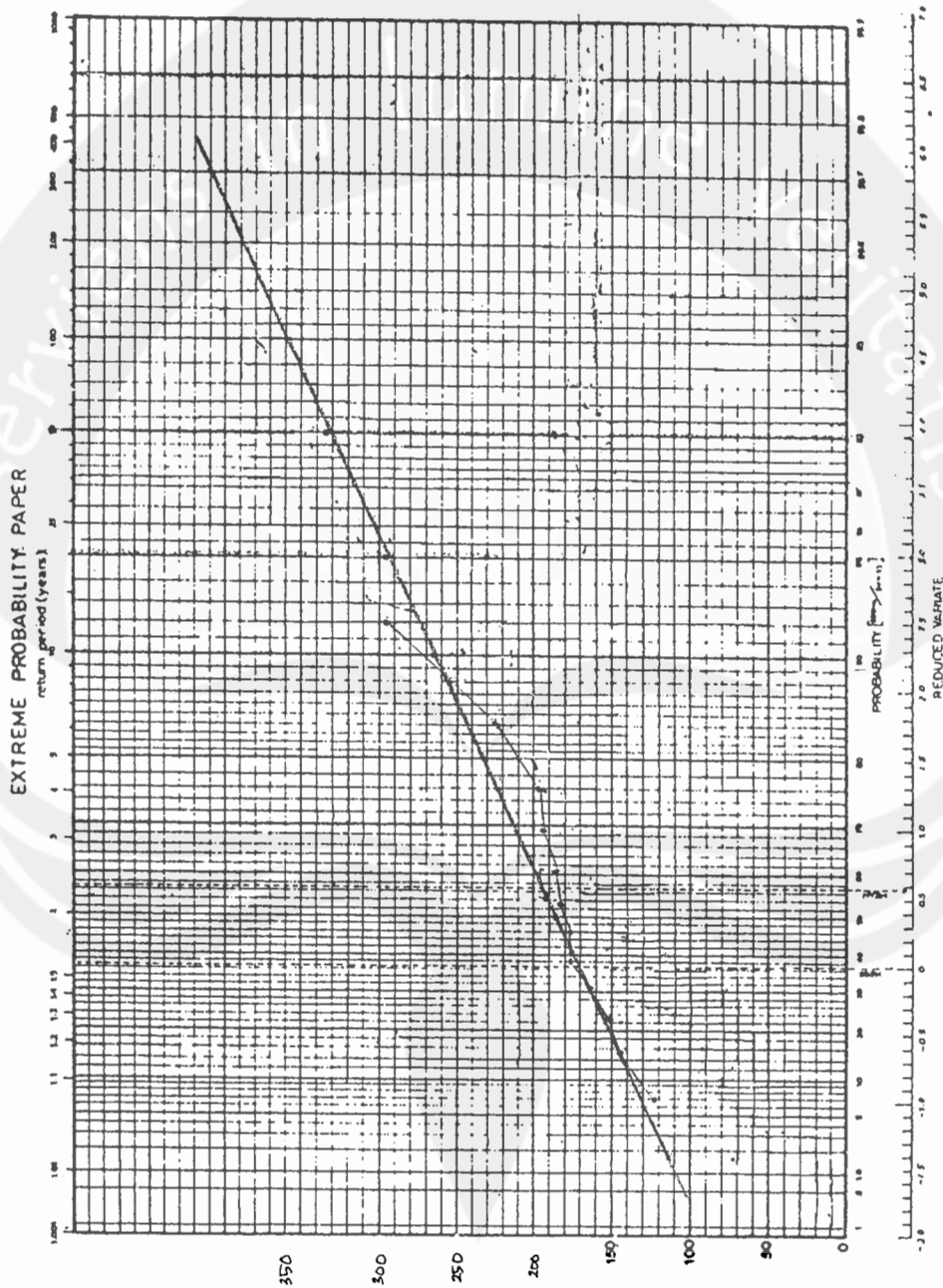
	Log Pearson III	Gumbel I
Chi-kuadrat	1,335	0,5001
Smirnov Kolmogorov	0,16	0,18

Terlihat bahwa yang penyimpangannya paling kecil adalah metode Gumbel, sehingga sebagai acuan pemilihan besaran debit digunakan hasil perhitungan dengan metode Gumbel I

Plotting data debit pada sebaran Log Pearson III



Plotting data debit pada sebaran Gumbel Tipe I



Faktor frekuensi K untuk sebaran Log
Normal

Faktor Frekuensi K untuk sebaran log normal.

C _v	Return Period, T, Tahun.					
	2	5	10	20	50	100
0.0500	-0.250	0.8334	1.2965	1.6863	2.1341	2.4370
0.1000	-0.0496	0.8222	1.3078	1.7247	2.2130	2.5489
0.1500	-0.0738	0.8085	1.3156	1.7598	2.2899	2.6607
0.2000	-0.0971	0.7926	1.3200	1.7911	2.3640	2.7716
0.2500	-0.1194	0.7746	1.3209	1.8183	2.4348	2.8805
0.3000	-0.1406	0.7547	1.3183	1.8414	2.5016	2.9866
0.3500	-0.1604	0.7333	1.3126	1.8602	2.5638	3.0890
0.4000	-0.1788	0.7106	1.3037	1.8746	2.6212	3.1870
0.4500	-0.1957	0.6870	1.2920	1.8848	2.6734	3.2199
0.5000	-0.2111	0.6626	1.2778	1.8909	2.7202	3.3673
0.5500	-0.2251	0.6379	1.2613	1.8931	2.7615	3.4488
0.6000	-0.2375	0.6129	1.2428	1.8915	2.7974	3.5241
0.6500	-0.2485	0.5879	1.2226	1.8866	2.8279	3.5930
0.7000	-0.2582	0.5631	1.2011	1.8786	2.8532	3.6556
0.7500	-0.2667	0.5387	1.1784	1.8677	2.8735	3.7118
0.8000	-0.2739	0.5148	1.1548	1.8543	2.8891	3.7617
0.8500	-0.2801	0.4914	1.1306	1.8388	2.9002	3.8056
0.9000	-0.2852	0.4686	1.1060	1.8212	2.9071	3.8437
0.9500	-0.2895	0.4466	1.0810	1.8021	2.9103	3.8762
1.0000	-0.2929	0.4254	1.0560	1.7815	2.9098	3.9035

Faktor frekuensi K untuk sebaran Log
Normal 3 Parameter

Faktor Frekuensi K untuk sebaran log normal 3 parameter

Coeff. of Skewness	Return Period, T. years					
	2	5	10	20	50	100
- 2.0	.2366	-.6144	-1.2437	-1.8916	-2.7943	-3.5196
- 1.8	.2240	-.6395	-1.2621	-1.8928	-2.7578	-3.4433
- 1.6	.2092	-.6654	-1.2792	-1.8901	-2.7138	-3.3570
- 1.4	.1950	-.6920	-1.2943	-1.8827	-2.6615	-3.2601
- 1.2	.1722	-.7186	-1.3067	-1.8696	-2.6002	-3.1521
- 1.0	.1495	-.7449	-1.3156	-1.8501	-2.5294	-3.0333
- 0.8	.1241	-.7700	-1.3201	-1.8235	-2.4492	-2.9043
- 0.6	.0959	-.7930	-1.3194	-1.7894	-2.3600	-2.7665
- 0.4	.0654	-.8131	-1.3128	-1.7478	-2.2631	-2.6223
- 0.2	.0332	-.8296	-1.3002	-1.6993	-2.1602	-2.4745
0.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.2	-.0332	.8296	1.3002	1.6993	2.1602	2.4745
0.4	-.0654	.8131	1.3128	1.7478	2.2631	2.6223
0.6	-.0959	.7930	1.3194	1.7894	2.3600	2.7665
0.8	-.1241	.7700	1.3201	1.8235	2.4492	2.9043
1.0	-.1495	.7449	1.3156	1.8501	2.5294	3.0333
1.2	-.1722	.7186	1.3051	1.8696	2.6002	3.1521
1.4	-.1950	.6920	1.2943	1.8827	2.6615	3.2601
1.6	-.2092	.6654	1.2792	1.8901	2.7138	3.3570
1.8	-.2240	.6395	1.2621	1.8928	2.7578	3.4433
2.0	-.2366	.6144	1.2437	1.8916	2.7943	3.5196

Faktor frekuensi K untuk sebaran Log
Pearson III (Cs positif)

PEARSON TYPE III DISTRIBUTION
VALUE FOR POSITIVE SKEW COEFFICIENTS
RECURRENCE INTERVAL IN YEARS

Skew Coefficient C_s	1.0526	1.1111	1.2500	Percent Chance				25	50	100	200
	95	90	80	50	20	10	4	2	1	0.5	
3.0	-0.667	-0.665	-0.660	-0.636	0.420	1.180	2.278	3.152	4.051	4.970	
2.9	-0.690	-0.688	-0.681	-0.651	0.440	1.195	2.277	3.134	4.013	4.909	
2.8	-0.714	-0.711	-0.702	-0.666	0.460	1.210	2.275	3.114	3.973	4.847	
2.7	-0.740	-0.736	-0.724	-0.681	0.479	1.224	2.272	3.097	3.932	4.783	
2.6	-0.769	-0.762	-0.747	-0.696	0.499	1.238	2.267	3.071	3.889	4.718	
2.5	-0.799	-0.790	-0.771	-0.711	0.518	1.250	2.262	3.048	3.845	4.652	
2.4	-0.832	-0.819	-0.795	-0.725	0.537	1.262	2.256	3.023	3.800	4.584	
2.3	-0.867	-0.850	-0.819	-0.739	0.555	1.274	2.248	2.997	3.753	4.515	
2.2	-0.905	-0.882	-0.844	-0.752	0.574	1.284	2.240	2.970	3.705	4.454	
2.1	-0.946	-0.914	-0.869	-0.765	0.592	1.294	2.230	2.942	3.656	4.372	
2.0	-0.990	-0.949	-0.895	-0.777	0.609	1.302	2.219	2.912	3.605	4.298	
1.9	-1.037	-0.984	-0.920	-0.788	0.627	1.310	2.207	2.881	3.553	4.223	
1.8	-1.087	-1.020	-0.945	-0.799	0.643	1.318	2.193	2.848	3.499	4.147	
1.7	-1.140	-1.056	-0.970	-0.808	0.660	1.324	2.179	2.815	3.444	4.069	
1.6	-1.197	-1.093	-0.994	-0.817	0.675	1.329	2.163	2.780	3.388	3.990	
1.5	-1.256	-1.131	-1.018	-0.825	0.690	1.333	2.146	2.743	3.330	3.910	
1.4	-1.318	-1.163	-1.041	-0.832	0.705	1.337	2.128	2.705	3.271	3.828	
1.3	-1.388	-1.206	-1.064	-0.838	0.719	1.339	2.108	2.666	3.211	3.745	
1.2	-1.449	-1.243	-1.086	-0.844	0.732	1.340	2.087	2.626	3.149	3.661	
1.1	-1.518	-1.280	-1.107	-0.848	0.745	1.341	2.066	2.585	3.087	3.575	
1.0	-1.588	-1.317	-1.128	-0.852	0.758	1.340	2.043	2.542	3.022	3.489	
.9	-1.660	-1.353	-1.147	-0.854	0.769	1.339	2.018	2.498	2.967	3.401	
.8	-1.733	-1.388	-1.166	-0.856	0.780	1.336	1.993	2.453	2.891	3.312	
.7	-1.805	-1.423	-1.183	-0.857	0.790	1.333	1.967	2.407	2.824	3.223	
.6	-1.880	-1.458	-1.200	-0.857	0.800	1.328	1.939	2.359	2.755	3.132	
.5	-1.955	-1.491	-1.216	-0.856	0.808	1.323	1.910	2.311	2.686	3.041	
.4	-2.029	-1.524	-1.231	-0.855	0.816	1.317	1.880	2.261	2.615	2.949	
.3	-2.104	-1.555	-1.245	-0.853	0.824	1.309	1.849	2.211	2.544	2.856	
.2	-2.175	-1.586	-1.258	-0.850	0.830	1.301	1.818	2.159	2.472	2.763	
.1	-2.252	-1.616	-1.270	-0.846	0.836	1.292	1.785	2.107	2.400	2.670	
0	-2.326	-1.645	-1.282	-0.842	0.842	1.282	1.751	2.054	2.326	2.576	

Diamil dari Dr. M.M.A. SHAHIN/Statistical Analysis in Hydrology.

PEARSON TYPE III DISTRIBUTION
TABEL 8 – 8b.
VALUE FOR NEGATIVE SKEW COEFFICIENT
RECURRENCE INTERVAL IN YEARS

Skew Coefficient C_s	1.0101	1.0525	1.1111	1.2500	Percent Chance							
	99	95	90	80	50	20	10	4	2	1	0.5	
0	-2.326	-1.645	-1.282	-0.842	0	0.842	1.282	1.751	2.054	2.326	2.576	
-1	-2.400	-1.725	-1.355	-0.938	0.017	0.846	1.270	1.718	2.000	2.252	2.482	
-2	-2.472	-1.700	-1.301	-0.830	0.033	0.850	1.258	1.680	1.945	2.178	2.388	
-3	-2.544	-1.728	-1.309	-0.824	0.050	0.853	1.245	1.643	1.890	2.104	2.294	
-4	-2.615	-1.750	-1.317	-0.818	0.066	0.855	1.231	1.606	1.834	2.029	2.201	
-5	-2.686	-1.774	-1.323	-0.808	0.083	0.856	1.218	1.567	1.777	1.955	2.108	
-6	-2.755	-1.797	-1.328	-0.800	0.099	0.857	1.200	1.528	1.720	1.880	2.016	
-7	-2.824	-1.818	-1.333	-0.790	0.118	0.857	1.183	1.488	1.663	1.805	1.926	
-8	-2.891	-1.839	-1.336	-0.780	0.132	0.856	1.166	1.448	1.605	1.733	1.837	
-9	-2.957	-1.858	-1.339	-0.769	0.148	0.854	1.147	1.407	1.549	1.660	1.749	
-1.0	-3.022	-1.877	-1.340	-0.758	0.164	0.852	1.128	1.366	1.492	1.588	1.664	
-1.1	-3.087	-1.894	-1.341	-0.745	0.180	0.848	1.107	1.324	1.435	1.518	1.581	
-1.2	-3.149	-1.910	-1.340	-0.732	0.195	0.844	1.085	1.282	1.379	1.449	1.501	
-1.3	-3.211	-1.925	-1.339	-0.719	0.210	0.838	1.064	1.240	1.324	1.383	1.424	
-1.4	-3.271	-1.938	-1.337	-0.705	0.225	0.832	1.041	1.198	1.270	1.318	1.351	
-1.5	-3.330	-1.951	-1.335	-0.690	0.240	0.825	1.018	1.157	1.217	1.256	1.282	
-1.6	-3.388	-1.962	-1.332	-0.675	0.254	0.817	0.994	1.116	1.166	1.197	1.216	
-1.7	-3.444	-1.972	-1.329	-0.660	0.268	0.808	0.970	1.075	1.116	1.140	1.155	
-1.8	-3.499	-1.981	-1.326	-0.643	0.282	0.799	0.945	1.035	1.069	1.087	1.097	
-1.9	-3.553	-1.989	-1.320	-0.627	0.294	0.788	0.920	0.998	1.023	1.037	1.044	
-2.0	-3.605	-1.996	-1.302	-0.609	0.307	0.777	0.895	0.959	0.980	0.990	0.995	
-2.1	-3.656	-2.001	-1.294	-0.592	0.319	0.765	0.869	0.922	0.939	0.946	0.949	
-2.2	-3.705	-2.005	-1.294	-0.574	0.330	0.752	0.844	0.888	0.900	0.905	0.907	
-2.3	-3.753	-2.009	-1.274	-0.555	0.341	0.739	0.819	0.855	0.854	0.867	0.869	
-2.4	-3.800	-2.011	-1.262	-0.537	0.351	0.725	0.795	0.823	0.830	0.832	0.833	
-2.5	-3.845	-2.012	-1.250	-0.518	0.360	0.711	0.771	0.792	0.795	0.799	0.800	
-2.6	-3.889	-2.013	-1.236	-0.499	0.368	0.696	0.747	0.754	0.766	0.769	0.769	
-2.7	-3.932	-2.013	-1.224	-0.479	0.376	0.681	0.724	0.738	0.740	0.740	0.741	
-2.8	-3.973	-2.010	-1.210	-0.460	0.384	0.666	0.702	0.712	0.714	0.714	0.714	
-2.9	-4.013	-2.007	-1.195	-0.440	0.390	0.651	0.681	0.693	0.689	0.690	0.690	
-3.0	-4.051	-2.003	-1.180	-0.420	0.390	0.636	0.660	0.666	0.666	0.667	0.667	

Dimiliki oleh Dr. M.M.A. BIAHIN / Statistical Analysis in Hydrology.

Mean dan Standard deviation untuk
Reduced variate

"Mean" dan "Standard deviation" untuk "reduced variate"

n	\bar{y}_n	σ_n	n	\bar{y}_n	σ_n	n	\bar{y}_n	σ_n	n	\bar{y}_n	σ_n
8	.4843	.9043	29	.5363	1.1086	49	.5481	1.1590	78	.5565	1.1923
9	.4902	.9288	30	.53622	1.11238	50	.54854	1.16066	80	.55688	1.19382
10	.4952	.9497	31	.5371	1.1159	51	.5489	1.1623	82	.5572	1.1953
11	.4996	.9676	32	.5380	1.1193	52	.5493	1.1638	84	.5576	1.1967
12	.5035	.9833	33	.5388	1.1226	53	.5497	1.1653	86	.5580	1.1980
13	.5070	.9972	34	.5396	1.1255	54	.5501	1.1667	88	.5583	1.1994
14	.5100	1.0095	35	.54034	1.12847	55	.5504	1.1681	90	.55860	1.20073
15	.5128	1.02057	36	.5410	1.1313	56	.5508	1.1696	92	.5589	1.2020
16	.5157	1.0316	37	.5418	1.1339	57	.5511	1.1708	94	.5592	1.2032
17	.5181	1.0411	38	.5424	1.1363	58	.5515	1.1721	96	.5595	1.2044
18	.5202	1.0493	39	.5430	1.1388	59	.5518	1.1734	98	.5598	1.2055
19	.5220	1.0566	40	.54362	1.14132	60	.55208	1.17467	100	.56002	1.20649
20	.52355	1.06283	41	.5442	1.1436	62	.5527	1.1770	150	.56461	1.22534
21	.5252	1.0696	42	.5448	1.1458	64	.5533	1.1793	200	.56715	1.23598
22	.5268	1.0754	43	.5453	1.1480	66	.5538	1.1814	250	.56878	1.24292
23	.5283	1.0811	44	.5458	1.1499	68	.5543	1.1834	300	.56993	1.24786
24	.5296	1.0864	45	.54630	1.15185	70	.55477	1.18536	400	.57144	1.25450
25	.53086	1.09145	46	.5468	1.1538	72	.5552	1.1873	500	.57240	1.25880
26	.5320	1.0961	47	.5473	1.1557	74	.5557	1.1890	750	.57377	1.26506
27	.5332	1.1004	48	.5477	1.1574	76	.5561	1.1906	1000	.57450	1.26851
28	.5343	1.1047									



Reduced Variate Sebagai Fungsi Waktu Balik.

$$Y_T = -\ln \left[-\ln \left\{ (T_r - 1) / T_r \right\} \right]$$

T_r (tahun)	Reduced Variate	T_r (tahun)	Reduced Variate
5	1,4999	200	5,2958
10	2,2504	500	6,2136
100	4,6001	1000	6,9072

Tabel Nilai χ^2

db	$\chi^2_{0,05}$	$\chi^2_{0,025}$	$\chi^2_{0,01}$	$\chi^2_{0,005}$	db
1	3.841	5.024	6.635	7.879	1
2	5.991	7.378	9.210	10.597	2
3	7.815	9.348	11.345	12.838	3
4	9.488	11.143	13.277	14.860	4
5	11.070	12.832	15.086	16.750	5
6	12.592	14.449	16.812	18.548	6
7	14.067	16.013	18.475	20.278	7
8	15.507	17.535	20.090	21.955	8
9	16.919	19.023	21.666	23.589	9
10	18.307	20.483	23.209	25.188	10
11	19.675	21.920	24.725	26.757	11
12	21.026	23.337	26.217	28.300	12
13	22.362	24.736	27.688	29.819	13
14	23.685	26.119	29.141	31.319	14
15	24.996	27.488	30.578	32.801	15
16	26.296	28.845	32.000	34.267	16
17	27.587	30.191	33.409	35.718	17
18	28.869	31.526	34.805	37.156	18
19	30.144	32.852	36.191	38.582	19
20	31.410	34.170	37.566	39.997	20
21	32.671	35.479	38.932	41.401	21
22	33.924	36.781	40.289	42.796	22
23	35.172	38.076	41.638	44.181	23
24	36.415	39.364	42.980	45.558	24
25	37.652	40.646	44.314	46.928	25
26	38.885	41.923	45.642	48.290	26
27	40.113	43.194	46.963	49.645	27
28	41.337	44.461	48.278	50.993	28
29	42.557	45.722	49.588	52.336	29
30	43.773	46.979	50.892	53.672	30

Tabel nilai Δ untuk uji Smirnov-Kolmogorov

Tabel Nilai D
Untuk Uji Kolmogorov-Smirnov Sampel Tunggal

Besarnya Sampel (n)	Tingkat Signifikansi untuk $D = \text{Maksimum } F_n(X) - F_e(X)$				
	0,20	0,15	0,10	0,05	0,01
1	.900	.925	.950	.975	.995
2	.684	.726	.776	.842	.929
3	.565	.597	.642	.708	.828
4	.494	.525	.564	.624	.733
5	.446	.474	.510	.565	.669
6	.410	.436	.470	.521	.618
7	.381	.405	.438	.486	.577
8	.358	.381	.411	.457	.543
9	.339	.360	.388	.432	.514
10	.322	.342	.368	.410	.490
11	.307	.326	.352	.391	.468
12	.295	.313	.338	.375	.450
13	.284	.302	.325	.361	.433
14	.274	.292	.314	.349	.418
15	.266	.283	.304	.338	.404
16	.258	.274	.295	.328	.392
17	.250	.266	.286	.318	.381
18	.244	.259	.278	.309	.371
19	.237	.252	.272	.301	.363
20	.231	.246	.264	.294	.356
25	.21	.22	.24	.27	.32
30	.19	.20	.22	.24	.29
35	.18	.19	.21	.23	.27
Di Atas	<u>1,07</u>	<u>1,14</u>	<u>1,22</u>	<u>1,36</u>	<u>1,63</u>
35	\sqrt{n}	\sqrt{n}	\sqrt{n}	\sqrt{n}	\sqrt{n}

TRANSFORMASI DATA HUJAN RANCANGAN MENJADI DATA DEBIT BANJIR RANCANGAN

Untuk dapat mentransformasikan data hujan rancangan menjadi data banjir perlu dilakukan analisa distribusi hujan daerah, analisa hujan netto, dan analisa hidrograf satuan sintetis.

Analisa Distribusi Hujan

Digunakan pendekatan dengan formulasi empiris Mononobe dengan pola distribusi terpusat selama 5 jam

Tabel : Distribusi Hujan Berdasar Metoda Mononobe

Jam ke	1	2	3	4	5
Persen (%)	50	24	10	8	8

Sumber : Laporan Studi Hidrologi, Persero PT. Indra Karya

Analisa Hujan Netto

Dari berbagai data yang ada dipilih salah satu seri data tahunan dari AWLR yang diasumsi sebagai data yang mewakili kondisi karakteristik DAS. Ditentukan bahwa data AWLR Bunder tahun 1982 digunakan sebagai data untuk analisa koefisien limpasan. Volume limpasan dari hasil pencatatan AWLR Bunder tahun 1982 sebesar $295,206.10^3$ meter kubik atau setara dengan tinggi hujan 765,42 mm. Pada waktu yang sama dari analisa hujan daerah di DAS Oyo menunjukkan bahwa tinggi hujan tahun 1982 sebesar 1343 mm. Dari dua data tersebut diperkirakan bahwa koefisien limpasan DAS Oyo yang diwakili oleh data AWLR Bunder sebesar 0,53, sehingga nilai inilah yang nantinya akan digunakan sebagai koefisien limpasan DAS Oyo.

Tabel : Curah Hujan Netto (C.H. netto)

Kala Ulang	C.H rancangan	Koef.limpasan	C.H netto
2	54,36427088	0,53	28,81306357
5	66,87998727	0,53	35,44639325
10	74,52801396	0,53	39,4998474
20	81,49145616	0,53	43,19047176
50	90,08026154	0,53	47,74253862
100	96,36191919	0,53	51,07181717

Tabel : Distribusi Hujan Netto Jam-jaman

t	Distribusi (%)	Kala Ulang					
		T 2	T 5	T 10	T 20	T 50	T 100
1	0,5	14,406532	17,723196	19,749924	21,595236	23,871269	25,535909
2	0,24	6,9151353	8,507134	9,4799634	10,365713	11,458209	12,257236
3	0,1	2,8813064	3,544639	3,9499847	4,3190472	4,7742539	5,1071817
4	0,08	2,3050451	2,835711	3,1599878	3,4552377	3,8194031	4,0857454
5	0,08	2,3050451	2,835711	3,1599878	3,4552377	3,8194031	4,0857454
C.H Netto		28,8130636	35,446393	39,499847	43,190472	47,742539	51,071817

ANALISIS HIDROGRAF SATUAN SINTETIS

Penetapan Parameter DAS

Parameter DAS merupakan faktor yang sangat menentukan dalam pengalihragaman (*transformation*) masukan menjadi keluaran, atau secara lebih spesifik masukan hujan menjadi hidrograf. Parameter yang dimaksudkan dapat terdiri dari :

1. faktor fisiografik,
2. faktor tata guna lahan,
3. faktor topografik.

Dalam kaitan ini, parameter yang dimaksudkan adalah parameter topografik, yang telah terbukti sangat berpengaruh terhadap pemakaian model hidrologi.

Parameter yang ditetapkan sebagai parameter karakteristik DAS adalah sebagai berikut.

1. Faktor Sumber (*Source Factor*, SF) adalah perbandingan antara panjang semua sungai tingkat satu dengan jumlah panjang semua sungai semua tingkat (dari tingkat satu sampai tingkat tertinggi).
2. Frekuensi Sumber (*Source Frequency*, SN) adalah perbandingan antara jumlah pangsa (*segment*) sungai-sungai tingkat satu dengan jumlah pangsa semua sungai semua tingkat.
3. Faktor Lebar (*Width Factor*, WF) adalah perbandingan antara lebar DAS yang diukur dari titik berjarak 0,75L dan lebar DAS yang diukur dari titik

berjarak $0,25L$ dari titik kontrol, dengan L adalah panjang sungai utama (*main stream length*/Gambar pada Lampiran IV).

4. Luas DAS sebelah hulu (RUA) adalah perbandingan antara luas DAS di hulu garis yang ditarik melalui titik di sungai yang paling dekat dengan titik berat DAS tegak lurus garis hubung antara titik tersebut dengan titik kontrol (Gambar pada Lampiran IV)
5. Faktor Simetri (*Symmetry Factor*, SIM) adalah hasil kali WF dan RUA.
6. Kerapatan-jaringan-kuras (*Drainage Density*, D) adalah panjang seluruh sistem sungai persatuan DAS.
7. Jumlah pertemuan sungai (JN) adalah jumlah semua titik pertemuan sungai semua tingkat. Nilai JN ini adalah jumlah pangsa sungai tingkat satu dikurangi satu.

Parameter DAS

Jumlah pertemuan sungai (JN) = 322

Luas DPS (A) = $638,00 \text{ km}^2$

Panjang seluruh sistem sungai = $753,48 \text{ km}$

Panjang sungai utama = $103,00 \text{ km}$

Panjang sungai utama diukur dari titik di sungai terdekat dengan titik berat

DAS/dalam km = $L_c = 48,50$

Landai sungai rata-rata (S) = $0,0048$

Faktor Lebar (WF) = $0,640$

Perbandingan DPS hulu dan DPS (RUA) = $0,51$

Faktor Simetri (SIM) = $RUA * WF = 0,33$

Faktor Sumber (SF) = 0,564

Frekuensi Sumber (SN) = 0,550

Kerapatan Jaringan Kuras (D) = 1,181





$$x \sim A = 0.75L$$

$$x \sim B = 0.25L$$

$$WF = \frac{w_u}{w_L}$$

Sketsa penetapan faktor-lebar.



$$RUA = \frac{A_u}{A}$$

Sketsa penetapan RUA

I. (HSS Gama-I)

$$\begin{aligned} \text{Waktu naik (TR)} &= 0,43 \left(\frac{L}{100.SF} \right)^3 + 1,0665.SIM + 1,2775 \\ &= 0,43 \left(\frac{103,00}{100.0,564} \right)^3 + (1,0665.0,33) + 1,2775 \\ &= 4,2485 \text{ jam} \end{aligned}$$

$$\begin{aligned} \text{Debit Puncak (QP)} &= 0,1836A^{0,5886} JN^{0,2381} TR^{-0,4008} \\ &= 0,1836 (638,00)^{0,5886} (322)^{0,2381} (4,2485)^{-0,4008} \\ &= 18,20178 \text{ m}^3/\text{det} \end{aligned}$$

$$\begin{aligned} \text{Waktu Dasar (TB)} &= 27,4132 TR^{0,1457} S^{-0,0986} SN^{0,7344} RUA^{0,2574} \\ &= 27,4132 (4,2485)^{0,1457} (0,0048)^{-0,0986} (0,55)^{0,7344} (0,51)^{0,2574} \\ &= 31,0580 \text{ jam} \end{aligned}$$

$$\begin{aligned} \text{Koefisien Tampungan (K)} &= 0,5617 A^{0,1798} S^{-0,1446} SF^{-1,0897} D^{0,0452} \\ &= 0,5617 (638,00)^{0,1798} (0,0048)^{-0,1446} (0,564)^{-1,0897} (1,181)^{0,0452} \\ &= 7,3013 \end{aligned}$$

$$\begin{aligned} \text{Aliran dasar (QB)} &= 0,4751 A^{0,6444} D^{0,9430} \\ &= 0,4751 (638,00)^{0,6444} (1,181)^{0,9430} \\ &= 35,673287 \text{ m}^3/\text{det} \end{aligned}$$

Sisi naik hidrograf satuan disajikan sebagai garis lurus dan sisi resesi hidrograf satuan disajikan dengan persamaan eksponensial sebagai berikut :

$$\begin{aligned} Q_t &= QP.e^{-t/K} \\ &= 18,20178.e^{-t/7,3013} \\ &= 18,20178.e^{-(t-TR)/7,3013} \end{aligned}$$

HIDROGRAF SATUAN CARA GAMA - I

f (jam)	Q (m ³ /det)
0	0
1	4,284284
2	8,568568
3	12,852852
4	17,137136
5	16,42151748
6	14,31961975
7	12,48675769
8	10,88849566
9	9,494805682
10	8,279503222
11	7,219755296
12	6,295651458
13	5,489829732
14	4,787150415
15	4,174411632
16	3,640101306
17	3,174180863
18	2,767896633
19	2,413615387
20	2,104680922
21	1,835289005
22	1,600378327
23	1,395535407
24	1,216911677
25	1,061151169
26	0,92532747
27	0,806888738
28	0,703609756
29	0,613550128
30	0,535017822
31	0,466537382

HIDROGRAF BANJIR RENCANA GAMA-I KALA ULANG 2 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					QB (m ³ /det)	Jumlah (m ³ /det)
		14,406532	6,9151353	2,8813064	2,3050451	2,3050451		
0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	61,7216745	0	0	0	0	35,673287	97,3949615
2	8,568568	123,443349	0	0	0	0	35,673287	159,116636
3	12,852852	185,165024	29,626404	0	0	0	35,673287	250,464714
4	17,137136	246,886698	59,252807	12,3443349	0	0	35,673287	354,157127
5	16,42151748	236,577117	88,879211	24,6886698	9,8754678	0	35,673287	395,693752
6	14,31961975	206,29606	118,50561	37,0330047	19,750936	9,8754678	35,673287	427,134369
7	12,48675769	179,890874	113,55702	49,3773396	29,626404	19,750936	35,673287	427,875855
8	10,88849566	156,865461	99,022108	47,3154234	39,501871	29,626404	35,673287	408,004555
9	9,494805682	136,787222	86,347619	41,259212	37,852338	39,501871	35,673287	377,42155
10	8,279503222	119,278928	75,295421	35,9781748	33,007369	37,852338	35,673287	337,085518
11	7,219755296	104,011636	65,657866	31,3730922	28,78254	33,007369	35,673287	298,50579
12	6,295651458	90,6985042	57,253885	27,3574444	25,098474	28,78254	35,673287	264,864134
13	5,489829732	79,0894077	49,925585	23,8557856	21,885955	25,098474	35,673287	235,528494
14	4,787150415	68,9662356	43,535282	20,8023271	19,084628	21,885955	35,673287	209,947715
15	4,174411632	60,1387948	37,962915	18,1397008	16,641862	19,084628	35,673287	187,641188
16	3,640101306	52,4412359	33,103793	15,8178815	14,511761	16,641862	35,673287	168,189819
17	3,174180863	45,7289382	28,866621	13,7932471	12,654305	14,511761	35,673287	151,228159
18	2,767896633	39,8757914	25,171793	12,027759	11,034598	12,654305	35,673287	136,437533
19	2,413615387	34,7718273	21,94989	10,4882472	9,6222071	11,034598	35,673287	123,540056
20	2,104680922	30,3211531	19,14038	9,14578763	8,3905977	9,6222071	35,673287	112,293412
21	1,835289005	26,4401498	16,690477	7,97515828	7,31663	8,3905977	35,673287	102,4863
22	1,600378327	23,0559016	14,554153	6,95436546	6,3801266	7,31663	35,673287	93,934464
23	1,395535407	20,1048255	12,691272	6,06423061	5,5634923	6,3801266	35,673287	86,4772338
24	1,216911677	17,531477	11,066833	5,28802996	4,8513844	5,5634923	35,673287	79,9745034
25	1,061151169	15,2875083	9,6503162	4,61118032	4,2304239	4,8513844	35,673287	74,3041001
26	0,92532747	13,3307598	8,4151089	4,0209651	3,6889442	4,2304239	35,673287	69,359489
27	0,806888738	11,6244684	7,3380039	3,5062954	3,2167721	3,6889442	35,673287	65,047771
28	0,703609756	10,1365765	6,3987647	3,05750165	2,8050363	3,2167721	35,673287	61,2879381
29	0,613550128	8,83912955	5,5797448	2,66615196	2,4460013	2,8050363	35,673287	58,0093509
30	0,535017822	7,70775138	4,8655567	2,32489368	2,1329216	2,4460013	35,673287	55,1504116
31	0,466537382	6,72118572	4,2427821	2,02731529	1,8599149	2,1329216	35,673287	52,6574066

HIDROGRAF RENCANA GAMA-I KALA ULANG 5 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					QB (m ³ /det)	Jumlah (m ³ /det)
		17,723196	8,507134	3,544639	2,835711	2,835711		
0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	75,9312051	0	0	0	0	35,673287	111,604492
2	8,568568	151,86241	36,446978	0	0	0	35,673287	223,982675
3	12,852852	227,793615	72,893956	15,18624	0	0	35,673287	351,547098
4	17,137136	303,72482	109,34093	30,37248	12,148991	0	35,673287	491,260513
5	16,42151748	291,041773	145,78791	45,55872	24,297983	12,148991	35,673287	554,508667
6	14,31961975	253,789427	139,70005	60,744961	36,446974	24,297983	35,673287	550,652681
7	12,48675769	221,305254	121,81892	58,208351	48,595965	36,446974	35,673287	522,048755
8	10,88849566	192,978943	106,22652	50,757883	46,566678	48,595965	35,673287	480,799276
9	9,494805682	168,278302	92,629892	44,261048	40,606303	46,566678	35,673287	428,01551
10	8,279503222	146,739258	80,773584	38,595786	35,408836	40,606303	35,673287	377,797055
11	7,219755296	127,957138	70,434843	33,655659	30,876627	35,408836	35,673287	334,00639
12	6,295651458	111,579065	61,419426	29,34785	26,924525	30,876627	35,673287	295,820779
13	5,489829732	97,2973284	53,557951	25,591426	23,478278	26,924525	35,673287	262,522795
14	4,787150415	84,8436051	46,702717	22,315812	20,47314	23,478278	35,673287	233,486839
15	4,174411632	73,9839155	40,72493	19,459465	17,852648	20,47314	35,673287	208,167385
16	3,640101306	64,5142289	35,512279	16,96872	15,567571	17,852648	35,673287	186,088734
17	3,174180863	56,2566296	30,96683	14,796782	13,574975	15,567571	35,673287	166,836074
18	2,767896633	49,0559745	27,003182	12,902845	11,837425	13,574975	35,673287	150,047689
19	2,413615387	42,7769786	23,546868	11,251325	10,322275	11,837425	35,673287	135,408159
20	2,104680922	37,3016725	20,53295	9,8111944	9,0010596	10,322275	35,673287	122,642438
21	1,835289005	32,5271868	17,904803	8,5553952	7,8489549	9,0010596	35,673287	111,510686
22	1,600378327	28,3638188	15,613049	7,4603341	6,8443157	7,8489549	35,673287	101,80376
23	1,395535407	24,7333476	13,614633	6,505437	5,9682668	6,8443157	35,673287	93,339287
24	1,216911677	21,5675642	11,872007	5,6727634	5,2043492	5,9682668	35,673287	85,9582374
25	1,061151169	18,8069902	10,352431	4,9466692	4,5382104	5,2043492	35,673287	79,5219367
26	0,92532747	16,3997601	9,0273552	4,3135126	3,9573351	4,5382104	35,673287	73,9094604
27	0,806888738	14,3006473	7,8718848	3,7613978	3,4508098	3,9573351	35,673287	69,0153618
28	0,703609756	12,4702136	6,8643106	3,2799518	3,009118	3,4508098	35,673287	64,7476909
29	0,613550128	10,8740692	5,9857025	2,8601293	2,6239613	3,009118	35,673287	61,0262673
30	0,535017822	9,48222573	5,2195532	2,4940426	2,2881033	2,6239613	35,673287	57,781173
31	0,466537382	8,26853346	4,5514683	2,1748137	1,9952339	2,2881033	35,673287	54,9514397

HIDROGRAF BANJIR RENCANA GAMA-I KALA ULANG 10 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					QB (m ³ /det)	Jumlah (m ³ /det)
		19,749924	9,4799634	3,9499847	3,1599878	3,1599878		
0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	84,61428339	0	0	0	0	35,673287	120,2875704
2	8,568568	169,2285668	40,6148555	0	0	0	35,673287	245,5167093
3	12,852852	253,8428502	81,229711	16,922856	0	0	35,673287	387,6687045
4	17,137136	338,4571336	121,844567	33,845713	13,538285	0	35,673287	543,3589848
5	16,4215175	324,3237222	162,459422	50,768569	27,07657	13,538285	35,673287	613,8398555
6	14,3196198	282,8114018	155,675385	67,691425	40,614856	27,07657	35,673287	609,5429243
7	12,4867577	246,6125154	135,749471	64,864743	54,153141	40,614856	35,673287	577,6680125
8	10,8884957	215,0469618	118,374006	56,562279	51,891795	54,153141	35,673287	531,7014691
9	9,49480568	187,5216906	103,22254	49,322502	45,249824	51,891795	35,673287	472,8816384
10	8,27950322	163,5195594	90,0104104	43,009391	39,458002	45,249824	35,673287	416,9204737
11	7,2197553	142,5896184	78,4893875	37,504337	34,407513	39,458002	35,673287	368,1221455
12	6,29565146	124,3386378	68,443016	32,703911	30,00347	34,407513	35,673287	325,5698354
13	5,48982973	108,42372	59,6825454	28,517923	26,163129	30,00347	35,673287	288,4640746
14	4,78715042	94,54585687	52,0433849	24,867727	22,814339	26,163129	35,673287	256,1077236
15	4,17441163	82,44431248	45,3820107	21,684743	19,894182	22,814339	35,673287	227,8928741
16	3,64010131	71,89172415	39,5732695	18,909171	17,347795	19,894182	35,673287	203,2894283
17	3,17418086	62,68983081	34,5080272	16,488862	15,127337	17,347795	35,673287	181,8351389
18	2,76789663	54,66574814	30,0911184	14,378344	13,19109	15,127337	35,673287	163,1269248
19	2,41361539	47,66872046	26,2395588	12,537966	11,502676	13,19109	35,673287	146,8132976
20	2,10468092	41,56728825	22,8809855	10,933149	10,030373	11,502676	35,673287	132,5877587
21	1,83528901	36,24681837	19,9522981	9,5337439	8,7465196	10,030373	35,673287	120,1830397
22	1,60037833	31,60735033	17,3984726	8,3134574	7,6269952	8,7465196	35,673287	109,3660821
23	1,39553541	27,56171823	15,171528	7,2493635	6,650766	7,6269952	35,673287	99,9336579
24	1,21691168	24,03391314	13,2296246	6,3214699	5,7994909	6,650766	35,673287	91,70855152
25	1,06115117	20,95765494	11,5362782	5,5123435	5,057176	5,7994909	35,673287	84,53623046
26	0,92532747	18,27514721	10,0596742	4,8067825	4,4098749	5,057176	35,673287	78,28194181
27	0,80688874	15,93599125	8,77207055	4,1915309	3,8454261	4,4098749	35,673287	72,8281806
28	0,70360976	13,89623921	7,6492757	3,6550293	3,3532247	3,8454261	35,673287	68,07248206
29	0,61355013	12,1175684	6,67019473	3,1871982	2,9240235	3,3532247	35,673287	63,92549657
30	0,53501782	10,56656132	5,81643276	2,7792478	2,5497586	2,9240235	35,673287	60,30931094
31	0,46653738	9,214077838	5,07194937	2,4235136	2,2233982	2,5497586	35,673287	57,15598464

HIDROGRAF BANJIR RENCANA GAMA-I KALA ULANG 20 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					QB (m ³ /det)	Jumlah (m ³ /det)
		21,595236	10,365713	4,3190472	3,4552377	3,4552377		
0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	92,5201241	0	0	0	0	35,673287	128,1934111
2	8,568568	185,040248	44,409658	0	0	0	35,673287	265,1231935
3	12,852852	277,560372	88,819317	18,504025	0	0	35,673287	420,5570007
4	17,137136	370,080496	133,22898	37,00805	14,80322	0	35,673287	590,7940276
5	16,4215175	354,626545	177,63863	55,512074	29,606439	14,80322	35,673287	667,8601991
6	14,3196198	309,235568	170,22074	74,016099	44,409659	29,606439	35,673287	663,1617894
7	12,4867577	269,654479	148,43307	70,925309	59,212878	44,409659	35,673287	628,308681
8	10,8884957	235,139633	129,43415	61,847114	56,740246	59,212878	35,673287	578,0473052
9	9,49480568	205,042569	112,86702	53,930896	49,47769	56,740246	35,673287	513,7317096
10	8,27950322	178,797826	98,420431	47,027927	43,144716	49,47769	35,673287	452,5418764
11	7,2197553	155,912319	85,822954	41,008514	37,622341	43,144716	35,673287	399,1841312
12	6,29565146	135,956079	74,837911	35,759565	32,806811	37,622341	35,673287	352,6559938
13	5,48982973	118,554169	65,258916	31,182464	28,607652	32,806811	35,673287	312,0832979
14	4,78715042	103,379643	56,905999	27,191216	24,945971	28,607652	35,673287	276,7037676
15	4,17441163	90,1474044	49,622227	23,710834	21,752972	24,945971	35,673287	245,8526953
16	3,64010131	78,6088468	43,270753	20,675929	18,968667	21,752972	35,673287	218,9504542
17	3,17418086	68,5471848	37,732245	18,029481	16,540743	18,968667	35,673287	195,4916074
18	2,76789663	59,773381	32,902648	15,721769	14,423584	16,540743	35,673287	175,0354122
19	2,41361539	52,1225939	28,691222	13,709437	12,577415	14,423584	35,673287	157,1975397
20	2,10468092	45,4510812	25,018844	11,954676	10,967549	12,577415	35,673287	141,6428535
21	1,83528901	39,6334992	21,816518	10,424519	9,5637408	10,967549	35,673287	128,0791135
22	1,60037833	34,5605477	19,024079	9,0902162	8,3396149	9,5637408	35,673287	116,2514857
23	1,39553541	30,1369165	16,589062	7,9266998	7,2721729	8,3396149	35,673287	105,9377535
24	1,21691168	26,2794949	14,46572	6,9121095	6,3413598	7,2721729	35,673287	96,94414353
25	1,06115117	22,9158099	12,614157	6,0273833	5,5296875	6,3413598	35,673287	89,1016847
26	0,92532747	19,9826651	10,999588	5,255899	4,8219065	5,5296875	35,673287	82,26303361
27	0,80688874	17,4249527	9,591679	4,583162	4,2047191	4,8219065	35,673287	76,29970635
28	0,70360976	15,1946187	8,3639771	3,996533	3,6665295	4,2047191	35,673287	71,09966446
29	0,61355013	13,2497598	7,2934168	3,4849905	3,1972264	3,6665295	35,673287	66,56521003
30	0,53501782	11,5538361	6,3598845	3,0389237	2,7879924	3,1972264	35,673287	62,61115016
31	0,46653738	10,0749849	5,5458412	2,649952	2,431139	2,7879924	35,673287	59,16319636

HIDROGRAF BANJIR RENCANA GAMA-I KALA ULANG 50 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					QB (m ³ /det)	Jumlah (m ³ /det)
		23,871269	11,458209	4,7742539	3,8194031	3,8194031		
0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	102,271296	0	0	0	0	35,673287	137,944583
2	8,568568	204,542592	49,090221	0	0	0	35,673287	289,3061
3	12,852852	306,813888	98,180443	20,45426	0	0	35,673287	461,121877
4	17,137136	409,085183	147,27066	40,908519	16,363408	0	35,673287	649,301062
5	16,421517	392,002461	196,36089	61,362779	32,726815	16,363408	35,673287	734,489636
6	14,31962	341,827495	188,16118	81,817038	49,090223	32,726815	35,673287	729,296038
7	12,486758	298,074752	164,0772	78,400494	65,45363	49,090223	35,673287	690,769582
8	10,888496	259,922209	143,07588	68,3655	62,720395	65,45363	35,673287	635,210901
9	9,4948057	226,653061	124,76266	59,614952	54,6924	62,720395	35,673287	564,116753
10	8,2795032	197,642249	108,79347	51,984443	47,691961	54,6924	35,673287	496,477807
11	7,2197553	172,344721	94,868278	45,330613	41,587554	47,691961	35,673287	437,496414
12	6,2956515	150,285189	82,725465	39,528451	36,26449	41,587554	35,673287	386,064436
13	5,4898297	131,049202	72,13689	34,468945	31,62276	36,26449	35,673287	341,215575
14	4,7871504	114,275355	62,903616	30,057039	27,575156	31,62276	35,673287	302,107213
15	4,1744116	99,648503	54,85217	26,209841	24,045631	27,575156	35,673287	268,004587
16	3,6401013	86,8938375	47,831281	22,855072	20,967873	24,045631	35,673287	238,26698
17	3,1741809	75,7717252	41,709042	19,929701	18,284057	20,967873	35,673287	212,335685
18	2,7678966	66,0732051	36,370428	17,378768	15,943761	18,284057	35,673287	189,723506
19	2,4136154	57,6160622	31,715138	15,154345	13,903014	15,943761	35,673287	170,005608
20	2,1046809	50,2414044	27,65571	13,214641	12,123476	13,903014	35,673287	152,811533
21	1,835289	43,8106775	24,115874	11,523213	10,571713	12,123476	35,673287	137,81824
22	1,6003783	38,2030615	21,029125	10,048281	9,2185701	10,571713	35,673287	124,744038
23	1,3955354	33,3132011	18,337469	8,7621357	8,0386248	9,2185701	35,673287	113,343288
24	1,2169117	29,049226	15,990336	7,6406125	7,0097085	8,0386248	35,673287	103,401795
25	1,0611512	25,331025	13,943628	6,6626404	6,1124899	7,0097085	35,673287	94,7327792
26	0,9253275	22,0887409	12,158892	5,8098453	5,3301123	6,1124899	35,673287	87,1733673
27	0,8068887	19,2614581	10,602596	5,0662051	4,6478762	5,3301123	35,673287	80,5815343
28	0,7036098	16,7960578	9,2454998	4,4177483	4,0529641	4,6478762	35,673287	74,8334331
29	0,6135501	14,6462202	8,0621076	3,8522917	3,5341986	4,0529641	35,673287	69,8210692
30	0,5350178	12,7715543	7,0301856	3,3592116	3,0818333	3,5341986	35,673287	65,4502705
31	0,4665374	11,1368393	6,130346	2,9292441	2,6873693	3,0818333	35,673287	61,6389191

HIDROGRAF BANJIR RENCANA GAMA-I KALA ULANG 100 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)						QB(m ³ /det)	Jumlah (m ³ /det)
		25,535909	12,257236	5,1071817	4,0857454	4,0857454	0		
0	0	0	0	0	0	0	0	35,673287	35,673287
1	4,284284	109,4030864	0	0	0	0	0	35,673287	145,0763734
2	8,568568	218,8061727	52,51348008	0	0	0	0	35,673287	306,9929398
3	12,852852	328,2092591	105,0269602	21,880617	0	0	0	35,673287	490,7901231
4	17,137136	437,6123454	157,5404402	43,761234	17,504494	0	0	35,673287	692,0918
5	16,421517	419,338376	210,0539203	65,641851	35,008987	17,504494	35,673287	35,673287	783,2209148
6	14,31962	365,6645069	201,2824152	87,522467	52,513481	35,008987	35,673287	35,673287	777,6651447
7	12,486758	318,8607081	175,5189587	83,867674	70,017975	52,513481	35,673287	35,673287	736,4520829
8	10,888496	278,0476343	153,0531359	73,1329	67,09414	70,017975	35,673287	35,673287	677,0190712
9	9,4948057	242,4584939	133,462861	63,77214	58,506321	67,09414	35,673287	35,673287	600,9672423
10	8,2795032	211,4246408	116,380074	55,609526	51,017713	58,506321	35,673287	35,673287	528,611561
11	7,2197553	184,3630142	101,483825	48,491698	44,487621	51,017713	35,673287	35,673287	465,5171579
12	6,2956515	160,7651827	88,49424453	42,284927	38,793359	44,487621	35,673287	35,673287	410,4986213
13	5,4898297	140,1877925	77,16728569	36,872602	33,827942	38,793359	35,673287	35,673287	362,5222681
14	4,7871504	122,2442374	67,29013862	32,153036	29,498082	33,827942	35,673287	35,673287	320,6867231
15	4,1744116	106,5973956	58,6772324	28,037558	25,722429	29,498082	35,673287	35,673287	284,2059839
16	3,6401013	92,9532957	51,16674853	24,448847	22,430047	25,722429	35,673287	35,673287	252,3946538
17	3,1741809	81,05559367	44,61758077	21,319479	19,559078	22,430047	35,673287	35,673287	224,6550645
18	2,7678966	70,68075654	38,90668394	18,590659	17,055583	19,559078	35,673287	35,673287	200,4660472
19	2,4136154	61,63386288	33,92676225	16,211118	14,872527	17,055583	35,673287	35,673287	179,3731408
20	2,1046809	53,7449405	29,58425341	14,136151	12,968895	14,872527	35,673287	35,673287	160,980054
21	1,835289	46,86577302	25,79757077	12,326772	11,308921	12,968895	35,673287	35,673287	144,9412189
22	1,6003783	40,86711532	22,49557046	10,748988	9,861418	11,308921	35,673287	35,673287	130,9552996
23	1,3955354	35,63626516	19,61621484	9,3731544	8,5991904	9,861418	35,673287	35,673287	118,7595298
24	1,2169117	31,07494584	17,10540683	8,1734229	7,4985236	8,5991904	35,673287	35,673287	108,1247766
25	1,0611512	27,09745969	14,91597362	7,1272529	6,5387384	7,4985236	35,673287	35,673287	98,85123519
26	0,9253275	23,62907807	13,00678031	6,214989	5,7018024	6,5387384	35,673287	35,673287	90,76467518
27	0,8068887	20,60463739	11,34195718	5,4194918	4,9719913	5,7018024	35,673287	35,673287	83,71316705
28	0,7036098	17,9673147	9,890225687	4,7258155	4,3355935	4,9719913	35,673287	35,673287	77,5642277
29	0,6135501	15,66756024	8,624310831	4,1209274	3,7806525	4,3355935	35,673287	35,673287	72,20233142
30	0,5350178	13,66216642	7,520428717	3,5934629	3,2967419	3,7806525	35,673287	35,673287	67,52673941
31	0,4665374	11,91345613	6,557839708	3,133512	2,8747723	3,2967419	35,673287	35,673287	63,4496071

II. HSS SNYDER

Parameter DAS : $L = 103,00 \text{ km}$

$$L_c = 48,50 \text{ km}$$

$$A = 638,00 \text{ km}^2$$

$$S = 0,0048$$

Berdasarkan kondisi tofografinya, diambil : $C_i = 2,0$ dan $C_p = 0,60$

Setelah persamaan-persamaan disesuaikan ke sistem metrik dengan menambahkan faktor konversi, didapat :

$$t_p = C_i 0,75 (L.L_c)^{0,3} = 2,0 \cdot 0,75 (103 \cdot 48,50)^{0,3}$$

$$= 19,30478 \text{ jam}$$

$$t_r = t_p / 5,5 = 3,50996 \text{ jam}$$

$$Q_p = \frac{275 C_p A}{t_p} = \frac{275 \cdot 0,6 \cdot 638,00}{19,30478} = 5453,0536 \text{ lt/dt} = 5,4530 \text{ m}^3/\text{det}$$

$$t_b = 3 + (3t_p / 24) = 3 + (3 \cdot 19,30478 / 24) = 5,41309 \text{ hari}$$

Bentuk HSS SNYDER dibuat dengan pertolongan persamaan Alexeyev :

$$\lambda = \frac{t_p Q_p}{hA} = \frac{19,30478 \cdot 3600 \cdot 5,4530}{10^{-3} \cdot 638,00 \cdot 10^6} = 0,594$$

$$y = 10^{-a \{(1-x)^2 / x\}}$$

$$a = 1,32 \lambda^2 + 0,15 \lambda + 0,045 = 0,5998$$

$$y = 10^{-0,5998 \{(1-x)^2 / x\}}$$

HIDROGRAF SATUAN CARA SNYDER

t (jam)	x (t/tp)	y (Q/QP)	Q (m ³ /det)
0	0	0	0
1	0,051800642	3,88618E-11	2,11913E-10
2	0,103601284	2,22821E-05	0,000121504
3	0,155401926	0,001764903	0,009624018
4	0,207202568	0,015155426	0,082642536
5	0,259003211	0,053511665	0,29179911
6	0,310803853	0,121156116	0,6606643
7	0,362604495	0,212797225	1,160383269
8	0,414405137	0,318906902	1,738999335
9	0,466205779	0,429945527	2,344492961
10	0,518006421	0,538268598	2,935178664
11	0,569807063	0,63854678	3,481995593
12	0,621607705	0,727515825	3,967143794
13	0,673408348	0,803520245	4,381595897
14	0,72520899	0,866059473	4,722622305
15	0,777009632	0,915410353	4,991732656
16	0,828810274	0,952339192	5,193105615
17	0,880610916	0,977893391	5,332452663
18	0,932411558	0,993256414	5,416227227
19	0,9842122	0,999650296	5,451093064
20	1,036012842	0,998272586	5,443580411
21	1,087813485	0,9902576	5,399874692
22	1,139614127	0,976654476	5,325696858
23	1,191414769	0,958416612	5,226245787
24	1,243215411	0,93639863	5,10618173
25	1,295016053	0,911358167	4,969636083
30	1,554019264	0,761258832	4,15114441
35	1,813022474	0,604394282	3,295762022
40	2,072025685	0,464861756	2,534891154
45	2,331028895	0,35005606	1,908855697
50	2,590032106	0,259727899	1,416296232
55	2,849035317	0,190643155	1,039577123
60	3,108038527	0,138808174	0,756920972

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 2 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		14,406532	6,9151353	2,8813064	2,3050451	2,3050451	
0	0	0	0	0	0	0	0
1	2,11913E-10	3,05294E-09	0	0	0	0	3,05294E-09
2	0,000121504	0,001750457	1,46541E-09	0	0	0	0,001750458
3	0,009624018	0,138648717	0,000840219	6,1059E-10	0	0	0,139488937
4	0,082642536	1,190592341	0,066551384	0,00035009	4,8847E-10	0	1,257493816
5	0,29179911	4,203813218	0,571484319	0,02772974	0,00028007	4,8847E-10	4,803307354
6	0,6606643	9,517881375	2,017830327	0,23811847	0,02218379	0,00028007	11,79629404
7	1,160383269	16,7170987	4,56858302	0,84076264	0,19049477	0,02218379	22,33912293
8	1,738999335	25,05294957	8,024207304	1,90357628	0,67261011	0,19049477	35,84383803
9	2,344492961	33,77601287	12,02541569	3,34341974	1,52286101	0,67261011	51,34031941
10	2,935178664	42,28574535	16,21248604	5,01058991	2,67473577	1,52286101	67,70641807
11	3,481995593	50,16348093	20,29715759	6,75520257	4,0084719	2,67473577	83,89904876
12	3,967143794	57,15278402	24,07847064	8,45714907	5,40416201	4,0084719	99,10103763
13	4,381595897	63,12360151	27,43333609	10,0326962	6,7657192	5,40416201	112,759515
14	4,722622305	68,03660936	30,29932846	11,4305568	8,02615688	6,7657192	124,5583707
15	4,991732656	71,91355624	32,65757221	12,6247203	9,14444536	8,02615688	134,366451
16	5,193105615	74,81464222	34,51850669	13,6073219	10,0997762	9,14444536	142,1846923
17	5,332452663	76,82214923	35,91102795	14,3827112	10,8858574	10,0997762	148,1015227
18	5,416227227	78,02905086	36,87463164	14,9629284	11,5061689	10,8858574	152,2586372
19	5,451093064	78,53134666	37,45394409	15,36443	11,9703427	11,5061689	154,8262323
20	5,443580411	78,42311539	37,69504607	15,6058102	12,2915439	11,9703427	155,9858582
21	5,399874692	77,79346755	37,64309506	15,7062693	12,484648	12,2915439	155,9190239
22	5,325696858	76,72482221	37,3408641	15,6846231	12,5650154	12,484648	154,7999728
23	5,226245787	75,29207718	36,82791434	15,5586935	12,5476984	12,5650154	152,7913987
24	5,10618173	73,5623705	36,14019673	15,3449644	12,4469547	12,5476984	150,0421847
25	4,969636083	71,59522126	35,30993753	15,0584154	12,2759714	12,4469547	146,6865004
30	4,15114441	59,80359478	34,3657059	14,7124741	12,0467322	12,2759714	133,2044785
35	3,295762022	47,48050104	28,70572525	14,3190443	11,7699792	12,0467322	114,321982
40	2,534891154	36,51899052	22,7906403	11,960719	11,4552353	11,7699792	94,49556426
45	1,908855697	27,49999069	17,5291153	9,49610021	9,56857508	11,4552353	75,54901658
50	1,416296232	20,40391698	13,19999542	7,3037981	7,5968801	9,56857508	58,07316569
55	1,039577123	14,97670109	9,793880066	5,49999814	5,84303843	7,5968801	43,71049783
60	0,756920972	10,9046062	7,188816463	4,0807834	4,39999847	5,84303843	32,41724297

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 5 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		17,723196	8,507134	3,544639	2,835711	2,835711	
0	0	0	0	0	0	0	0
1	2,12E-10	3,7558E-09	0	0	0	0	3,7558E-09
2	0,000121504	0,00215344	1,8028E-09	0	0	0	0,00215344
3	0,009624018	0,17056836	0,00103365	7,5116E-10	0	0	0,17160201
4	0,082642536	1,46468986	0,08187281	0,00043069	6,0092E-10	0	1,54699336
5	0,29179911	5,17161282	0,70305113	0,03411367	0,00034455	6,009E-10	5,90912217
6	0,6606643	11,7090829	2,48237413	0,29293796	0,02729093	0,0003446	14,5120304
7	1,160383269	20,5657001	5,62035973	1,03432251	0,23435035	0,0272909	27,4820236
8	1,73899335	30,8206261	9,87153596	2,34181644	0,82745795	0,2343503	44,0957868
9	2,344492961	41,5519083	14,7939004	4,11313979	1,87345302	0,8274579	63,1598594
10	2,935178664	52,0207468	19,9449158	6,16412486	3,2905116	1,873453	83,295752
11	3,481995593	61,7120904	24,9699582	8,31038118	4,93129954	3,2905116	103,214241
12	3,967143794	70,310467	29,6218031	10,4041488	6,64830448	4,9312995	121,916023
13	4,381595897	77,6558829	33,7490239	12,3424174	8,32331842	6,6483045	138,718947
14	4,722622305	83,6999607	37,2748234	14,0620926	9,87393321	8,3233184	153,234128
15	4,991732656	88,4694562	40,1759808	15,5311757	11,2496733	9,8739332	165,300219
16	5,193105615	92,0384287	42,4653386	16,7399912	12,4249397	11,249673	174,918371
17	5,332452663	94,5081037	44,1784453	17,6938903	13,391992	12,42494	182,197371
18	5,416227227	95,9928567	45,3638894	18,4076847	14,1551112	13,391992	187,311534
19	5,451093064	96,6107908	46,0765708	18,9016197	14,7261467	14,155111	190,470239
20	5,443580411	96,4776426	46,3731791	19,1985703	15,1212947	14,726147	191,896833
21	5,399874692	95,7030375	46,309268	19,3221571	15,3588551	15,121295	191,814612
22	5,325696858	94,3883693	45,9374576	19,2955, 74	15,4577246	15,358855	190,437934
23	5,226245787	92,6257784	45,3064168	19,1406064	15,4364209	15,457725	187,966947
24	5,10618173	90,4978596	44,4603732	18,8776728	15,3124841	15,436421	184,584811
25	4,969636083	88,0778343	43,4389722	18,5251546	15,1021372	15,312484	180,456582
30	4,15114441	73,571546	42,2773601	18,0995709	14,8201227	15,102137	163,870737
35	3,295762022	58,4114363	35,3143417	17,6155659	14,4796557	14,820123	140,641122
40	2,534891154	44,9263728	28,0374892	14,7143084	14,0924517	14,479656	116,250278
45	1,908855697	33,8310237	21,5646587	11,6822866	11,7714459	14,092452	92,9418665
50	1,416296232	25,1012957	16,2388912	8,98527405	9,34582862	11,771446	71,4427354
55	1,039577123	18,4246291	12,0486218	6,76620435	7,18821873	9,3458286	53,7735026
60	0,756920972	13,4150587	8,84382189	5,02025886	5,4129631	7,1882187	39,8803213

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 10 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		19,749924	9,4799634	3,9499847	3,1599878	3,1599878	
1	2,12E-10	4,18527E-09	0	0	0	0	4,18527E-09
2	0,000121504	0,002399695	2,00893E-09	0	0	0	0,002399697
3	0,009624018	0,190073624	0,001151853	8,37053E-10	0	0	0,191225478
4	0,082642536	1,632183805	0,091235338	0,000479939	6,69642E-10	0	1,723899083
5	0,29179911	5,763010246	0,783448217	0,038014724	0,000383951	6,69642E-10	6,584857138
6	0,6606643	13,04806971	2,766244883	0,326436753	0,030411779	0,000383951	16,17154708
7	1,160383269	22,91748137	6,263073384	1,15260202	0,261149406	0,030411779	30,62471796
8	1,738999335	34,3451047	11,00039092	2,609613877	0,922081628	0,261149406	49,13834053
9	2,344492961	46,3035578	16,48565005	4,583496159	2,087691128	0,922081628	70,38247676
10	2,935178664	57,96955554	22,22570746	6,869020767	3,666796973	2,087691128	92,81877187
11	3,481995593	68,76914833	27,82538631	9,260711325	5,495216683	3,666796973	115,0172596
12	3,967143794	78,35078843	33,00919078	11,59391081	7,408569154	5,495216683	135,8576759
13	4,381595897	86,53618596	37,60837797	13,75382932	9,275128769	7,408569154	154,5820912
14	4,722622305	93,2714316	41,53736874	15,67015729	11,00306359	9,275128769	170,75715
15	4,991732656	98,58634058	44,7702866	17,30723675	12,53612599	11,00306359	184,2030535
16	5,193105615	102,5634412	47,32144288	18,65428585	13,84578958	12,53612599	194,9210855
17	5,332452663	105,3155348	49,23045116	19,71726762	14,92342887	13,84578958	203,0324721
18	5,416227227	106,9700761	50,55145608	20,51268772	15,77381429	14,92342887	208,7314631
19	5,451093064	107,6586737	51,34563588	21,06310643	16,41015039	15,77381429	212,2513807
20	5,443580411	107,5102994	51,67616274	21,39401468	16,85048536	16,41015039	213,8411126
21	5,399874692	106,6471148	51,60494306	21,5317342	17,11521196	16,85048536	213,7494894
22	5,325696858	105,1821082	51,19061444	21,50205934	17,22538758	17,11521196	212,2153815
23	5,226245787	103,2179571	50,48741129	21,32942242	17,20164769	17,22538758	209,4618261
24	5,10618173	100,8467011	49,54461878	21,03642111	17,06353815	17,20164769	205,6929268
25	4,969636083	98,14993495	48,40641591	20,6435909	16,8291371	17,06353815	201,0926171
30	4,15114441	81,98478661	47,11196818	20,16933971	16,51487293	16,8291371	182,6101045
35	3,295762022	65,09104946	39,35269707	19,62998649	16,13547197	16,51487293	156,7240779
40	2,534891154	50,06390764	31,24370334	16,39695691	15,70398939	16,13547197	129,5440293
45	1,908855697	37,69975494	24,03067536	13,01820956	13,11756569	15,70398939	103,570195
50	1,416296232	27,97174294	18,09588214	10,01278127	10,41456778	13,11756569	79,61253983
55	1,039577123	20,53156917	13,42643644	7,539950798	8,010225121	10,41456778	59,92274931
60	0,756920972	14,94913167	9,855153078	5,594348447	6,031960714	8,010225121	44,44081903

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 20 TAHUN

(jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		21,595236	10,365713	4,3190472	3,4552377	3,4552377	
1	2.12E-10	4.57631E-09	0	0	0	0	4.57631E-09
2	0,000121504	0,002623908	2,19663E-09	0	0	0	0,00262391
3	0,009624018	0,20783294	0,001259476	9,152622E-10	0	0	0,209092416
4	0,082642536	1,784685069	0,099759808	5,247815E-04	7,3221E-10	0	1,884969659
5	0,29179911	6,301470645	0,85664881	4,156659E-02	0,000419825	7,3221E-10	7,200105869
6	0,6606643	14,26720148	3,024705828	3,569370E-01	0,03325327	0,000419825	17,68251741
7	1,160383269	25,05875054	6,848256523	1,260294E+00	0,285549606	0,03325327	33,48610407
8	1,738999335	37,55410104	12,02819994	2,853440E+00	1,008235286	0,285549606	53,72952617
9	2,344492961	50,62987879	18,02596801	5,011750E+00	2,282752196	1,008235286	76,9585844
10	2,935178664	63,38587595	24,30234116	7,510820E+00	4,009400017	2,282752196	101,4911895
11	3,481995593	75,19451658	30,42521963	1,012598E+01	6,008656063	4,009400017	125,7637681
12	3,967143794	85,67140648	36,09336698	1,267718E+01	8,100780466	6,008656063	148,5513852
13	4,381595897	94,62159745	41,122274	1,503890E+01	10,14173998	8,100780466	169,0252952
14	4,722622305	101,9861432	45,41836555	1,713428E+01	12,03112244	10,14173998	186,7116525
15	4,991732656	107,7976448	48,95334742	1,892432E+01	13,7074248	12,03112244	201,4138589
16	5,193105615	112,1463413	51,74286808	2,039723E+01	15,13945533	13,7074248	213,1333182
17	5,332452663	115,1555737	53,83024238	2,155953E+01	16,31778263	15,13945533	222,002583
18	5,416227227	116,9647052	55,27467389	2,242927E+01	17,24762286	16,31778263	228,2340528
19	5,451093064	117,7176412	56,14305698	2,303111E+01	17,9434143	17,24762286	232,0828501
20	5,443580411	117,5554037	56,50446624	2,339294E+01	18,42489147	17,9434143	233,8211167
21	5,399874692	116,6115683	56,42659223	2,354353E+01	18,71435251	18,42489147	233,7209328
22	5,325696858	115,0096805	55,97355129	2,351108E+01	18,83482226	18,71435251	232,0434873
23	5,226245787	112,8620112	55,20464516	2,332231E+01	18,80886426	18,83482226	229,0326565
24	5,10618173	110,2691995	54,1737639	2,300194E+01	18,65785061	18,80886426	224,9116144
25	4,969636083	107,320464	52,92921434	2,257240E+01	18,40154856	18,65785061	219,8814798
30	4,15114441	89,6449432	51,51382135	2,205384E+01	18,05792147	18,40154856	199,6720745
35	3,295762022	71,17275866	43,02957158	2,146409E+01	17,64307162	18,05792147	171,3674161
40	2,534891154	54,7415727	34,16292324	1,792899E+01	17,17127395	17,64307162	141,6478301
45	1,908855697	41,22218927	26,27595419	1,423455E+01	14,34319066	17,17127395	113,2471598
50	1,416296232	30,58525138	19,78665031	1,094831E+01	11,38764119	14,34319066	87,05104808
55	1,039577123	22,44991331	14,68092026	8,244438E+00	8,758651481	11,38764119	65,5215641
60	0,756920972	16,34588702	10,7759581	6,117050E+00	6,595550168	8,758651481	48,59309705

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 50 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		23,871269	11,458209	4,7742539	3,8194031	3,8194031	
1	-2,12E-10	5,058632E-09	0	0	0	0	5,058632E-09
2	0,000121504	2,900455E-03	2,42814E-09	0	0	0	2,900457E-03
3	0,009624018	2,297375E-01	0,001392218	1,01173E-09	0	0	2,311297E-01
4	0,082642536	1,972782E+00	0,11027401	0,000580091	8,09381E-10	0	2,083636E+00
5	0,29179911	6,965615E+00	0,94693545	0,045947505	0,000464073	8,09381E-10	7,958962E+00
6	0,6606643	1,577090E+01	3,343495188	0,39455645	0,036758004	0,000464073	1,954617E+01
7	1,160383269	2,769982E+01	7,570029628	1,393123039	0,315645158	0,036758004	3,701538E+01
8	1,738999335	4,151212E+01	13,29591402	3,154179111	1,114498425	0,315645158	5,939236E+01
9	2,344492961	5,596602E+01	19,92581783	5,539964348	2,523343275	1,114498425	8,506965E+01
10	2,935178664	7,006644E+01	26,86369035	8,302424357	4,431971455	2,523343275	1,121879E+02
11	3,481995593	8,311965E+01	33,63189058	11,19320466	6,641939451	4,431971455	1,390187E+02
12	3,967143794	9,470076E+01	39,89743324	14,01328818	8,954563683	6,641939451	1,642080E+02
13	4,381595897	1,045943E+02	45,45636272	16,62393104	11,21063049	8,954563683	1,868397E+02
14	4,722622305	1,127350E+02	50,20524154	18,94015173	13,29914476	11,21063049	2,063902E+02
15	4,991732656	1,191590E+02	54,1127934	20,9188513	15,1521213	13,29914476	2,226419E+02
16	5,193105615	1,239660E+02	57,19631604	22,54699796	16,73508095	15,1521213	2,355965E+02
17	5,332452663	1,272924E+02	59,5036895	23,8317991	18,03759827	16,73508095	2,454006E+02
18	5,416227227	1,292922E+02	61,1003571	24,79320474	19,06543918	18,03759827	2,522888E+02
19	5,451093064	1,301245E+02	62,06026356	25,45848292	19,83456368	19,06543918	2,565433E+02
20	5,443580411	1,299452E+02	62,45976361	25,85844396	20,36678623	19,83456368	2,584647E+02
21	5,399874692	1,289019E+02	62,37368206	26,02490232	20,68675506	20,36678623	2,583540E+02
22	5,325696858	1,271311E+02	61,87289279	25,98903501	20,81992175	20,68675506	2,564997E+02
23	5,226245787	1,247571E+02	61,02294767	25,78037281	20,7912279	20,81992175	2,531716E+02
24	5,10618173	1,218910E+02	59,88341651	25,42622899	20,62429814	20,7912279	2,486162E+02
25	4,969636083	1,186315E+02	58,50769745	24,95142433	20,34098309	20,62429814	2,430559E+02
30	4,15114441	9,909308E+01	56,94312889	24,37820804	19,96113936	20,34098309	2,207165E+02
35	3,295762022	7,867402E+01	47,56468024	23,72630445	19,50256633	19,96113936	1,894287E+02
40	2,534891154	6,051107E+01	37,76353006	19,81861739	18,98104346	19,50256633	1,565768E+02
45	1,908855697	4,556681E+01	29,04531263	15,73480469	15,85489383	18,98104346	1,251829E+02
50	1,416296232	3,380879E+01	21,87206753	12,10221398	12,58784368	15,85489383	9,622581E+01
55	1,039577123	2,481603E+01	16,22821823	9,113361756	9,681771132	12,58784368	7,242722E+01
60	0,756920972	1,806866E+01	11,91169195	6,761757809	7,290689367	9,681771132	5,371457E+01

HIDROGRAF BANJIR RENCANA SNYDER KALA ULANG 100 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		25,535909	12,257236	5,1071817	4,0857454	4,0857454	
1	2,12E-10	5,41361E-09	0	0	0	0	5,41361E-09
2	0,0001215	3,10272E-03	2,59853E-09	0	0	0	3,10272E-03
3	0,009624	2,45758E-01	0,001489303	1,0827E-09	0	0	2,47247E-01
4	0,0826425	2,11035E+00	0,11796386	0,00062054	8,66178E-10	0	2,22894E+00
5	0,2917991	7,45136E+00	1,012969067	0,04915161	0,000496434	8,66178E-10	8,51397E+00
6	0,6606643	1,68707E+01	3,576650556	0,42207045	0,039321287	0,000496434	2,09092E+01
7	1,1603833	2,96314E+01	8,097918242	1,49027107	0,337656361	0,039321287	3,95966E+01
8	1,7389993	4,44069E+01	14,22309158	3,37413262	1,192216871	0,337656361	6,35340E+01
9	2,344493	5,98688E+01	21,31532525	5,9262882	2,699306125	1,192216871	9,10019E+01
10	2,9351787	7,49525E+01	28,73700352	8,88138558	4,741030604	2,699306125	1,20011E+02
11	3,4819956	8,89159E+01	35,97717759	11,9737515	7,105108534	4,741030604	1,48713E+02
12	3,9671438	1,01305E+02	42,67964173	14,9904908	9,579001331	7,105108534	1,75659E+02
13	4,3815959	1,11888E+02	48,62621773	17,7831842	11,99239272	9,579001331	1,99869E+02
14	4,7226223	1,20596E+02	53,70625497	20,2609242	14,22654748	11,99239272	2,20783E+02
15	4,9917327	1,27468E+02	57,88629613	22,3776064	16,20873951	14,22654748	2,38168E+02
16	5,1931056	1,32611E+02	61,18484521	24,1192902	17,90208528	16,20873951	2,52026E+02
17	5,3324527	1,36169E+02	63,6531211	25,4936857	19,29543236	17,90208528	2,62513E+02
18	5,4162272	1,38308E+02	65,36113075	26,522134	20,39494874	19,29543236	2,69882E+02
19	5,4510931	1,39199E+02	66,38797535	27,2338047	21,21770738	20,39494874	2,74433E+02
20	5,4435804	1,39007E+02	66,81533414	27,6616566	21,78704394	21,21770738	2,76489E+02
21	5,3998747	1,37891E+02	66,72324978	27,8397227	22,12932548	21,78704394	2,76370E+02
22	5,3256969	1,35997E+02	66,18753847	27,8013543	22,27177841	22,12932548	2,74387E+02
23	5,2262458	1,33457E+02	65,27832325	27,5781412	22,24108362	22,27177841	2,70826E+02
24	5,1061817	1,30391E+02	64,05932801	27,1993015	22,06251318	22,24108362	2,65953E+02
25	4,9696361	1,26904E+02	62,58767452	26,6913868	21,75944144	22,06251318	2,60005E+02
30	4,1511444	1,06003E+02	60,9140023	26,0781979	21,35310968	21,75944144	2,36108E+02
35	3,295762	8,41603E+01	50,8815567	25,3808345	20,86255851	21,35310968	2,02638E+02
40	2,5348912	6,47307E+01	40,3969329	21,2006488	20,30466777	20,86255851	1,67496E+02
45	1,9088557	4,87444E+01	31,07075911	16,8320555	16,96051918	20,30466777	1,33912E+02
50	1,4162962	3,61664E+01	23,39729477	12,9461497	13,46564452	16,96051918	1,02936E+02
55	1,0395771	2,65465E+01	17,35987716	9,74887288	10,35691987	13,46564452	7,74779E+01
60	0,756921	1,93287E+01	12,74234214	7,2332822	7,799098383	10,35691987	5,74603E+01

III. HSS NAKAYASU

$$L = 103,00 \text{ km}$$

$$t_g = 0,4 + 0,058L$$

$$= 6,374 \text{ jam}$$

$$t_r = (0,5 \text{ sampai } 1) t_g \text{ ambil } 0,5t_g = 3,187 \text{ jam}$$

$$T_p = t_g + 0,8t_r = 8,9236 \text{ jam}$$

$$T_{0,3} = 2t_g = 12,748 \text{ jam}$$

$$Q_p = \frac{A.R_a}{3,6(0,3T_p + T_{0,3})} = \frac{638,00.1}{3,6(0,3.8,9236 + 12,748)} = 10,29775 \text{ m}^3/\text{det}$$

$$Q_a = Q_p \left(\frac{t}{T_p} \right)^{2,4} = 10,29775 \left(\frac{t}{8,9236} \right)^{2,4}$$

$$Q_{d1} = Q_p.0,3 \text{ pangkat } \frac{t - T_p}{T_{0,3}} = 10,29775.0,3^{\frac{t - 8,9236}{12,748}}$$

$$Q_{d2} = Q_p.0,3 \text{ pangkat } \frac{t - T_p + 0,5T_{0,3}}{1,5T_{0,3}} = 10,29775.0,3^{\frac{t - 8,9236 + 0,5.12,748}{1,5.12,748}}$$

$$= 10,29775.0,3^{\frac{t - 2,5496}{19,122}}$$

$$Q_{d3} = Q_p.0,3 \text{ pangkat } \frac{t - T_p + 1,5T_{0,3}}{2T_{0,3}} = 10,29775.0,3^{\frac{t - 8,9236 + 1,5.12,748}{2.12,748}}$$

$$= 10,29775.0,3^{\frac{t + 10,1984}{25,498}}$$

HIDROGRAF SATUAN NAKAYASU

t (jam)	Q (m ³ /det)
0	0
1	0,053882299
2	0,284392479
3	0,752553063
4	1,501032501
5	2,564331263
6	3,971998882
7	5,750179641
8	7,922497037
9	10,22371375
10	9,302338728
11	8,463999283
12	7,701212131
13	7,007168397
14	6,37567283
15	5,801088505
16	5,278286502
17	4,802600128
18	4,369783258
19	3,975972435
20	3,61765238
21	3,291624617
22	3,026103048
23	2,841445683
24	2,668056389
25	2,505247571
30	1,828642788
35	1,334772054
40	0,974283468
45	0,759989649
50	0,60017015
55	0,473959361
60	0,374289651
65	0,295579652
70	0,233421711

HIDROGRAF BANJIR RENCANA NAKAYASU KALA ULANG 2 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		14,406532	6,9151353	2,8813064	2,3050451	2,3050451	
0	0	0	0	0	0	0	0
1	0,053882299	0,776257063	0	0	0	0	0,776257063
2	0,284392479	4,097109343	0,372603387	0	0	0	4,46971273
3	0,752553063	10,84167979	1,966612467	0,155251413	0	0	12,96354367
4	1,501032501	21,62467276	5,204006254	0,819421869	0,124201129	0	27,77230201
5	2,564331263	36,94312039	10,37984283	2,168335958	0,655537489	0,124201129	50,2710378
6	3,971998882	57,22272899	17,73269764	4,324934551	1,734668751	0,655537489	81,67056742
7	5,750179641	82,840147	27,46690968	7,388624079	3,459947611	1,734668751	122,8902971
8	7,922497037	114,1357071	39,76327022	11,4445458	5,910899212	3,459947611	174,7143699
9	10,22371375	147,2882592	54,78513892	16,5680294	9,155636559	5,910899212	233,7079633
10	9,302338728	134,0144406	70,69836382	22,82714142	13,25442341	9,155636559	249,9500058
11	8,463999283	121,9368765	64,32693091	29,45765185	18,26171297	13,25442341	247,2375957
12	7,701212131	110,947759	58,52970022	26,80288811	23,56612127	18,26171297	238,1081816
13	7,007168397	100,9489957	53,25492386	24,3873753	21,4423103	23,56612127	223,5997265
14	6,37567283	91,85133465	48,45551754	22,1895518	19,50990007	21,4423103	203,4486144
15	5,801088505	83,57356718	44,08864025	20,18979915	17,75164129	19,50990007	185,1135479
16	5,278286502	76,04180339	40,1153119	18,37026693	16,15183918	17,75164129	168,4308627
17	4,802600128	69,18881243	36,50006531	16,71471344	14,69621342	16,15183918	153,2516438
18	4,369783258	62,95342234	33,21062968	15,20836068	13,37177063	14,69621342	139,4403967
19	3,975972435	57,27997412	30,21764246	13,83776249	12,16668844	13,37177063	126,8738381
20	3,61765238	52,11782478	27,49438734	12,59068447	11,07020989	12,16668844	115,4397949
21	3,291624617	47,42089537	25,01655568	11,45599482	10,07254749	11,07020989	105,0362032
22	3,026103048	43,59565039	22,76202958	10,42356496	9,164795779	10,07254749	96,01858819
23	2,841445683	40,93537816	20,92591201	9,484179074	8,338851892	9,164795779	88,84911691
24	2,668056389	38,43743974	19,64898135	8,719130078	7,587343193	8,338851892	82,73174625
25	2,505247571	36,09192929	18,44997092	8,187075632	6,975304002	7,587343193	77,29162304
30	1,828642788	26,34440084	17,32412591	7,687487949	6,549660448	6,975304002	64,88097915
35	1,334772054	19,22943631	12,64531229	7,218385859	6,149990306	6,549660448	51,79278522
40	0,974283468	14,03604596	9,230129351	5,268880169	5,774708637	6,149990306	40,45975442
45	0,759989649	10,9488152	6,737302001	3,845887263	4,215104098	5,774708637	31,5218172
50	0,60017015	8,646370468	5,255431251	2,807209191	3,076709784	4,215104098	24,00082479
55	0,473959361	6,828110703	4,150257788	2,18976304	2,245767334	3,076709784	18,49060865
60	0,374289651	5,392215837	3,277493109	1,729274094	1,751810417	2,245767334	14,39656079
65	0,295579652	4,258277714	2,58826358	1,365622141	1,383419263	1,751810417	11,34739211
70	0,233421711	3,362797343	2,043973285	1,078443167	1,092497703	1,383419263	8,961130762

HIDROGRAF BANJIR RENCANA NAKAYASU KALA ULANG 5 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		17,723196	8,507134	3,544639	2,835711	2,835711	
0	0	0	0	0	0	0	0
1	0,053882299	0,954966544	0	0	0	0	0,954966544
2	0,284392479	5,040343638	0,458383937	0	0	0	5,498727575
3	0,752553063	13,33764544	2,419364924	0,190993298	0	0	15,94800366
4	1,501032501	26,60309321	6,402069752	1,008068671	0,152794628	0	34,16602626
5	2,564331263	45,44814558	12,76948462	2,667528938	0,80645488	0,152794628	61,84440865
6	3,971998882	70,39651469	21,81510967	5,320618343	2,134023	0,80645488	100,4727206
7	5,750179641	101,9115608	33,79032673	9,089628603	4,256494374	2,134023	151,1820335
8	7,922497037	140,4119678	48,91754873	14,07930214	7,271702369	4,256494374	214,9370154
9	10,22371375	181,1968826	67,3977439	20,38231101	11,26344092	7,271702369	287,5120808
10	9,302338728	164,8671725	86,97450282	28,08239197	16,30584766	11,26344092	307,4933559
11	8,463999283	150,0091182	79,13624208	36,23937447	22,46591199	16,30584766	304,1564944
12	7,701212131	136,490092	72,00437608	32,97343265	28,99149753	22,46591199	292,9253103
13	7,007168397	124,1894189	65,51524356	30,00182195	26,37874426	28,99149753	275,0767262
14	6,37567283	112,9972992	59,61092051	27,29801687	24,00145587	26,37874426	250,2864367
15	5,801088505	102,8138286	54,23870311	24,83788238	21,83841195	24,00145587	227,7302819
16	5,278286502	93,54810621	49,35063726	22,59945857	19,8703045	21,83841195	207,2069185
17	4,802600128	85,11742338	44,90309056	20,56276456	18,07956558	19,8703045	188,5331486
18	4,369783258	77,44652517	40,85636284	18,70962019	16,45021048	18,07956558	171,5422843
19	3,975972435	70,46693876	37,17433173	17,02348371	14,96769509	16,45021048	156,0826598
20	3,61765238	64,11636219	33,82413029	15,48930416	13,61878601	14,96769509	142,0162777
21	3,291624617	58,33810824	30,77585356	14,09338696	12,39144245	13,61878601	129,2175772
22	3,026103048	53,63221743	28,00229169	12,82327171	11,27470877	12,39144245	118,1239321
23	2,841445683	50,35949876	25,74346412	11,66762099	10,25861665	11,27470877	109,3039093
24	2,668056389	47,28648632	24,17255918	10,72644288	9,334096133	10,25861665	101,7782012
25	2,505247571	44,40099372	22,69751322	10,07189918	8,581153699	9,334096133	95,08565596
30	1,828642788	32,40939455	21,31247679	9,45729673	8,057518779	8,581153699	79,81784054
35	1,334772054	23,65642673	15,55650924	8,880198243	7,56583685	8,057518779	63,71648984
40	0,974283468	17,26741686	11,35508473	6,481878544	7,104158093	7,56583685	49,77437507
45	0,759989649	13,46944551	8,288360015	4,73128508	5,185502469	7,104158093	38,77875117
50	0,60017015	10,6369332	6,465333785	3,453483177	3,785027797	5,185502469	29,52628043
55	0,473959361	8,400074654	5,105727887	2,69388895	2,762786347	3,785027797	22,74750563
60	0,374289651	6,633608849	4,032035796	2,127386519	2,155111008	2,762786347	17,71092852
65	0,295579652	5,238616105	3,184132218	1,680014836	1,701909095	2,155111008	13,95978326
70	0,233421711	4,136978728	2,514555707	1,326721695	1,344011774	1,701909095	11,024157

HIDROGRAF BANJIR RENCANA NAKAYASU
KALA ULANG 10 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		19,749974	9,4799634	3,9499847	3,1599878	3,1599878	
0	0	0	0	0	0	0	0
1	0,0538823	1,06417131	0	0	0	0	1,06417131
2	0,2843925	5,616729846	0,51080222	0	0	0	6,12753207
3	0,7525531	14,8628658	2,69603029	0,21283426	0	0	17,7717303
4	1,5010325	29,64527782	7,13417549	1,12334594	0,17026741	0	38,0730667
5	2,5643313	50,64534756	14,2297332	2,97257308	0,89867676	0,17026741	68,916598
6	3,9719989	78,44667605	24,3097665	5,92905541	2,3780585	0,89867676	111,962233
7	5,7501796	113,5656109	37,654404	10,1290693	4,74324439	2,3780585	168,470387
8	7,922497	156,4687144	54,5114925	15,6893348	8,10325551	4,74324439	239,516042
9	10,223714	201,9175696	75,1049819	22,7131216	12,551468	8,10325551	320,390397
10	9,3623387	183,7204829	96,9204322	31,2937421	18,1704975	12,551468	342,656623
11	8,4639993	167,1633426	88,1858307	40,3835129	25,034994	18,1704975	338,938178
12	7,7012121	152,0983543	80,2384034	36,7440956	32,3068107	25,034994	326,422658
13	7,0071684	138,3910433	73,0072091	33,4326677	29,3952769	32,3068107	306,533008
14	6,3756728	125,9190538	66,4276999	30,4196701	26,7461345	29,3952769	278,907835
15	5,8010885	114,5710571	60,4411451	27,678208	24,3357364	26,7461345	253,772281
16	5,2782865	104,2457573	54,9941067	25,1838101	22,1425666	24,3357364	230,901977
17	4,8026001	94,85098753	50,0379629	22,9142108	20,1470484	22,1425666	210,092776
18	4,3697833	86,30288724	45,5284734	20,8491509	18,3313689	20,1470484	191,158929
19	3,9759724	78,52515342	41,4253854	18,970197	16,679321	18,3313689	173,931426
20	3,6176524	71,44835956	37,6920732	17,260577	15,1761578	16,679321	158,256489
21	3,2916246	65,00933602	34,2952122	15,7050303	13,8084618	15,1761578	143,994198
22	3,026103	59,76530521	31,2044809	14,2896716	12,5640244	13,8084618	131,631944
23	2,8414457	56,11833629	28,6873461	13,0018669	11,4317374	12,5640244	121,803311
24	2,6680564	52,69391091	26,9368011	11,9530607	10,4014936	11,4317374	113,417004
25	2,5052476	49,47844913	25,2930769	11,223667	9,56244871	10,4014936	105,959135
30	1,8286428	36,11555609	23,7496553	10,5387819	8,97893369	9,56244871	88,9453757
35	1,3347721	26,36164662	17,3354667	9,89568958	8,43102564	8,97893369	71,0027622
40	0,9742835	19,24202445	12,6535902	7,22311103	7,91655176	8,43102564	55,4663031
45	0,7599896	15,00973781	9,23617162	5,27232919	5,7784889	7,91655176	43,2132793
50	0,6001702	11,85331485	7,20467406	3,84840479	4,21786341	5,7784889	32,902746
55	0,4739594	9,360661359	5,68959106	3,00194749	3,07872387	4,21786341	25,3487872
60	0,3742897	7,392192161	4,4931174	2,37066291	2,40155802	3,07872387	19,7362544
65	0,2955797	5,837675663	3,54825219	1,87213222	1,89653035	2,40155802	15,5561485
70	0,2334217	4,610061052	2,80208428	1,47843839	1,4977058	1,89653035	12,2848199

HIDROGRAF BANJIR RENCANA NAKAYASU
KALA ULANG 20 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah(m ³ /det)
		21,595236	10,365713	4,3190472	3,4552377	3,4552377	
0	0	0	0	0	0	0	0
1	0,0538823	1,16360096	0	0	0	0	1,16360096
2	0,2843925	6,1415227	0,558528447	0	0	0	6,70005115
3	0,7525531	16,251561	2,947930817	0,232720193	0	0	19,432212
4	1,5010325	32,4151511	7,800749068	1,22830454	0,186176151	0	41,6303809
5	2,5643313	55,3773388	15,55927211	3,2503122	0,982643615	0,18617615	75,3557429
6	3,9719989	85,7762532	26,58112191	6,483030221	2,600249715	0,98264362	122,423299
7	5,7501796	124,176486	41,17260045	11,07546776	5,186424086	2,60024971	184,211228
8	7,922497	171,088193	59,60471186	17,15525065	8,860374055	5,18642409	261,894954
9	10,223714	220,783511	82,12233053	24,83529728	13,72420028	8,86037406	350,325713
10	9,3023387	200,8862	105,9760825	34,21763864	19,86823748	13,7242003	374,672359
11	8,4639993	182,782062	96,42537348	44,15670225	27,37411044	19,8682375	370,606486
12	7,7012121	166,309493	87,7353874	40,17724004	35,32536118	27,3741104	356,921593
13	7,0071684	151,321455	79,8285547	36,5564124	32,14179147	35,3253612	335,173575
14	6,3756728	137,684159	72,63429655	33,26189869	29,24512942	32,1417915	304,967276
15	5,8010885	125,275875	66,08839474	30,26429104	26,60951849	29,2451294	277,483209
16	5,2782865	113,985843	60,13241853	27,53683188	24,21143242	26,6095185	252,476044
17	4,8026001	103,713283	54,71320301	25,05517506	22,02946513	24,2114324	229,722559
18	4,3697833	94,3665007	49,78237458	22,79716854	20,0441397	22,0294651	209,019649
19	3,9759724	85,8620631	45,29591912	20,74265664	18,23773451	20,0441397	190,182513
20	3,6176524	78,1240569	41,21378916	18,87330015	16,59412502	18,2377345	173,043006
21	3,2916246	71,0834104	37,4995463	17,17241261	15,09863985	16,594125	157,448134
22	3,026103	65,3494095	34,12003608	15,62481138	13,73792985	15,0986399	143,930827
23	2,8414457	61,3616901	31,3677157	14,21668209	12,49984889	13,7379299	133,183867
24	2,6680564	57,6173074	29,45361046	13,0698819	11,37334547	12,4998489	124,013994
25	2,5052476	54,1014125	27,6563068	12,27233802	10,45590534	11,3733455	115,859308
30	1,8286428	39,4899726	25,96867731	11,52346148	9,817870246	10,4559053	97,2558869
35	1,3347721	28,8247175	18,95518632	10,82028251	9,218769021	9,81787025	77,6368256
40	0,9742835	21,0398814	13,83586403	7,897994513	8,656225855	9,21876902	60,6487348
45	0,7599896	16,4121558	10,09914281	5,764943502	6,318395501	8,65622586	47,2508635
50	0,6001702	12,960816	7,877834585	4,207976284	4,611954722	6,3183955	35,9769771
55	0,4739594	10,2352643	6,221191526	3,282431166	3,366380969	4,61195472	27,7172226
60	0,3742897	8,08287335	4,91292671	2,592163206	2,625944887	3,36638097	21,5802891
65	0,2955797	6,38311234	3,879779101	2,047052851	2,073730529	2,62594489	17,0096197
70	0,2334217	5,04079694	3,063893841	1,616574669	1,637642252	2,07373053	13,4326382

HIDROGRAF BANJIR RENCANA NAKAYASU
KALA ULANG 50 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		23,871269	11,458209	4,7742539	3,8194031	3,8194031	
0	0	0	0	0	0	0	0
1	0,0538823	1,286238878	0	0	0	0	1,286238878
2	0,2843925	6,788809869	0,617394655	0	0	0	7,406204524
3	0,7525531	17,96439749	3,258628703	0,257247781	0	0	21,48027397
4	1,5010325	35,83155059	8,622910703	1,357762002	0,205798224	0	46,01802151
5	2,5643313	61,21384227	17,1991441	3,592879573	1,086209596	0,205798224	83,29787376
6	3,9719989	94,81665421	29,38264398	7,166310267	2,874303643	1,086209596	135,3261217
7	5,7501796	137,264084	45,51199354	12,24216811	5,733048184	2,874303643	203,6261981
8	7,922497	189,120057	65,88675964	18,96333124	9,794214917	5,733048184	289,497411
9	10,223714	244,0530271	90,77762643	27,45281738	15,17066491	9,794214917	387,2483507
10	9,3023387	222,0586294	117,1454518	37,8240122	21,96225379	15,17066491	414,1610121
11	8,4639993	202,0464041	106,588141	48,81060644	30,2592096	21,96225379	409,6666149
12	7,7012121	183,8377057	96,98227296	44,41172682	39,04848495	30,2592096	394,5394
13	7,0071684	167,2700018	88,2420978	40,40928167	35,52938127	39,04848495	370,4992475
14	6,3756728	152,1954005	80,28960003	36,7675419	32,32742516	35,52938127	337,1093488
15	5,8010885	138,4793441	73,05379146	33,45400106	29,41403337	32,32742516	306,7285951
16	5,2782865	125,9993969	66,47008446	30,43908073	26,76320071	29,41403337	279,0857962
17	4,8026091	114,6441589	60,47970988	27,6958694	24,35126446	26,76320071	253,9342033
18	4,3697833	104,3122726	55,02919569	25,19987991	22,1566954	24,35126446	231,0493081
19	3,9759724	94,9115067	50,06989034	22,92883226	20,15990382	22,1566954	210,2268285
20	3,6176524	86,35795359	45,55752274	20,86245496	18,34306571	20,15990382	191,2809008
21	3,2916246	78,57525627	41,45181729	18,98230174	16,68996388	18,34306571	174,0424049
22	3,026103	72,23691873	37,71612262	17,27159108	15,18584131	16,68996388	159,1004376
23	2,8414457	67,82891465	34,67372063	15,71505158	13,81727279	15,18584131	147,220801
24	2,6680564	63,68989203	32,55787869	14,44738405	12,5720412	13,81727279	137,0844688
25	2,5052476	59,80343937	30,57114785	13,56578321	11,55790718	12,5720412	128,0703188
30	1,8286428	43,65202418	28,7056506	12,73797867	10,85262652	11,55790718	107,5061871
35	1,3347721	31,86270385	20,95297139	11,96068812	10,19038289	10,85262652	85,81937277
40	0,9742835	23,25738351	15,29409769	8,73040502	9,56855045	10,19038289	67,04081955
45	0,7599896	18,14191618	11,16354397	6,372540904	6,984323979	9,56855045	52,23087548
50	0,6001702	14,32682429	8,708119675	4,6514768	5,098032697	6,984323979	39,76877744
55	0,4739594	11,31401233	6,876875587	3,628383312	3,72118142	5,098032697	30,63848535
60	0,3742897	8,934770113	5,430725863	2,865364918	2,902706634	3,72118142	23,85474895
65	0,2955797	7,05586253	4,288689609	2,262802514	2,292291922	2,902706634	18,80235321
70	0,2334217	5,572072191	3,386813979	1,78695406	1,810242002	2,292291922	14,84837415

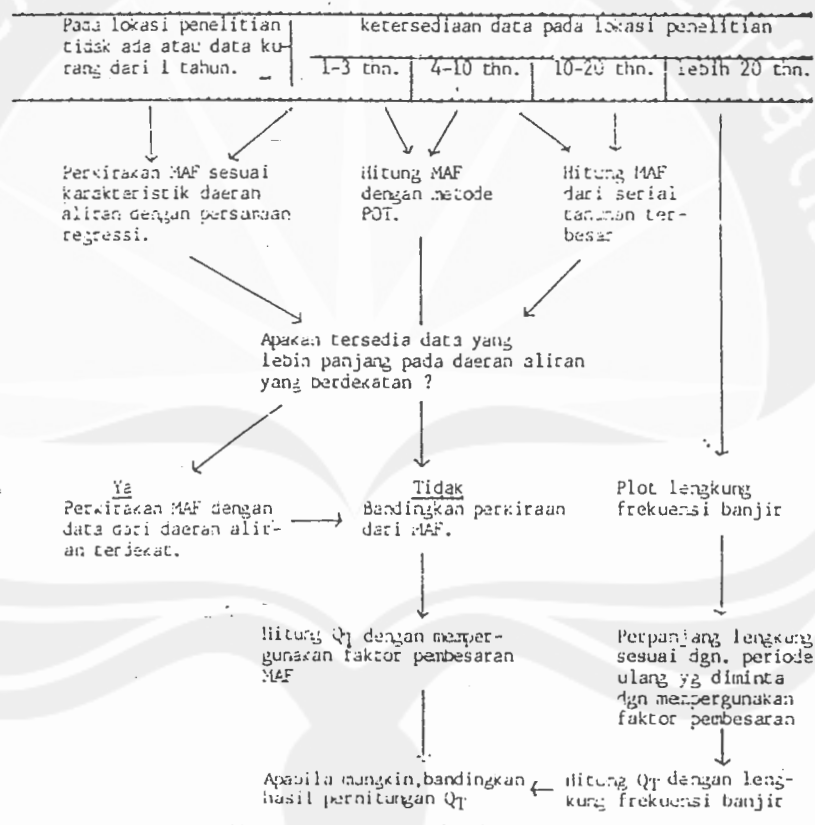
HIDROGRAF BANJIR RENCANA NAKAYASU
KALA ULANG 100 TAHUN

t (jam)	Q (m ³ /det)	Akibat Hujan (mm/jam)					Jumlah (m ³ /det)
		25,535909	12,257236	5,1071817	4,0857454	4,0857454	
0	0	0	0	0	0	0	0
1	0,0538823	1,37593351	0	0	0	0	1,37593351
2	0,2843925	7,262221	0,660448067	0	0	0	7,922669068
3	0,7525531	19,21712748	3,485865989	0,275186697	0	0	22,97818016
4	1,5010325	38,33022933	9,224220949	1,452444172	0,220149359	0	49,22704381
5	2,5643313	65,48253072	18,3985096	3,843425421	1,161955349	0,22014936	89,10657045
6	3,9719989	101,4286025	31,43161393	7,666045715	3,074740367	1,16195535	144,7629578
7	5,7501796	146,836063	48,68572791	13,09650589	6,132836632	3,07474037	217,8258738
8	7,922497	202,3081624	70,4813084	20,28572009	10,47720481	6,13283663	309,6852324
9	10,223714	261,0718303	97,10791544	29,36721202	16,22857623	10,4772048	414,2527389
10	9,3023387	237,5436745	125,3144753	40,4616317	23,49376985	16,2285762	443,0421276
11	8,4639993	216,1359159	114,0209608	52,21436505	32,36930567	23,4937698	438,2343173
12	7,7012121	196,6574514	103,7452369	47,50873398	41,77149245	32,3693057	422,0522204
13	7,0071684	178,9344146	94,3955742	43,22718233	38,00698755	41,7714924	396,3356511
14	6,3756728	162,8086004	85,88851677	39,3314895	34,58174621	38,0069876	360,6173405
15	5,8010885	148,136068	78,14812617	35,78688222	31,46519191	34,5817462	328,1180145
16	5,2782865	134,7858437	71,1053108	32,56171945	28,62950606	31,4651919	298,547572
17	4,8026001	122,6387591	64,69720331	29,62721303	26,04937581	28,6295061	271,6420575
18	4,3697833	111,5863887	58,86660284	26,95716822	23,70177065	26,0493758	247,1613062
19	3,9759724	101,5300694	53,56146518	24,52775134	21,56573479	23,7017707	224,8867914
20	3,6176524	92,38004248	48,73443204	22,3172773	19,62220127	21,5657348	204,6196879
21	3,2916246	84,05462625	44,34241923	20,30601348	17,85382202	19,6222013	186,1790822
22	3,026103	77,27429083	40,34621955	18,47600813	16,24481094	17,853822	170,1951515
23	2,8414457	72,55889882	37,09165863	16,81092492	14,78080665	16,2448109	157,4871
24	2,6680564	68,13124544	34,2827053	15,45485786	13,44874007	14,7808067	146,6439205
25	2,5052476	63,97377474	32,70299696	14,51177948	12,36388641	13,4487401	137,0011777
30	1,8286428	46,69605613	30,70741107	13,62624882	11,6094237	12,3638864	115,0030261
35	1,3347721	34,08461888	22,41410636	12,7947547	10,90099916	11,6094237	91,8039028
40	0,9742835	24,8792148	16,36061664	9,339211044	10,23580386	10,9009992	71,7158455
45	0,7599896	19,40702527	11,94202279	6,816923643	7,471368908	10,2358039	55,87314447
50	0,6001702	15,32589161	9,315371885	4,975842862	5,453538968	7,47136891	42,54201423
55	0,4739594	12,10298411	7,356427782	3,881404977	3,980674328	5,45353897	32,77503016
60	0,3742897	9,557827719	5,80943222	3,065178262	3,105124012	3,98067433	25,51823654
65	0,2955797	7,547896321	4,587757185	2,420596774	2,452142634	3,10512401	20,11351693
70	0,2334217	5,96063529	3,62299014	1,911565506	1,936477438	2,45214263	15,88381101

Rekapitulasi Debit banjir rencana

No	Kala ulang (tahun)	GAMA I	NAKAYASU	SNYDER
		$Q_{rencana} (m^3/det)$	$Q_{rencana} (m^3/det)$	$Q_{rencana} (m^3/det)$
1	2	427,875855	249,9500028	155,9858582
2	5	554,508667	307,4933559	191,896833
3	10	613,8398555	342,656623	213,8411126
4	20	667,8601991	374,672359	233,8211167
5	50	734,489636	414,1610121	258,4347
6	100	783,2209148	443,0421276	276,489

Gambar 3.4.1. Petunjuk penggunaan Manual.



Metoda MAF (Mean Annual Flood)

$$X_{med} = 180,5$$

$$X_{max} = 299$$

$$\frac{X_{max}}{X_{med}} = 2,523 < 3,00$$

$$X_{med}$$

Untuk Luas DPS = 638,00 km²

Tabel Nilai X_T

T	C	XT	Sc	Sxt	Batas
5	1,24	230	0,138675649	61	169-291
10	1,48	275	0,2368	79	196-354
20	1,75	325	0,364288399	103	222-428
50	2,18	404	0,592600738	147	257-551
100	2,57	477	0,8224	191	286-668
200	3,01	558	1,108176046	246	312-804
500	3,7	686	1,597790243	339	347-1025
1000	4,32	801	2,0736	430	371-1231

Metoda Regresi

$$AREA = 638,00 \text{ km}^2$$

$$SIMS = 1,699$$

$$LAKE = 0$$

$$ARF = 1,152 - 0,1233 \cdot \log AREA$$

$$= 0,8062$$

$$APBAR = PBAR \times ARF$$

$$= 120 \times 0,8062 = 96,73987$$

$$V = 1,02 - 0,0275 \cdot \log AREA$$

$$= 0,94287$$

$$\bar{X} = (8,00)(10^{-6})(AREA)^V (APBAR)^{2,445} (SIMS)^{0,117} (1 + LAKE)^{-0,85}$$

$$\bar{X} = (8,00)(10^{-6})(638,00)^{0,94287} (96,73987)^{2,445} (1,699)^{0,117} (1 + 0)^{-0,85}$$

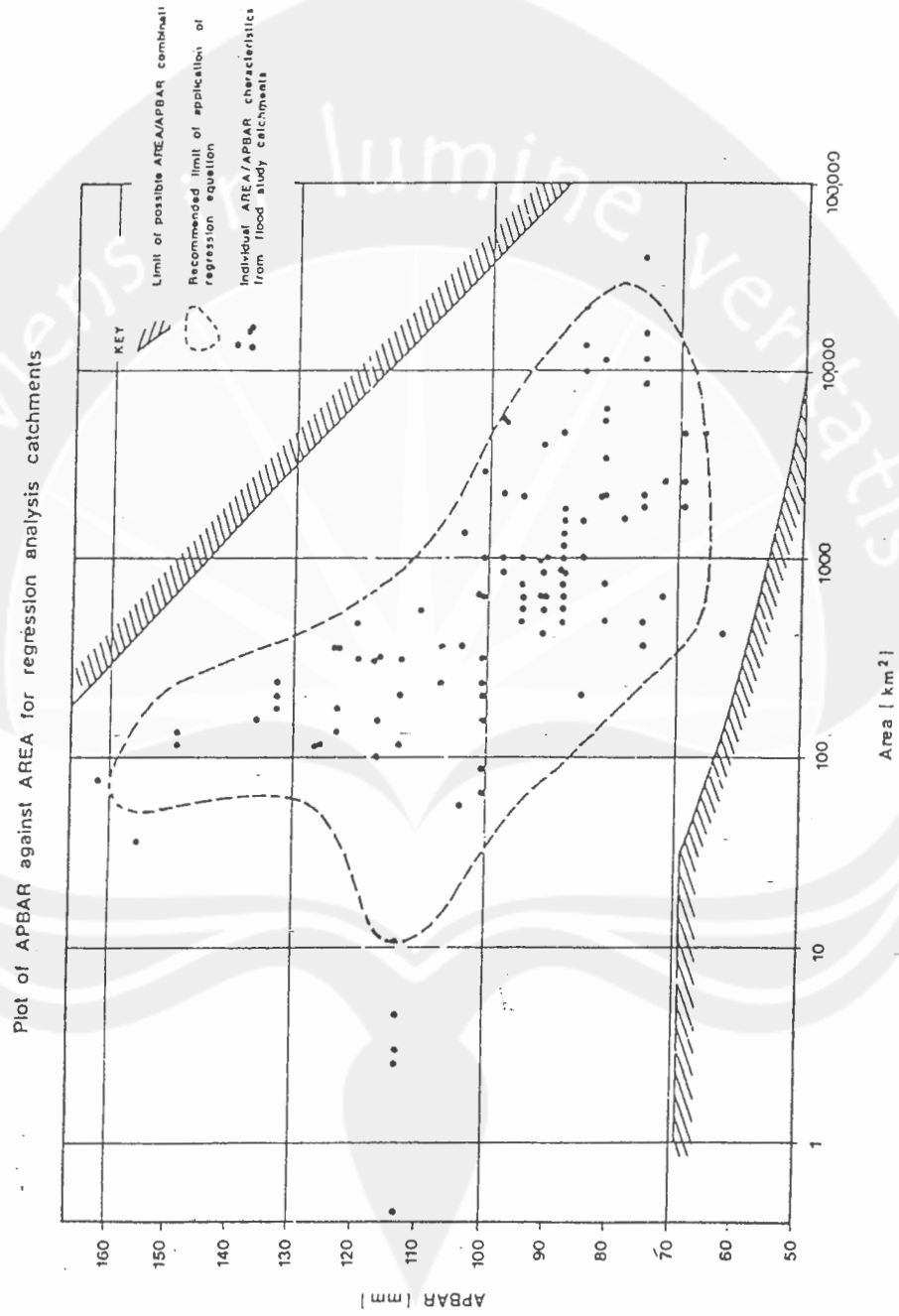
$$\bar{X} = 268,7876 \text{ m}^3/\text{det}$$

$$\bar{X} = 269 \text{ m}^3/\text{det} \text{ (dibulatkan)}$$

$$\text{Batas kesalahan standar} = \frac{\bar{X}}{1,59} \leq \bar{X} \leq (1,59)\bar{X} = 169,1824 \leq \bar{X} \leq 427,71$$

$$X_T = \bar{X} \times C$$

T	C	X _T	Batas
5	1,24	334	210-531
10	1,48	398	250-633
20	1,75	471	296-749
50	2,18	586	369-932
100	2,57	691	435-1099
200	3,01	810	509-1288
500	3,70	995	626-1582
1000	4,32	1162	731-1848



LEMBAR KONSULTASI TUGAS AKHIR

Nama : Eva Olivia

No. Mahasiswa : 8464/TSH

Dosen Pembimbing I : Prof.Ir.Hardjoso Prodjopangarso

Dosen Pembimbing II : Ir. Bambang Priyosutrisno

Tanggal	Keterangan	Paraf
19/01/01	Konsultasi analisis hasil	
31/01/01	- Perbaiki pada uji kecocokan Ol: kuduak untuk Ep - Check hasil, cermat apakah ada perbedaan wilayah dari data u & maksimum - Bila muncul data di tabel. Dat u terlah muncul hasil apa meraguk	
12/02/01	- Ditanya tentang syarat data - serial data (menggunakan 1980) → lihat tabel - Selanjutnya untuk kaitan ul, s, u, t → hitung faktor per teori C (sebagai tabel & kesimpulan) - Untuk analisis data lebih lanjut catatan u) & berikan! → mengacu ke UH dan metode regresi	
20/2/01	→ Untuk mendahulukan kesimpulan buat grafik pertama hasil (termasuk revisi) setelah Untuk UAH pilih u) mendebat.	
21/2/01	Perbaiki catat u) & berikan pada Bal I - II	
22/2/01	Perbaiki dan lengkapi catat pada Bal V dan Hasil Analisis oby lamp dan lengkapi di Daftar Pustaka all. (semua gambar dan tabel & beri nomor) → Daftar disusun secara lengkap!	
28/2/01	Perbaiki catat u) & tulis dan & paraf sieur klunas pada Bal VI. Dan selanjutnya no. lain	
01/03/01	Ace	