PUMP OPTIMATION IN 2D FLOOD AREA MODELLING

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ABSTRACT
Flood can be happened from two condition, tidal and run off from upper area. In crowded area flood can be more destructive because it doesn't have an infiltration area to reduce the flood discharge. River and channel condition is a big thing which can change the condition in a one of area whether the flood will happened or not. Several modification in a river often used to reduce the flood, but when the flood come from the downstream as a tidal it become harder to be maintained. One of solution is with use a pump and a dike in the middle of river, the dike will hold the tidal from the downstream and the pump will pump the water from upper dike to lower dike. It doesn't automatically fix the problem, but it worth enough to be tried. However there are several thing that need to be considered carefully such channel capacity in lower dike, it have to be capable to accommodate discharge from the pump. This research show several channel treatment and how it end, the result of flood with pump simulation show the smallest flood area.
Keywords *: Flood, Pump, Tidal*

1. INTRODUCTION

North Jakarta area is a crowded area which have a flood problem, the crowded area which only have small infiltration area and bad drainage make this condition become worst[1]. Flood which happened in North Jakarta area is come from two conditions, such as flood from the South and Tidal from North.

Figure 1 Flood and Tidal ways

Figure 2 Tidal Location

Tidal survey graphic can be seen below :

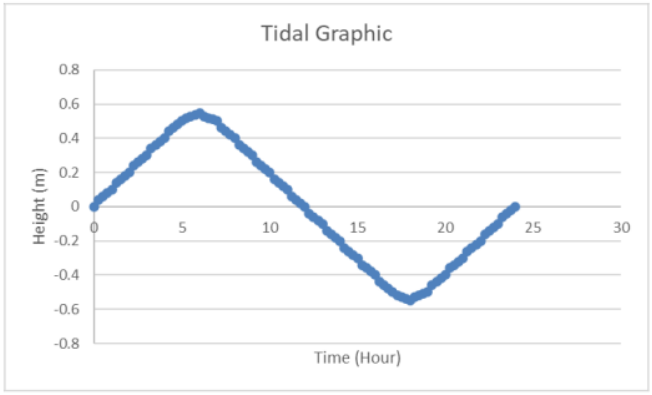


Figure 3 Tidal Graphic

From data above, the peak of tidal is in 6th hour in 0.55 m, the lowest hight is -0.55 m in 18th hour.

2. LITERATURE REVIEW

2.1. Discharge Volume

Volume discharge can be calculated from several ways, ones of it are through Hidrograph or through empirical calculation.

a. Hidrograph
   Hidrograph can be transformed into volume by multiply it with 3600 seconds for each hour.
b. Qp Calculation
   Peak discharge calculation based on SNI 2415-2106[2] is :

$$Qp = 0.00278\ CIA$$

C = Run Off Coefficient
I = Rain depth (mm)
A = Area (Ha)

2.2. Pump And Flood

Pump in flood management always become a crutial part of flood control, the quality and capacity of pump always become a big problem in budgeting management. For a big capacity pump the axial submersible pump become a first priority, otherwise for an area which only need small capacity pump the mobile pump become a priority. Another important thing while choose the pump is that the pump efficiency is an important thing

3. METHODOLOGY

The methodology which need to be completed in order to complete the research are :

1. Preparation
   Preparation step is the first step which need to be fixed and finished before the start of another steps. Here are several steps which accounted in preparation steps :
   - Work approachment method
   - Determination of primer and secondary data
   - Evaluation of past research
2. Field Survey
   Field survey is intend to collect field data and clarify sevral aspects that related to this research based on field condition. It includes topography survey and an interview with the villagers.
3. Analysis
   In analysis, here are things to do in this research :
   - Rainfall Analysis
   - Rainfall Design
   - Volume Calculation
   - 2D Modelling
4. Conclusions and Suggestions
   This one is the outcome from analysis step, it contain the conclusion from this research

4. ANALYSIS AND DISCUSSION

4.1. Rainfall Data

Rainfall data that used in this research is come from Soekarno Hatta rainfall station. Here are 11 last maximum annual data which can be seen below.

Table 1. Annual Maximum Daily Rainfall Data

No	Year	Maximum Rainfall (mm/day)
1	2010	106.2
2	2011	75.5
3	2012	101.1
4	2013	134.6
5	2014	104.1
6	2015	127.7
7	2016	147.6
8	2017	125.5
9	2018	85.4
10	2019	57
11	2020	147.9

4.2. Catchment Area

Based on the map of river and channel in water system at research location, the water catchment area is around 17 km^2. The stream is come to the North from South, West and East.

Figure 4. Catchment Area

4.3. Rainfall Analysis

Based on rainfall analysis, the frequency analysis can be seen below.

Table 2. Resume of Frequency Analysis Results Test

Kala Ulang T (Tahun)	t	Distribusi Probabilitas					
		Normal	Lognormal 2 Paramet.	Lognormal 3 Paramet.	Gumbel I	Pearson III	Log Pearson III
2	0.0000	110.2	106.5	108.4	106.2	112.1	110.9
5	0.8416	135.1	132.9	134.3	140.8	135.5	136.9
10	1.2816	148.1	149.3	149.0	163.7	146.7	149.5
20	1.6449	158.9	164.3	161.8	185.7	155.5	159.2
25	1.7507	162.0	168.9	165.6	192.7	157.9	161.8
50	2.0537	171.0	182.9	176.8	214.2	164.8	169.0
100	2.3263	179.0	196.6	187.3	235.5	170.7	175.0
1000	3.0902	201.6	240.4	218.7	306.0	186.1	188.6
Penyimpangan Maksimum		11.38	15.03	13.06	10.86	9.77	9.57
Delta Kritis (Sig. Level 5 %)		39.1	39.1	39.1	39.1	39.1	39.1

Table 3. Rainfall Plan

Return Period (Year)	Rainfall Plan (mm/day)
2	110.90
5	136.89
10	149.51
20	159.16
25	161.82
50	169.02
100	174.95
1000	188.63

4.4. Discharge Analysis

Based on rainfall data, the model use Qp25 so the Qp is 162.49 m^3/s, in order to simulate the greater flood condition, so the Tp is equalized with Tidal Peak, at 6^{th} hour.

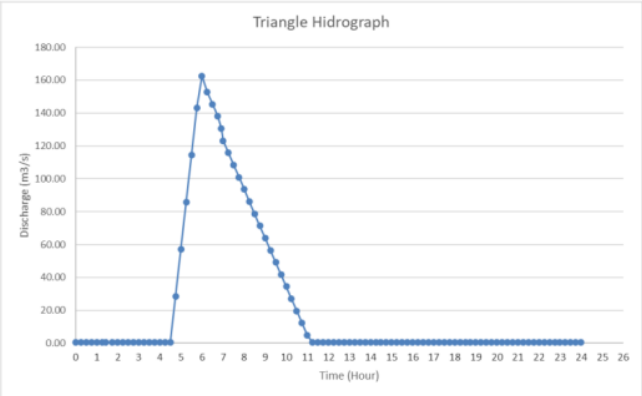


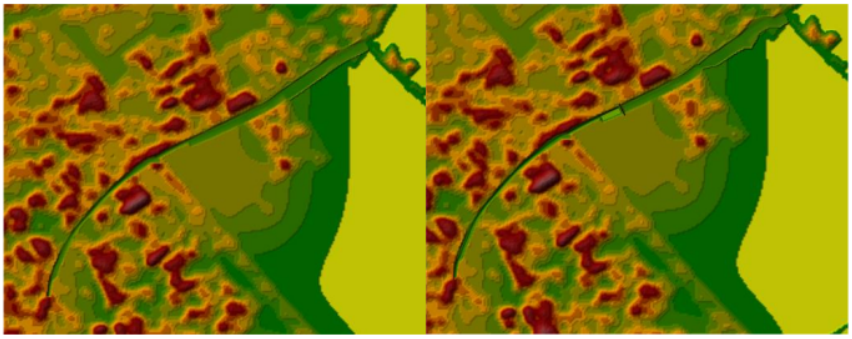
Figure 5. Triangle Hidrograph

4.5. Volume Analysis

Based on Figure 5 the volume of hydrograph is around 2.049.494 m^3.

4.6. Model Analysis

DEM model that used for this research are :



(a) (b)

Figure 6. Dem Model Origilan (a) and Normalized (b)

Pump Characteristic can be seen below :

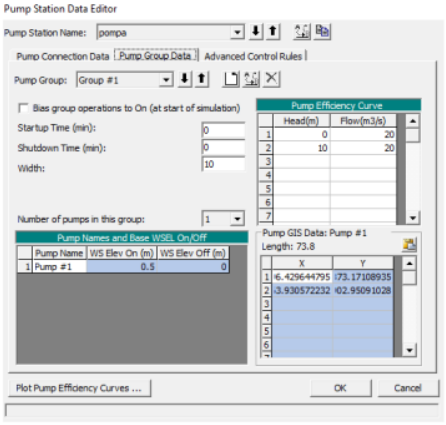


Figure 7. Pump Characteristic

From characteristic above, the pump will automatically on while water table is at 0.5 m and automatically off while water elevation is at 0 m.

The results of models are :

a. Original Condition

   Wet area in original condition can be seen below, the flood area is around 391.592 Ha.

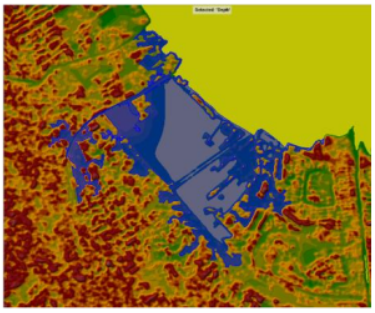


Figure 8. Original Condition

b. Normalized Condition
Wet area in normalized condition can be seen below, the flood area is around 347.153 Ha.

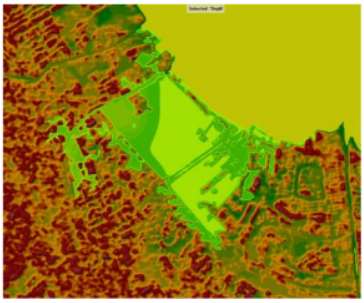


Figure 9. Normalized Condition

c. Normalized And Pump Condition
Wet area in normalized and pumped condition can be seen below, the flood area is around 335.008 Ha.

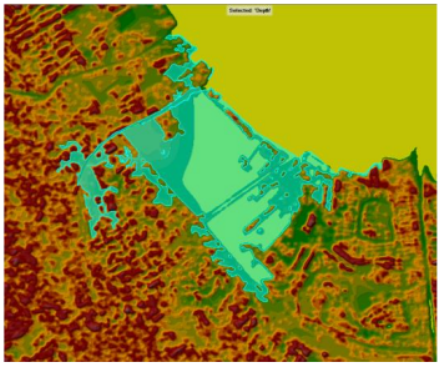


Figure 10. Normalized and Pumped Condition

The pump simulation can be seen below, we can see that the pump is active after 5th hour, and it inactive at 12th hour. After it the pump still control the water to keep it under elevation 0.

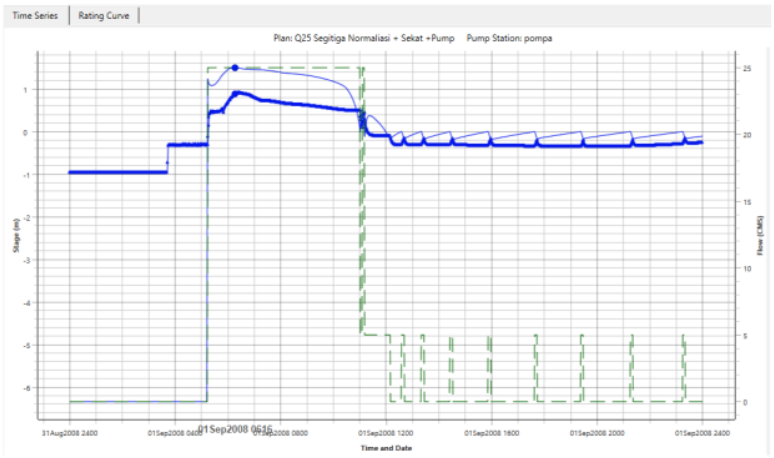


Figure 11. Pump Simulation And Hidrograph Flow

5. CONCLUSIONS AND RECCOMENDATIONS

Based on the results of the model, here are the conclution:

1. Flood area in original condition is around 391.592 Ha
2. Flood area in normalized condition is around 347.153 Ha
3. Flood area in normalized an pumped condition is around 335.008 Ha

6. ACKNOWLEDGE

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7. REFERENCE

[1] Widyanto, B. E., et al. "Policy Suitability Among Three Sources Of Regulations To Support The Zero Run-Off Concept On The Discharge Of The Q 5 Flood In Crowded Area" International Journal of Psychosocial Rehabilitation,24(2), 4600-4608

[2] National Standard Of Indonesia Number 2415-2016 about Discharge Design Calculation

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