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Analysis of Flood Management of Linei River at Toboali City Using SWMM 5.1 (Case Study of the Rawabangun Region)

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Abstract— *Rawabangun, is one of the areas in the city of Toboali, South Bangka Regency which is often hit by floods. There is the main river that passes through the Rawabangun area namely Linei River and wastewater from almost all of the drainage in Toboali city ends on this river. The Rawabangun area is ± 1 kilometer from the coast so that the sea tides have an effect on the output process of water in the river downstream channel. This study aims to analyze floods and how to handle it. The analysis is conducted by modeling the condition of the drainage and the river network using the Storm Water Management Model (SWMM) 5.1 software and the rainfall used is the rain with the return period of 5 years. From the analysis found 9 overflow points in the channel. Conducted the implementation of 3 alternatives for flood management, namely infiltration wells, retention ponds and modification of existing channels. From the analysis selected the most effective management in reducing flooding namely the handling with 1267 infiltration wells combined with 3 retention pools. The combination of these two treatments is able to overcome flooding in 9 channel overflow points.*

Keywords— *Flood, Tides of Sea Water, Flood Management, Reduction, SWMM 5.1.*

I. Preliminary

Flooding is a common problem that occurs in most parts of Indonesia, especially in densely populated areas such as in urban areas. Therefore the losses caused can be very large either in terms of material and loss of life. Currently, it is appropriate for the problem of flooding to get serious attention and is a problem for all of us. Assuming that, the problem of flooding is a common problem, it should be necessary from various parties to pay attention to the matters that can cause flooding and anticipated as early as possible, to minimize the losses incurred (R. J. Kodoatie, 2013).

Toboali, the capital of South Bangka Regency, is one of the areas in Bangka Belitung which was hit by a flood. One of the areas in Toboali that is often flooded is the Rawabangun area. There is one main river called Linei River in the Rawabangun area and wastewater from almost all of the Toboali drainage ends in this river. The Rawabangun area in Toboali is at an altitude of ± 5 meters above sea level (Dinas PU Kab. Bangka Selatan, 2016). The distance between the Rawabangun and the sea area is only around ± 1 kilometer so that the tides are thought to have an effect on the output process of wastewater in the downstream of Linei river. When there is excess water due to rain in the river channel, it is suspected that water cannot flow out because it is held back by the sea tides, so that excess water will inundate low areas in the surrounding area. This situation makes the residents of the Rawabangun area must always be alert in the event of rain which flushes Toboali Subdistrict with high and medium intensity and within a certain period (Dinas PU Kab. Bangka Selatan, 2016).

Previous research conducted by James Andrew Griffith et al. (2019) regarding flooding due to the influence of sea tides, the sea level rise (sea tide) will increase urban flooding. In another study conducted by Try Al Tanto (2014), who examined flood events in the coastal area of Bungus - Padang City that the flooding which occurred in the area was caused by tides of sea water and inundation elevation was at points < 0.5 m to 2,5 m. If rain occurs with high intensity accompanied by sea tide then it can be ascertained that the area in the elevation range will be flooded either from seawater or from water in the drainage system on the land. Based on these two studies, the writers suspect that the flood conditions that occur in the Rawabangun and surrounding areas are one of the effects of the presence of sea tides that enter the Linei River channel. Then, future land use changes will also lead to an increase in runoff and flooding at the study site.

From the background described, the problems in this study are:

1. How is the current condition of the Linei River network and existing drainage and land use change based on the Regional Spatial Plan/Rencana Tata Ruang Wilayah (RTRW) 2011- 2031 in South Bangka Regency?
2. How is the alternative for flood control which in accordance with the Linei River area, especially the Rawabangun and surrounding areas?
3. How is the ability of the application of alternative controls in reducing flood discharges that occur?.

II. Research Methodology

The location of this study was in the city of Toboali, Toboali Subdistrict, South Bangka Regency, Bangka Belitung Islands Province. Geographical location of South Bangka Regency at 2° 26' 27" - 3°5' 56" South Latitude and 107° 14' 31" -105° 53' 09" East Longitude. The catchment area/Daerah Tangkapan Air (DTA) of Linei River namely 412 ha.

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Figure 1. Map of Study Location of Liner River Catchment Area

The analysis used in the study carried out with the assist of the Storm Water Management Model (SWMM) software. The steps of working on this research are as follows:

a. Data collection
- Daily rainfall data;
- Data of drainage and river network;
- Geometry data of drainage and river channels;
- Land/soil data and topographic data;
- Land use data;
- Data on groundwater depth/kedalaman muka air tanah (MAT);
- Highest tide data.

b. Analysis of Design Rainfall

Before the rainfall data used for the analysis then should be conducted testing on rainfall data. Testing of rain data is done by statistical analysis. Statistical analysis used among other consistency test, outlier-inlier test, stationary test, persistence test, and test of no trend. After the rain data test is complete and the test results show the data can be used, the next step is to analyze the design rainfall with frequency analysis. From the frequency analysis obtained the selected design rainfall. The design rainfall used in this study is rainfall with 5 year return period. Process of rainfall data analysis described as follows:

1. Point Rain

At the study location there was only 1 rain station so that the rainfall used in this study was taken based on daily rainfall data from Rias station.

2. Design Rainfall

Design Rainfall in the study using Log Pearson III, Log Normal and Gumbel. Frequency analysis shows that only Log Pearson III statistical parameters meet the criteria so that the design rainfall analysis uses the Log Pearson III method. The equation used in the Log Pearson III method is as follows (Soewarno, 1995):

$$Log\ X = \overline{Log\ X} + k\ \overline{(SLogX)} \tag{1}$$

with:

$Log\ X$: logarithmic value of design rainfall
$\overline{Log\ X}$: logarithmic average value
$\overline{SLogX}$: standard deviation value of log x
k : Log Pearson Type III distribution constant

In this study, used the design rainfall with a return period of 5 years.

3. Rain Intensity

After obtained design rainfall with 5 year return period then the next step is to change it to rain intensity. Rain intensity is the amount of rainfall expressed in the height/depth of rain (mm/hour) per unit of time, which occurs at one time duration, when rainwater is concentrated. The amount of rainfall intensity varies depending on the duration and frequency of rainfall. One common formula for calculating the intensity of rainfall is Mononobe formula. This formula is often used in calculating rain intensity in urban areas (Suhardjono, 2015):

$$Ri = \frac{R24}{t}\left(\frac{t}{T}\right)^{2/3} \tag{2}$$

$$R_T = T \cdot Ri - (t - 1) \cdot R_{(t-1)} \tag{3}$$

with:

Ri : Rain intensity during concentration time (mm/hour)
R_{24} : Daily maximum rainfall in 24 hours (mm)
t : The duration of rain (hour)
T : Concentration time (hour)
R_T : Rainfall up to T-hour (mm/hour)

c. Construction of Existing Models

The model was built with the help of Storm Water Management Model (SWMM) 5.1 software. The input variable in this model are the variable of sub catchment area/sub daerah tangkapan air (Sub DTA), variable of junction (node), and variable of conduit (channel). Then, the existing model is calibrated using the Root Mean Square Error (RMSE) method. The variable used as the calibration number is the channel discharge in the model with the observation channel discharge in the field. Calibration is said to be good if the RMSE value is close to 0 (zero). The smaller the calibration number then the existing model approach will increasingly represent the field conditions.

d. Evaluation of existing drainage and river networks

Evaluation of the existing drainage and river network using the SWMM model. From this evaluation found the point on the conduit (channel) and junction (node) which its capacity is exceeded (flood).

e. Flood Management

Flood management/handling in this study among others with applying:

1. Infiltration wells

Infiltration wells are placed in the home's grounds of the residents with the input of runoff water discharge from the roofs of each house. Theoretically, according to Sunjoto (2011) the volume and efficiency of infiltration wells can be calculated based on the balance of water entering the well and the water that seeps into the soil. Rainwater discharge on the roof and dimensions from the construction of infiltration wells with side walls and empty fixed spaces can be calculated by:

$$Q = C\ x\ I\ x\ A \tag{4}$$

$$H = \frac{Q}{FK}\left\{1 - exp\left(\frac{-FKT}{\pi R^2}\right)\right\} \quad (5)$$

$$F = \frac{2\pi L + 2\pi R ln2}{\ln\left[\frac{L+2R}{2R} + \sqrt{1+\left(\frac{L}{2R}\right)^2}\right]} \quad (6)$$

with:
Q = Input water discharge (m^3/hour)
C = Roof drainage coefficient (0,95)
I = Rain intensity (m/h)
A = Roof area (m^2)
R = The radius of the well (m)
H = Depth of well (m)
F = Geometric factors of wells (m)
K = Soil permeability coefficient (m/h)

2. Retention Pool
The retention pool will be placed in an open area / land that is still adequate in accordance with the planned size.
3. The Changing of Channel Dimensions
In the dimensions of the existing channel, the changes made namely by changing the depth of the drainage and river channel at the study location.

In summary, the alternative of flood management in this study conducted by applying several scenarios that can be seen in the table below:

TABLE 1. The Alternative of Flood Management

No.	The Alternative of Flood Management
1.	Construction of Retention Pool 1 (SU1)
2.	Construction of Retention Pool 2 (SU2)
3.	Construction of Retention Pool 3 (SU3)
4.	Construction of the 3 Retention Pools (SU1+SU2+SU3)
5.	Construction of Infiltration Wells of 1267 Units
6.	Changes in Existing Channel Dimensions
7.	Combination of Construction of 3 Units of Retention Pools and 1267 Units of Infiltration Wells

III. RESULT AND DISSCUSSION

Hydrological Analysis

The Linei River catchment area has an area of 412 ha. The closest rain gauge station from Linei River catchment area is only one station, namely the rias rain station. Because there is only one rain station at the study location, the data on that station will be used in the calculation. Data can be used if the data series has passed statistical tests and is declared feasible. Rainfall data can be seen in table 2.

TABLE 2. Rainfall of Linei River Cathment Area

No.	Year	Rainfall (mm)
1.	2007	148.6
2.	2008	107.1
3.	2009	92.0
4.	2010	124.7
5.	2011	87.0
6.	2012	108.4
7.	2013	128.4
8.	2014	137.6
9.	2015	141.4
10.	2016	183.9

Rain data in table 2 above is declared feasible after conducted the test with statistical analysis including consistency test, outlier-inlier test, stationary test, persistence test, and test of no trend. The data in table 2 can be used in design rainfall analysis.

Design rainfall analysis was carried out by the Log Pearson Type III method. From the analysis of rain data carried out by Log Pearson III frequency analysis, the design rainfall for the 2, 5, 10, 20, 25, 100, 200, and 1000 years return period was obtained. The design rainfall obtained from the analysis can be seen in table 3 below:

TABLE 3. Design Rainfall

Tr (Tahun)	P_{Tr} (%)	X_T (mm)
2	50	123.289
5	20	148.964
10	10	165.254
25	4	184.491
50	2	198.151
100	1	212.529
200	0,5	224.812
1000	0,1	254.601

After the design rainfall is obtained then further conducted goodness of fit test of frequency distribution/ pengujian kesesuaian distribusi frekwensi. The goodness of fit test of frequency distribution/pengujian kesesuaian distribusi frekwensi that can be conducted namely with Smirnov Kolmogorov and Chi Square test (Limantara, 2010).

In the Smirnov-Kolmogorov test with $\alpha = 5\%$, obtained Δ max = 0.161 dan Δ Critical = 0.409. Because of Δ max < Δ Critical, then distribution can be accepted.While in the Chi Square test with $\alpha = 5\%$ and dk = 1, obtained the value of (c^2) arithmetic = 0,4 and (c^2) critical = 3,821. Because of (c^2) arithmetic < (c^2) critical, then distribution can be accepted.

After passing the goodness of fit test of frequency distribution and stated that the distribution is accepted then further the design rainfall intensity analysis can be carried out. According to Suripin (2004) if short rainfall data is not available, there is only daily rainfall data, then the rainfall intensity can be calculated using the Mononobe formula. Then, according to Suhardjono (2015), the rainfall used as the basis for calculating the drainage system for the typology of medium cities with an area of 101 - 500 ha is the rainfall intensity with the return period of 2-5 years. This study was determined using design rainfall with the 5-year return period. From the Log Pearson Type III distribution, obtained the design rainfall value with 5-year return period equal to 148,964 mm/day.

TABLE 4. Distribution of Rainfall Intensity with 5-year Return Period

No	Hour	Ratio (%)	Hourly rain intensity (mm)
			5 year return period
1	1	0.550	81.978
2	2	0.143	21.308
3	3	0.100	14.947
4	4	0.080	11.899
5	5	0.067	10.048
6	6	0.059	8.784
Design Rainfall (mm)			148.964

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After the value of hourly rainfall intensity from the design rainfall is obtained then rain intensity can be used in building/constructing the SWMM model.

Existing Condition SWMM Modeling

a. Modeling of the existing condition

Existing condition modeling is carried out to determine the condition of the drainage and river channels at the study site before flood control is carried out. The input for this existing model namely in the form of the data of 5-year return period rainfall intensity, types of Linei River catchment area land cover, the dimensions of drainage channel and rivers at the study location, and the sea tide data in the river downstream. The existing drainage and river schemes in the SWMM model that built can be seen in Figure 2. Then, for the land use map of the study location can be seen in Figure 3.

b. Calibration of existing models

Calibration is a verification process to determine and adjust the correctness of the simulation results with the actual conditions in the field. After the existing model is built based on field conditions then calibration is carried out for the model. In this study calibration was done using the Root Mean Square Error (RMSE) method. Model calibration is done by comparing the discharge on the channel in the field with the discharge of the simulation results. The discharge used as calibration comparison data is the channel discharge data at the location/sample observation point during the rain on January 9th, 2019. Rain data uses daily rainfall data from January 2019 from BMKG of Bangka Belitung Islands Province. Then, for the channel in the simulation model it is adjusted to the observation point, namely channel 11 (C11). Recapitulation of calibration of existing models is presented in table 5.

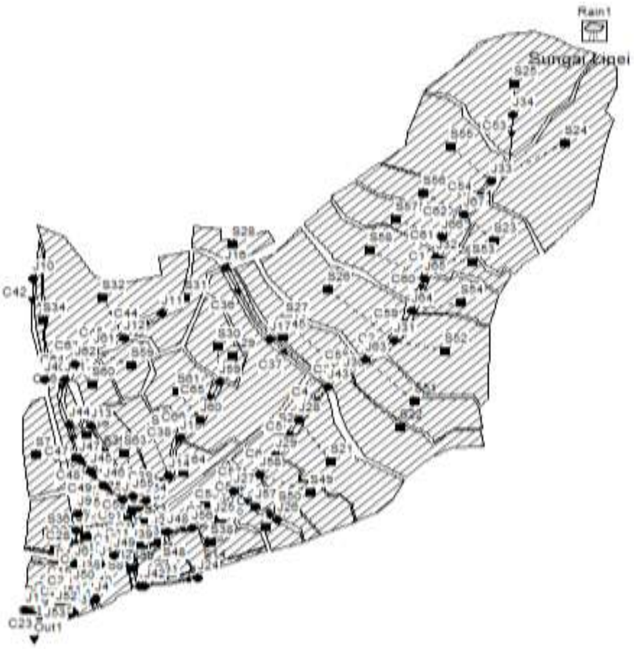

Figure 2. The Display of Linei River Catchment Area Existing SWMM Model

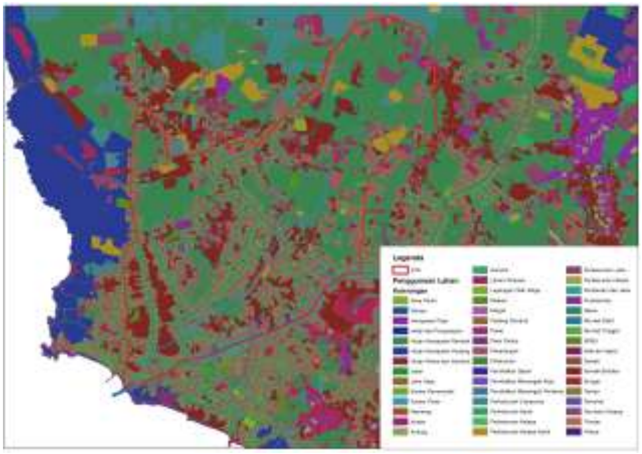
Figure 3. Map of land use of study location

RMSE value obtained is equal to 0,0835542 = 8%. This number shows the small level of error between the observation discharge and the simulation discharge so that the existing model can be used in each implementation of the planned flood management/handling alternatives.

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Qobs - Qsim)^2};$$

$$= \sqrt{\frac{1}{10}\sum_{i=1}^{n}(0.069813)}$$

$$= 0{,}0835542 \approx 8\%$$

TABLE 5. Calculation of calibration With RMSE Method

Obs Channel	Q (m³/sec) Channel C11 Sim	Q (m³/sec) Channel C11 Obs	(Qobs-Qsim)²	RMSE
Channel C11 with width = 3m and h = 1,5m	0	0.03	0.0009972	0.0835542
	0	0.06	0.0041179	
	0	0.10	0.0095699	
	0	0.13	0.0175819	
	0.01	0.15	0.0205662	
	2.51	2.54	0.0009195	
	5.74	5.82	0.0069772	
	7.29	7.25	0.0016000	
	6.92	6.93	0.0002081	
	5.65	5.74	0.0072751	
		Σ =	**0.0698130**	n = 10

Evaluation of the Conditions of the Existing Drainage and Rivers

After the existing model is calibrated then an evaluation of the existing drainage channel and river is carried out using the design rainfall intensity with the 5-year return period. From the evaluation results, it is known that there are 9 overflow points on the channel. As for the existing conditions included in the model are the state of land use in 2019 and land use change in 2031 in accordance with the Regional Spatial Plan /Rencana Tata Ruang Wilayah (RTRW) 2011 - 2031 of South Bangka Regency. The details of overflow channel can be seen in table 6. Then, the water level profile on each overflow channel can be seen in Figures 4, 5, 6, and 7.

TABLE 6. Channel Simulation Results That Overflow Conditions in 2019 and 2031

No	Channel Name	Channel width (m)	Channel height (m)	Maximum discharge (m^3/sec)		Information
				2019	2031	
1	C7	3	1.50	9.446	9.446	Overflow
2	C8	3	1.50	8.887	8.887	Overflow
3	C9	3	1.50	8.492	8.492	Overflow
4	C10	3	1.50	6.486	6.486	Overflow
5	C11	3	1.50	8.498	8.505	Overflow
6	C14	3	1.50	6.82	6.839	Overflow
7	C41	2	0.80	3.449	3.512	Overflow
8	C52	2	0.80	2.205	2.206	Overflow
9	C55	3	1.50	9.344	9.345	Overflow

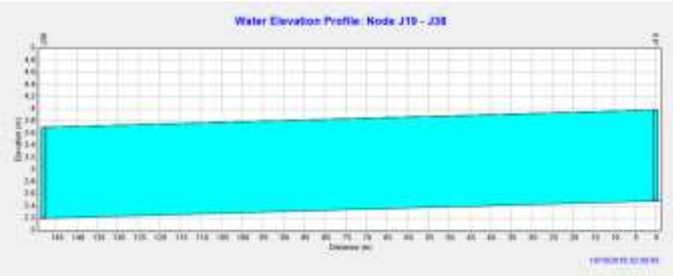

Figure 4. Water level profile of the existing condition simulation result in C14 channel at 02:00 (*node* J19–J38)

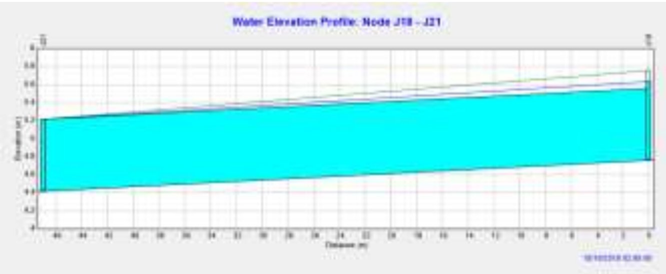

Figure 5. Water level profile of the existing condition simulation result in C41 channel at 02:00 (*node* J18–J21)

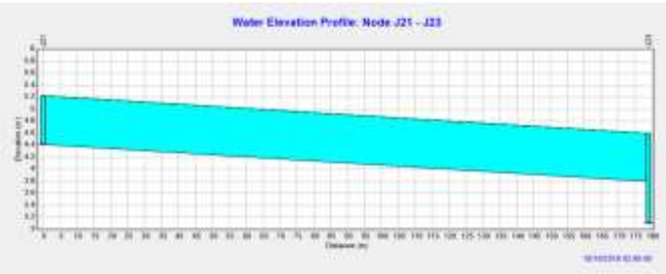

Figure 6. Water level profile of the existing condition simulation result in C52 channel at 02:00 (*node* J21–J23)

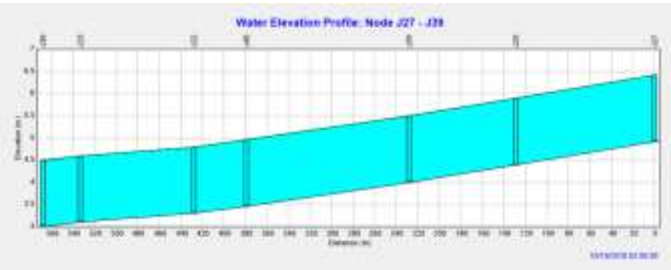

Figure 7. Water level profile of the existing condition simulation result in channel of C11-C10-C9-C8-C7-C55 at 02:00 (*node* J27–J39)

Flood Management

As for the alternative of flood management/handling that will be applied to the study location, among others:

1. Infiltration wells

   The type of soil at the study location for a depth of > 3 m is fine silt sand, brownish gray with a permeability coefficient value of 3,6 cm/hour. Infiltration wells are planned with a diameter of 1.2 m and a depth of 3 m. The plans design of the infiltration wells can be seen in Figure 8.

   Calculation of infiltration wells by design rainfall with 5-year return period equal to 148.96 mm/day and if te is the effective rainfall duration using the formula (SNI: 03-2453-2002) then:

   te = effective rainfall duration (hour) = 0,90 x $R^{0,92}$/60 (SNI: 03-2453-2002)
   te = 0,90 x $148,96^{0,92}$/60
   te = 1,497 hour

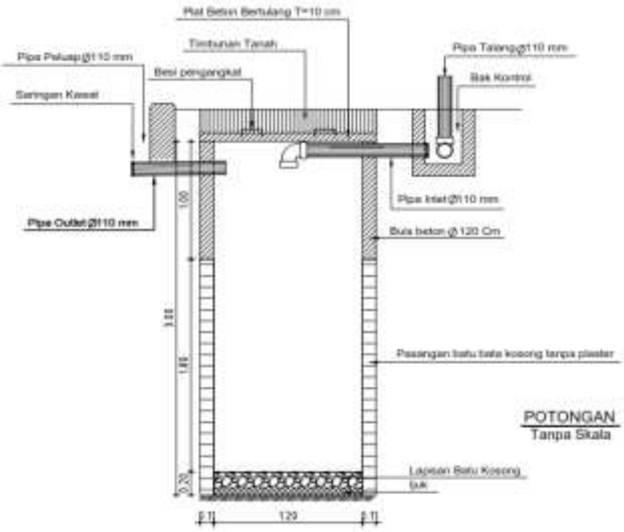

Figure 8. Plans Design of infiltration well

by using the mononobe method rain intensity equation, then:

I = R_{24}/24(24/te)$^{2/3}$
I = 148,96/24 x (24/1,497)$^{2/3}$
I = 39,49 mm/hour = 0,0395 m/hour

- The geometry factor of the well (F)

L = 2 m
K = 0,036 m/jam = 0,001 cm/dt = 0,00001 m/dt
H = 3 m
R = 0,6 m
T = 1,497 jam = 5390,361 second; T = 0,9 $R^{0,92}$/60 (SNI: 03-2453-2002)

$$F = \frac{2\pi L + 2\pi R ln2}{\ln\left[\frac{L+2R}{2R} + \sqrt{1+\left(\frac{L}{2R}\right)^2}\right]}$$

$$= \frac{(2\pi \ x \ 2) + (2\pi \ x \ 0,6 \ x \ Ln(2))}{\ln\left[\frac{2+(2x0,6)}{2(0,6)} + \sqrt{1+\left(\frac{2}{2(0,6)}\right)^2}\right]}$$

F = 9,936 m

- Calculate the roof runoff discharge (Qroof)

Q = C x I x A
T = 1,497 hour; I = 0,0395 m/hour
A = 154 m^2
C = 0,95
Q = 0,95 x 0,0395 m/hour x 154 m^2
Q = 5,77788 m^3/hour
Q = 0,0016 m^3/second

- Calculate the depth of the design wells with Qroof = 5,77788 m^3/hour:

$$H = \frac{Q}{FK}\left\{1 - \exp\left(\frac{-FKT}{\pi R^2}\right)\right\}$$

$$H = \frac{5{,}77788}{9{,}936 \times 0{,}036}\left\{1 - \exp\left(\frac{-9{,}936 \times 0{,}036 \times 1{,}497}{\pi(0{,}6^2)}\right)\right\}$$

H = 6,0956 meter

- Calculate the ability of infiltration wells for 1 roof of a house

If planned infiltration wells with a depth of 3 meters, then:

$$n = \frac{H\ analysis}{H\ design}$$

$$n = \frac{6{,}0956}{3}$$

n = 2,03 ≈ 2 wells for 1 roof catch with an area of 154 m^2

However, the number of infiltration wells in the study locations was determined based on field observations because their placement had to pay attention to the distance criteria as stated in the technical requirements of infiltration wells so that obtain the number of infiltration wells equal to 1267 units.

2. Retention Pool
The retention pool applied in this study is a retention pool on the river body. As for the data of the pool dimension and spillway structure can be seen in table 7 and table 8. Then, for placement locations of 3 units of retention pools can be seen in Figure 9.

TABLE 7. Retention Pool Dimension

No	Retention Name	Pool Dimension Plan			Pool base elevation (m)
		L (m)	W (m)	H (m)	
1	SU1	450	30	3	10.93
2	SU2	250	30	3	6.51
3	SU3	250	30	3	5.55

TABLE 8. Spillway Dimension

Weir ID	Inlet Node	Type	Height (m)	Length (m)	inlet offset (m)	discharge coef.
Reg1	SU1	Transverse	0.6	6	2.4	1.5
Reg2	SU2	Transverse	0.5	5	2.5	1.5
Reg3	SU3	Transverse	0.5	5	2.5	1.5

3. The Changing of Channel Dimensions
Changes in dimensions are carried out only at the depth of the channel because it considers the state of the study site. Recapitulation of channel changes can be seen in table 9.

TABLE 9. Recapitulation of Channel Dimension Changes

No	Channel Name	Shape	Old heigth (m)	New height (m)	Old width (m)	New width (m)
1	C1 – C22	Rectangular	1.5	2	3	3
2	C41	Rectangular	0.8	1	2	2
3	C51	Rectangular	0.8	1	2	2
4	C52	Rectangular	0.8	1	2	2
5	C53 – C55	Rectangular	1.5	2	3	3

Figure 9. Location of Retention Pool Placement

4. Combination of Infiltration Wells and Retention Pools
Handling is done by combining the application of 1267 units of infiltration well and 3 units of retention pond at the study site.

The Ability of Handling/Management in Reducing Flood Points

After all flood handling/management is implemented and simulated, the capabilities of each alternative are obtained. The recapitulation of flood reduction capabilities of each handling can be seen in table 10.

TABLE 10. The Ability of Handling in Reducing Flood Points

No.	Handling Alternative	Reduction (%)
1.	Construction of Retention Pool 1 (SU1)	33,33
2.	Construction of Retention Pool 2 (SU2)	11,11
3.	Construction of Retention Pool 3 (SU3)	0,00
4.	Construction of the 3 Retention Pools (SU1+SU2+SU3)	55,56
5.	Construction of Infiltration Wells of 1267 Units	88,89
6.	Changes in Existing Channel Dimensions	55,56
7.	Combination of Construction of 3 Units of Retention Pools and 1267 Units of Infiltration Wells	100

Based on table 10 above, the selected handling/management in overcoming the Linei River flood is a combination of the construction of 3 units of retention ponds and 1267 units of infiltration wells. As for the results of the simulation after its application can be seen in figures 10, 11, 12, and 13.

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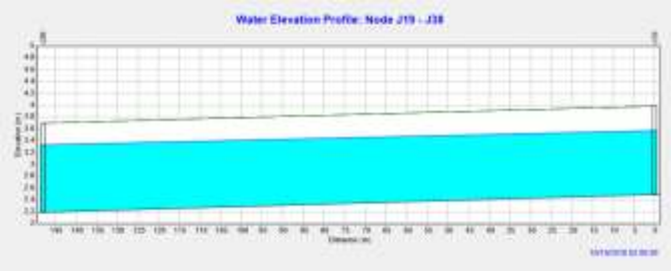

Figure 10. Water level profile of the condition simulation results after combination handling in C14 channel at 02:00 (*node* J19–J38)

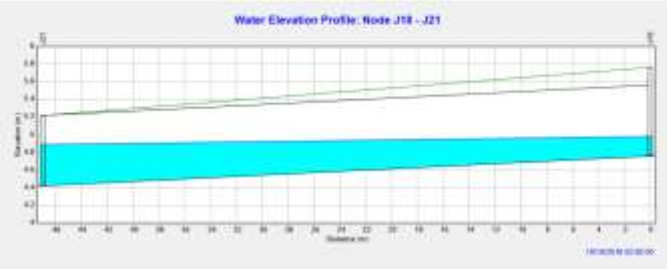

Figure 11. Water level profile of the condition simulation results after combination handling in C41 channel at 02:00 (*node* J18–J21)

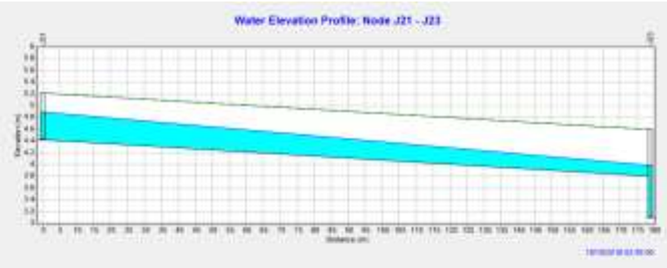

Figure 12. Water level profile of the condition simulation results after combination handling in C52 channel at 02:00 (*node* J21–J23)

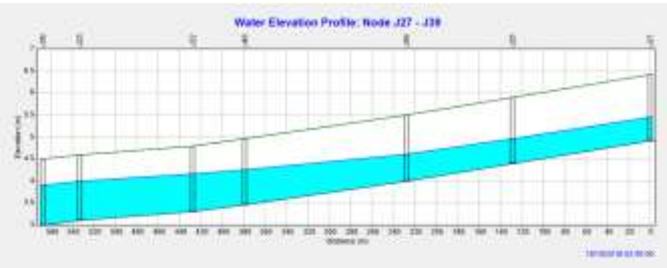

Figure 13. Water level profile of the condition simulation results after combination handling in channel of C11-C10-C9-C8-C7-C55 at 02:00 (*node* J27–J39)

IV. Conclusion

The conclusions that can be drawn from this study are as follows:

1. In general, the existing conditions of the Linei River channel and drainage at the study sites that have also accommodated changes in land use in the 2011-2031 Regional Spatial Plan/ Rencana Tata Ruang Wilayah (RTRW) of South Bangka Regency have been unable to accommodate rainfall with a 5 year return period. There are 9 channels that exceed their capacity so that they are identified as the overflow points.
2. Recommendations for inundation/overflow handling for study sites based on groundwater depth data, soil permeability, land use, as well as the density of surrounding buildings are :
   a. Infiltration wells
   - Design: infiltration wells in circular shape with a diameter of 1.2 meters, a depth of 3 meters, and construction of walls made of stone pairs without plaster.
   - The number applied in the Linei River catchment area equal to 1267 units.

   b. Retention Pool
   - Retention pool that applied equal to 3 units.
   - Storage unit 1 (SU1) with a length of 450 meters, width of 30 meters and depth of 3 meters. Storage unit 2 (SU2) with a length of 250 meters, a width of 30 meters and a depth of 3 meters. Storage unit 3 (SU3) with a length of 250 meters, a width of 30 meters and a depth of 3 meters.
3. Application of combination of the 2 handlings simultaneously, namely 1267 units of infiltration well and 3 units of retention pond capable of overcoming floods on 9 overflow channels.

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