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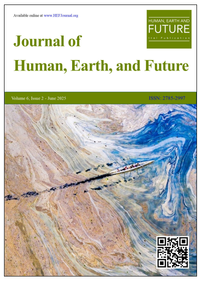

Optimization Model of Canal Blocking Performance in Block-C Region Ex. Peat Land Development-Center Borneo

Yakubson [1*], Lily M. Limantara [1*], Dian Sisinggih [1], Sumiadi [1]

[1] *Department of Water Resources Engineering, Faculty of Engineering, University of Brawijaya, Malang, Indonesia.*

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Abstract

This study aims to optimize the performance of canal blocking in peatlands. Drought in peatlands increases the risk of fire disasters. Canal blocking is essential for reducing fire hazards and enhancing ecosystem health. Maintaining the water table height is key to managing peatland water levels and mitigating fire risks. The methodology involves simulating the hydraulic conditions of installed canal blocks using collected parameters. After conducting hydraulic simulations under existing conditions, further simulations were performed by varying the number and spacing of canal blocks to achieve a water level height close to the target of approximately ±0.6 meters. The simulation results show that in the branch canals, an additional 28 canal blocks are needed. However, in the main canal, the required number of blocks decreases significantly—from an initial 102 to just 30. Although this reduction is substantial, the minimum water level remains above the critical threshold. Optimization of canal blocking installation is achieved by prioritizing block placement at the dome outlet, specifically in the branch canals, to maintain water flow more efficiently.

Keywords: Block-C Region; Ex. PLG; Optimization; Water Level Height; Canal Blocking.

1. Introduction

Peatlands are vital ecosystems that serve as significant carbon sinks, storing approximately 600 Gt of carbon globally [1], and possess exceptional water retention capacity, making them crucial for hydrological regulation in surrounding areas [2, 3]. However, large-scale land conversion (Pembangunan Lahan Gambut/PLG) in Indonesia, particularly in Borneo during 1993–1997, led to severe degradation of peat swamp forests. Unsustainable drainage practices disrupted the hydrological unity of peat domes (KHG), resulting in chronic peat dewatering [4]. In response, canal blocks have been constructed in recent years to rewet the peatland and restore hydrological functions [5]. Initial observations indicate that these blocks have successfully elevated water levels in primary canals, with reported increases of up to 0.6 m in some locations.

However, monitoring data reveals that secondary canals continue to exhibit low water levels, particularly in segments farther from the primary canals. This spatial variability in water retention highlights the need for optimized block placement and adaptive management strategies [6] to ensure uniform rewetting across the entire canal network [4]. The disruption of hydrological regimes in peatlands has resulted in annual drought-induced wildfires, releasing massive carbon emissions and hazardous haze that persist for months. This phenomenon has caused significant socio-economic and environmental impacts, including public health crises, economic losses, and biodiversity decline [7, 8]. Although canal construction was initially implemented to manage water resources, it has exacerbated the problem by accelerating peat drainage and increasing fire vulnerability [9].

* Corresponding author: yakubsonbwskii@gmail.com; lilymont2001@ub.ac.id

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To address these challenges, canal blocking has emerged as a key restoration strategy to rewet degraded peatlands and reduce fire risk [10]. By elevating groundwater tables (GWL), canal blocks aim to restore hydrological balance, prevent irreversible peat subsidence, and revive ecosystem functions [11]. However, existing studies on canal blocking have primarily focused on technical design and short-term hydrological impacts, with limited attention to long-term sustainability and socioeconomic trade-offs [12, 13].

This study aims to fill this gap by evaluating the effectiveness of canal blocking in maintaining GWL and reducing fire risk in the ex-PLG Block C area. Using the Storm Water Management Model (SWMM 5.2), we simulate surface-subsurface hydrological routing to assess the hydrological and socioeconomic impacts of canal blocks. Our approach integrates catchment-scale parameters (e.g., peat hydraulic conductivity, canal geometry, rainfall patterns) and community needs (e.g., irrigation, traditional transportation) to provide a holistic understanding of canal block efficacy.

The significance of this study lies in its potential to inform policy decisions and conservation strategies for peatland restoration. By addressing the knowledge gap in long-term canal block performance and community-integrated approaches, this research contributes to the sustainable management [14] of peatland ecosystems in Indonesia and beyond. Specifically, the findings align with Indonesia's National Peatland Restoration Strategy, which emphasizes community participation and adaptive management to achieve ecological and socioeconomic sustainability [15, 16].

2. Material and Methods

The area of ex-PLG is a plain area of river estuary and dominated by peat land. The depth of peat is deeper than 0.5 m involves 920,000 ha. However, 450,000 ha of the area is deeper than 3 m. The deep peat has been designed to be legal protected based on the President Decision No 32/ 1990. The soil mineral is in the 532,000 ha. The traditional residences are most found along river edge and channel embankment that is suitable for agriculture by regulating the watering and practices of local agriculture based experienced water management.

Hydrology in this area is determined by [17, 18] (i) water moving of ebb and flow that reaches in ex-PLG area, (ii) river flow from upstream to the area, and (iii) rainfall in the area. In downstream area of river that is in area of Block-C-ex PLG towards the main canal, most of them are not affected by ebb and flow of sea, the flow is more as seasonal behaviour by river flow. However, in the southern area, there is often flooding due to the ebb and flow [19], but it is potential for agricultural development with irrigation that utilized the ebb and flow water. The canals with the hydrology condition are affected by ebb and flow are as follows Main Canal (KU): Kanamit Bahaur, Branch Canal (KC): Kahayan Dandang, KC Sebangau SCP2, KC Sebangau Kanamit and part of KU SCP 1 and KU Buntol Kanamit. Figure 1 presents the map of peat depth.

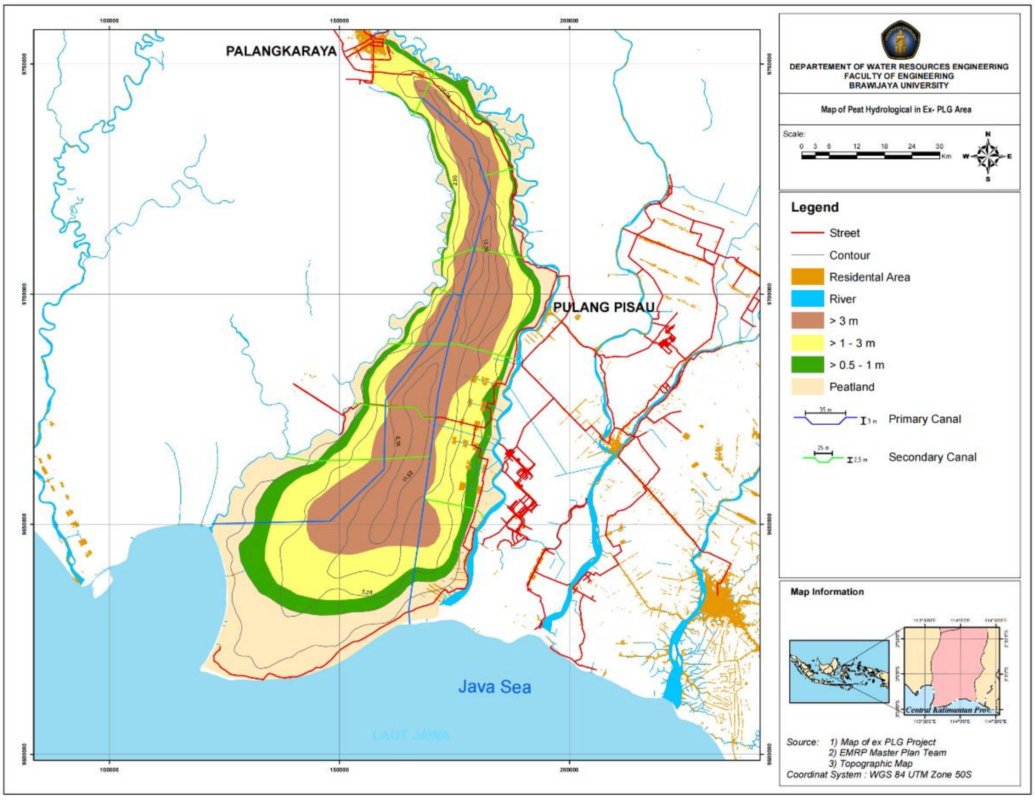

Figure 1. Map of Peat Depth

Nowadays, there has been carried out the development of canal blocking which has been located in some locations with the aim to give the impacts of ecology and economy for society, so the function of area utilization can be customized for the function like plantation for agriculture and plantation development, however, the adaptive vegetation is utilizing the limited plantation area that is in accordance with the condition of area, and the protected area is returns back its function to the protected plantation area.

The canal blocking is developed in peat centre dome of upstream protected area and then the network is gradually expanded towards the edge of dome or until downstream plantation area. However, number of blockings in each canal is presented in Table 1.

Table 1. Number of Existing Canal Blocking

No.	Name of canal	Canal length (km)	Number of blockings
1	KC Kahayan Kelampangan	6.71	5
2	KC Sebangau Kelampangan	4.42	5
3	KC Kahayan Pilang	7.38	0
4	KC Kahayan Garung	11.66	0
5	KC Sebangau Garung	9.49	0
6	KC SCP Segmen 1	1.99	3
7	KC SCP Segmen 2	3.04	4
8	KC Kahayan Buntol	15.63	13
9	KC Sebangau Kanamit	31.41	0
10	KC Sebagau SCP 2	44.12	0
11	KC Kahayan Dandang	13.76	0
12	KU Kelampangan Jabiren Segmen 1	6.76	13
13	KU Kelampangan Jabiren Segmen 2	15.48	0
14	KU Jabiren Garung	16.37	27
15	KU Garung Buntol Segmen 1	10.74	20
16	KU Garung Buntol Segmen 2	10.79	16
17	KU Buntol Kanamit	24.74	10
18	KU SCP Segmen 1	12.10	5
19	KU SCP Segmen 2	28.27	11
20	KU Kanamit Bahaur	36.68	0

The analysis method that can be carried out in this research is by carrying out the hydraulic simulation in the canal blockings that have been installed with the collected parameters such as rainfall during 20 years, data of soil type, data of land use, data of topography, and dimension of building.

After being carried out the hydraulic simulation in existing condition, so there will be carried out some simulations by trials of number and distance between blockings for obtaining the condition of water level height that is the nearest condition that has been determined such as water level height with the value about ±0.6 m, so there is obtained the ideal number and distance between canal blockings in the research location.

As explained in the introduction, the program that will be used for optimization modelling is SWMM 5.2. Storm Water Management Model (SWMM) 5.2 is a tool that helps predict the quantity and quality of runoff from drainage systems. It is used for planning, analysis, and design of stormwater runoff, combined and other drainage systems which was developed by U.S. Environmental Protection Agency (.gov).

2.1. Surface Flow Velocity

Every surface of sub-catchment is assumed as non-linear storage. Inflow is come from rainfall and run-off from downstream sub-catchment [19]. The outflow includes infiltration, evaporation, and surface run-off. The capacity of this storage is maximum depression saving that is maximum surface saving which is produced by inundation, surface wetting, and interception. The surface run-off (Q) only happens when the water depth (d) in storage is more than maximum depression saving (ds) which the outflow is determined by Manning equation. The water depth over sub-catchment (d) is continuously updated over time by solving the water balance equation numerically over the sub-catchment. Figure 2 presents the conceptual of surface water flow.

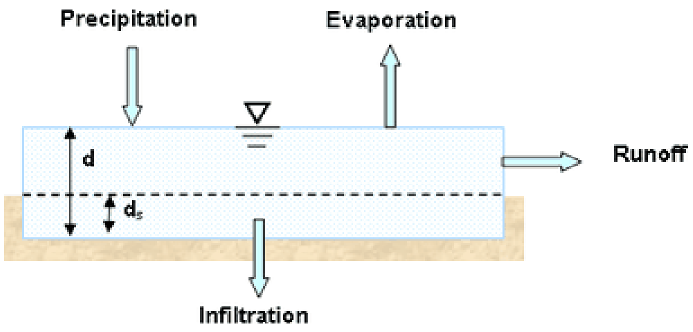

Figure 2. Conceptual of Surface Water Flow

2.2. Infiltration

Infiltration is the process by which rainfall enters the soil surface and moves into the unsaturated zone within the porous sub-catchment area. The infiltration analysis applied in this study uses the Curve Number (CN) method. For runoff estimation, this approach is based on the NRCS-SCS (Curve Number) method. The main assumption of this method is that the total infiltration capacity of the land can be determined based on a tabulated curve number. During a rainfall event, this infiltration capacity decreases in relation to cumulative rainfall and the remaining soil storage capacity [20]. The input parameters used in this method include the curve number and the time period required for fully saturated soil to return to a dry state. This time period is essential for analysing the recovery of infiltration capacity during dry conditions.

2.3. Groundwater

The defined schematic of the two-zone groundwater model used in SWMM is presented in Figure 3. The upper zone represents the unsaturated layer, where the moisture content is variable. In contrast, the lower zone is fully saturated, with a constant moisture content equal to the soil porosity (ϕ).

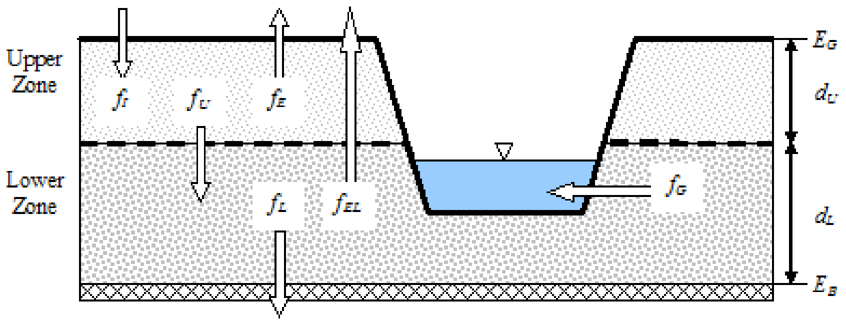

Figure 3. Model of Groundwater in SWMM

The flow illustrated in Figure 3 represents volume per unit of time and includes the following components:

f_I is surface infiltration; f_{EU} is evapotranspiration from the upper zone, expressed as a constant fraction of surface evaporation; f_U is percolation from the upper zone to the lower zone, which depends on the moisture content in the upper zone depth (d_U); f_{EL} is evaporation from the lower zone to the groundwater, dependent on the depth of the lower zone (d_L); f_L is seepage from the lower zone into the groundwater, also dependent on d_L; and f_G is lateral groundwater flow into the conveyance network, which depends on the depth of the upper zone (d_L) and the depth of the receiving channel or node.

2.4. Flow Routing

Flow routing in SWMM channels is based on the Saint Venant equations, which include the momentum equation for gradually varied unsteady flow and the principle of mass conservation. The dynamic wave analysis solves the full one-dimensional Saint Venant equations and theoretically provides the most accurate results. This includes the momentum and continuity equations for open channels, as well as a continuity formulation for volume at junction nodes. This analysis also makes it possible to represent pressurized flow in closed conduits when they become full, allowing the flow to exceed that of normal open-channel conditions. Flooding occurs when the water depth at a node exceeds the available maximum depth; in such cases, the excess flow either leaves the system or inundates the node and potentially re-enters the drainage system.

The methodology workflow used in this study is illustrated in Figure 4.

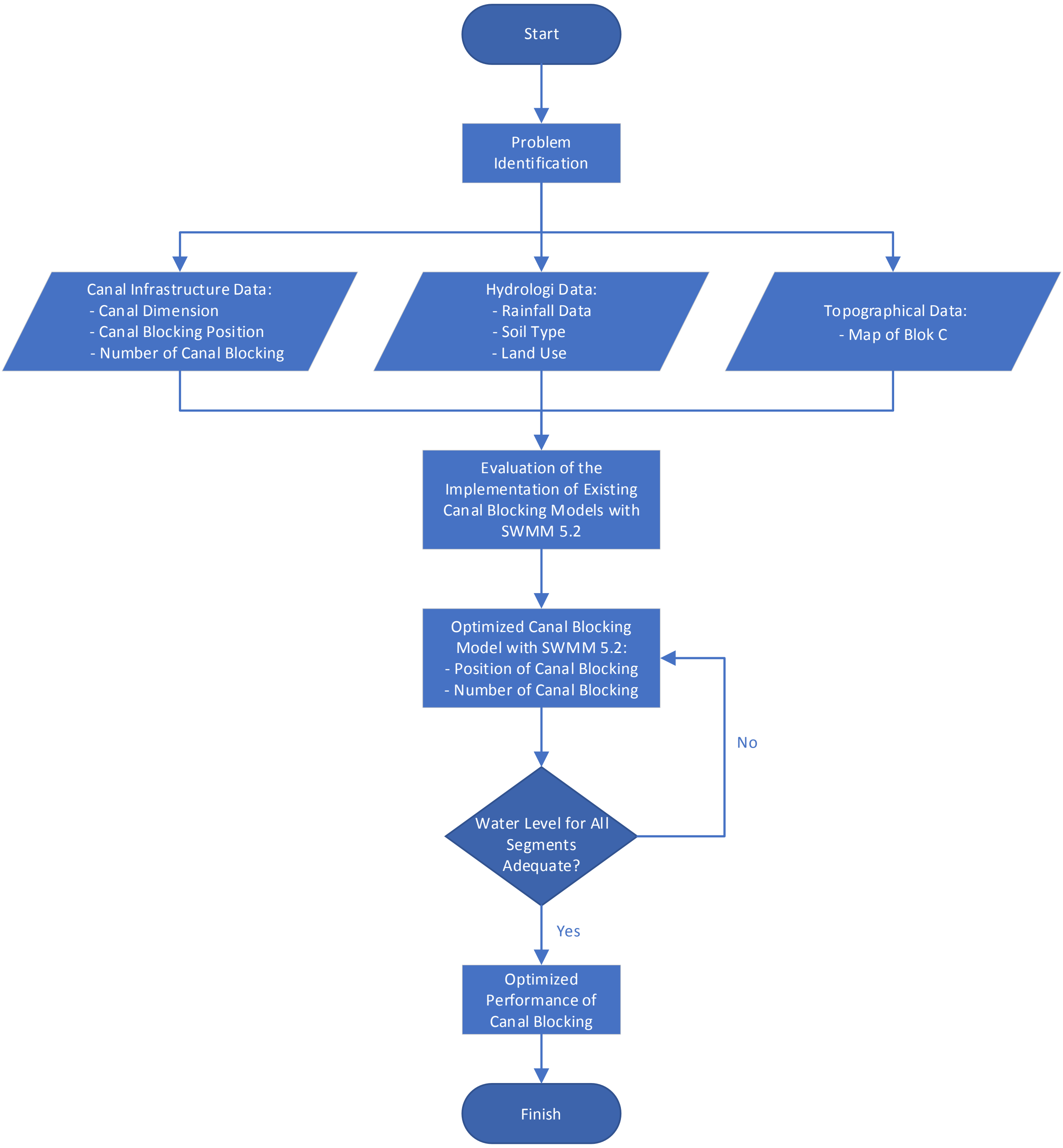

Figure 4. Workflow of the Research

3. Results and Discussion

3.1. Surface Run-off Velocity

After conducting the rainfall data tests, various hydrological parameters were analysed and a canal blocking model was developed, resulting in the calculation of runoff values (Table 2). Using the duration curve method to determine the dependable discharge, the runoff value was estimated, which is assumed to represent the surface runoff velocity occurring during the dry season. The dry season condition was selected in this study to obtain the minimum water level depth. This is because one of the main objectives of constructing canal blockings is to prevent peatland fires, which typically occur during dry periods.

Table 2. Analysis Result of Runoff in the Area of Blok C Ex. PLG

No	Sub Catchment	Area (km^2)	Area (ha)	Width (m)	Slope (%)	CN	Runoff (CMS)
1	CA 1	272.965	27296.5	26092.88	5.86	82.13	35.77
2	CA 2	1484.55	148455	33196.47	8.24	84.19	352.87
3	CA 3	378.102	37810.2	24299.02	10.12	89.74	49.82
4	CA 4	104.432	10443.2	11420.62	13.98	89.38	9.73
5	CA 5	160.356	16035.6	23111.82	12.27	89.61	9.66
6	CA 6	498.064	49806.4	41955.55	5.49	86.03	78.32
7	CA 7	126.031	12603.1	17855.60	17.58	91.60	5.41
8	CA 8	120.883	12088.3	16846.70	4.83	92.94	12.33
9	CA 9	34.368	3436.8	12099.29	5.32	92.06	0.97
10	CA 10	89.892	8989.2	28646.98	7.01	91.83	2.46
11	CA 11	51.9055	5190.55	7840.01	5.49	91.97	3.65
12	CA 12	371.523	37152.3	31677.23	12.78	82.79	34.30
13	CA 13	159.13	15913	32460.20	6.22	83.54	17.99
14	CA 14	260.371	26037.1	48283.18	4.72	94.61	17.65
15	CA 15	244.879	24487.9	66743.44	5.53	91.01	14.69
16	CA 16	314.312	31431.2	35631.05	5.92	77.12	47.46

3.2. Modelling of Canal Hydraulic

The output of canal blocking model that has been made as the flow scheme which it illustrates the information about various hydraulic conditions that are flow discharge, velocity, and water level height. Therefore, then it can be determined which channel that is needed to be optimized the number of canal blockings. Figure 5 presents the model analysis output of existing canal blocking.

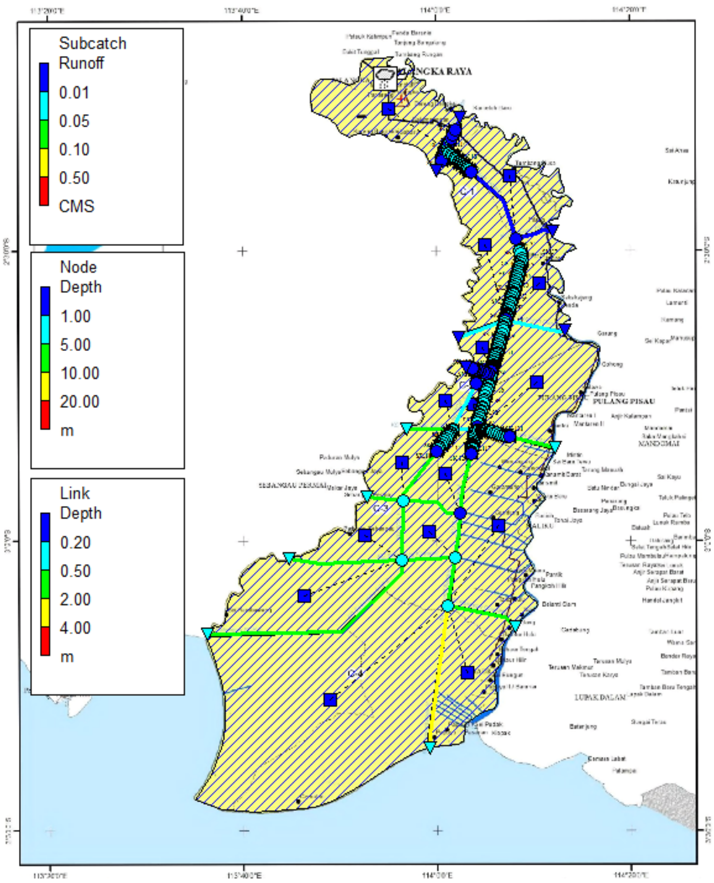

Figure 5. Model Analysis Output of Existing Canal Blocking

After being carried out the recapitulation, so it can be obtained the data for existing water level as presented in Table 3.

Table 3. Recapitulation of Modelling Result for Existing Canal Blocking

No.	Name of Canal	Existing		
		Number of blocking (unit)	Average of Water Level (m)	Lowest Water Level (m)
1	KC Kahayan Kelampangan	5.00	0.42	0.06
2	KC Sebangau Kelampangan	5.00	0.61	0.06
3	KC Kahayan Pilang	0.00	0.11	0.11
4	KC Kahayan Garung	0.00	0.19	0.19
5	KC Sebangau Garung	0.00	0.19	0.19
6	KC SCP Segmen 1	3.00	1.02	0.60
7	KC SCP Segmen 2	4.00	1.11	0.75
8	KC Kahayan Buntol	13.00	1.31	1.11
9	KC Sebangau Kanamit	0.00	1.73	1.45
10	KC Sebagau SCP 2	0.00	1.91	1.42
11	KC Kahayan Dandang	0.00	1.77	1.67
12	KU Kelampangan Jabiren Segmen 1	13.00	1.96	1.92
13	KU Kelampangan Jabiren Segmen 2	0.00	0.40	0.24
14	KU Jabiren Garung	27.00	2.02	2.00
15	KU Garung Buntol Segmen 1	20.00	1.93	1.85
16	KU Garung Buntol Segmen 2	16.00	1.92	1.84
17	KU Buntol Kanamit	10.00	1.75	1.50
18	KU SCP Segmen 1	5.00	1.68	1.36
19	KU SCP Segmen 2	11.00	1.92	1.83
20	KU Kanamit Bahaur	0.00	2.14	1.88

Based on the recapitulation of the existing condition of water level height, it can be known which canal is needed the additional number of blockings [16] because the water level height is under the allowed limitation that is 0.6 m, on the contrary, for the canal that has the water level height is more than 0.6 m, is also carried out to be trial for decreasing the number of blockings but it still fulfils the allowed limitation of minimum water level height. By adjustment of the distance between blockings, it produces the condition of water level height (TMA) and the different need of blockings number too. In this stage, the optimization process is carried out, so it is obtained the most optimal of blockings number composition in each canal. In the form of graphic, there is presented the selection process of optimal blockings number composition based on the distance between blockings in each canal.

The optimization graphic of canal blocking illustrates the beginning of water level height and number of blockings in the existing condition (Figures 6 to 21). The water level height in the graphic is illustrated as bar chart; however, number of blockings is informed in the point form with the nominal information. The red line is as the information of minimum water level height that must be fulfilled. The various numbers and distances of blockings are trial carried out, so there is obtained the bar chart graphic of the lowest water level height that is nearest the minimum water level height line. By the manner, so it is obtained the most optimal composition of blocking number and distance between blockings.

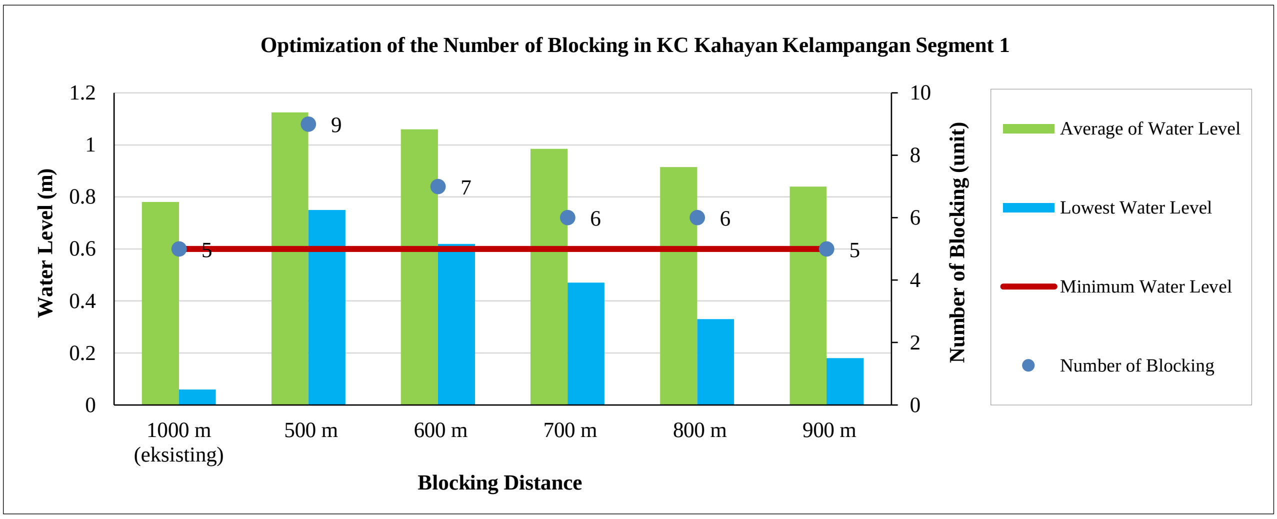

Figure 6. Curve of Canal Blocking Optimization in KC Kahayan Kelampangan Segment 1

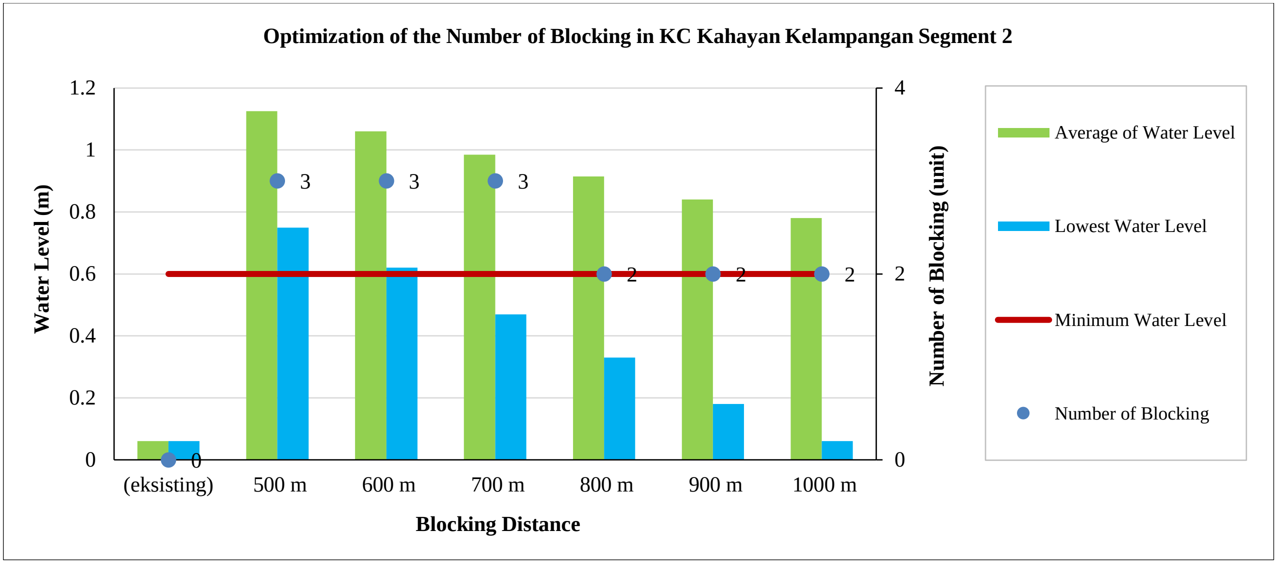

Figure 7. Curve of Canal Blocking Optimization in KC Kahayan Kelampangan Segment 2

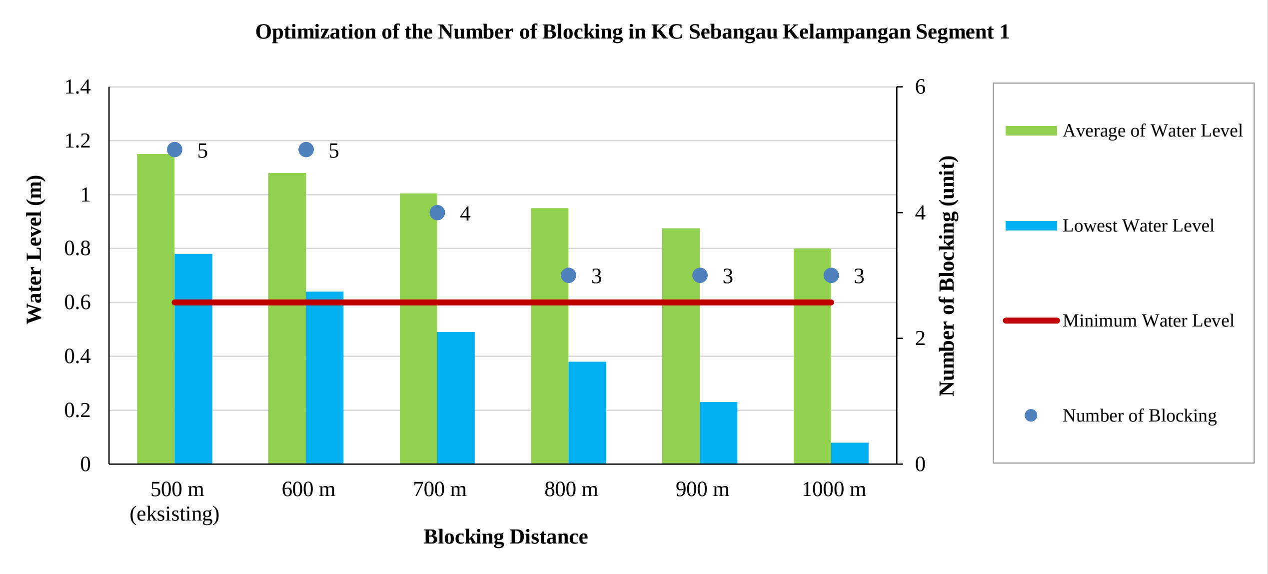

Figure 8. Curve of Canal Blocking Optimization in KC Sebangau Kelampangan Segment 1

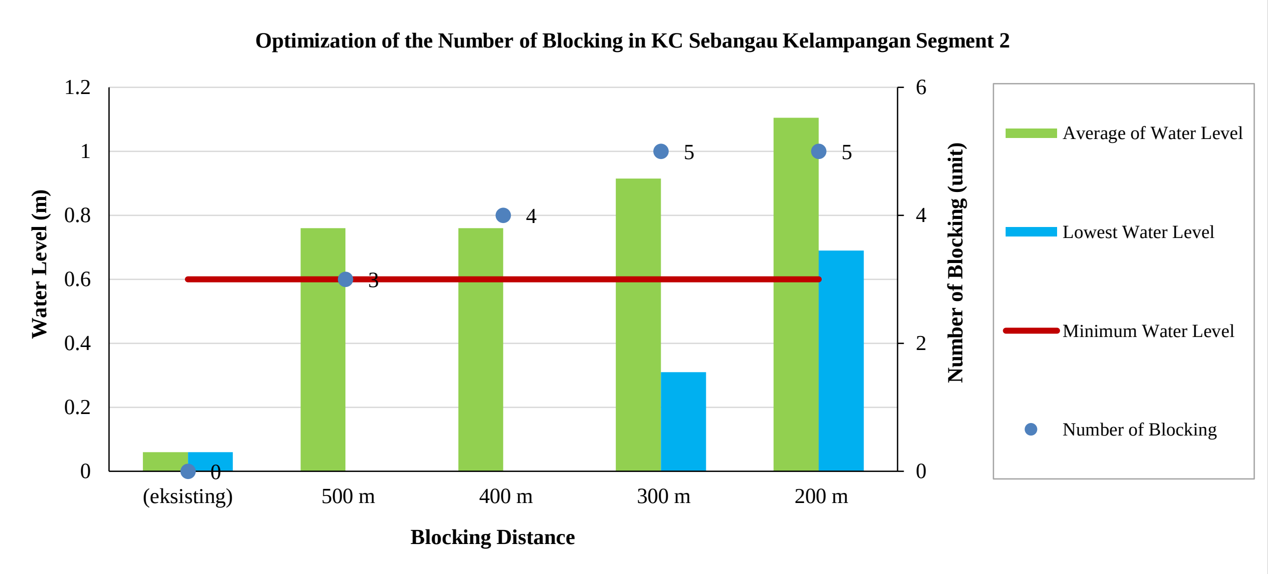

Figure 9. Curve of Canal Blocking Optimization in KC Sebangau Kelampangan Segment 2

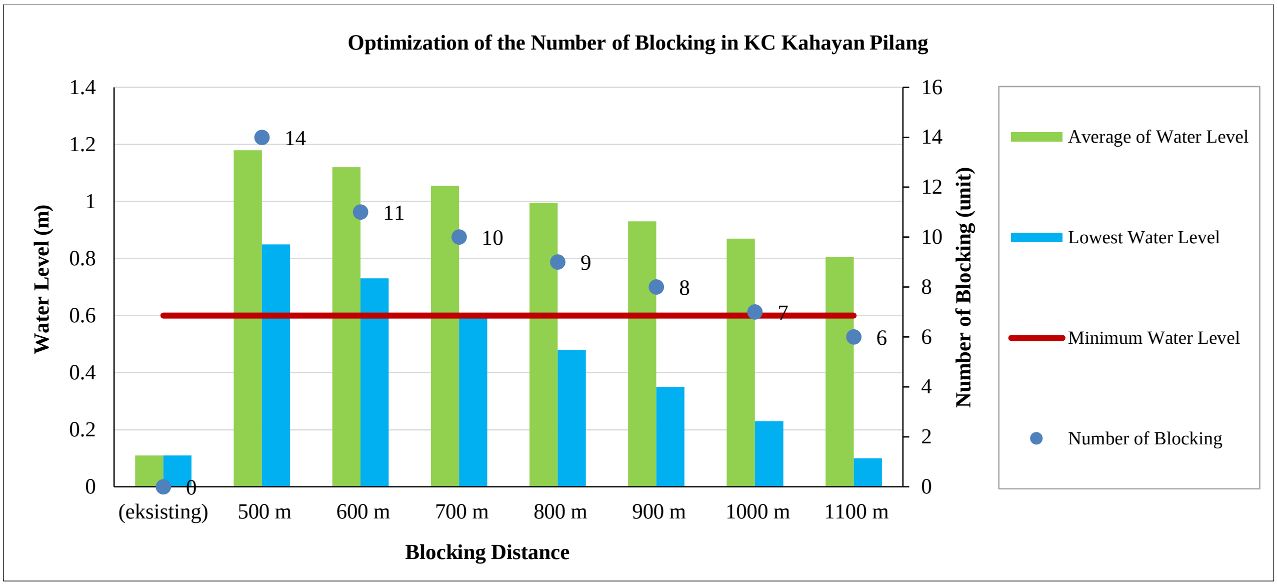

Figure 10. Curve of Canal Blocking Optimization in KC Kahayan Pilang

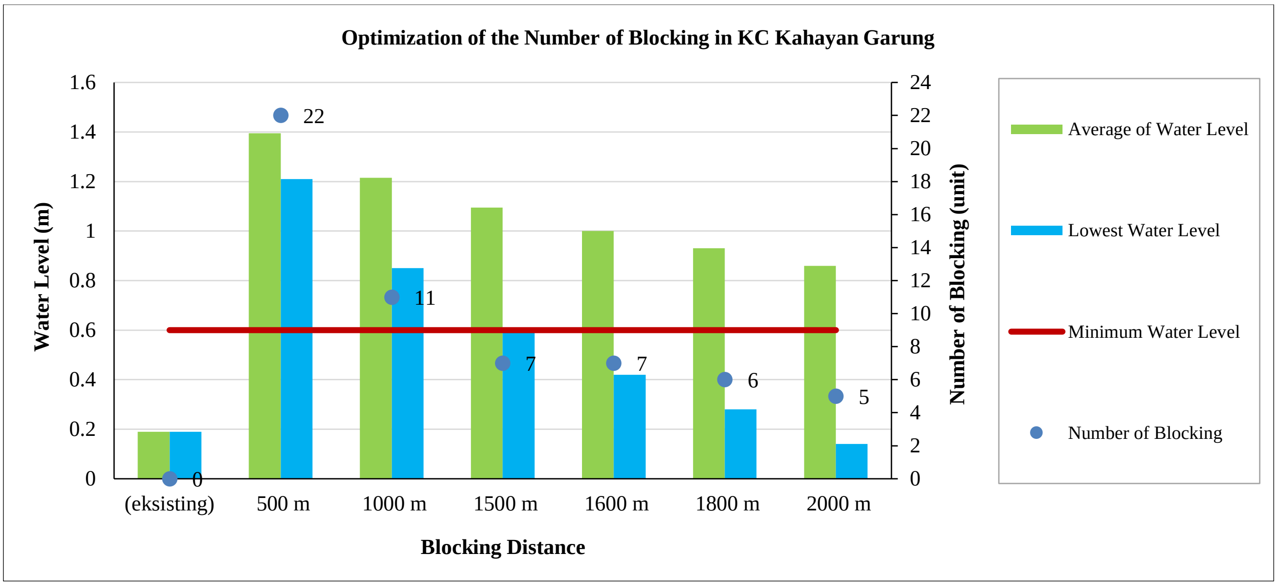

Figure 11. Curve of Canal Blocking Optimization in KC Kahayan Garung

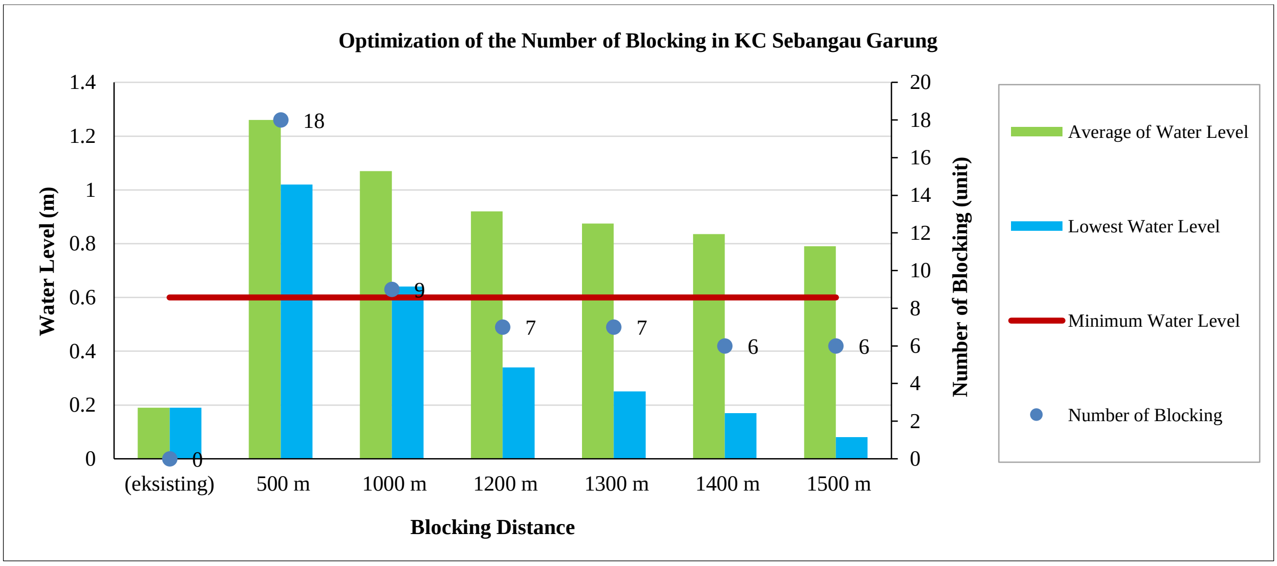

Figure 12. Curve of Canal Blocking Optimization in KC Sebangau Garung

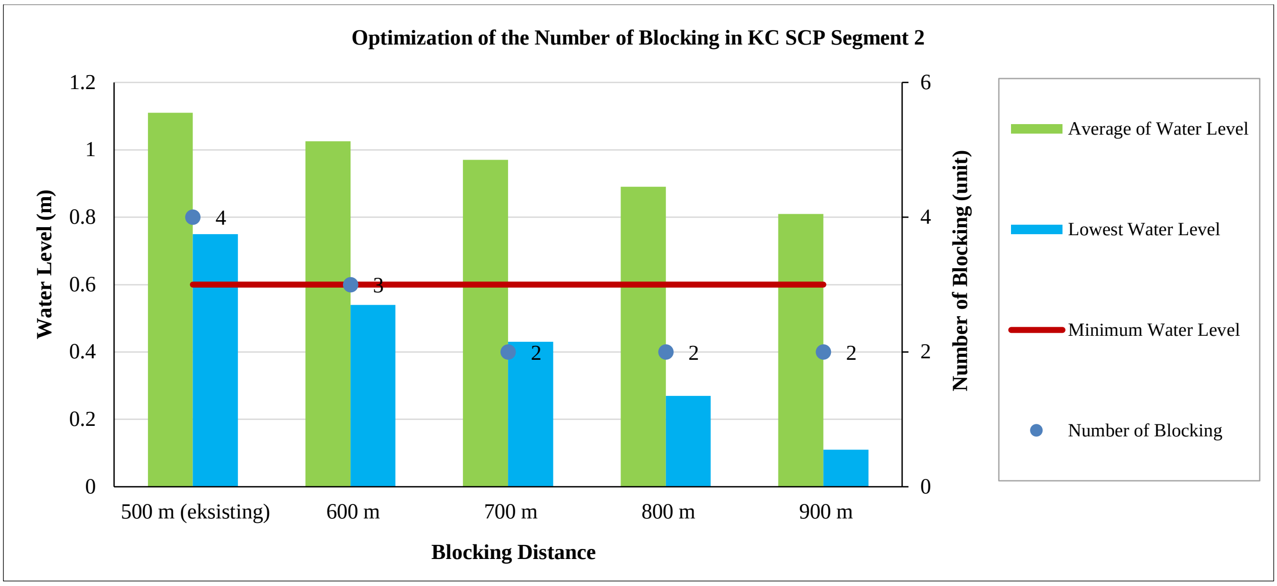

Figure 13. Curve of Canal Blocking Optimization in KC SCP Segment 2

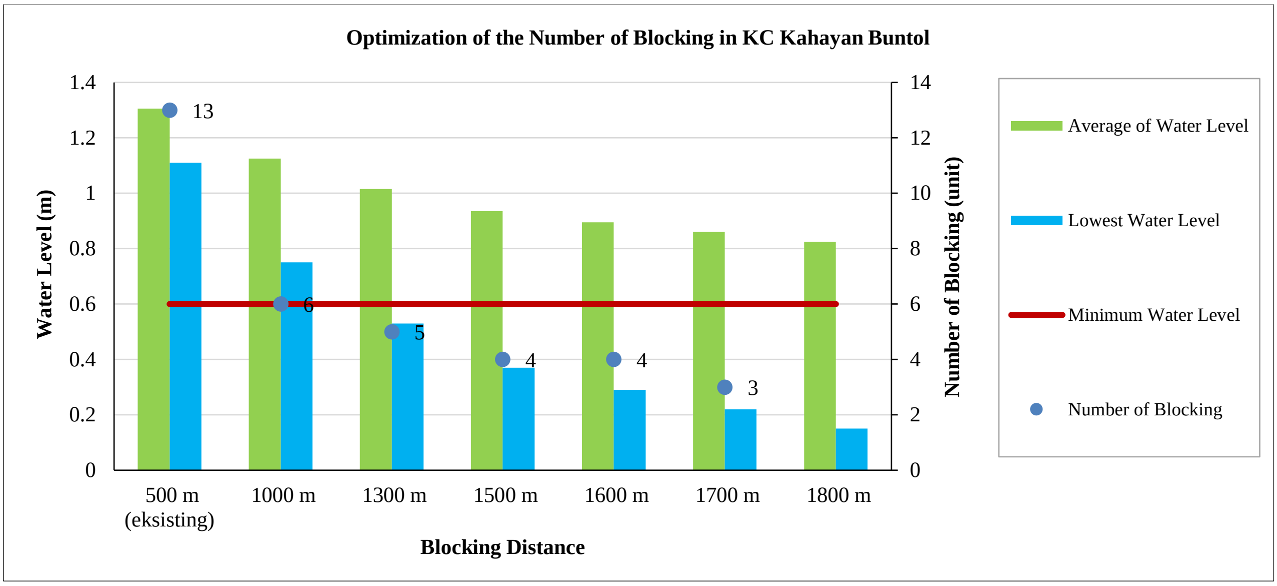

Figure 14. Curve of Canal Blocking Optimization in KC Kahayan Buntol

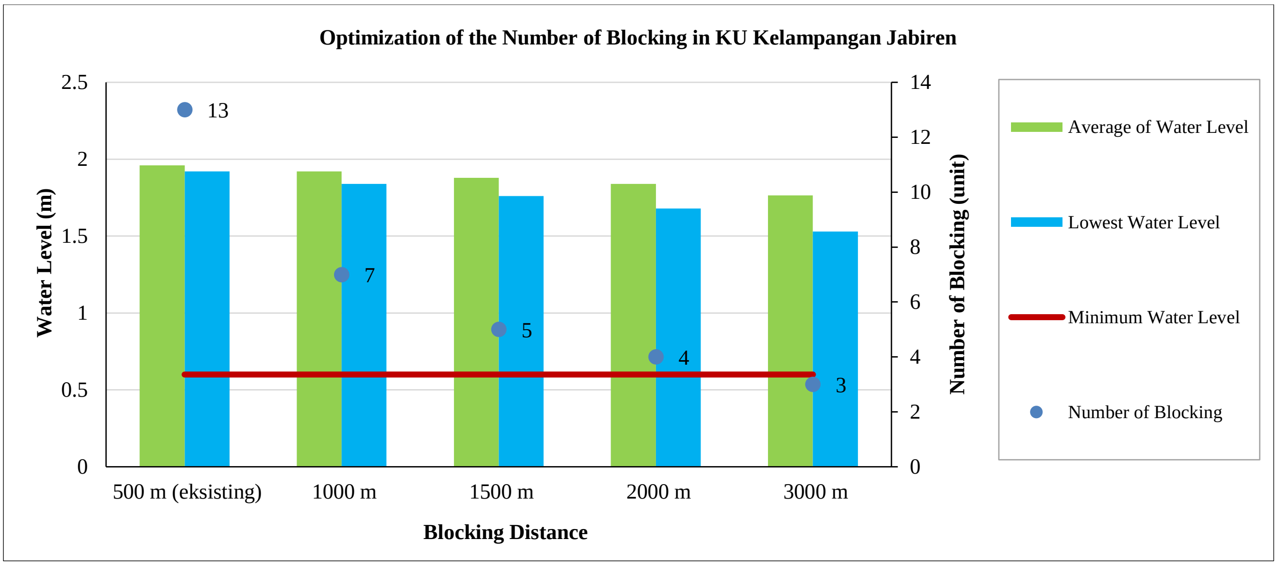

Figure 15. Curve of Canal Blocking Optimization in KU Kelampangan Jabiren

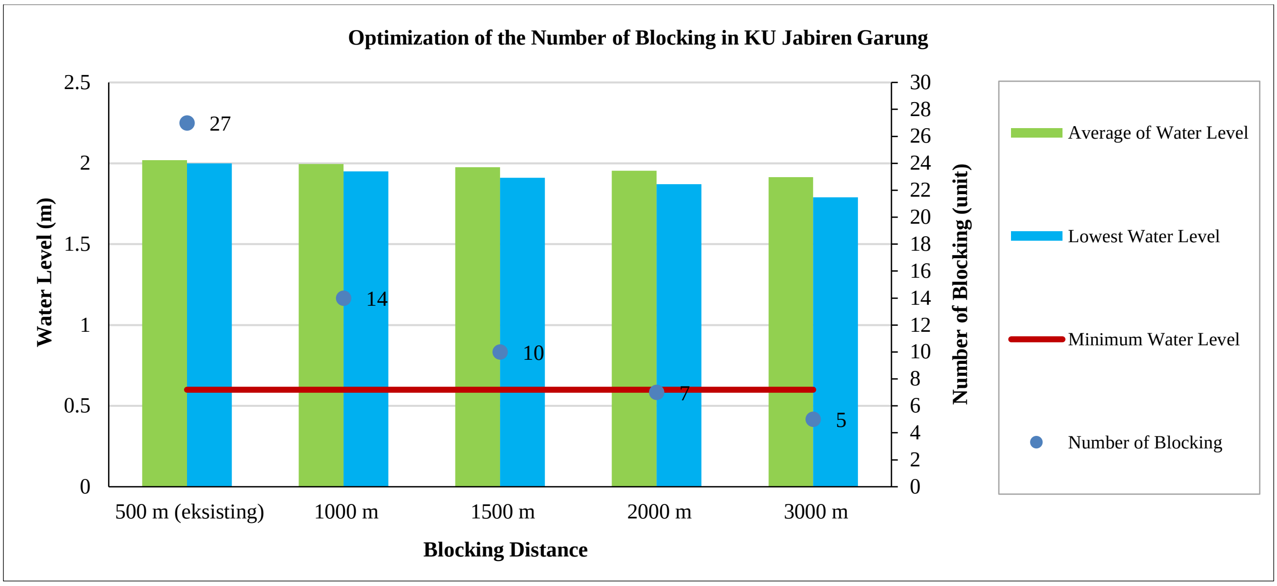

Figure 16. Curve of Canal Blocking Optimization in KU Jabiren Garung

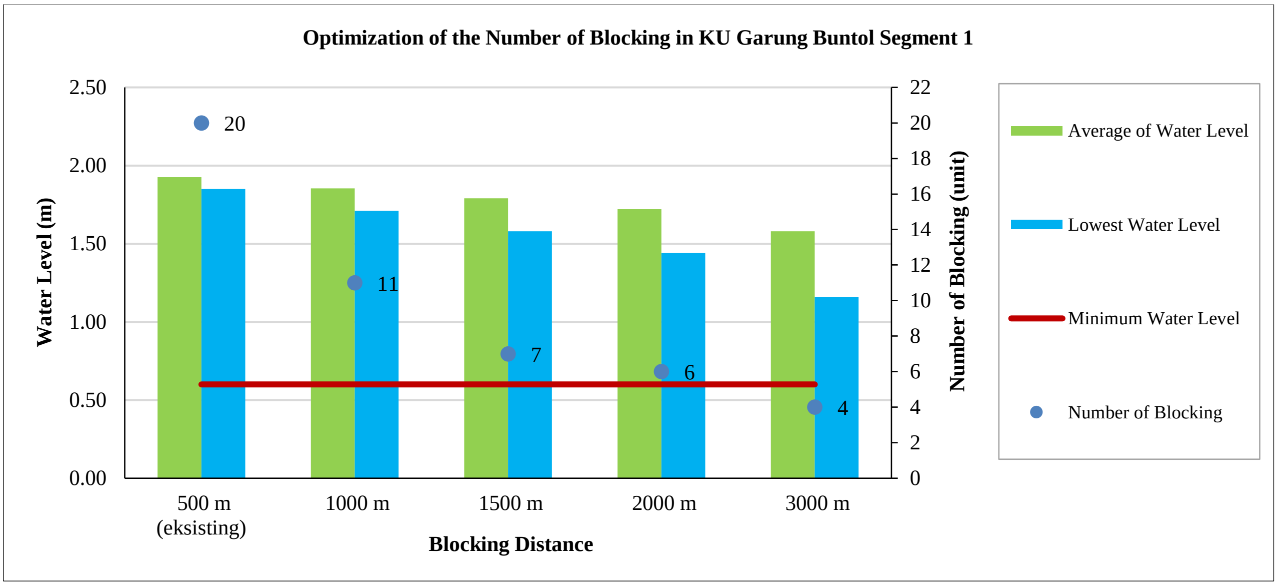

Figure 17. Curve of Canal Blocking Optimization in KU Garung Buntol Segment 1

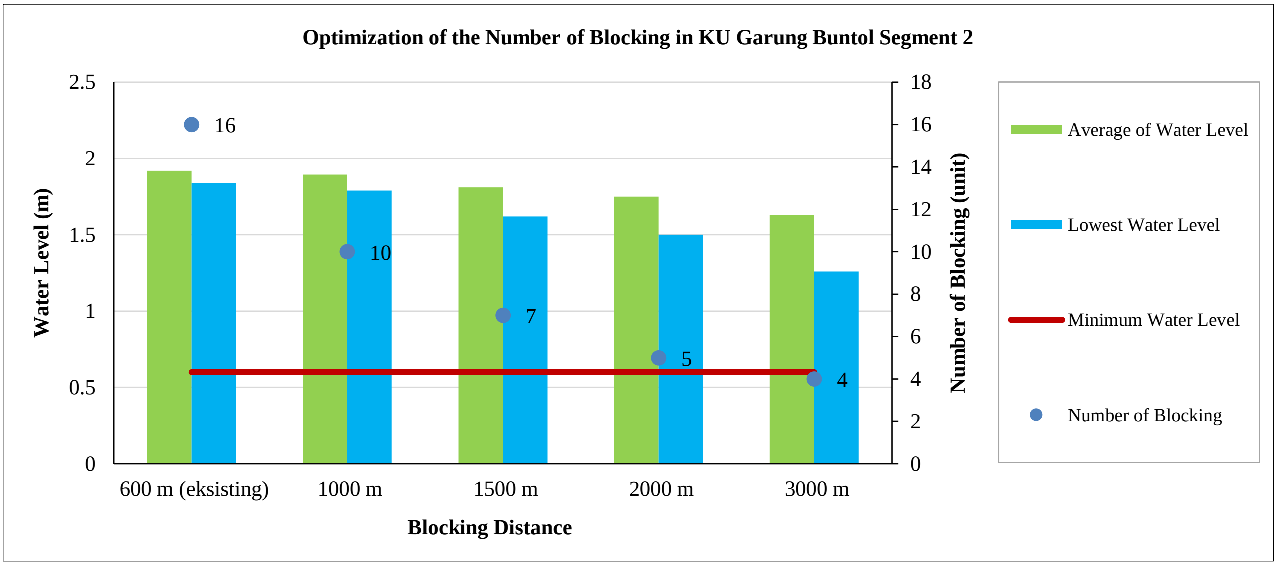

Figure 18. Curve of Canal Blocking Optimization in KU Garung Buntol Segment 2

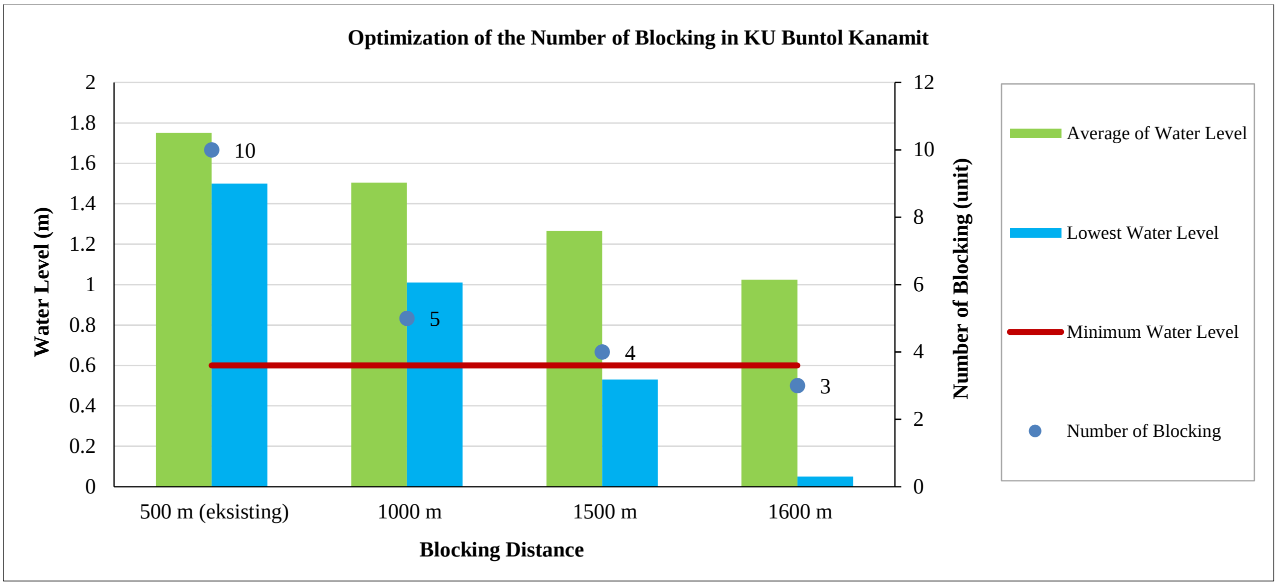

Figure 19. Curve of Canal Blocking Optimization in KU Buntol Kanamit

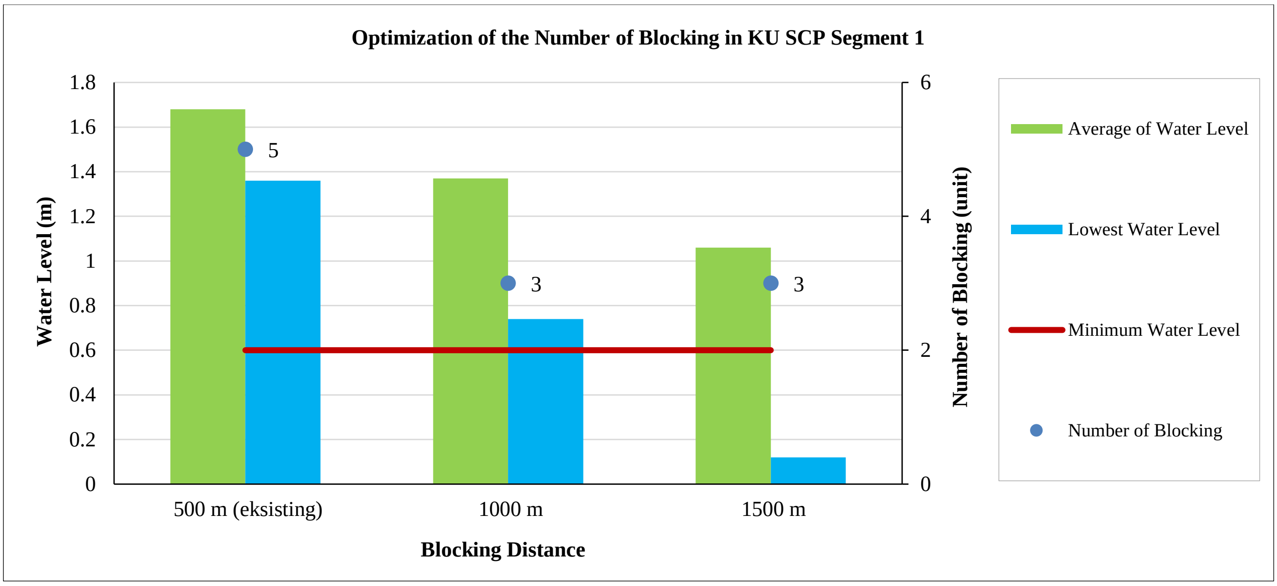

Figure 20. Curve of Canal Blocking Optimization in KU SCP Segment 1

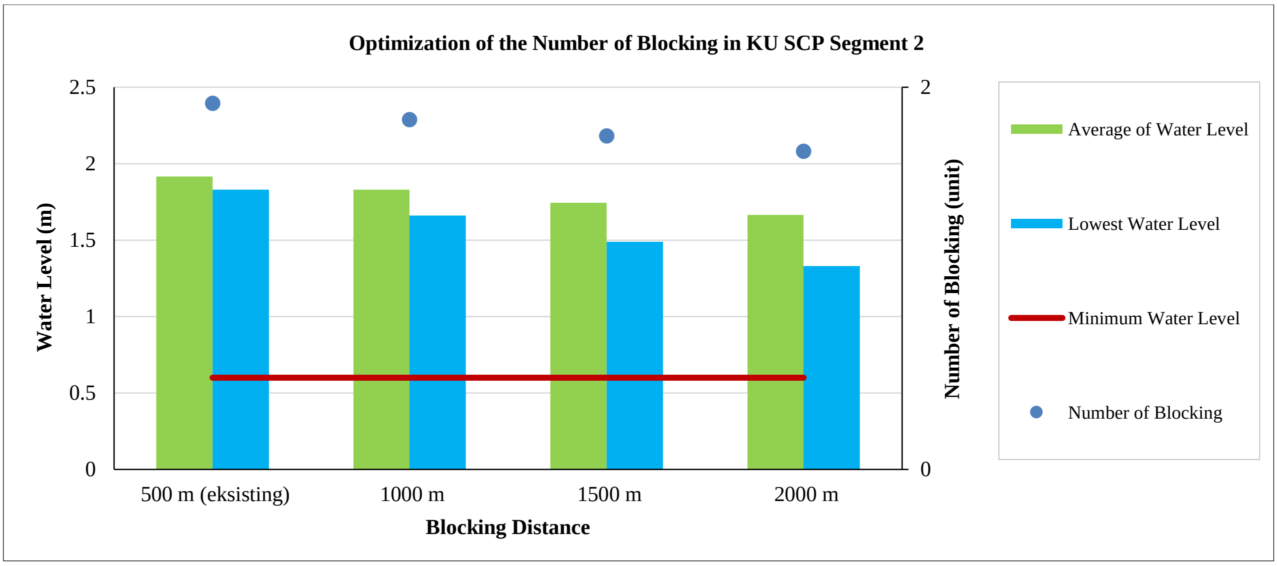

Figure 21. Curve of Canal Blocking Optimization in KU SCP Segment 2

As an explanation of the presented graphs, Figure 6, titled *Optimization of Canal Blocking for KC Kahayan Kelampangan Segment 1*, illustrates the optimization process for canal blocking in the Branch Canal of KC Kahayan Kelampangan Segment 1, which extends over 6.71 km. Under current conditions, the canal contains five blockings, each spaced 1000 meters apart. The graph shows that the average water level in the canal is 0.78 meters. However, at the point with the highest bed elevation, the water level reaches only 0.06 meters—significantly below the target minimum of 0.6 meters. To address this, the spacing between blockings was gradually reduced through trials at 900 m, 800 m, 700 m, and 500 m. Simulation results indicate that an optimal spacing of 600 m—requiring seven blockings (an increase from the original five)—produces the most effective water level retention.

Meanwhile, Figure 17, titled *Optimization of Canal Blocking for KU Garung Buntol Segment 1*, presents the optimization results for canal blocking in the Main Canal of KU Garung Buntol Segment 1, which spans 10.74 km. In the existing condition, the canal has 20 blockings spaced 500 meters apart. Due to the relatively flat bed slope, the average water level is 1.93 meters, with the lowest level reaching 1.85 meters—well above the minimum threshold of 0.6 meters. Unlike the previous segment, the blocking intervals in this canal can be increased to reduce the number of structures. After conducting several simulations with spacings of 1000 m, 1500 m, 2000 m, and 3000 m, the optimal spacing was determined to be 3000 m, requiring only four blockings—representing a significant reduction from the original 20.

Based on these graphs, it can be concluded that optimal placement of canal blockings can be achieved by prioritizing their installation in the branch canals, which serve as outlets from peat domes. This approach helps restrict water outflow from the peat domes. By limiting water flow through the branch canals, the water level in the main canal can be more effectively maintained, allowing for wider spacing between blockings in the main canal. Consequently, the overall number of required blockings can be reduced, thereby enhancing water management efficiency.

Following the optimization analysis of the number and spacing of blockings, the changes in the composition between existing and optimized conditions are presented in tabular form (Table 4). The most significant improvement in water level was observed in the branch canals, where the initial water levels were often far below the minimum required. As a result, the number of blockings had to be increased from the initial 30 units to 58 units—an addition of 28 blockings.

In contrast, for the main canal, the number of required blockings decreased significantly from 102 to 30 units as a result of the optimization. Despite this considerable reduction, the lowest water level remained above the required minimum—exceedingly even 1 meter in some sections. This outcome is attributed to the presence of blockings in the branch canals (peat dome outlets), which effectively trap surface water in the canal. Additionally, the relatively flat slope of the main canal bed allows for fewer blockings while still maintaining appropriate water levels.

Table 4. Modelling Result Recapitulation of Canal Blocking Optimization

No.	Name of canal	Existing		Optimization	
		Number of blocking (unit)	Lowest water level (m)	Number of blocking (unit)	Lowest water level (m)
1	KC Kahayan Kelampangan	5.00	0.06	10.00	0.62
2	KC Sebangau Kelampangan	5.00	0.06	9.00	0.64
3	KC Kahayan Pilang	0.00	0.11	10.00	0.60
4	KC Kahayan Garung	0.00	0.19	7.00	0.61
5	KC Sebangau Garung	0.00	0.19	9.00	0.64
6	KC SCP Segmen 1	3.00	0.60	3.00	0.60
7	KC SCP Segmen 2	4.00	0.75	4.00	0.75
8	KC Kahayan Buntol	13.00	1.11	6.00	0.75
9	KC Sebangau Kanamit	0.00	1.45	0.00	1.45
10	KC Sebagau SCP 2	0.00	1.42	0.00	1.42
11	KC Kahayan Dandang	0.00	1.67	0.00	1.67
12	KU Kelampangan Jabiren Segmen 1	13.00	1.92	3.00	1.53
13	KU Kelampangan Jabiren Segmen 2	0.00	0.24	1.00	1.68
14	KU Jabiren Garung	27.00	2.00	5.00	1.79
15	KU Garung Buntol Segmen 1	20.00	1.85	4.00	1.16
16	KU Garung Buntol Segmen 2	16.00	1.84	4.00	1.26
17	KU Buntol Kanamit	10.00	1.50	5.00	1.01
18	KU SCP Segmen 1	5.00	1.36	5.00	1.36
19	KU SCP Segmen 2	11.00	1.83	3.00	1.33
20	KU Kanamit Bahaur	0.00	1.88	0.00	1.88
	Number of blockings in branch canal	30.00		58.00	
	Number of canal blockings in main canal	102.00		30.00	
	Total	**132.00**		**88.00**	

For clearer, the model illustration of canal blockings due to optimization result can be seen in Figures 22 to 30.

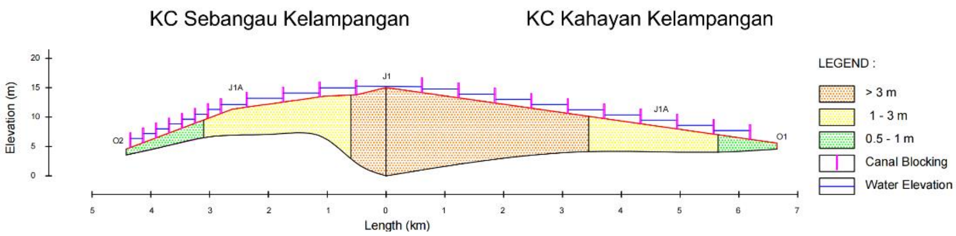

Figure 22. Visualization of Modelling Result in the KC Sebangau Kelampangan – KC Kahayan Kelampangan Due to the Optimal Condition

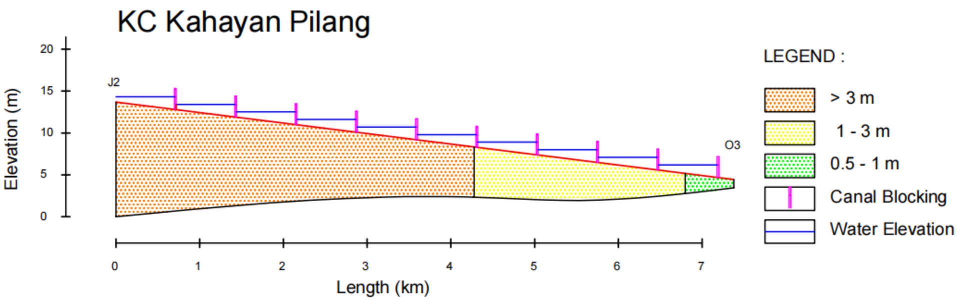

Figure 23. Visualization of Modelling Result in the KC Kahayan Pilang Due to the Optimal Condition

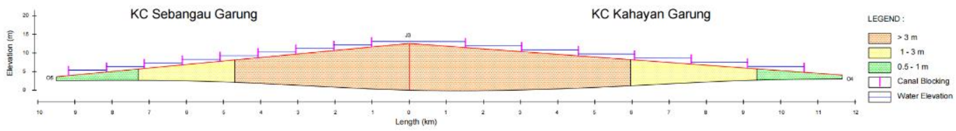

Figure 24. Visualization of Modelling Result in the KC Sebangau Garung – KC Kahayan Garung Due to the Optimal Condition

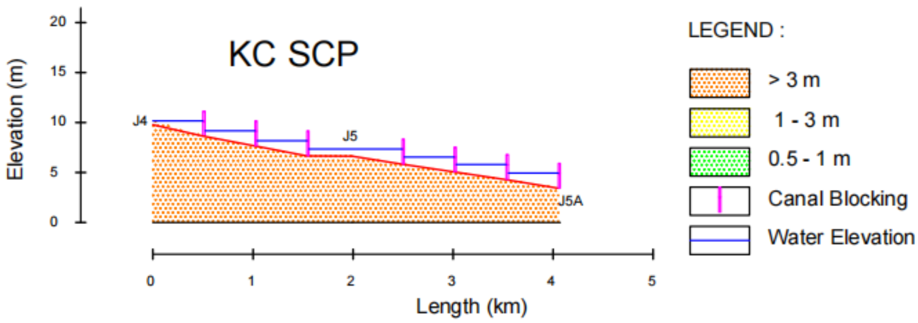

Figure 25. Visualization of Modelling Result in the KC SCP Due to the Optimal Condition

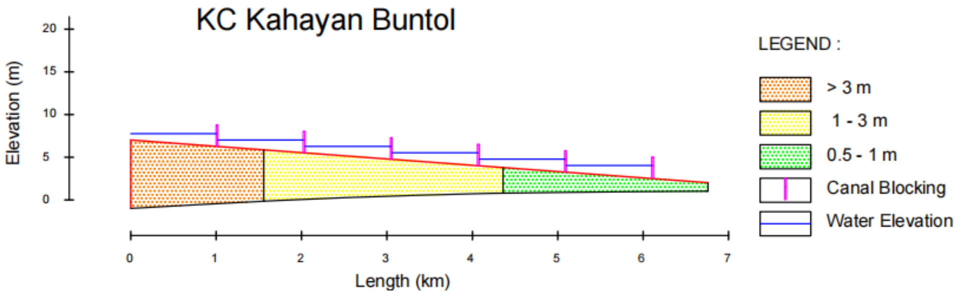

Figure 26. Visualization of Modelling Result in the KC Kahayan Buntol Due to the Optimal Condition

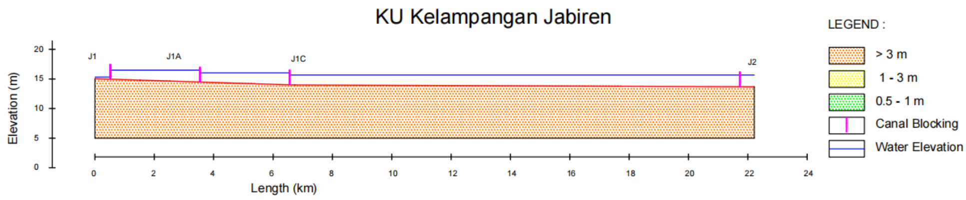

Figure 27. Visualization of Modelling Result in the KU Kelampangan Jabiren Due to the Optimal Condition

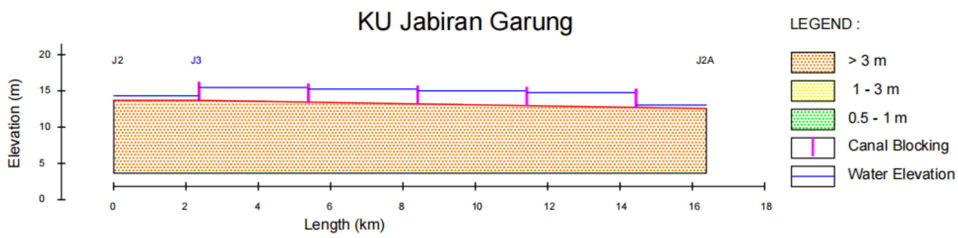

Figure 28. Visualization of Modelling Result in the KU Jabiren Garung Due to the Optimal Condition

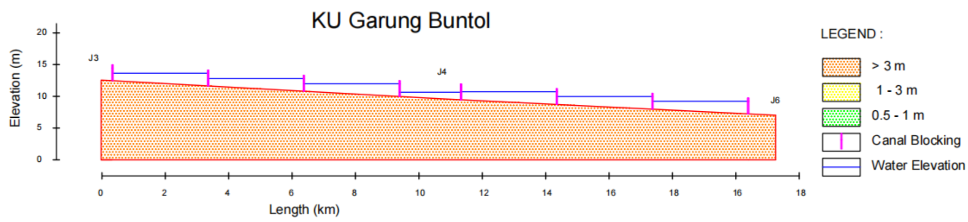

Figure 29. Visualization of Modelling Result in the KU Garung Buntol Due to the Optimal Condition

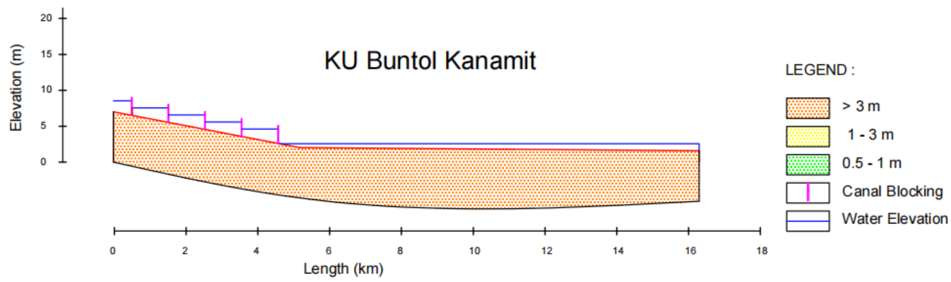

Figure 30. Visualization of Modelling Result in the KU Buntol Kanamit Due to the Optimal Condition

4. Conclusion

In the modelling result of existing canal blocking, there is still obtained the lowest water level height is still under allowed minimum water level height, so it is needed to optimize the number of canal blockings. The whole number of canal blockings in existing condition is 132 units that consist of 102 units in main canal and 30 units in branch canal.

The optimization analysis produces the number of canal blockings is less that is 88 units of canal blockings that consists of 30 units in main canal and 59 units in branch canal. Installing optimization of canal blocking is carried out by blocking strategy in the dome outlet formerly that is branch canal so the water flow can be efficiently hold.

By knowing the optimization result of canal blocking and the stage of installing, so this study can know the strategy of protecting the peat land by installing method of canal blocking.

5. Declarations

5.1. Author Contributions

Conceptualization, Y. and L.M.L.; methodology, D.S.; software, D.S.; validation, Y., L.M.L., and S.; formal analysis, Y.; investigation, Y.; resources, S.; data curation, Y.; writing—original draft preparation, L.M.L.; writing—review and editing, E.Y.; visualization, D.S.; supervision, L.M.L.; project administration, Y.; funding acquisition, Y. All authors have read and agreed to the published version of the manuscript.

5.2. Data Availability Statement

The data presented in this study are available in the article.

5.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

5.4. Institutional Review Board Statement

Not applicable.

5.5. Informed Consent Statement

Not applicable.

5.6. Declaration of Competing Interest

The authors declare that there are no conflicts of interest concerning the publication of this manuscript. Furthermore, all ethical considerations, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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