NUMERICAL METHOD APPROACH TO ANALYSIS OF DRAINAGE CHANNELS OF PIT-3 WEST BANKO TANJUNG ENIM

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(Received: 8 October 2021; Accepted: 1 December 2021; Published on-line: 1 March 2022)

ABSTRACT: The drainage network system should be designed to accommodate normal flow rates, especially during the rainy season. This means that the capacity of the drainage channel has been calculated to accommodate the water discharge that occurs so that the area in question does not experience puddles or the channel can to be function properly. For this reason, research is needed to analyze the ability of the ex-coal mine drainage channel in PIT-3 West Banko Tanjung Enim. The research was carried out with the help of the HEC-RAS software program to see the changes in the water level in the drainage channel where the water was overflowing from the channel body. The results showed that all the section profiles of the drainage channel (P_1) till (P_{10}) were still in the safe condition or the channel was still stable (stable channel).

KEY WORDS: Drainage channel, IDF curve, HEC-RAS Program, Stable channel

1. INTRODUCTION

Flood disaster has become a routine phenomenon in the rainy season that spreads in various river basins (DAS) in most parts of Indonesia. The number of flood events in the rainy season during the last 3 years has continued to increase. The number of human victims, property losses, public/social facilities and infrastructure, transportation infrastructure, and agricultural / irrigation infrastructure [1].

The problem of rainfall as a contributing factor, the occurrence of disasters is also inseparable from the damage to environmental ecosystems in watersheds and the poor management of water resources. The existence of land degradation causes an increase in the surface runoff coefficient. The upstream watershed area, which is a recharge area, will be more susceptible to drought. On the other hand, the downstream area is prone to flooding. Inundation/flooding is experienced by urban areas located in the lowlands and areas located in the highlands. A flood or puddle in an area occurs when the system that functions to accommodate the puddle cannot accommodate the flowing discharge; this is a result of three possibilities: decreased system capacity, increased water flow rate, or a combination of both [2].

The drainage network system in an area should be designed to accommodate normal flow rates, especially during the rainy season. The capacity of the drainage channel has been calculated to accommodate the water discharge that occurs so that the area in question does not experience inundation or flooding. If the drainage system's capacity decreases due to various reasons, even the normal discharge cannot be accommodated by the existing system. Meanwhile, the causes of decreased drainage capacity include a lot of sediment, physical damage to the network system occurs, and the existence of other buildings on top of the network system. At certain times during the rainy season, there is often an increase in flow rates, or there has been an increase in discharge due to various reasons, so the capacity of the existing system can no longer accommodate the flow rate, resulting in flooding in an area. Meanwhile, the causes of increased discharge include unusually high rainfall, changes in land use, environmental damage to river basins (Watershed) in an area. Then if an urban or area decreases the system capacity while there is an increase in flow rate, the flood will increase, both in frequency, area, depth and duration [3].

The definition of a system here is a drainage network system in an area. In contrast, the drainage system, in general, can be defined as a series of water structures that function to reduce and remove excess water (flood) from an area of land so that the land can be used optimally. Hence, the drainage system is the engineering of infrastructure in an area to overcome inundation—flood [4].

Bukit Asam is a state-owned company engaged in the mining industry. In the process of mining activities, PT. Bukit Asam applies the open-pit mining method. The open-pit method is a mining method in which all mining activities and activities are carried out on or relatively close to the earth's surface, and the workplace is directly related to the outside air.

The disadvantages of the open pit method are that it requires a place for large piling up of land cover, disturbing the landscape, decreasing environmental quality, work that is highly dependent on weather/season conditions, scattered mechanical tools, and limited excavation. Based on these shortcomings, the weather or season is one of the main factors affecting the mining operation using the open-pit method. The weather condition in question is water (rain) in the mining area [5].

The impact is caused by water entering the mining site if it is not properly managed. The work location will be flooded, causing damage to road bodies, decreasing work efficiency, and threatening employees' safety and health. It is necessary to apply an optimal runoff system to anticipate this problem.

Based on the description above, it is necessary to study the drainage network system in the West Banko Tanjung Enim coal mine area so that ex-mining water can be flowed according to the principle of flow hydraulics with the help of the HEC-RAS program. HEC-RAS 4.1.0 is a program that can model unstable flow with a one-dimensional view with a more accurate geometric modelling. Thus, this study aimed to analyze the ability of the ex-coal mine drainage channel in PIT-3 West Banko Tanjung Enim

The approach points for modeling a river or channel cross section can be made more than some other one-dimensional unstable flow programs are often used. Thus, the depiction of each cross-section of each profile using the HEC-RAS program will be closer than before. Simulation with HEC-RAS 4.1.0 aims to determine the longitudinal profile of the river, maximum water level, and flow velocity. In addition, this model can also modify the channel view to get a channel view that can anticipate the planned flood discharge. Modelling that will be discussed consists of 3 studies: the existing model, sluice gates, and pumping systems [6].

2. METHOD

This research was conducted in Tanjung Enim, located in the IUP (Mining Business License) West Banko, where there are four holes (Pit), namely West Pit 3, East Pit 3, Pit 1 East and Pit 1 North (Fig. 1).

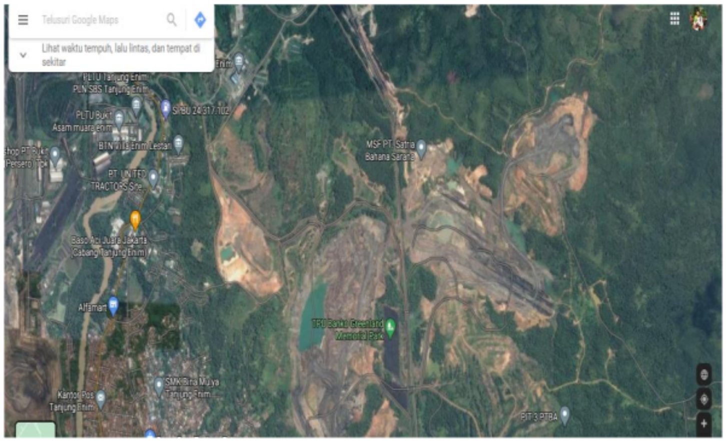

Fig. 1. Research location PIT-3 PTBA

The materials used in this study include collecting rainfall data (secondary data) to analyze rainfall with a certain return period and topographical surveys to obtain cross-sectional and longitudinal profile images of the channels connected to the existing storage ponds.

Rainfall data were used to calculate rainfall intensity, but previously the concentration-time was calculated. Then the rainfall frequency intensity curve (IDF-Curve) is made and calculates the planned discharge for each specific return period.

3. RESULT AND DISCUSSION

The results of the analysis of the frequency of rainfall for each period is 10-minute. The rainfall intensity data then was used to get the IDF curve and its shape, shown in Fig. 2.

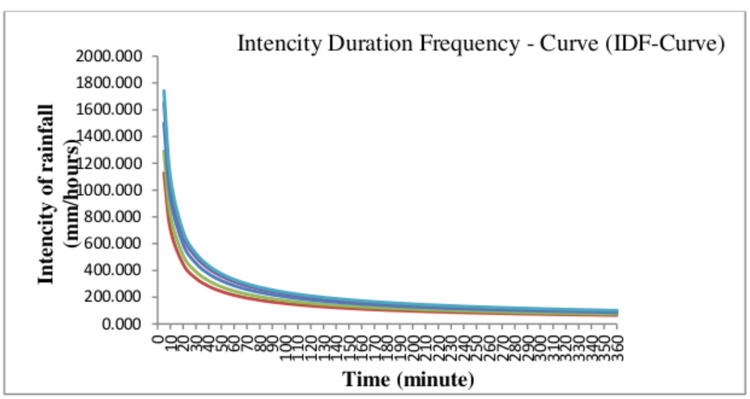

Fig. 2. IDF (Intensity Duration Frequency) Curve

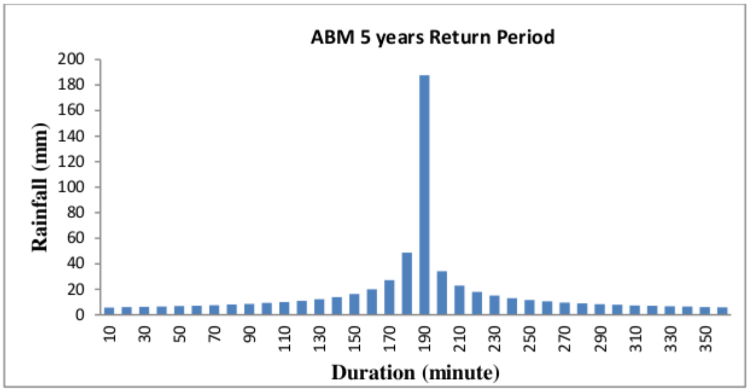

Fig. 3. Hyetograph with the ABM Method for a 5 Year Return Period

3.1. Flow Discharge

To calculate runoff discharge using the Rational Formula. The results are as in Table 1.

Table 1: The results of the calculation of runoff discharge

No.	R	R_{24} (mm)	I (mm/hour)	Q (m^3/sec)
1	5	619,771	454,8194	41.36
2	10	710,154	521,1472	47.29
3	20	824,343	604,9449	54.90
4	50	909,054	667,1106	60.54
5	100	958,292	703,2436	63.82

3.2. Simulation Results

After all data such as flood, the discharge has been inputted into the HEC-RAS Program. The data is running, and the results are seen. Each return period discharge is seen in each cross-section.

The pattern of water level movement in the ex-mining flow channel at Pit-3 West Banko PTBA is as shown below:

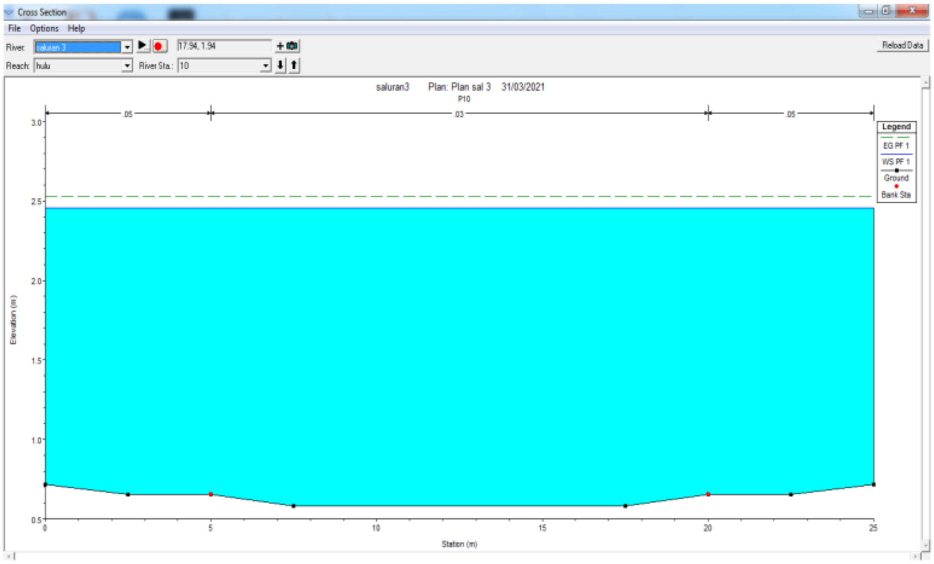

Fig. 4. The pattern of water flow movement in the P-10 channel

In Fig. 4. that the channel does not increase the water level in the channel. This means that the P-10 channel does not overflow, and this condition is due to the influence of the holding pond.

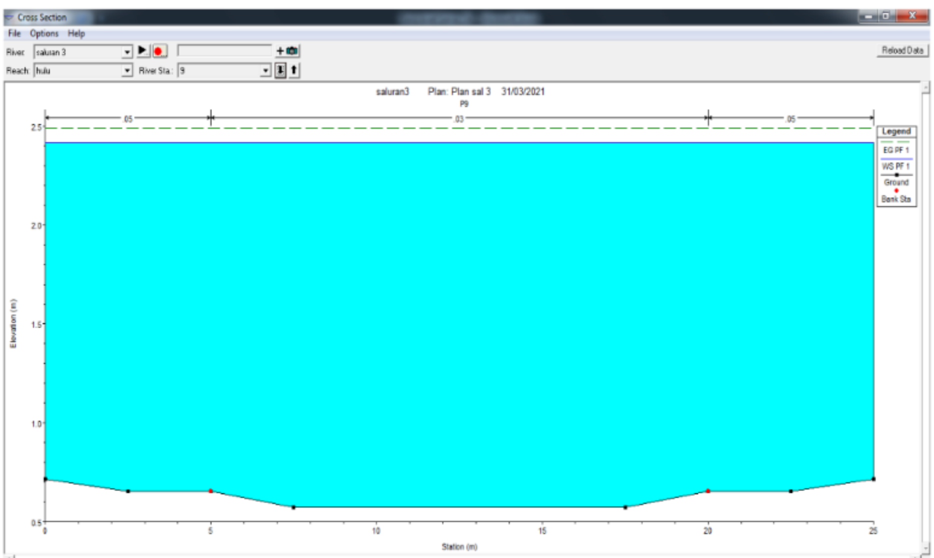

Fig. 5. The pattern of water flow movement in the P-9 channel

In Fig. 5, the channel does not increase the water level in the channel. This means that the P-9 channel does not overflow, and there is little influence on the presence of a storage pool, increasing flow in the channel.

https://doi.org/10.51630/ijes.v3i1.32

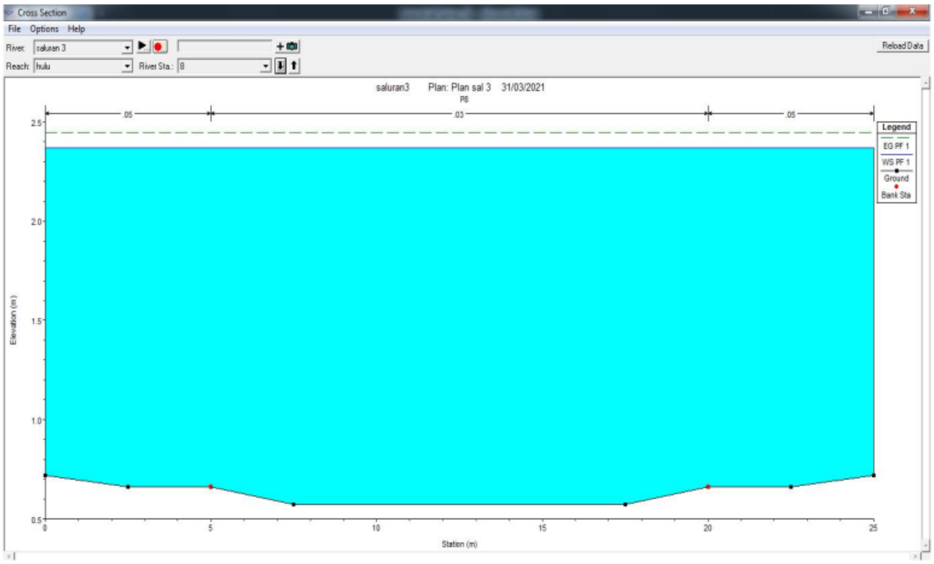

Fig. 6. The pattern of water flow movement in the P-8 channel

In Fig. 6, the channel does not increase the water level in the channel. This means that in the P-8 channel, there is no overflow, and there is little influence on the presence of a storage pool, increasing flow in the channel.

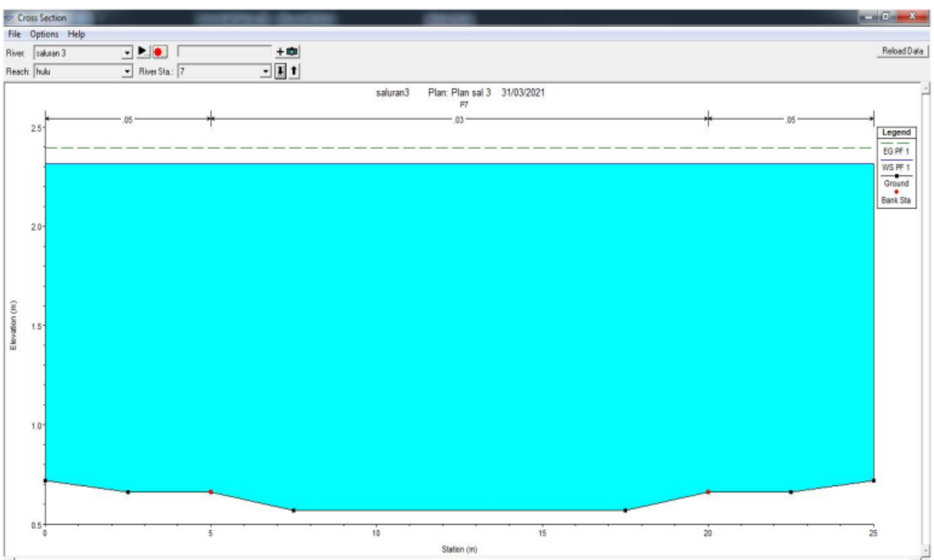

Fig. 7. The pattern of water flow movement in the P-7 channel

In Fig. 7, the channel does not increase the water level in the channel. This means that the P-7 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

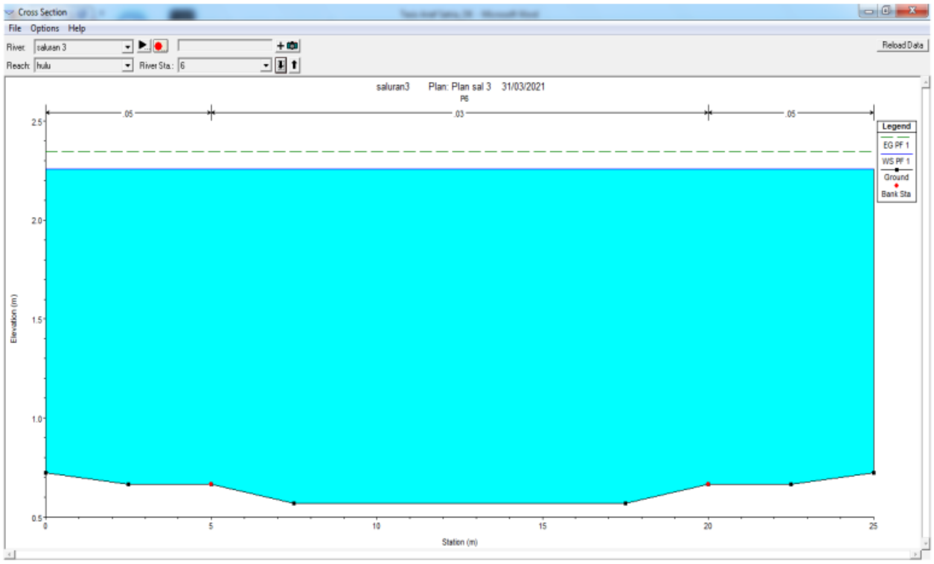

Fig. 8. The pattern of water flow movement in the P-6 channel

In Fig. 8. the channel does not increase the water level in the channel. This means that the P-6 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

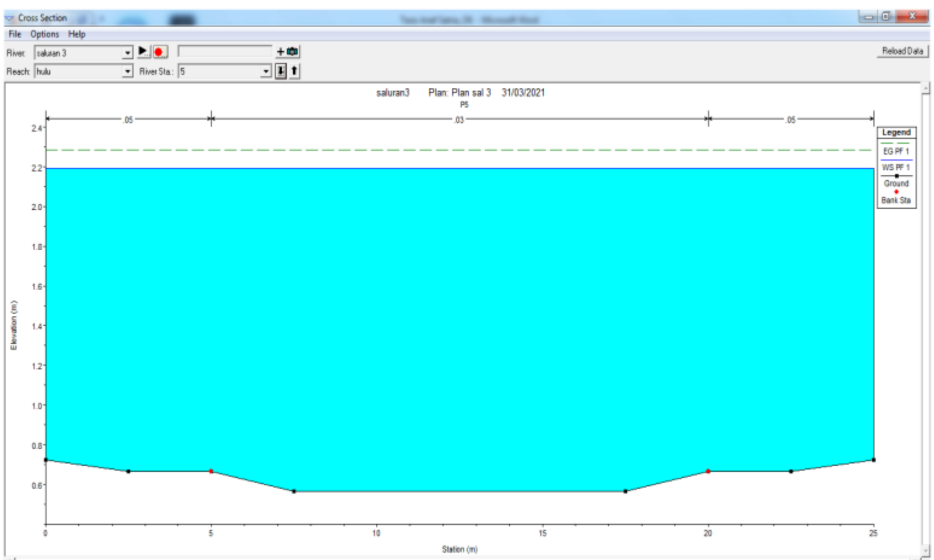

Fig. 9. The pattern of water flow movement in the P-5 channel

In Fig. 9. the channel does not increase the water level in the channel. This means that the P-5 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

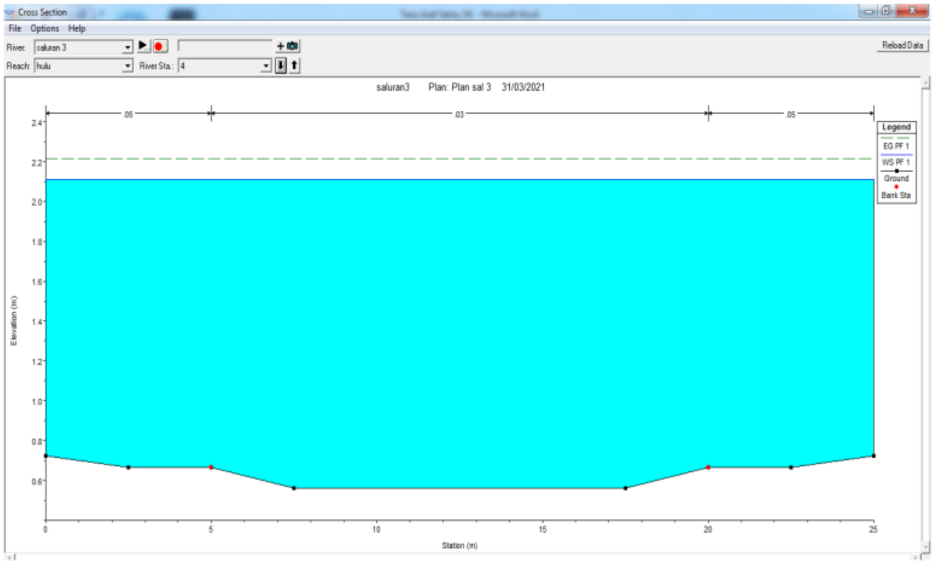

Fig. 10. The pattern of water flow movement in the P-4 channel

In Fig. 10, the channel does not increase the water level in the channel. This means that the P-4 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

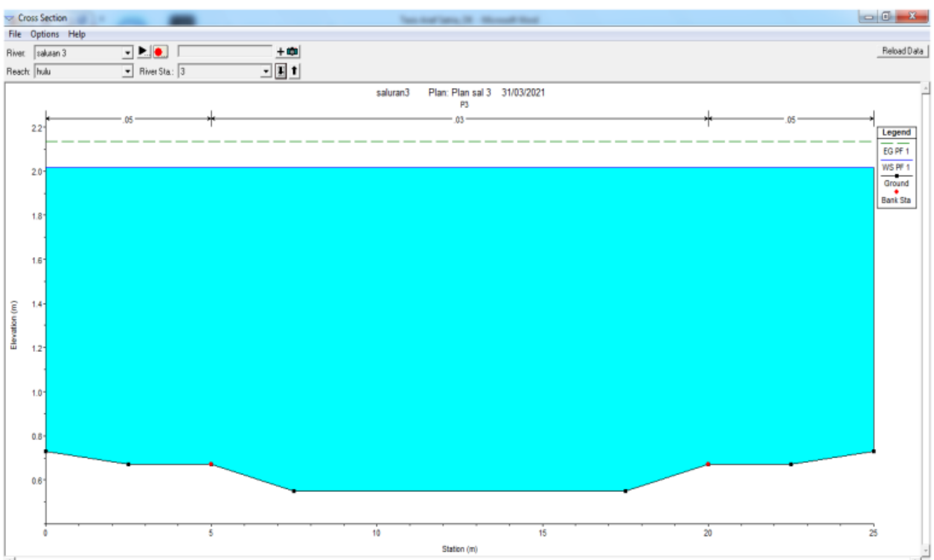

Fig. 11. The pattern of water flow movement in the P-3 channel

In Fig. 11, the channel does not increase the water level in the channel. This means that in the P-3 channel, there is no overflow, and it has a little effect due to the presence of a storage pool, increasing flow in the channel.

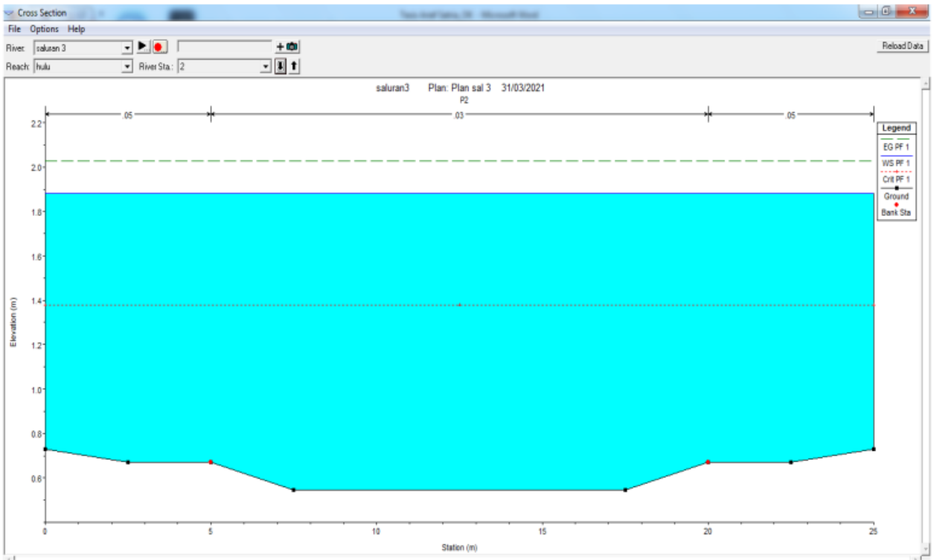

Fig. 12. The pattern of water flow movement in the P-2 channel

In Fig. 12, it can be seen that the channel does not increase the water level in the channel. This means that the P-2 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

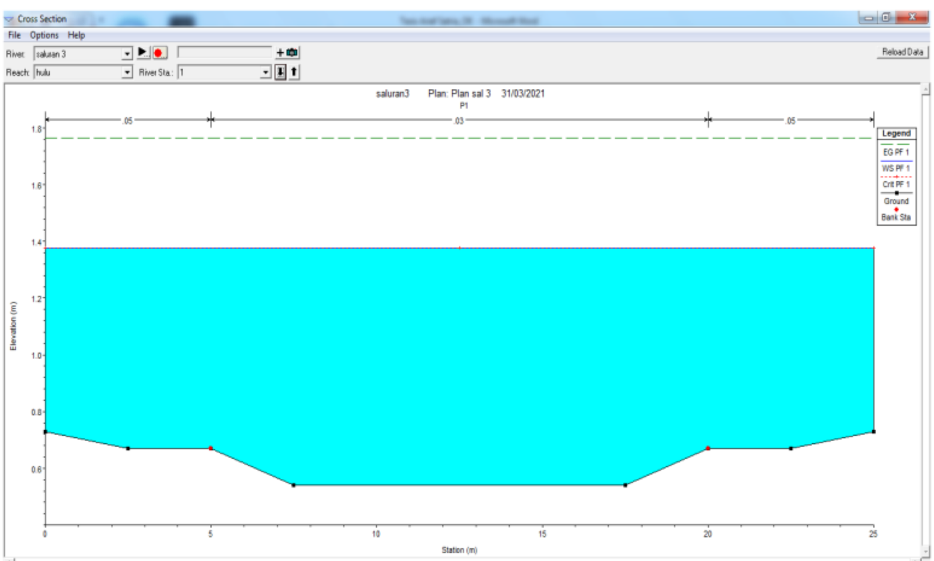

Fig. 13. The pattern of water flow movement in the P-1 channel

In Fig. 13, the channel does not increase the water level in the channel. This means that the P-1 channel does not overflow and has a little effect due to a storage pool, increasing flow in the channel.

4. CONCLUSION

The average diameter (d_{50}) used as sediment in the channel is 0.025 mm in diameter based on the result results of the sieve analysis in the soil mechanics laboratory. The water drainage channel of the former coal mine, the Pit-3 channel, west Banko, Tanjung Enim, both at the profile (P-1) to (P-10), is still safe or the condition of the channel is stable. Soo, it is concluded that there is no overflow in the channel body based on the results. Analysis with the HEC-RAS program.

ACKNOWLEDGEMENT

We would like to thanks the Rector of Universitas Bina Darma for support.

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