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Calculation of Runoff Discharge in the Coal Mining Open Pit Mine Dewatering System at PT. Kalimantan Prima Persada Jobsite PELH Kebur Village, West Merapi District, Lahat Regency, South Sumatra Province

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Abstract. PT Kalimantan Prima Persada Jobsite PELH is a company engaged in coal mining contractors. Mining carried out by PT Kalimantan Prima Persada Jobsite PELH uses the open pit method, during the rainy season, the problem that is often found is water. The purpose of this study is to find the amount of runoff water discharge that enters the mine area. Runoff water and groundwater are the main things that must be considered so as not to disturb and damage the mining site. The stages used in calculating runoff water discharge are calculating the catchment area, calculating planned rainfall data using the Gumbel method, calculating rain intensity using the Mononnobe method, calculating runoff water discharge using the rational method. Based on the calculation, it is obtained that the catchment area in Pit PE PT Kalimantan Prima Persada Jobsite PELH is 540.18 Ha or 5.40 km^2, the average daily maximum rainfall for the last 10 years is 547.4 mm / day, the planned rainfall is 385.140 mm / day, rain intensity is 80.87 mm / day, and runoff water discharge is 30,204.27 m^3 / hour.

Keywords: *Groundwater, Rainfall, Catchment Area, Runoff Water*

1. Introduction

Mining is an activity in the research, management, and exploitation of minerals which includes general investigation, exploration, feasibility studies, construction, mining, processing and refining, transportation and sales, and post-mining activities. Coal mining is one type of mining business in Indonesia. One of the coal mining companies engaged in coal mining is PT. Kalimantan Prima Persada Jobsite Priamanaya Energi Lingkungan Hidup (PELH)

PT Kalimantan Prima Persada Jobsite PELH uses the open pit mining method. The increase in the amount of overburden and coal stripping in the open pit method results in a change in the dimensions of the mine front which is getting deeper, as well as the direction of mining towards the spread of coal, causing the formation of a large basin. Large basins can serve as storage for surface water and groundwater. When the weather abnormal weather such as heavy rainfall, water from rainwater falls to the ground and flows as runoff to low-lying areas. Some of it seeps out and enters through cracks in the pores of the soil around the site[1]. Water entering the mining area comes from rainwater catchment runoff so that at certain periods there will be runoff water [2].

As the mine is a potential water source, this could be one of the reasons why the pit floor is flooded and the front of the mine becomes muddy. This can disrupt unloading, loading and transportation activities in the mining area and temporarily halt production. Open pit mine drainage systems are particularly important in mining areas where heavy rainfall can occur.

This can be confirmed by historical rainfall data collected by the company internally through rainfall measurements. The highest average rainfall data in 2022 was 490.89 mm and the lowest average rainfall data was 159.63 mm.

When extreme weather events, such as heavy rainfall, occur, mud accumulates at the mine front and floods the PE pit. This can cause disruption to the production process and concerns about not meeting production targets. Implementing a proper drainage system will increase mining productivity and not affect the environmental conditions of the mining area.

The dewatering system at PT KPP Jobsite PELH pit is mine dewatering, where water entering the mining site is removed through several stages. This is based on the collection of water from runoff and groundwater in the sump. The water collected in the sump is pumped through a pipe approximately 300 m long to an open channel and is first treated to neutralize the acidity of the water produced by the pump before flowing into the river.

Based on field observations, the sump in pit PE is located next to the mining area. Sumps should be made and placed in areas that do not interfere with mining activities because of the potential for disruption of mining activities. In addition, the calculation of groundwater discharge has not been carried out, affecting the effectiveness of the sump, so that the existing sump cannot accommodate all incoming water which results in stagnant water in the mining area and hampers production activities.

Furthermore, the absence of a total water discharge calculation results in not maximizing pumping performance, resulting in the selection of pumps that are not in accordance with what is needed, so it takes a long time to drain the water that inundates the mining site.

Surface runoff and the potential for groundwater to enter and collect in the catchment area (swamp) are important obstacles that must be overcome [3].

This is because mine expansion has a significant impact on the amount of runoff water that accumulates in water storage areas. The overflow of water into the mining site can cause disruption of mining operations and hamper production towards production targets, resulting in material losses and financial losses for the company. Therefore, the purpose of the evaluation is to determine whether the existing basin is able to accommodate the existing water.

Based on the problems that have been described, there are several things that must be considered in conducting research, including In conducting data analysis, the author uses a method that combines theory and field data to get problem solving from both. First, determine the catchment area, calculate the rainfall plan with the gumbel method, calculate the rain intensity with the mononobe method, and calculate the amount of runoff discharge with the rational method.

2. Research Location

The location of the IUP carried out by PT Kalimantan Prima Persada Jobsite PELH is located in a South Sumatra province, Lahat Regency, West Merapi District, Kebur Village.

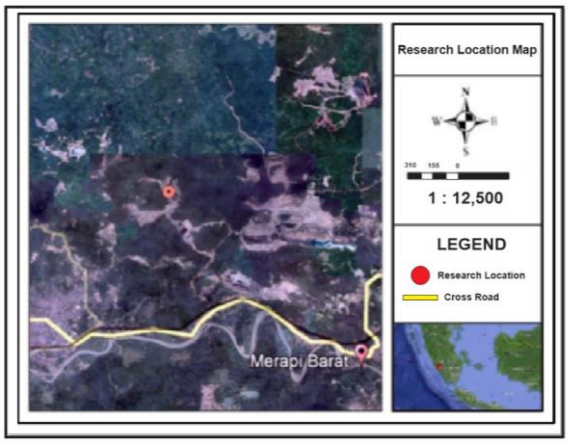

Fig 1. Map of Research Location

3. Research Methods

After field observations to obtain primary data, the research continued with secondary data searches and literature reviews to analyze current data and theories. After the data was mathematically processed and the research questions evaluated.

3.1. Type of research

The type of quantitative research used in this study is related to applied research.

States that a quantitative approach is an approach based on concrete data, which is in the form of numbers and is measured using statistics as a computational test tool. This approach draws conclusions about the issues discussed.

In other words, quantitative research is carried out by dividing the problem into parts that can be measured or written, and determining the relationship between variables.

3.2. Data Collection Methods

The data used in this research consists of primary and secondary data. Primary data comes from direct collection in the field or data obtained through direct observation. Secondary data comes from companies and other literature studies.

Primary data consists of the catchment area of rainfall and the actual situation in the field. Meanwhile, secondary data consists of rainfall data from 2013-2022 and pipe length.

3.3. Data Anlysis Methods

In analyzing the data, the author uses a method that combines theory and field data to get problem solving from both. First, determining the area of the catchment area, calculating the rainfall plan with the gumbel method, calculating the rain intensity with the mononnobe method, and calculating the amount of runoff discharge using the rational method.

4. Result and Discussion

4.1 Determination of Catchment Area

To determine the area of the watershed, the author used Global Mapper 20.1 software, which is calculated based on the estimated watershed and used to calculate measurements using a topographic map of the mining area. The results of measurements made by Global Mapper 20.1 software show that the catchment area is 540.15 Ha. The following is an image of the catchment area map in the PE Energy pit of PT Kalimantan Prima Persada shown in Figure 2 below.

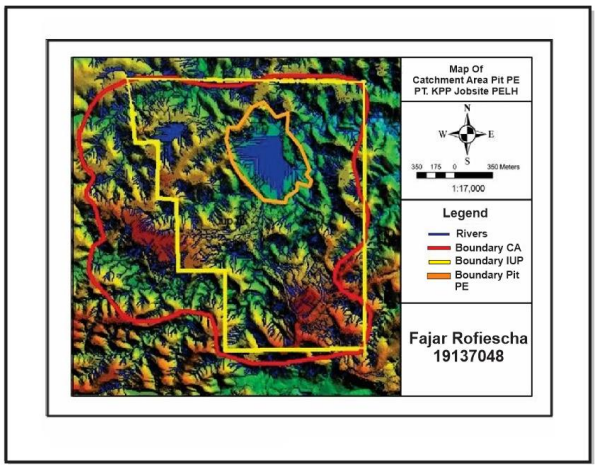

Fig 2. Map of Catchment Area

4.2 Rainfall

The frequency analysis calculation is used to select the type of distribution used to calculate the rainfall plan. The distribution used is the gumbel method. The following are the steps in determining rainfall to get runoff water discharge:

4.2.1 Determining the Maximum Rainfall Table in the Study Area

The first step is to sort the last 10 years of rainfall data from 2013 to 2022. It can be seen in Table 1 below.

Table 1. Daily Maximum Rainfall Data

Tahun	Xi	Xr
2013	466.4	547.4
2014	709.2	547.4
2015	472.9	547.4
2016	705.8	547.4
2017	510.5	547.4
2018	461.5	547.4
2019	433.4	547.4
2020	626.6	547.4
2021	594.2	547.4
2022	493.5	547.4

The maximum rainfall calculation results in a value of 547.4 mm/year. Based on the analysis of rainfall data, the Gumbel distribution method is used to determine the highest annual rainfall The rainfall data is analyzed using the Gumbel method as follows. Parameters that must be sought such as Calculation of Average Maximum Daily Rainfall (Xr), Calculation of Reduce Mean (Yn), Calculation of Reduce Mean Average (Yr), Calculation of Standard Deviation (Sx), Calculation of Reduce Standard Deviation (Sn), Calculation of Reduce Variate (Yt), Calculation of Reduce Variate (K), Calculation of Plan Rainfall (Xt).

Table 2. Result of Gumbel Method Analysis

Xr	547.4
Yn	-0.874
Yr	0.495
Sx	103.54
Sn	1.12
Yt	2.25
K	1.5
Xt	385.140

4.3 Rainfall Intensity

The determination of the rainfall intensity value is obtained from calculations using the Mononobe method by looking at the catchment area of 540.15 Ha. To be able to calculate the rain intensity, the time of concentration (Tc) value in the PE pit must be obtained first. The time of concentration (Tc) is the time for the flow to travel from the farthest distance to the observation location.
To find the tc value, the Mc Dermot method can be seen in the following equation:

$$Tc = 0{,}76 \times A^{0{,}38}$$

The result of the rain concentration time is 1.44 hours

The calculation of rain intensity that the author gets is as follows:

$$I = \left(\frac{Xt}{24}\right)\left(\frac{24}{Tc}\right)^{2/3}$$

The result of rain intensity is 80,87 mm/jam

4.4 Runoff Discharge

By knowing the rainwater catchment area, rainfall intensity value, and runoff coefficient value, the amount of runoff water to be released can be determined.
To calculate the amount of water runoff, you can use the following rational formula:

$$Q = 0{,}278\ x\ C\ x\ I\ x\ A$$

The result of runoff discharge is obtained with a rainwater catchment area of 5.4018 km^2, rainfall intensity of 80.87 mm/hour and a runoff coefficient of 0.9, then the result of runoff water discharge for the rainwater catchment area is 393,472.8 m^3/hour.
Furthermore, to get the amount of runoff water discharge that enters the mine opening area, by dividing the area of the mine opening area by the area of the rainwater catchment area and multiplying it by the results of the previous runoff discharge that has been obtained, the result is 30,204.27 m^3 / hour.

5. Conclusions and Suggestions

5.1 Conclusions

Based on the objectives of the research conducted, it can be concluded that:

1. The catchment area in Pit PE of PT Kalimantan Prima Persada Jobsite PELH is 540.18 Ha or 5.40 km^2.
2. Calculation of planned rainfall is 385.140 mm/day.
3. Rainfall intensity calculation is 80.87 mm/hour.
4. The calculation of runoff water discharge is 30,204.27m3 / hour.

5.2 Suggestions

Based on field observations and the problems discussed, the author suggests that the company needs to maintain and improve the maintenance and management of the mine drainage system. Regular tree planting and forest protection measures can minimize the increase in water runoff.

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