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WATER QUALITY MANAGEMENT SCENARIO IN BATULICIN RIVER, TANAH BUMBU REGENCY USING THE WASP METHOD

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ABSTRACT
The Batulicin River is one of the rivers used by the community for various activities in Tanah Bumbu Regency. In order to obtain a simulation scenario for the management of the Batulicin River, a study was carried out on the water quality of the Batulicin River, as well as modeling using the WASP method. The water quality of the Batulicin River is known with reference to Government Regulation of the Republic of Indonesia Number 22 of 2021 Appendix VI. Selection of the most optimal scenario for reducing the BOD pollution load on the Batulicin River is by referring to Scenarios 3, 4 and 5. The process in Scenarios 3, 4 and 5 is carried out by reducing the BOD pollution load respectively, namely 5549.10 kg/day, 5895.61 kg/day and 6789.96 kg/day. Management of river water quality in terms of BOD parameters, the most optimal is carried out through scenario 5, namely reducing pollutant materials from community's domestic activities by 95.85%, industrial activities by 50% and plantation activities by 50%, so that water quality is obtained against the BOD parameter at All segments of the Batulicin River meet class 1 and 2 water quality standards.

KEYWORDS: Water Quality; Batulicin River; Wasp Method.

INTRODUCTION
The Batulicin River is located in Tanah Bumbu Regency, South Kalimantan Province. The Batulicin River is used by the community to meet household, industrial activities as well as for agriculture. The Batulicin Watershed is one of the priority watersheds that has received attention for management (Badaruddin, 2014).

The value of water holding capacity indicates the maximum ability of a river to absorb materials that enter river bodies, so that it does not interfere with the quality and function of water (KLHK, 2017). Taking into account the activities of the community around the Batulicin River, as well as the need for pollution control of the Batulicin River, it is important to select a management scenario through Biochemical Oxygen Demand (BOD) modeling along the Batulicin River using the WASP program so that a simulation scenario for the management of the Batulicin River can be selected

MATERIALS AND METHODS
The research process was carried out through the stages of determining the location of the segments, determining the test parameters and sampling locations. Water sampling is the primary data collection, accompanied by the collection of river condition data. River water quality standards are based on Government Regulation of the Republic of Indonesia Number 22 of 2021 Appendix VI Number I class 1 and 2. Primary and secondary data collected are used to determine quality, and are used to build a river water quality model. The built river water quality model can be simulated by changing the concentration of pollutant substances so that recommendations for controlling water pollution can be obtained.

Location and Time of Research
The research location is in the Batulicin watershed area, Tanah Bumbu Regency, South Kalimantan Province. The process of determining sample points begins with dividing the Batulicin River channel into several segments. Determination of segment distribution in this study is based on water use, area topography, river morphology, potential water sources, potential sources of pollutant and administrative boundaries (KLHK, 2017). The research time for the environmental sampling process was carried out from July to August 2022.

Pollutant load capacity

Wardhani and Sulistyowati (2018) The calculation of the water pollutant load capacity is calculated using the following formula:

DTBPA=BPM-BPA

DTBPA: Water pollutant load capacity (kg/day)

BPM: Maximum pollutant load (kg/day)

BPA: Actual Pollutant Load (kg/day)

Modeling

River water quality modeling is carried out using the WASP method, and is carried out through a trial-and-error approach so as to produce values that are close to the observations (Diansyukma, 2021). The adjustment process in the model can be carried out to obtain results that are almost the same as the existing conditions in the river basin by adjusting several fixed values for each parameter as part of the model calibration process. Calibration is applied to the hydraulic data and various physical, chemical and biological determinations of the model. The model that has been calibrated can be continued in the verification process so that it can be used for the implementation of river water quality control scenarios (KLHK, 2017).

Determining the similarity of modeling results with actual conditions, can be determined by carrying out the model verification process. This process is carried out through the process of calculating the amount of deviation from the existing condition value with the modeling simulation result value. After obtaining the appropriate validation value, the modeling results can be used as a basis in the management scenario setting process. The process of setting scenarios in the specified modeling is useful for obtaining information regarding the selection of steps in making appropriate and optimal decisions (Budiman, 2010).

RESULTS AND DISCUSSION

River Segmentation and Sampling Points

The Batulicin watershed is divided into 9 segments with 9 sampling points on the Batulicin River. The procedure for naming the segments starts from the upstream part of the river as Segment 1 to the downstream, namely Segment 9.

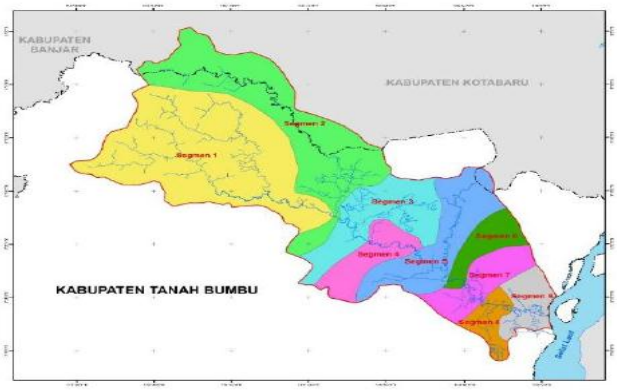

Figure 1: Segmentation map of the batulicin watershed.

Batulicin river hydraulics data

Based on the results of measurements on the Batulicin River, it is known that there has been an increase in river water discharge from the upstream segment to the downstream segment. Segment 1 is the upstream part of the Batulicin River, it is known that the average discharge is 35.05 m^3/s. The downstream section of Segment 9 is known to have an average debit of 73.61 m^3/s.

Table 1: Batulicin river debit.

Segment	Sampling point	Debit (m^3/s)
1	1	35.03
2	2	42.99
3	3	43.82
4	4	47.06
5	5	53.09
6	6	53.94
7	7	57.76
8	8	67.26
9	9	73.61

Batulicin river water quality

Analysis of the water quality of the Batulicin River with Biochemical Oxygen Demand (BOD) parameters. Test data is compared with surface water class 1 and 2 quality standards in accordance with Government Regulation

Number 22 of 2021 concerning Implementation of Environmental Protection and Management.

Table 2: Batulicin River BOD Concentration.

Location	BOD concentration (mg/L)	Quality Standards Class 1 (mg/L)	Quality Standards Class 2 (mg/L)
Segment 1	1.83	2	3
Segment 2	1.86	2	3
Segment 3	1.82	2	3
Segment 4	1.87	2	3
Segment 5	1.99	2	3
Segment 6	1.97	2	3
Segment 7	2.09	2	3
Segment 8	2.10	2	3
Segment 9	1.77	2	3

The Batulicin River Basin in the upper reaches is a forest area which is a Meratus mountain area. The concentration of BOD in Batulicin River water is in the range of 1.77 mg/l to 2.10 mg/l. Table 2 shows that the concentration of BOD in each segment is still below the class 2 quality standard, but Segments 7 and 8 have exceeded the class 1 quality standard.

The BOD parameter in the river can be converted into other compounds through chemical, physical or biological processes. BOD pollutants that enter the Batulicin River are in the form of organic compounds, both originating from certain and indeterminate sources. The effect of organic compounds on each segment did not show a significant increase, but in segments 7 and 8 it was found that the BOD concentration had exceeded the class 1 quality standard.

The addition of organic pollutant loads to river water in each segment can lead to an increase in BOD concentrations, but in the process of flow, river water can absorb oxygen from the atmosphere and from aquatic plant production, thereby increasing DO concentrations in river water. Oxygen absorbed into the water becomes a raw material in the decomposition process of organic compounds. This shows that the organic compounds that enter the river flow are capable of self-purification processes so that the river is able to restore its quality (Saily et al, 2019).

Estimation of potential pollutant loads

The inventory was carried out on variable pollutant sources which were part of the scope of the research, so that pollutant sources of the Batulicin River could be identified. The sources of these pollutants included:

Table 3: Estimation of Potential Pollutant Loads in Each Segment.

Segment	Pollutant Load Source (Kg/Day)			Amount (Kg/day)
	Industry	Domestic	Plantation	
Segment 1		58.62	513.42	572.04
Segment 2		73.70	1229.59	1303.29
Segment 3	10.69	92.36	1862.74	1965.79
Segment 4		47.89	1677.38	1725.27
Segment 5		136.76	2809.55	2946.31
Segment 6	84.53	32.33	523.87	640.73
Segment 7		134.73	1662.32	1797.05
Segment 8		37.02	693.33	730.35
Segment 9		631.50	126.00	757.50

Pollution load capacity of the batulicin river

The pollutant load carrying capacity is calculated using a numerical method, to determine the ability of the river to accommodate pollutant materials. Calculation of pollutant load capacity is the result of subtracting the maximum pollutant load minus the actual pollutant load. A negative value (-) indicates that the pollutant load exceeds the capacity of the river and a value (+) indicates that the river still has an allocation of pollutant load (Andesgur, 2018).

Table 3: Pollution load capacity of the batulicin river.

Location	Actual Poluttan (kg/day)	Maximum Pollutant Load Class 1 (kg/day)	Maximum Pollutant Load Class 2 (kg/day)	DTBPA Class 1 (kg/day)	DTBPA Class 2 (kg/day)
Segment 1	5539	6053	9080	515	3541

Location	Actual Poluttan (kg/day)	Maximum Pollutant Load Class 1 (kg/day)	Maximum Pollutant Load Class 2 (kg/day)	DTBPA Class 1 (kg/day)	DTBPA Class 2 (kg/day)
Segment 2	6909	7429	11143	520	4234
Segment 3	6891	7572	11358	681	4468
Segment 4	7603	8132	12198	529	4595
Segment 5	9128	9174	13761	46	4633
Segment 6	9181	9321	13981	140	4800
Segment 7	10430	9981	14971	-449	4541
Segment 8	12204	11623	17434	-581	5230
Segment 9	11257	12720	19080	1463	7823

Modeling with WASP
BOD parameter modeling in the Batulicin River was carried out using WASP software to simulate water quality with various treatments or scenarios. Calibration of water quality parameters resulting from modeling aims to adjust and determine the suitability between model results and research results or input data.

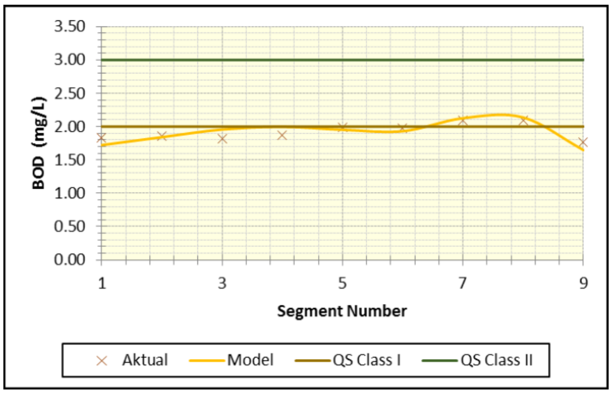

Figure 2: Results of discharge calibration of the batulicin river.

Calculation of model validity needs to be done to find out whether the results of model building and calibration can describe the actual conditions. Calculation of the model suitability level based on RMSE (Root Mean Square Error) and MAE (Mean Absolute Error) which shows the model fit value with the actual data.

Table 5: Results of validation of the Batulicin River BOD model.

Location	Actual BOD (BOD_A)	Model BOD (BOD_M)	$[BOD_A – BOD_M]^2$
Segment 1	1.830	1.723	0.012
Segment 2	1.856	1.838	0.000
Segment 3	1.817	1.954	0.019
Segment 4	1.869	1.994	0.016
Segment 5	1.987	1.951	0.001
Segment 6	1.974	1.929	0.002
Segment 7	2.092	2.125	0.001
Segment 8	2.098	2.136	0.001
Segment 9	1.765	1.646	0.014
RMSE			**0.086**
MAE			**0.073**

Scenario of batulicin watershed management
Analysis of scenarios 1 to 5 for each segment is carried out to find out the most optimal scenario for each segment, in order to obtain directions for controlling the Batulicin River water quality.

Scenario 1
Scenario 1 was conducted to determine the effect of industrial activities on the condition of the quality of the Batulicin River. Reducing the pollutant load is carried out by optimizing the WWTP function from industrial activities, increasing the effectiveness of WWTP treatment and limiting the discharge of waste, so that it can produce wastewater containing 50% less concentration than the actual concentration of pollutant load which is currently discharged into water bodies. Scenario 1 process is carried out by reducing the BOD pollution load, which is 47.61 kg/day.

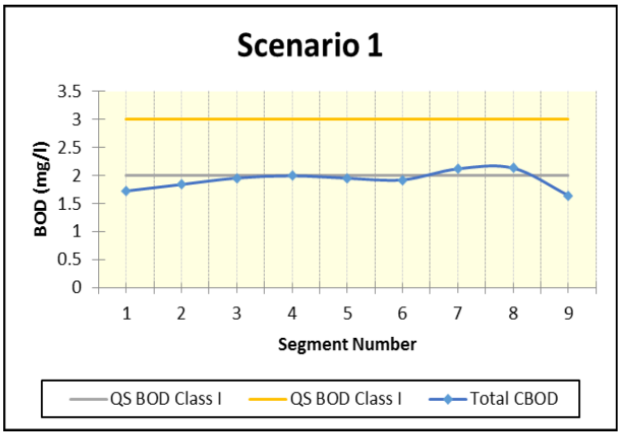

Figure 3: Graph of Scenario 1 Results.

Table 6: Results of Scenario 1 Batulicin River.

Segment	Initial BOD cons (mg/l)	Final BOD cons (mg/l)	Decreased BOD Concentration (%)
1	1.723	1.723	0.000
2	1.838	1.838	0.000
3	1.954	1.953	0.062
4	1.994	1.993	0.050
5	1.951	1.950	0.036
6	1.929	1.920	0.473
7	2.125	2.117	0.335
8	2.136	2.131	0.256
9	1.646	1.644	0.151

Based on the class 1 quality standard for the BOD parameter, it is known that all segments still have a capacity allocation, except for segments 7 and 8. Based on class 2 quality standards, it is known that all segments still have a capacity allocation for BOD pollutant materials. Reducing pollutant concentrations from industrial activities by 50% has not resulted in a significant change in the carrying capacity of pollutant loads in each segment of the Batulicin River.

Scenario 2

Scenario 2 is carried out by reducing the concentration of pollutant loads from domestic activities. Development and utilization of Communal WWTPs can reduce the concentration of domestic pollutants and can reduce the impact of domestic waste pollution and contamination on surface water quality. Scenario 2 was carried out to determine the effect of the community's domestic activities on the condition of the quality of the Batulicin River. Putri and Hardiansyah (2022) Testing the effectiveness of applying Communal WWTP technology which was built using different methods, can give different results on its effectiveness. Communal WWTP using an ABR (Anaerobic Baffled Reactor) and AF (anaerobic filter) treatment system is able to reduce BOD concentrations by 24.01%. The Scenario 2 process is carried out by reducing the BOD pollution load, which is 298.90 kg/day.

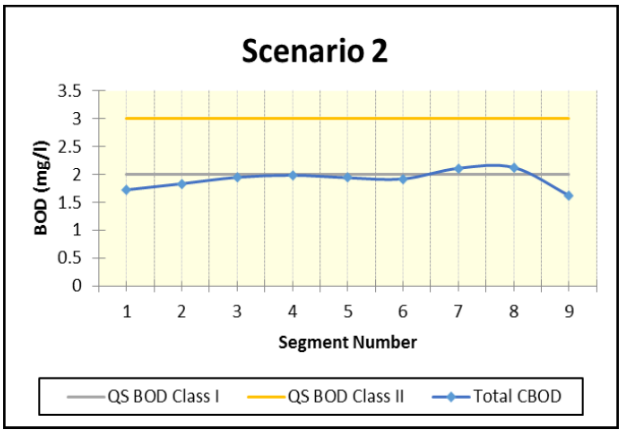

Figure 4: Graph of Scenario 2 Results.

Table 7: Results of Scenario 2 Batulicin River.

Segment	Initial BOD cons (mg/l)	Final BOD cons (mg/l)	Decreased BOD Concentration (%)
1	1.723	1.723	0.000
2	1.838	1.832	0.326
3	1.954	1.946	0.430
4	1.994	1.985	0.468
5	1.951	1.939	0.621
6	1.929	1.917	0.657
7	2.125	2.110	0.707
8	2.136	2.123	0.600
9	1.646	1.622	1.469

Based on the class 1 quality standard for the BOD parameter, it is known that all segments still meet the quality standard, except for segment 7 and segment 8. Based on class 2 quality standard, it is known that all segments meet the BOD parameter quality standard. The reduction in pollutant loads from the domestic sector has not been able to significantly reduce pollutant loads in all segments.

Scenario 3

Scenario 3 is carried out by reducing the concentration of pollutant loads from plantation activities. This scenario was carried out to determine the effect of plantation activities on the condition of the quality of the Batulicin River. Pollution reduction is carried out by carrying out management of plantation areas by implementing environmentally friendly agriculture or Good Agricultural Practices (GAP), so as to minimize pollutant carried by the flow of rainwater into water bodies. This scenario is carried out by reducing 50% of the pollutant carried by the flow to the river. The Scenario 3 process is carried out by reducing the BOD pollution load, which is 5549.10 kg/day.

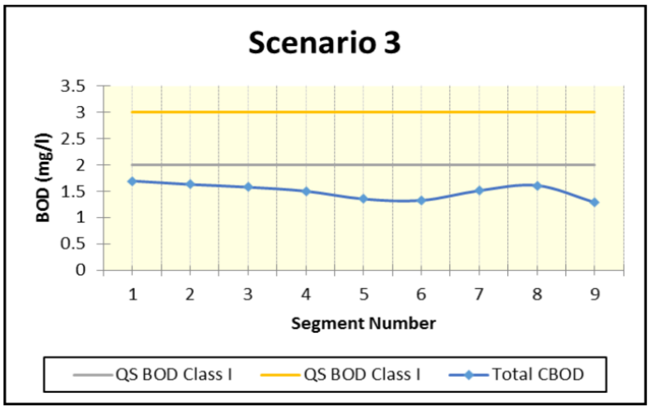

Figure 5: Graph of Scenario 3 Results.

Table 8: Results of Scenario 3 Batulicin River.

Segment	Initial BOD cons (mg/l)	Final BOD cons (mg/l)	Decreased BOD Concentration (%)
1	1.723	1.694	1.639
2	1.838	1.628	11.411
3	1.954	1.577	19.295
4	1.994	1.501	24.716
5	1.951	1.352	30.685
6	1.929	1.325	31.318
7	2.125	1.511	28.879
8	2.136	1.609	24.667
9	1.646	1.289	21.730

Based on class 1 and 2 quality standards for BOD parameters, it is known that all segments meet quality standards. The results of scenario 3 show success in reducing the BOD pollutant load, so that all segments meet the quality standard status. Segments 7 and 8 underwent a change in status from the initial condition of exceeding class 1 quality standards, to meeting class 1 and 2 quality standards. Controlling organic waste from the plantation sector was able to maintain the quality of Batulicin River water from BOD pollutants.

Scenario 4

Scenario 4 is carried out by reducing several pollutant variables in the Batulicin River. This scenario was carried out to determine the effect of integrated handling of various pollutant sources both from residential, industrial and plantation activities on the quality conditions of the Batulicin River. The pollutant load from industrial activities was reduced by 50%, the pollutant load from community's domestic activities was reduced by 24.01%, the pollutant load from plantation activities was reduced by 50% with the aim of knowing the effect of integrated watershed management, through overall management of all sources pollutant both point source and nonpoint source. The Scenario 4 process is carried out by reducing the BOD pollution load, which is 5895.61 kg/day.

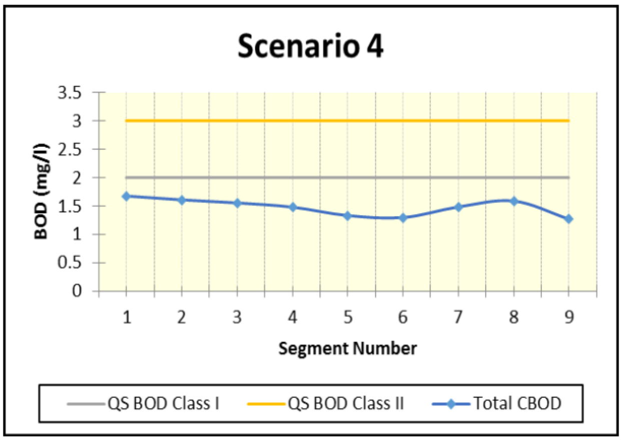

Figure 6: Graph of Scenario 4 Results.

Table 9: Scenario 4 Results of the Batulicin River.

Segment	Initial BOD cons (mg/l)	Final BOD cons (mg/l)	Decreased BOD Concentration (%)
1	1.723	1.676	2.732
2	1.838	1.608	12.506
3	1.954	1.555	20.459
4	1.994	1.480	25.782
5	1.951	1.332	31.735
6	1.929	1.296	32.811
7	2.125	1.484	30.175
8	2.136	1.587	25.688
9	1.646	1.269	22.934

Based on the class 1 and 2 quality standards for the BOD parameter, it is known that all segments meet the quality standards and are below the stipulated quality standard values. The results of scenario 4 are able to change the quality status of the Batulicin River from BOD contaminants in segments 7 and 8, so that they are able to meet quality standards.

Scenario 5

Scenario 5 is carried out by reducing several pollutant variables in the Batulicin River. The pollutant load from industrial activities was reduced by 50%, the pollutant load from community's domestic activities was reduced by 95.85%, the pollutant load from plantation activities was reduced by 50%. The difference with scenario 4 is that in scenario 5, a domestic wastewater treatment system or Communal IPAL is implemented which is equipped with 3 treatment systems. Putri and Hardiansyah (2022) Testing the effectiveness of applying Communal WWTP technology which was built using different methods, can give different results on its effectiveness. Communal WWTP that applies the combination technology of ABR (anaerobic balled reactor), AF (anaerobic filter) and RBC (Rotating Biological Contactor) has an effectiveness in reducing BOD concentrations by 95.85%. The Scenario 5 process is carried out by reducing the BOD pollution load, which is 6789.96 kg/day.

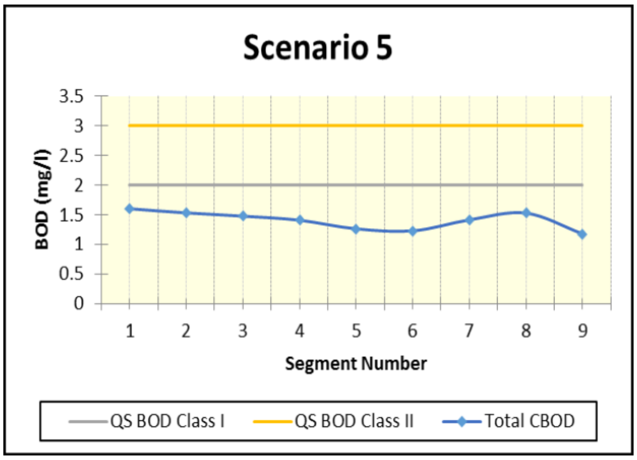

Figure 7: Graph of Scenario 5 Results.

Table 10: Results of Scenario 5 Batulicin River.

Segment	Initial BOD cons (mg/l)	Final BOD cons (mg/l)	Decreased BOD Concentration (%)
1	1.723	1.600	7.104
2	1.838	1.531	16.726
3	1.954	1.476	24.493
4	1.994	1.407	29.450
5	1.951	1.262	35.323
6	1.929	1.227	36.406
7	2.125	1.412	33.522
8	2.136	1.527	28.501
9	1.646	1.177	28.526

Based on the class 1 and 2 quality standards for the BOD parameter, it is known that all segments meet the quality standards and are below the stipulated quality standard values. The results of scenario 4 are able to change the quality status of the Batulicin River from BOD contaminants in segments 7 and 8, so that they are able to meet quality standards. River water quality conditions for the BOD parameter are able to produce lower BOD concentrations compared to the results in scenario 4.

Scenario selection

Segments 7 and 8 it is known that the initial concentration of BOD exceeds the class 1 quality standard but still meets the class 2 quality standard. In segments 7 and 8 there is an accumulation of BOD pollutant, in which the self-purification ability of the river against polluting materials has not been able to be decomposed. to be able to meet class 1 quality standards, so efforts are needed to reduce pollutant materials from their sources.

The scenarios carried out on the Batulicin River, especially efforts on segments 7 and 8, which are expected to be able to meet class 1 and 2 quality standards, are through scenarios 3, 4 and 5. In this scenario, reduction of pollutant is carried out, where in scenario 3 pollutants come from activities plantations, and in scenarios 4 and 5 carried out by reducing pollutant loads from several sectors including the industrial sector, plantations and community settlements.

CONCLUSION

1. Selection of the most optimal scenario to reduce the BOD pollution load on the Batulicin River is by referring to Scenarios 3, 4 and 5.
2. The process in Scenario 3 is carried out by reducing the BOD pollution load of 5549.10 kg/day, in Scenario 4 a reduction of 5895.61 kg/day is carried out and in Scenario 5 a reduction is carried out of 6789.96 kg/day.
3. Management of river water quality in terms of BOD parameters, the most optimal is carried out through scenario 5, namely reducing pollutant materials from community's domestic activities by 95.85%, industrial activities by 50% and plantation activities by 50%, so that water quality is obtained against the BOD parameter at All segments of the Batulicin River meet class 1 and 2 water quality standards.

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