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PROSIDING

SEMINAR NASIONAL INACID

Tema:
Strategi Pengelolaan Irigasi
dan Rawa Berkelanjutan
Mendukung Ketahanan Pangan Nasional
Dalam Perspektif Perubahan Iklim Global

Palembang, 16-17 Mei 2014





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**Balai Besar Wilayah Sungai Sumatera VIII
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C20.11

Nomor Makalah : 3.21

**WATER QUALITY STANDARD DETERMINATION AS AN EFFORT TO MANAGE
WATERSHED QUALITY USING STORET METHOD
(CASE STUDY: SUGUTAMU RIVER, CILIWUNG TRIBUTERY)**

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ABSTRACT

Sugutamu very strategic river existence, because it is located between the city of Depok and Bogor needed an integrated management system , especially the quality and status of water quality. One of the designated river Sugutamu forward is very strategic Sugutamu river water as a source of raw water , so that the necessary management and careful monitoring of water quality based on the function of space and time . It is necessary for the determination of the status of research and the quality of river water quality from upstream and downstream Sugutamu so that referrals can be determined recommendations Sub - watershed management Sugutamu future . Having conducted research at 10 sampling points in the sub - watershed Sugutamu STORET generated using the

Sub - Class River watershed Sugutamu are Class II or Class III . Consider Sugutamu River is expected to be designated as a Class I with a raw water source of drinking water , the necessary management measures in the area around the sub - watershed Sugutamu . Efforts to manage quality and water quality sub - watershed Sugutamu is domestic wastewater settlement watershed by doing more processing before discharged into drainage channels and perform routine water quality monitoring method STORET .

Keywords : Water Quality , STORET Methods.

I. INTRODUCTION

Ciliwung watershed has a total area of 337 and spread out from Bogor to Jakarta , one part of Ciliwung watershed is Ciliwung Creeks where in this case was planned to study the water quality of the Sugutamu River, which has a total area of 13.21 km² and length 13.74 km included in the administrative area of the Sukmajaya District and Cilodong, Depok, and also partly in Cibinong subdistrict, Bogor regency, West Java. Sugutamu River is a sub- watershed of the Ciliwung watershed which located in the central part of the Ciliwung watershed.

The rapid growth of settlements along the river was followed by further shrinking the environmental conditions especially the water quality of Sugutamu sub-watershed. Defect of Sugutamu flood plain impact to human activities on that flood plain. Policies that are considered didn't pro-environment allegedly also be the cause of environmental degradation around the River Sugutamu. Spatial policy, especially the downstream Sugutamu consistently held that no further degrade the environment . Changes of land into residential areas along the banks of the River Sugutamu automatically degrade the quality of water in the river. River pollutant sources can not be separated from the influence of land use and population behavior in disposing of garbage or ^{C21} from agricultural activities, industrial, service and residence.

The administration Watershed Sugutamu pass Bogor regency, and Depok. Because of Jakarta as the capital city, it still a magnet for people to earn a living. Logical consequences to be borne by the city is supporting the provision of space for settlement. As a result of this phenomenon, Depok and Bogor will have the burden to change the spatial projection is mainly cultivated area (lowland, upland conservation areas even) to be converted into residential areas. Increased industrialization in the area around the Sugutamu River also inevitable. Thus, directly or indirectly, the ecological burden Sugutamu river will also be degenerate. Spatial ecological load on the load will also result in ecological river flow Sugutamu on both quantity and quality.

The results of this study can be used as a guide in improving environmental conditions around the river so that the burden of environmental Sugutamu entering into water bodies is reduced and the quality

is getting better with STORET method as one of the basic management of the Water Resources Management (NRM), especially river water

II. RESEARCH METHODS

2.1. Determination of Sampling Point Location

Fragment to be taken along the segment includes Sugutamu sub-watershed in 3 areas, Sukmajaya District, Cilodong District (Depok) and Cibinong district ,Bogor regency. Segments that will be taken by 10 points sampling plan. The basis of this fragment is determining the use of Sugutamu sub-watershed, around conditions Sugutamu Sub- watershed, and surrounding land use Sugutamu sub-watershed.

In the study, a sample of the designation of the river/water samples by purposive with notice to drainage channels cut in pieces that make up the river. Some considerations are used in determining the location of the sample is considered to represent a point that the region is reviewed, free from distractions and selected local areas as well as the activity of a mixture of relatively unspoiled region (upstream) as a comparison. The possibility of changes in water quality. Determination of the point of making the river water quality is also based on the consideration of ease of access, cost and time so specified point is considered to represent the water quality of the river from upstream to downstream. River water sampling sites Sugutamu plan consists of 10 sampling points.

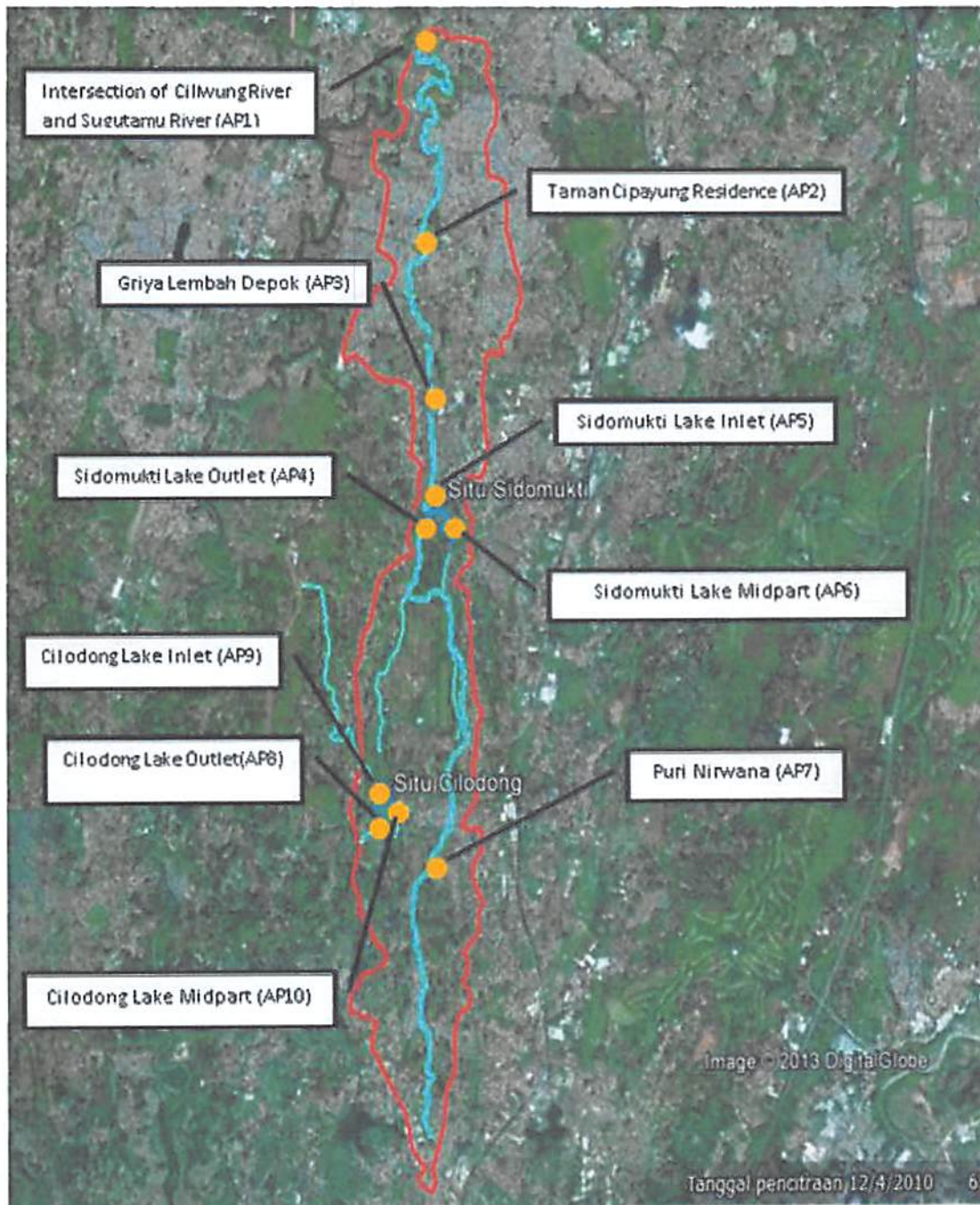


Figure 1 Sampling Points Location

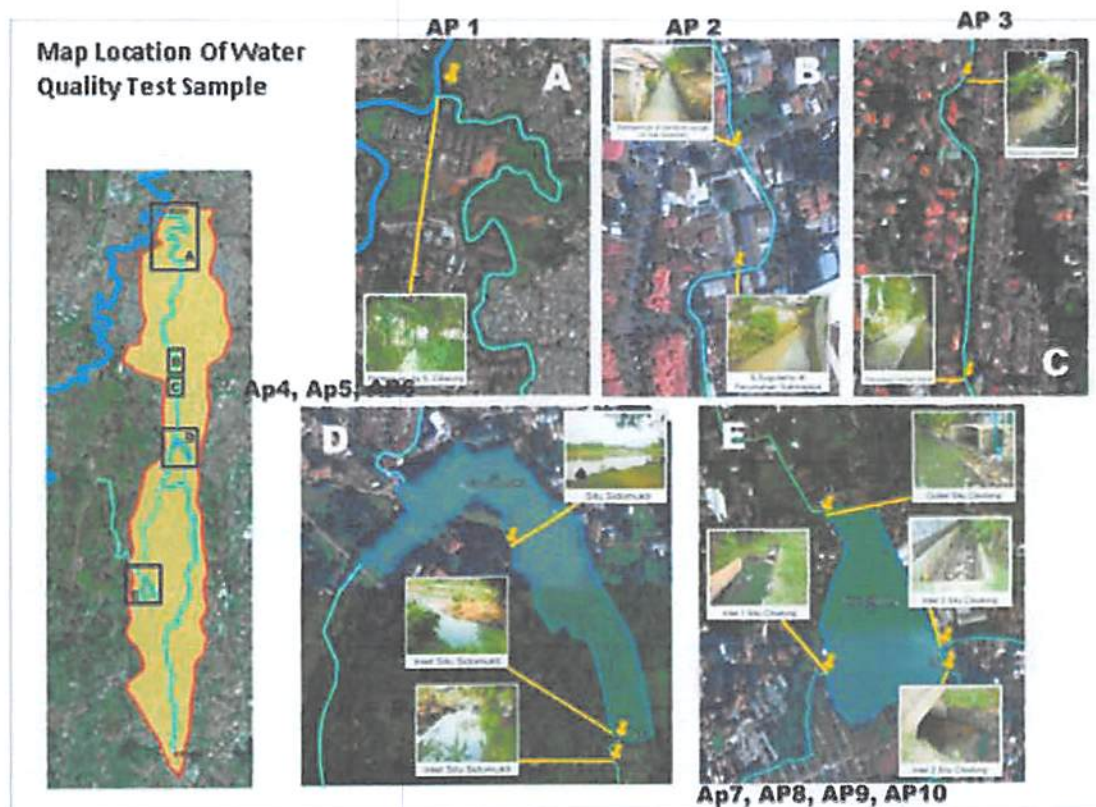


Figure 2 Sampling Points Location

Table 1 Sugutamu Sub-Watershed Water Quality Sampling Location

No	Code	Sampling Point Location	Coordinate	Time
1	AP 1	Sugutamu confluence with the Ciliwung River - Downstream Village Blooms Jaya, Sukma Jaya subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
2	AP 2	Sub-watershed Sugutamu in Housing Cipayung Park - Lower Village Abadi Jaya Sukma Jaya subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
3	AP 3	Sub-watershed Sugutamu in Griya Depok Valley - Lower Village Abadi Jaya Sukma Jaya subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
4	AP 4	Sidomukti Situ Outlet, Village Sukma Jaya Sukma Jaya subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
5	AP 5	Inlet Situ Sidomukti, Village Sukma Jaya Sukma Jaya subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
6	AP 6	There Sidomukti Central Section, Village Sukma Jaya Sukma Jaya	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013

No	Code	Sampling Point Location	Coordinate	Time
		subdistrict, Depok.		
7	AP 7	Sub-watershed Sugutamu in Puri Nirwana 2 - Upper Village Pabuaran, Cibinong subdistrict, Bogor.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
8	AP 8	Outlet Situ Cilodong, Cilodong Village, District Cilodong, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
9	AP 9	Inlet Situ Cilodong, Village Cilodong, Cilodong subdistrict, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013
10	AP 10	There Cilodong Central Section, Village Cilodong, District Cilodong, Depok.	SL 06° 22' 31,5" EL 106° 50' 29,3"	18 July 2013 01 August 2013

Source: Consultant and Unilab Perdana Co. Analysis Data, 2013

2.2. Data Collection and Analysis Techniques

Sampling methods or sample water testing is the process of taking water at predetermined locations, measuring the parameters that can be measured directly in the location (eg, pH, temperature, and dissolved oxygen), preserve, save and carry test sample to a laboratory.

Table 2 Water Analysis Methods

No	Parameter	Unit	Analytical method
1	Temperature	°C	expansion
2	TDS	mg/l	gravimetric
3	TSS	mg/l	gravimetric
4	Ph	mg/l	potentiometric
5	Cooper	mg/l	Atomic Absorption Spectrophotometer
6	Zinc	mg/l	Atomic Absorption Spectrophotometer
7	Cadmium	mg/l	Atomic Absorption Spectrophotometer
8	Reciprocal	mg/l	Atomic Absorption Spectrophotometer
9	Chromium hexavalent	mg/l	colorimetric
10	Nitrate	mg/l	colorimetric
11	Nitrite	mg/l	colorimetric
12	BOD	mg/l	Winkler
13	COD	mg/l	Open Reflux
14	DO	mg/l	Winkler
15	Phenol	mg/l	distillation
16	Phospate	mg/l	colorimetric
17	MBAS	mg/l	colorimetric
18	Chlorine free	mg/l	colorimetric
19	Fecal coliform	total/100 ml	MPN
20	Total coliform	total/100 ml	MPN

Source: Watershed Water Monitoring Books, 2009.

The total area of Ciliwung Creeks Watershed (Sugutamu River) is 13,21 km² and 13,74 km long river included in the administrative area of the Sukmajaya District and Cilodong, Depok, and also partly in Cibinong subdistrict, Bogor regency, West Java. Sukmajaya subdistrict, Depok has boundaries are: north bordering Cimanggis, the south by the District Cilodong, east by Cimanggis and Tapos, west and is bordered by the District Cipayung and Jewel Mas. While in the Cilodong District, Depok has borders : Sukmajaya Subdistrict north, south Bogor Regency, east of the Tapos Distric, west of the District Cipayung. In District Sukmajaya are with an area of 7.5 ha sidomukti, while in Cilodong District are there with an area of 1 ha and has volume of 3,000 m³. River/time Sugutamu itself, including all tributary of the Ciliwung River and is located in the central area of Ciliwung watershed. Location work can be seen in the following figure:

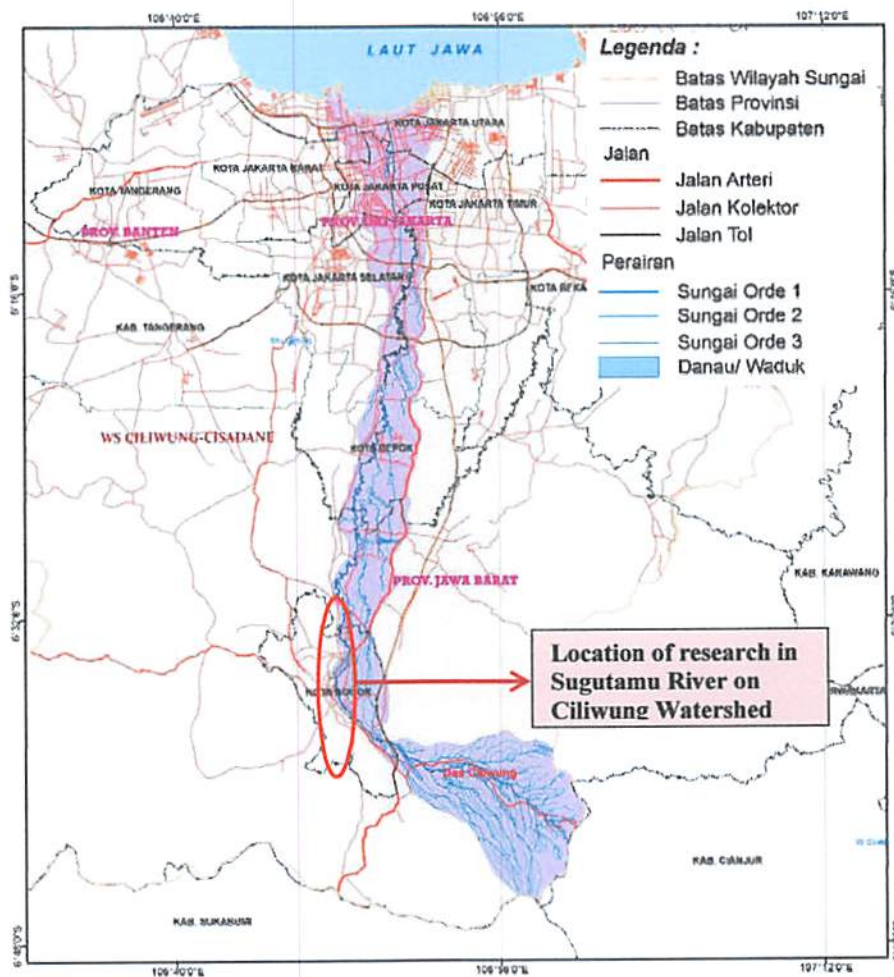


Figure 3 Sugutamu River Water Quality Research Location

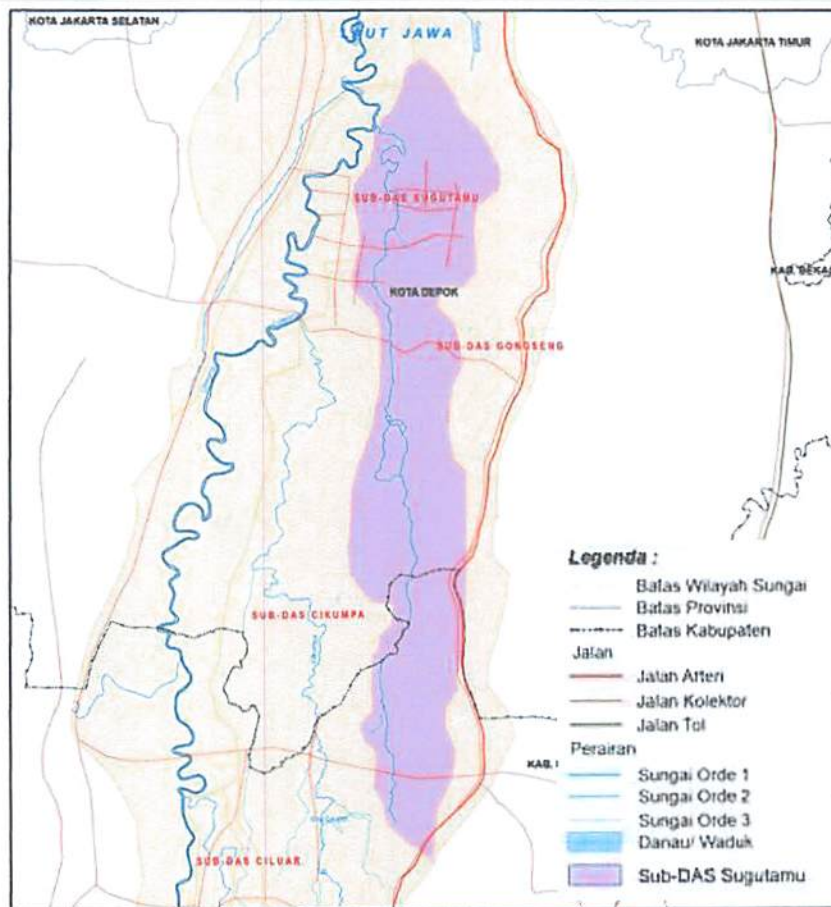


Figure 4 Sugutamu Catchment Area

2.3. River Water Quality Determining Criteria

The criteria determining the quality of the river water benchmarks used to evaluate water quality the river is attachment PP no. 82 / 2001 on water quality management and water pollution control are entailed criteria water quality by class. PP no. 82 / 2001 about water quality management and water pollution control is guidelines determination water quality. With guidelines this can be known parameters that has filled or beyond quality standards water. In principle guidelines determination water quality is to compare between data water quality raw with water quality adapted to aimed. Quality standards water by class is as follows:

Table 3. Water Quality Criteria Based on Class (Government Regulation No 82 Year 2001)

NO	PARAMETERS	UNIT	WATER QUALITY CRITEA (MAX. CLASS LVL)			
			Class I	Class II	Class III	Class IV
I PHYSIC						
1	Temperatur	OC	Dev. 3	Dev. 3	Dev. 3	Dev. 5
2	Residu terlarut	mg/L	1000	1000	1000	2000
3	Residu tersuspensi	mg/L	50	50	400	400
II CHEMISTRY						
1	pH		06-Sep	06-Sep	06-Sep	06-Sep
2	B O D	mg/L	2	3	6	12
3	C O D	mg/L	10	25	50	100
4	D O	mg/L	6	4	3	0
5	Total Fosfat sebagai P	mg/L	0,2	0,2	1	5
6	NO3 sebagai N	mg/L	10	10	20	20
7	Cadmium (Cd)	mg/L	0,01	0,01	0,01	0,01
8	Chrom (Cr+6)	mg/L	0,05	0,05	0,05	1
9	Copper (Cu)	mg/L	0,02	0,02	0,02	0,2
10	Reciprocal (Pb)	mg/L	0,03	0,03	0,03	1
11	Zinc (Zn)	mg/L	0,05	0,05	0,05	2
12	cyanide (CN)	mg/L	0,02	0,02	0,02	-
13	Nitrite as N (NO2)	mg/L	0,06	0,06	0,06	-
14	Chlorin free	mg/L	0,03	0,03	0,03	-
15	Sulfur as H2S	mg/L	0,002	0,002	0,002	-
III ORGANIC CHEMISTRY						
1	Detergent as MBAS	µg/L	200	200	200	-
2	Seny.Phenol sebagai Phenol	µg/L	1	1	1	-
IV MICROBIOLOGY						
1	Fecal Coliform	tot/100ml	100	1000	2000	2000
2	Total Coliform	tot/100ml	1000	5000	10000	10000

Sumber : Government Regulation No. 82 year 2001 about Water Quality Management and Polluted Water Control

2.4. Criteria for the determination of the Status of Water Quality

Refers to the decision of the Minister of State for the environment No. 115 in 2003 about the determination of the Status of Water Quality Guidelines, one of the methods used to determine the status of the quality of river water quality is with the method of STORET. With this in mind STORET method parameter meet or exceed the quality of raw water. In principle the method is to compare data between the STORET water quality with raw water quality tailored to allocation so as to determine the status of the quality of the water.

2.5. The procedure of the use of STORET methods

Method of determining the status of water quality is with the methods STORET where principle this method is by comparing between data the quality of water taken in series and water quality standards,

which were adapted to is aimed to determine the status of water quality. The determination of the status of water quality by using the method storet done by steps as follows:

1. to conduct collecting data of water quality and water debit periodically so as to form data from time to time (time series data).
2. compare data of measurement from each of the parameters of water quality standards with the value of the corresponding to that class of water.
3. if measurement result fulfill the water quality standards (measurement result & it; quality standards and given the 0 scores.
4. if measurement result not fulfill the quality standards (water or result of measuring & gt; quality standards and given a score in accordance with the table 4 the following:

Table 4 STORET Methods To Determine Water Quality Status

Number Of Samples	Value	Parameter		
		Physics	Chemistry	Biology
< 10	Maximum	-1	-2	-3
	Minimum	-1	-2	-3
	Average	-3	-6	-9
> 10	Maximum	-2	-4	-6
	Minimum	-2	-4	-6
	Average	-6	-12	-18

Sumber : Environment Ministerial Decree No 115 Year 2013 about Water Quality Status Determination guidance

5. number of negatives of all parameters are calculated and determined the status of mutunya of the total score obtained by use of the value system.

How to determine the status of the quality of the water is to use a value system of the US-EPA (the United State Environmental Protection Agency) to classify the quality of water in four classes as shown in table below:

Table 5. Water Quality Standard Grading System

No	Category		Skor	Status
1	Class A	Very Good	0	Fulfill EQS*
2	Class B	Good	-1 s/d -10	Light Polluted
3	Class C	Mid	-11 s/d -30	Mid Polluted
4	Class D	Worse	>-31	Heavy Polluted

*EQS = Environment Quality Standard

Sumber : Environment Ministerial Decree No 115 Year 2013 about Water Quality Status Determination guidance

III. RESULT AND DISCUSSION

As mention earlier, 10 sampling points have been taken. Water quality monitoring carried out 2 times in the year 2013 on dry season (July and August 2013). This period of time are chosen because most of the water bodies monitored are utilize as acceptance of wastewater whether from domestic, industry and/or agriculture activity. On dry season, like any other river characteristic in Indonesia, water discharge are mostly small, therefore it will affect the water quality in the river. On dry season, water quality are tend to be worse because of thinning factor from the rain water is reduced.

After water sample are taken, water quality analysis are conducted in the lab. Analysis result toward water parameter are analyze with STORET methods, and result of determining water quality on 10 sampling points are divided into 3 places, they are: Sugutamu River, Sidomukti Lake and Cilodong Lake.

Based on laboratory lab analysis on August and July 2013, Sugutamu river exceed the class I quality on the same parameter which is ferro, DO, BOD, COD, phosphate, chloride, fat oil, sulfide, fecal coliform and total coliform. Sidomukti Lake has not fulfill the standard quality of class I on ferro, DO, BOD, COD, phosphate, chloride, phosphate fecal and phosphate total parameter. While Cilodong Lake has not fulfill the standard quality of class I on DO, BOD, COD, chloride, coliform fecal and coliform total.

3.1. Status and Quality of Sugutamu Sub-Watershed

Sugutamu river is a small river which pass through Depok City and Bogor Regency, which transverse with a length of 13,74 km, therefore to monitor the quality of water in Sugutamu River, sampling are taken in 4 location. These locations are:

1. Intersection of Sugutamu River and Ciliwung River (AP1)
2. Sugutamu sub-watershed in Taman Cipayung Residential (AP2)
3. Sugutamu sub-watershed in Griya Lembah Depok (AP3)
4. Sugutamu sub-watershed in Puri Nirwana (AP7)

Based on STORET method calculation, water quality score in Sugutamu River based on Government Regulation No. 82 Year 2001 and Environment Ministerial Decree No. 115 Year 2003, is as follow:

Table 6 Water Quality Status in Sugutamu River in AP1

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-60	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-30	CLASS C	MID	MID POLLUTED
CLASS III	-4	CLASS B	GOOD	LIGHT POLLUTED
CLASS IV	0	CLASS A	VERY GOOD	FULLFILL EQS

Table 7 Water Quality Status in Sugutamu River in AP2

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-70	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-45	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-10	CLASS B	GOOD	LIGHT POLLUTED
CLASS IV	0	CLASS A	VERY GOOD	FULFILL EQS

From STORET Method calculation above, water quality score of Sugutamu River on AP1 only fulfill Standard Quality of Class IV with light, medium and heavy status, which can be utilize to irrigate agriculture and/or other utilization which has the same standard.

Table 8 Water Quality Status in Sugutamu River in AP3

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-100	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-65	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-60	CLASS D	WORSE	HEAVY POLLUTED
CLASS IV	-20	CLASS C	MID	MID POLLUTED

Table 9 Water Quality Status in Sugutamu River in AP7

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-70	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-50	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-32	CLASS D	WORSE	HEAVY POLLUTED
CLASS IV	-30	CLASS C	MID	MID POLLUTED

From the STORET method calculation above in AP3 and AP7, still has not fulfill the standard quality of river class I, II, III and IV, and catagorized as medium and heavy polluted.

3.2. Water Quality in Sugutamu River – Sidomukti Lake

Sidomukti Lake is one of lakes that has been passed by Sugutamu River, which is located in Sukmajaya village, Depok. To observe the quality of water in Sugutamu River, analysis of lakes passed by the river are needed, because these lakes are an indicator of pollutant compiling accumulation from the upstream of the river, therefore, these lakes must be analyze. Water quality in Sidomukti Lakes took 3 sampling points, they are Sidomukti Lake Outlet (AP4), Sidomukti Lake Inlet (AP5) and Sidomukti Lake midpart (AP6).

Based on STORET method calculation, water quality score in Sugutamu River based on Government Regulation No. 82 Year 2001 and Environment Ministerial Decree No. 115 Year 2003, is as follow:

Table 10 Water Quality Status in Sugutamu River in AP4

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-70	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-20	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-8	CLASS B	GOOD	LIGHT POLLUTED
CLASS IV	0	CLASS A	VERY GOOD	FULFILL EQS

Based on calculation result toward water quality from Sugutamu River – Sidomukti Lake observation fulfills standard quality of class II and IV which are taken in the Sidomukti Lake Outlet, shows that Sugutamu River – Sidomukti Lake is in a heavy poluted condition.

Sidomukti Lake Inlet, Sukmajaya Village, Depok (AP5)

Table 11 Water Quality Status in Sugutamu River in AP5

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-80	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-35	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-23	CLASS C	MID	MID POLLUTED
CLASS IV	-15	CLASS C	MID	MID POLLUTED

From STORET Method calculation above, water quality score from Sugutamu River – Sidomukti Lake observation which are taken in the Sidomukti Lake Inlet has not fulfill the standard quality of Class I, II, III and IV and it is categorized as mid and heavy polluted.

Table 12 Water Quality Status in Sugutamu River in AP6

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-80	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-40	CLASS D	WORSE	HEAVY POLLUTED
CLASS III	-20	CLASS C	MID	MID POLLUTED
CLASS IV	0	CLASS A	VERY GOOD	FULFILL EQS

Based on STORET Method calculation above, water quality score from Sugutamu River – Sidomukti Lake observation fulfill the standard quality of class IV, water are utilize for irrigation and/or other utilization with the same standard. It is shown that it is heavy polluted.

3.3. Cilodong Lake Water Quality

Table 13 Water Quality Status in Sugutamu River in AP8

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-55	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-20	CLASS C	MID	MID POLLUTED
CLASS III	-8	CLASS B	GOOD	LIGHT POLLUTED
CLASS IV	0	CLASS A	VERY GOOD	FULFILL EQS

Based on STORET Method calculation above, water quality score from Sugutamu River – Cilodong Lake observation which are taken from Cilodong Lake Outlet fulfills the standard quality of class IV, and can be utilize as irrigation and/or other utilization with the same standard. It is shown that it is light, mid and heavy polluted.

Table 14 Water Quality Status in Sugutamu River in AP9

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-60	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-10	CLASS B	GOOD	LIGHT POLLUTED
CLASS III	0	CLASS A	VERY GOOD	FULFILL EQS
CLASS IV	0	CLASS A	VERY GOOD	FULFILL EQS

From the STORET Method Calculation above, water quality score from Sugutamu River – Cilodong Lake, which are taken from Cilodong Lake Inlet fulfills the standard quality of class II, and it is utilize for fresh water cultivation, farming, irrigation and/or other utilization with the same standard.

Table 15 Water Quality Status in Sugutamu River in AP10

WATER CLASS	SCORE TOTAL	CATEGORY		STATUS
		CLASS	STATUS	
CLASS I	-40	CLASS D	WORSE	HEAVY POLLUTED
CLASS II	-10	CLASS C	GOOD	HEAVY POLLUTED
CLASS III	-8	CLASS D	GOOD	HEAVY POLLUTED
CLASS IV	0	CLASS C	MID	MID POLLUTED

From the STORET Method calculation above, water quality score from Sugutamu River – Cilodong Lake midpart observation fulfill the standard quality of class IV, and it can be utilize as irrigation and/or other utilization with the same standard. It is shown that it is light and heavy polluted.

IV. WATER QUALITY MANAGEMENT EFFORT RECOMMENDATION

River has a dinamic characteristic, therefore, in its potential utilization may reduce its benefits and endanger its environment widely. Flood disaster caused by riverbed constringency due to wild settlements

intervention, waste disposal and sedimentation accumulation. Pollution caused by domestics, industrial and agricultural liquid waste caused degradation of environmental support.

One of the important effort to manage water quality is conducting water quality monitoring. Water quality monitoring serves to give factual information about present water quality condition, past liability and future environment changes prediction. Basic information from monitoring activity may be used as reference to compose planning, evaluation, controlling and supervising environment, spatial planning, location or activity permit, as well as determining of water quality and waste water. Monitoring result can be used as a basic consideration, regulation compose or decision maker and environment management regulation evaluation in local environment law.

In this case, analysis in order to monitor water quality has been done and provide information which causes degradation of water quality in Sugutamu River, is spatial change to settlement along the river bank, which automatically decreasing water quality. Waste disposal and domestic waste are dispose directly to the river, therefore, from the water quality analysis result of Sugutamu River, further study and effort to manage waste and local waste must be done.

V. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

From the water quality analysis, main cause of water quality degradation in Sugutamu Sub-Watershed, Sidomukti lake and Cilodong Lake is trash and domestic pollution which are directly thrown to the river. Water quality identification shows that water quality for Sugutamu Sub-Watershed fulfil the water quality class II and III. To improve the water quality for drinking, variety management are required in Sugutamu Sub-Watershed. With determination and monitoring using STORET Methods is the easiest way to manage a watershed or sub-watershed.

5.2. Suggestions

The ownership of sanitation facilities and infrastructure especially latrines and septic tanks as well as infiltration structures in populous settlements, Sugutamu Riverbanks are required, because if these requirements are not fulfilled, it may impact water organisms life, groundwater qualities, society health and environment aesthetics. Other than that, health promotion are needed so that societies doesnt throw away excrement in open water bodies, as a preventions of water borne disease, such as typhoid fever, Hepatitis A, dysentery, cholera, polio, etc. Efforts to prevent and control pollution of the river are:

1. Conducting sanitation of poluted river periodically, as well as from local government and societies, together cleans Sugutamu rivers and lakes to maintain its continuity.
2. Installation of appealing board along the riverbanks and placements of trash bins.
3. Conducting waste reduction program such as 3R or wastes banks.
4. Normalization river channel, sedimentation dredging, waste filtering blocks construction, riverbanks settlement curbing.
5. Constructing demonstration plot for vegetatives water quality increasement in river banks.
6. Activity result evaluation by monitoring as well as analysis river water qualtiy with quality standards established.
7. Gives counseling and approach to societies through environmental programs to develops societies awareness to environment.

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