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Environmental Management As Control Of Environmental Pollution Due To Housing Projects

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ABSTRACT: Housing construction will cause environmental damage, such as air, water, and noise pollution. Therefore, this study aims to determine air, water, and noise quality in a housing project, using a qualitative descriptive method. Laboratory results for several parameters, such as air, water, and noise quality before project commencement and construction, were made. The results of this comparison will indicate the success of overcoming environmental pollution. It is known that overcoming environmental pollution can improve air and water quality during construction, while noise still occurs but is still within normal limits. Based on the results of this study, everyone who will carry out a construction project needs to make efforts to manage and control the environment according to the environmental conditions and the project. After that, ecological pollution was reduced.

ABSTRAK: Pembangunan perumahan akan menimbulkan kerusakan lingkungan, seperti pencemaran udara, air, dan kebisingan. Oleh karena itu, penelitian ini bertujuan untuk mengetahui kualitas udara, air, dan kebisingan pada suatu proyek perumahan, dengan menggunakan metode deskriptif kualitatif. Beberapa parameter seperti kualitas udara, air, dan kebisingan sebelum proyek dimulai dan selama konstruksi diukur dan di uji laboratorium. Hasil perbandingan ini akan menunjukkan keberhasilan penanggulangan pencemaran lingkungan. Diketahui bahwa upaya pengendalian pencemaran lingkungan akibat proyek pembanguan perumahan dapat meningkatkan kualitas udara dan air selama konstruksi, sedangkan kebisingan masih terjadi namun masih dalam batas normal. Berdasarkan hasil penelitian ini, maka setiap orang yang akan melaksanakan suatu proyek konstruksi perlu melakukan upaya pengelolaan dan pengendalian lingkungan sesuai dengan kondisi lingkungan dan proyek tersebut. Setelah itu, polusi ekologis berkurang.

***KEY*WORDS:** Environmental impact, Environmental pollution, Environmental monitoring, Housing project, Project noise, Project management

1. INTRODUCTION

Environmental protection and management is a systematic and integrated effort to preserve ecological functions and prevent environmental pollution or damage, including planning, utilization, control, maintenance, supervision, and law enforcement [1].

One of the most potent instruments in protecting the environment is the environmental protection law [2]. The role of law in preventing and reducing pollution and environmental damage helps anticipate activities that negatively impact the environment [3] and put policies into environmental laws and regulations [4].

Environmental management problems are considered as one of the leading causes of natural disasters in Indonesia. Development without considering environmental balance factors will result in damage [5]. Environmental damage due to exploitation of natural resources, including housing construction, can disrupt natural resources, earth, air, water, soil, flora, and fauna, and leave waste, pollution, and damage. Environmental damage indeed occurs globally [6]; it is concluded that environmental pollution is a severe problem [7].

Based on the problems that have been described, this research is significant to determine the quality of air, water, noise before and during construction. After the tests are carried out, environmental management efforts and environmental pollution control must be formulated. Furthermore, it will be identified whether the prevention of environmental pollution can maintain air, water, and noise quality or even improve its quality.

The research location as a project sampling will be targeted at the Bela Negara Regency, located in BabakanTegalpanjang Village, Cireunghas District, Sukabumi Regency, West Java Province, Indonesia, has built 166 residential units. The results of this study are expected to provide solutions for dealing with the environmental pollution in the housing project in this case study and other housing projects.

2. MATERIALS AND METHODS

2.1. Methods

The research method in this study uses a qualitative descriptive method [8], primary and secondary data sources obtained by observation, interview, laboratory testing, and literature study.

Water data collection is carried out directly at the housing project site before and during construction. Then laboratory tests are carried out. Air quality data retrieval using gravimetry and gas analyzer, while noise measurement using a sound level meter. These tools are shown in Figure 1.

Fig. 1. Gravimetric, gas analyzer, and sound level meter device

Data were collected before and during construction for laboratory testing. The results of laboratory tests are compared in conditions before construction and during construction after controlling and controlling environmental pollution measures have been carried out.

Identify the source of the impact, the type of impact, then carry out environmental management and environmental monitoring efforts and create a Matrix of environmental management and monitoring efforts [9].

2.2. Literature Study

Previous studies are used as a reference in the calculation process. Meanwhile, the environmental impact management system refers to laws and regulations related to benchmarks and quality standards.

Provision of quality standards for wastewater quality [10], ambient air quality standard based on Government Regulation of the Republic of Indonesia Number 41, 1999 [11], water quality standards based on the Regulation of the Minister of Health in 2017 [12], rainwater runoff management system based on the Regulation of the State Minister of the Environment Number 11, 2009 [13], waste management system based on Government Regulation of the Republic of Indonesia Number 27, 2020 [14], hazardous and toxic waste storage management system based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia, 2020 [15], The standard of clean water needs is based on the Indonesian National Standard Number 03-7065-2005 [16], solid waste generation standard based on Indonesian National Standard Number 19-3964, 1994 [17], and wastewater treatment plants [18].

3. RESULTS AND DISCUSSION

3.1. Location

The housing development was located at Bela Negara Regency, which is situated in Babakan RT 05/09 Tegal Panjang Village, Cireunghas District, Sukabumi Regency, West Java Province, Indonesia. The land area is 16,000 m2 and has a Land Use Designation Letter (SPPL) issued by the Land and Spatial Planning Office of Sukabumi Regency on November 9, 2020, with Number: 503/1551-Bid.TR.

3.2. Analysis

The analysis begins by measuring the level of threat caused by this housing development. The stages observed were pre-construction, construction, and operational. Several parameters are used as a reference in determining environmental impacts, such as licensing, noise, worker recruitment, air quality, water quality (sanitation), waste, green open space management, and waste management. Meanwhile, the points observed in this study are as follows:

- Source of impact
- Type of impact
- The magnitude of the impact
- Environmental management
- Environmental monitoring

- Environmental management and monitoring result

3.3. Pre-construction stage

Initial observations will define the environmental conditions of development, the sources of impacts, types of effects, and the magnitude of the impacts of environmental pollution. The pre-construction stage is closely related to community social and licensing administration[19]. Therefore, it is essential to study it before moving on to the next step. However, environmental conditions, including air, water, and noise quality, are also considered in this stage. The data collection and laboratory tests of air quality conditions are described in Table 1, river water quality is displayed in Table 2, feasible water quality is shown in Table 3, and the situations are presented in Table 4.

Table 1. Air quality before construction

Parameters (units)	**Sampling Point Project main area**	**Qty. Standards**	**Method**
Dust TSP (ug/Nm3)	3,7	-	Gravimetri
NO2 (ug/Nm3)	4,8	200	Gas analyzer
SO2 (ug/Nm3)	6,2	150	Gas analyzer
CO (ug/Nm3)	11,5	10.000	Gas analyzer

Based on the initial conditions before construction, it can be seen that the air quality is in good condition, below the standard based on Government Regulation of the Republic of Indonesia Number 41, 1999 [11]. River water quality in pre-construction condition as in Table 2.

Table 2. River water quality before construction

Test description	**Result**	**Units**
Physical Properties		
Temperature	26,3	˚C
Total Suspended Solids, (TSS)	35	mg/L
Total Dissolved Solids, (TDS)	90	mg/L
Chemical Properties		
pH	7,34	pH Unit
COD	35	mg/L
BOD5	16	mg/L
Nitrite, NO2-N	0,002	mg/L
Nitrate, NO3-N	1,4	mg/L
Iron, Fe	0,91	mg/L
Copper, Cu	<0,01	mg/L
Manganense, Mn	0,02	mg/L
KromHeksavelen, Cr6-	0,02	mg/L
Zinc, Zn	0,02	mg/L

River water quality is categorized in class 1 but contains iron Fe and BOD5 within normal limits. Useable water quality before construction is shown in Table 3.

Table 3. Useable water quality before construction

Test Description	Result	Specification*	Unit
Physical Properties			
Temperature	26,1	Air temp.± 3°	°C
Turbidity	0,95	25	NTU
Total Dissolved Solids (TDS)	29	1000	mg/L
Color	10	50	TCU
Smell	no smell	no smell	-
Rasa	no taste	no taste	-
Chemical Properties			
pH	5,2	6,5-8,5	pH Unit
Iron, Fe	2,55	1	mg/L
Manganese, Mn	0,8	0,5	mg/L
Zinc, Zn	<0,01	15	mg/L
Sulfate, SO_4	1	400	mg/L
Hexavalent Chromium, Cr^{6+}	0,037	0,05	mg/L
Nitrate, NO_3-N	1,9	10	mg/L
Nitrite, NO_2-N	0,011	1	mg/L

Useable water quality before construction was in good condition, below the average threshold based on the Minister of Health no. 32 of 2017 concerning environmental health quality standards and water health requirements for swimming pool sanitation hygiene, solus per aqua, and public baths (for sanitation hygiene purposes)[20]. Pre-construction noise based on laboratory measurements and tests as in Table 4.

Table 4. Noise pollution level before construction

Parameter (unit)	Sampling PointProject main area	Qty. standards	Method
Noise dB (A)	44,2	55	Sound Level Meter

The noise pollution before construction was below the standard noise threshold, as described in Table 4.

3.4 Environmental Management and Control Efforts Pre-Construction Stage

Environmental management and control efforts are applied at the pre-construction and construction stages. Sources impacts of housing project consist of community approvals and permits. The type of impact is public perception and compliant company licensing.

The source of the impact of community outreach activities is caused by public unrest. Various perceptions in the community in the form of positive and hostile towards the housing development plan are the types of impacts of this activity. The magnitude of the measurable impact comes from residents who assess this development triggers a negative effect.

Suggested environmental management is an effort to build two-way communication to increase positive perceptions and create several programs, which can be mutually beneficial to both parties. On the other hand, environmental monitoring also applies observation, documentation, and recording of existing data. Implementing environmental management and monitoring on socialization issues is the disappearance of public unrest supported by good relations between the company and the local community.

Sukabumi Regency Government required permits based on applicable laws and regulations regarding housing development. Document licensing is another source of impact. The type of impact is in the form of complex administrative rules. The magnitude of the impact of licensing is needed to ensure legal certainty in investment and orderly company administration. Environmental management is realized by completing permits in following standards and regulations. Continuous coordination is an effort to monitor the environment in terms of this impact. Fulfill the required documents and compliance with applicable policies results from environmental management and monitoring activities.

Recruitment of labor in this project is also another source of impact. It is expected to reduce the unemployment rate around the construction site. The magnitude of the effect is the total number of people empowered to complete housing units, including social and public facilities. During construction, an entire workforce of 20 people is required. If calculated based on the average wage of daily workers with a salary of Rp. 100.000 per day and the adequate working time per month is 24 days, then the worker's income in one month is Rp. 2,400,000. The micro-economic sector will rotate from the salary paid to workers as many as 20 people are Rp. 36,000,000-, per month.

Environmental management is carried out by prioritizing the local community to work during the construction phase based on the needs of the project and the capabilities of the local community. Environmental monitoring will observe the existing conditions using documentation and recording. Implementing environmental management impacts reducing the unemployment rate at the project location and strengthening the relationship between the company and the local community.

3.5 Environmental Management and Control Efforts in Construction Phase

Environmental management and control efforts at the construction stage aim to prevent environmental pollution. Prevention of environmental pollution is focused on the quality of air, water, and noise.

Housing projects in the early stages include land preparation work. To anticipate environmental pollution, in this work, before land clearing is carried out, the controlled area is first fenced to maintain a safe distance between the activity location and residents. The use of land is cut, and fill activities are designed so that nothing is wasted. Backhoe machines are used for this activity. Furthermore, the outer boundary of the land is made of ditches, drainage, and temporary settling ponds.

Before the land preparation work, a retaining wall (TPT) was first erected to maintain the stability of the soil in the unstable cliff area. Design of retaining wall as described inFigure 2.

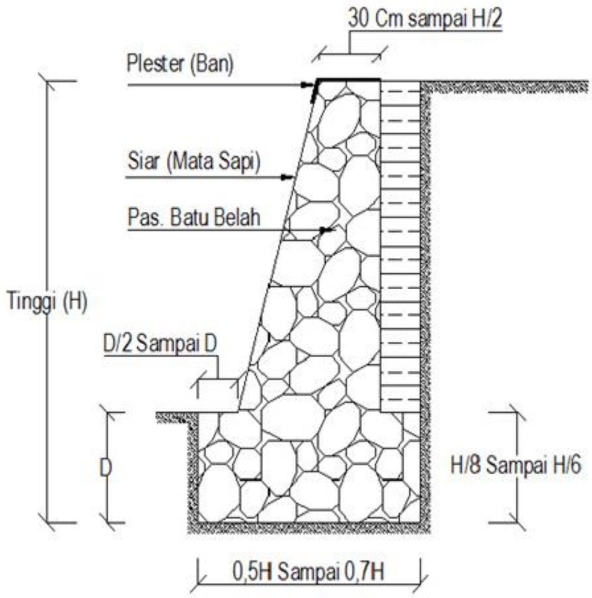

Fig. 2. Retaining wall design

Construction activities require a variety of heavy equipment and materials. Mobilization of equipment and materials is adjusted to the stages of work to avoid accumulation at the site location. Tools that are no longer in use are immediately pulled off the site.

The construction of a road network and drainage system in housing consists of 2 types of roads, namely ROW 6 and ROW 8 roads with flexible pavement using asphalt. The road structure includes subgrades defined as a layer of backfill, sub-base course, base course, and pavement from the flexible or concrete pavement. Sub-grade compaction needs to be carried out to ensure maximum density according to the road designation. Road damage is prevented by drainage channels on the left and right sides of the road to channel water from the road body to the canal. The road surface must have a slope of ±2% to accommodate rainwater entering the canal-road and drainage design as described in Figure 3.

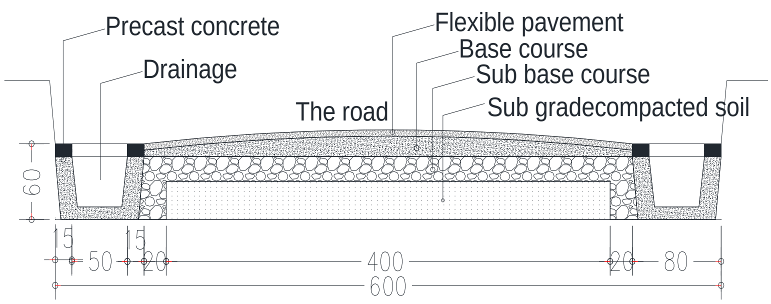

Fig. 3. The geometric design of the roads

On the left and right road, drainage is built with a width of 0.8 m and a depth of 0.4 m. This drainage is connected to infiltration wells to accommodate water runoff and the nearest main drainage at the housing entrance. Drainage design as described in Figure 4.

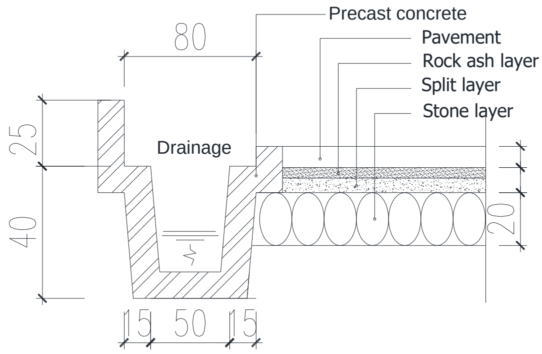

Fig. 4. Drainage structure design

There are 287 housing units in this development. Of course, it will trigger household waste in domestic liquid waste that comes from household activities such as bathing, washing, etc. The volume of domestic liquid waste is 80% of clean water needs [21].

Water needs are assumed when the housing is fully occupied, and each housing unit is filled with at least five people [22]. The volume of water is calculated by multiplying the amount of clean water needed for each person. Five people for each house amounted to 287 units, bringing the total number to 1435 people. The water requirement per person per day is 0.12 m^3, and the entire water requirement is 0.12 × 1435 or as much as 172.2 m^3/day.

Another need for clean water is for gardening. This need is identified as 2 m^3/day so that the total need for clean water in housing is 174.2 m^3/day. Based on the full use of clean water, domestic liquid waste of 80% of clean water needs can be calculated using Equation 1.

$$\text{Q all} = 0.8 \text{ x } \Sigma \text{ clean water needs} \quad (1)$$

Based on Equation 1, the emergence of domestic liquid waste is:

$$\text{Q all} = 0.8 \text{ x } 174.2\text{m}^3/\text{day} \quad (1)$$

So it is, estimated that the incidence of domestic liquid waste is as much as 139,366 m^3 / day. The impact of this waste further needs to be taken control measures not to pollute the environment.

Control environmental pollution due to household waste by making septic tanks, communal IPAL, and bio pores. Dirty drains are channeled separately by a septic tank. Dirty water channels using pipes are made in each housing unit, conducted directly on communal IPAL, while rainwater channels are directed to the road drainage. Septic tanks are made of brick pairs, plastered, waterproof, and the top is covered with reinforced concrete plates with a thickness of 10 cm, and the septic tank structure uses reinforced concrete[19]. Septic tanks are equipped with control and catchment holes-Septic tanks are designed to combat environmental pollution, as described in Figure 5.

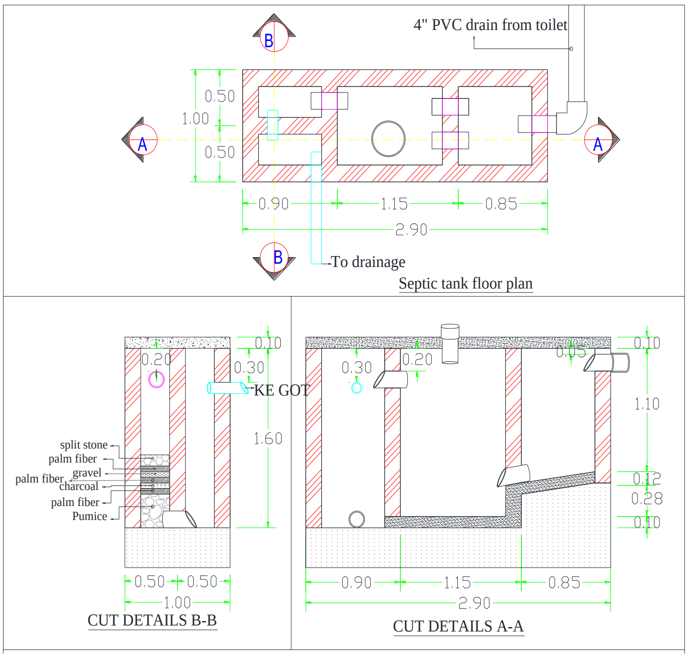

Fig. 5. Septic tank design

As in Figure 5, Septic tanks are made on every housing unit placed in the house's front yard. For dirty water reservoirs (Grey Water), the remains of washing, and other activities, a communal Wastewater Treatment Plant (IPAL) is created. Communal IPAL is created and placed in a green open space (RTH) area that manages domestic liquid waste by separation, deposition, and filtering before being discharged into the receiving water body (environment). The design of the wastewater management plant (IPAL) is described in Figure 6.

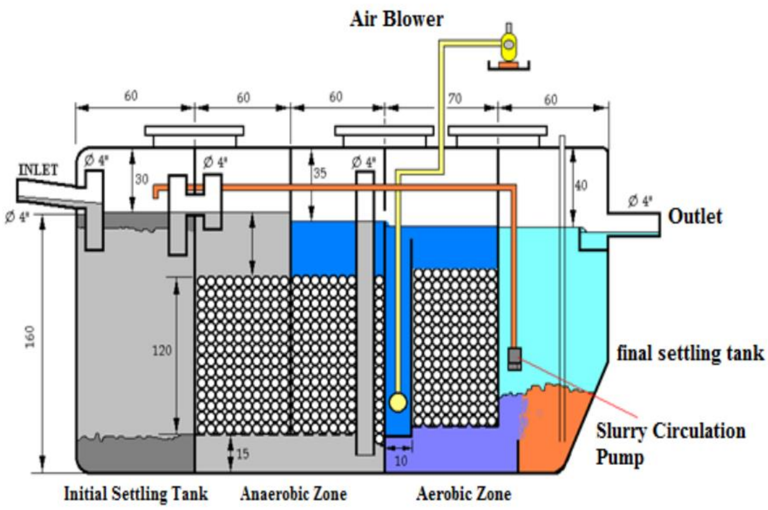

Fig. 6. Design of wastewater management installations

Domestic liquid waste management needs special handling so as not to pollute the environment. The design described in Figure 3-6 is a step to combat domestic fluid waste management. The domestic liquid waste management scheme will be illustrated in Figure 7.

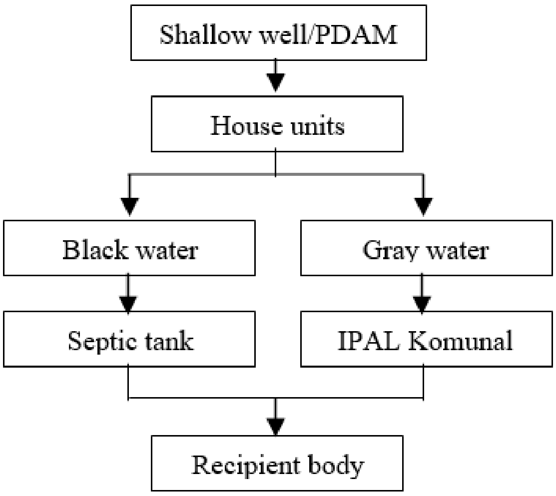

Figure 7. Domestic liquid waste management scheme

Green open spaces to anticipate the source of the impact of soil cleaning and maturation activities that lead to increased runoff and erosion. This type of impact is caused by runoff water that carries mud grains that, when there is rain, will cause puddles, turbidity, and siltation in the receiving body of water. The amount of impact on this point is related to housing development, which is 16,000 m^2. Find out the need for open space can be calculated using the rational method Thomspson 2006 Management of green open spaces to anticipate the source of soil cleaning and maturation activities that lead to increased runoff and erosion. This type of impact is caused by runoff water that carries mud grains that, when there is rain, will cause puddles, turbidity, and siltation in the receiving body of water. The amount of impact on this point is related to housing development, which is 16,000 m^2. Determine the need for open space can be calculated using the rational method Thomspson 2006 [23]. This equation will calculate the number of runoff flows that water can pass through from the rest of the watertight section. Calculating runoff water discharge on a development project can be used rational method using Equation 2.

$$Q = 0.278\, C \,.\, I \,.\, A \qquad (2)$$

Where:

Q: is the volume runoff (m^3/second day-rain)

C: is the coefficient of surface runoff

A: is land area (m^2) the intensity of rain (m/day)

From climate data, over the past 10 years the lowest monthly rainfall of 0.5 mm occurred in July and the highest in December was 418.0 mm, while the average daily rainfall was 0.3048 m / day. Thus, in can be the volume of run off with the calculation of Equation 2 as follows:

$$Q = 0{,}278 \text{ x } 0{,}60 \text{ x } 0{,}3048 \text{ x } 16.000 \qquad (2)$$

$$= 0{,}278 \text{ x } 0{,}60 \text{ x } 12{,}7 \text{ x } 0{,}060$$

= 0,12 m^3/second.

A value of 0.12 m^3/s indicates a runoff value that is below the safe threshold. This runoff water control can be done by making a mud trap so that runoff does not enter the road body and create a water catcher system in trenches, drainage, temporary deposition ponds, and make catchment wells. Monitoring in the form of observation and data collection is needed to maintain this runoff value. A catchment well measuring 1 m^2 with a depth of 3 m can accommodate a water capacity of 3 m^3. Catchment wells are designed for 142 units, placed at each corner of the block, serves to catch rainwater so as not to pump into the road body. The catchment's design has been well described. A value of 0.12 m^3/s indicates a runoff value that is below the safe threshold. This runoff water control can be done by making a mud trap so that runoff does not enter the road body and create a water catcher system in trenches, drainage, temporary deposition ponds, and make catchment wells. Monitoring in the form of observation and data collection is needed to maintain this runoff valuethe design of the catchment well, as described in Figure 8-9.

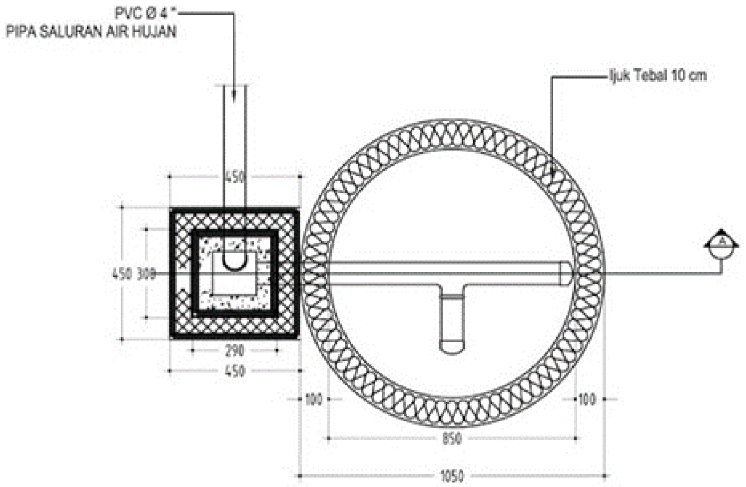

Fig. 8. The cross-sectional design of catchment wells

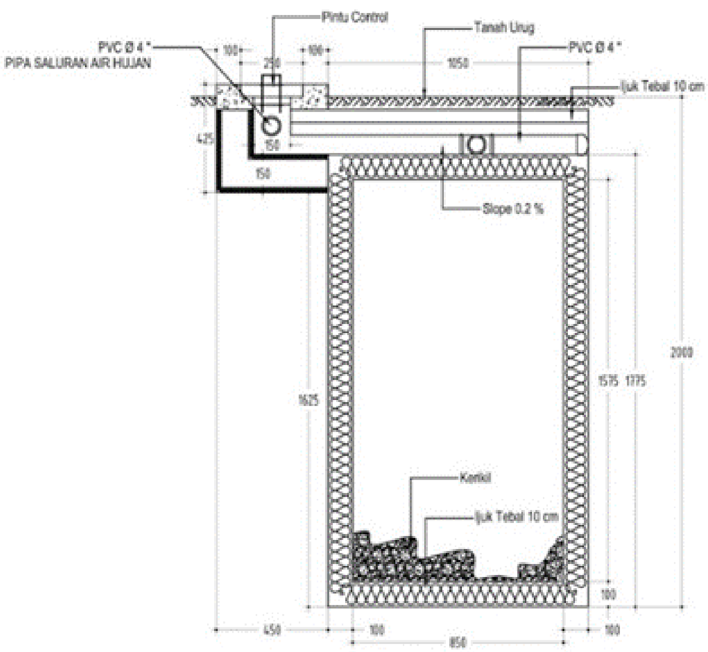

Fig. 9. Design of catchment well pieces

The impact caused by housing in addition to domestic liquid waste also causes waste. The types of rubbish from household activities described before including remains of food, drinks, kitchen activities, and others. The volume of solid waste can be calculated based on assumptions [24] using Equation 3.

$$\bar{x} = 0.7(\Sigma \text{ house occupant} \times \Sigma \text{ house unit}) \quad (3)$$

Based on Equation 3, the volume of waste every day can be calculated:

$$\bar{x} = 0.7(5 \times 287) = 1004.5 \text{ kg/day} \quad (3)$$

After calculating the results volume of garbage in housing can be identified as much as 1004.5 kg/ day. Countermeasures waste by providing temporary trash cans placed on each block, which will then be dumped into landfills. Temporary landfills as illustrated in Figure 10.

Fig. 10. Temporary landfill

3.6 Result

The results of environmental management and control efforts at the pre-construction and construction stages take data on air, water, and noise quality during the construction process, which is further compared to the quality of conditions before the construction process or in existing conditions. Comparison measurement of air, water, and noise quality as described consecutively in Table 5, Table 6, dan Table 7.

Table 5. Comparison of air quality of existing conditions and construction process conditions

Parameters (units)	Existing condition	Const. conditions	Qty. Standards
Dust TSP(ug/Nm^3)	3,7	3,2	-
NO_2 (ug/Nm^3)	4,8	4,4	200
SO_2 (ug/Nm^3)	6,2	6,1	150
CO (ug/Nm^3)	11,5	13,5	10.000

After efforts to manage and control the environment based on the results of laboratory tests as described in Table 5, It can be stated that air quality is improving. In contrast, the quality of carbon monoxide (CO) worsens by two ug / Nm^3 but is still within the average threshold below the standard of standard quality.

See the comparison of clean water quality between existing conditions with construction stage conditions as described in Table 6.

Table 6. Comparison of clean water quality of existing conditions with construction stage conditions

Test Description (Unit)	Existing results	Construction stage results	Specification *
	Physical Properties		
Temperature (°C)	26,1	22,5	Air T.± 3°
Turbidity (NTU)	0,95	0,59	25
Total Dissolved Solids (mg/L)	29	89	1000
Color (TCU)	10	17	50
Smell	no smell	no smell	no smell
Flavor	no taste	no taste	no taste
	Chemical Properties		
pH (pH Unit)	5,2	5,7	6,5-8,5
Iron, Fe	2,55	0,8	1
Manganese, Mn (mg/L)	0,8	0,3	0,5
Zinc, Zn (mg/L)	<0,01	0,09	15
Sulfate, SO_4 (mg/L)	1	8	400
Hexavalent Chromium, Cr^{6+} (mg/L)	0,037	0,035	0,05
Nitrate, NO_3-N (mg/L)	1,9	1,8	10
Nitrite, NO_2-N (mg/L)	0,011	0,015	1

The quality of clean water at the construction stage is improving compared to clean water quality before construction. While the total rate of dissolved solids (TDS) is 89 decreased by 60 mg / L from existing conditions but is still within the standard threshold of < 1000 mg / L. Color quality worsened from 10 TCU to 17 TCU but is still in good condition due to <50 TCU.

Housing development activities contribute to noise pollution. This type of impact comes from the intensity in and out of the vehicle carrying tools and building materials using dump trucks that disturb the surrounding environment. The magnitude of the impact is measurable from the increase in noise intensity. The calculation is based on all vehicles carrying tools and materials in the state of the engine is alive it will cause the noise of 60 dBA. Nevertheless, the noise strength weakens with a certain distance and can be calculated using a model [25]such as Equation 4.

$$\mathrm{Y} = 90\,\mathrm{e} - 0.0011\mathrm{x} \qquad (4)$$

The noise calculation value recorded 46.2 dBA during the construction. Based on Ministry of Lh No. 48 of 1996 concerning Raw Noise Level, the maximum standard for residential areas is 55 dBA.

So, the magnitude of the impact did not cross the standard limit. A comparison of noise quality in existing conditions with construction stage conditions is shown in Table 7.

Table 7. Comparison of existing condition noise with construction stage conditions

Parameter (unit)	Existing condition	Construction stage conditions	Qty. Standards
Noise (dBA)	44,2	45,2	55

Noise quality decreases at the construction stage by one dBA. The noise value at the construction stage is 45.2 dBA <55 dBA so that it can be concluded that noise due to housing project activities is safe because it is below the standard value of quality standards specified.

4. CONCLUSION

Housing development activities are changing the condition of open land into standing house buildings. These changes will have both positive and negative impacts. The positive impact is the increase in residential facilities and the increase in microeconomics in the region around housing. The negative effect is causing community unrest around housing, environmental damage, air pollution, water, and noise. To anticipate the negative impact of housing projects, it is necessary to manage and control the environment. It is essential to socialize and benefit by recruiting labor to the community around the housing to increase trust between two parties. Environmental damage and pollution can be controlled by creating solutions. A safety fence around the project, organize buildings with green open spaces, plan the proper use of tools and mobilization, create household waste shelters using septic tanks, wastewater management installations, catchment wells, and provide temporary landfills in an organized manner. Environmental management and control efforts have been successful in anticipating negative impacts and improve air and water quality. It is recommended in every housing project or others to make environmental management and control efforts and conduct regular monitoring.

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REFERENCES

[1] M. N. Al-attas, A. Ghoni, and T. Index, "Undang-undang Nomor 32 tahun 2009 tentang perlindungan dan pengelolaan lingkungan hidup," Jakarta Pres. Republik Indonesia, 2009. Avaliable at Google Scholar

[2] M. Iizuka, "Role of environmental awareness in achieving sustainable development," 2016. Avaliable at Google Scholar

[3] N. Listiyani and M. Yasir Said, "Political law on the environment: The authority of the government and local government to file litigation in law number 32 year 2009 on

environmental protection and management," Resources, vol. 7, no. 4, pp. 1–13, 2018.doi: 10.3390/resources7040077

[4] R. V. Bartlett, The New Environmental Regulation, vol. 5, no. 04. 2007.doi: 10.1017/S1537592707072428

[5] B. Yue, G. Sheng, S. She, and J. Xu, "Impact of consumer environmental responsibility on green consumption behavior in China: The role of environmental concern and price sensitivity," Sustain., vol. 12, no. 5, pp. 1–16, 2020.doi: 10.3390/su12052074

[6] R. C. Rembet, "Pengaturan Hukum Pengelolaan Lingkungan Hidup Menurut Deklarasi Stockholm 1972," Lex Soc., vol. 8, no. 4, 2020.doi: 10.35796/les.v8i4.30908

[7] P. Paikun, S Rico, R Debby, S Cece, L Herlina, "Pure Experiments Creating New Types of Asphalt Using Oil Waste, Resin Stones and Plant Branchs," in 2020 6th International Conference on Computing Engineering and Design (ICCED), 2020, pp. 1–6.doi: 10.1109/ICCED51276.2020.9415779

[8] O. D. Apuke, "Quantitative Research Methods : A Synopsis Approach," Kuwait Chapter Arab. J. Bus. Manag. Rev., vol. 6, no. 11, pp. 40–47, 2017.doi: 10.12816/0040336

[9] A. M. Pratami, "Kajian Usaha Pengelolaan Lingkungan dan Usaha Pemantauan Lingkungan pada Lokasi Tambang Batugamping di CV. Empat Jaya Upaya Pengelolaan Lingkungan Hidup (UKL) dan Upaya Pemantauan Lingkungan Hidup (UPL)," ReTII, 2017. Avaliable at Google Scholar

[10] Menteri Peraturan Hidup, "BERITA NEGARA." 2014. Avaliable at Google Scholar

[11] A. Ghopur, "Pelaksanaan Putusan Mahkamah Konstitusi Nomor 35/PUU-X/2012 Terhadap Pengujian Undang-undang Nomor 41 Tahun 1999 Tentang Kehutanan Terkait Dengan Hutan Adat di Provinsi Riau." Universitas Islam Riau, 2019. Avaliable at Google Scholar

[12] R. I. Kemenkes, "Tata Naskah Dinas Di Lingkungan Kementerian Kesehatan (Peraturan Menteri Kesehatan Nomor 14 Tahun 2017)," 2017. Avaliable at Google Scholar

[13] Y. K. Bintang, D. Chandrasasi, and R. Haribowo, "Studi efektifitas dan kinerja instalasi pengolahan air limbah (IPAL) pada peternakan sapi skala rumah tangga," J. Tek. Pengair., vol. 10, no. 1, pp. 51–58, 2019.doi: 10.21776/ub.pengairan.2019.010.01.5

[14] M. A. Adi and Y. Trihadiningrum, "Pengelolaan Limbah Elektronik di Asrama Mahasiswa di Kota Surabaya," J. Tek. ITS, vol. 9, no. 2, pp. C121–C126, 2021. Avaliable at Google Scholar

[15] A. Dore, "Menakar Peluang Dan Tantangan Pengakuan Hutan Adat Dalam Peraturan Menteri Lingkungan Hidup Dan Kehutaan No. 17/2020 Tentang Hutan Adat Dan Hutan Hak," J. Ilm. Maju, vol. 4, no. 1, pp. 27–33, 2021. Avaliable at Google Scholar

[16] P. Mahardhika, "Evaluasi Instalasi Plumbing Air Bersih Rumah Tipe 42 Menggunakan Pipe Flow Expert Berdasarkan SNI 03-7065-2005 dan BS 6700," JTT (Jurnal Teknol. Ter., vol. 4, no. 1, 2018.doi: 10.31884/jtt.v4i1.68

[17] S. M. H. Pratiwi, "Perencanaan Tempat Pengolahan Sampah Terpadu 3r Di Kecamatan Plampang, Sumbawa, Nusa Tenggara Barat." Universitas Muhammadiyah Malang, 2020. Avaliable at Google Scholar

[18] R. Kemenkes, "Instalasi Pengolahan Air Limbah," Seri Sanitasi Lingkung. Pedoman Tek.

Dengan Sist. Biofilter Anaerob Aerob Pengolah. Air Limbah Instal. Pada Fasilitas Pelayanan Kesehat. Kementeri., vol. 24, no. 2, pp. 1–9, 2011. Avaliable at Google Scholar

[19] A. Apriyana, Paikun and B. Jatmika, "Analisis Daya Tampung Septic Tank Type Komunal Di Kelurahan Tegal Gundil Kota Bogor," J. TESLINK Tek. Sipil dan Lingkung., vol. 1, no. 1, pp. 50–62, 2019. Avaliable at Google Scholar

[20] M. E. Saputri, "Kajian Kualitas Air Wudhu di Kawasan Wisata Religi Masjid Menara dan Makam Sunan Kudus Berdasarkan Parameter Fisika, Kimia, dan Biologi Menurut Permenkes RI Nomor 32 Tahun 2017," 2020. Avaliable at Google Scholar

[21] R. Pradana, R. Haribowo, and T. B. Prayogo, "Studi Evaluasi Instalasi Pengolahan Air Limbah Domestik Desa Pandanrejo, Kecamatan Bumiaji, Kota Batu, Jawa Timur," J. Mhs. Jur. Tek. Pengair., vol. 3, no. 2, p. 44, 2020. Avaliable at Google Scholar

[22] S. Choiriyah and D. E. Prasetiyo, "Studi Kelayakan Perumahan Citrapuri Keniten 1 Ponorogo Dilihat dari Site Plan," REKAYASA J. Tek. SIPIL, vol. 3, no. 2, pp. 21–24, 2019. Avaliable at Google Scholar

[23] F. Rahman, P. Nuraripah, and R. Layyinah, "Preventing Islamic Radicalism Through Integrative Epistemology of Sadrian Philosophy: The Case Study of Hizbut Tahrir Indonesia's Reasoning," Anal. J. Stud. Keislam., vol. 18, no. 2, pp. 101–120, 2018.doi: 10.24042/ajsk.v18i2.3674

[24] L. Siami, T. Sotiyorini, and N. Janah, "Municipal Solid Waste Quantification and Characterization in Banyuwangi, Indonesia," Indones. J. Urban Environ. Technol., vol. 2, no. 2, pp. 189–200, 2019.doi: 10.25105/urbanenvirotech.v0i0.4359

[25] Paikun, S. Rahayu, A. Selpi, A. Awalia, and Jasmanyah, "Quick Ways to Calculate Shophouse Construction Project Materials Using Regression Analysis Program," 5th Int. Conf. Comput. Eng. Des. ICCED 2019, pp. 4–9, 2019.doi: 10.1109/ICCED46541.2019.9161083