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DESIGN MAPPING OF WASTEWATER TREATMENT INSTALLATION (IPAL) IN THE COAL SPECIAL PORT AREA OF PT TELEN ORBIT PRIMA MONTALLAT DISTRICT NORTH BARITO REGENCY CENTRAL KALIMANTAN PROVINCE

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ABSTRACT

This research aims to design an effective Waste Water Treatment Plant (IPAL) system in the special port area of Persia (PT) in order to ensure the sustainability of mining operations while complying with environmental regulations. The IPAL design is based on assessing the topography, hydrological characteristics, and water quality of the catchment area. Water quality analysis is carried out both during the dry season and after rain, taking important parameters such as pH, Total Suspended Solids (TSS), iron (Fe), and manganese (Mn) into consideration. The results of this research provide important information for designing IPALs that comply with environmental conditions and applicable regulations. Based on the data that has been analyzed, it can be concluded that the proposed WWTP design is an effective solution in managing coal mining wastewater in this port area.

Keywords: *IPAL, wastewater, coal mining*

INTRODUCTION

Coal mining has become one of the most important industrial sectors in the global economy. However, the processing and management of waste water from mining activities has become a serious problem that requires special attention. This does not only apply at the mining location itself, but also at the coal storage location at the port, as experienced by PT. Telen Orbit Prima. Factors such as topography, soil type, vegetation, and varying coal processing processes cause significant variations in the nature and amount of wastewater produced (CHRISPIM, 2021).

Wastewater in the context of coal mining comes from various sources, including rain that falls during land clearing activities, coal landfills, and from various other open areas around the mining site (Fitriyanti, 2014). Apart from that, the coal washing processing process in coal processing plants, workshop areas, offices and other supporting facilities also contributes to producing waste water (Indrayani, 2018).

The importance of conducting research related to wastewater processing and management in the context of coal mining is to ensure that the wastewater produced meets the established Environmental Quality Standards (BML). Therefore, it is necessary to develop an effective and efficient wastewater treatment system (IPAL) (Hariyadi et al., 2020). In the context of coal mining, the creation of a settling pond or sedimentation pond is one of the key components in this system. Before a settling pond can be built, it is necessary to calculate the runoff water discharge and create an open channel to manage waste water from various sources, such as coal piles, drainage from haul roads, and other supporting facilities in the port area (Hutagalung, 2018).

To properly understand the challenges faced in wastewater management in the coal mining industry, precise mapping is needed regarding the position or location of various wastewater sources, wastewater management channel systems, and calculations for the dimensions of the carrying capacity of construction or design of existing IPALs in the Harbor area. This research will help in identifying critical problems, developing effective solutions, and ensuring that the environment around mining sites remains protected (Brad et al., 2021; Syarifuddin et al., 2017).

By understanding the complexities of wastewater processing and management in the coal mining industry, we can design better measures to maintain the sustainability of mining operations, comply with environmental regulations, and protect the surrounding ecosystem. Therefore, this research will provide valuable guidance for coal mining companies such as PT. Telen Orbit Prima, as well as for the coal mining industry as a whole.

METHOD

The research was carried out using direct observation methods and data processing related to research. Data on IPAL capacity and available land area are used to determine the dimensions of the IPAL, while topographic data is used to determine the layout of each section of the IPAL. Location of the special coal mining port of PT. Telen Orbit Prima is located in the Paring Lahung Village area, Montallat District, North Barito Regency, Central Kalimantan Province. Geographically it is located at 114° 48' 15.93" East Longitude and 01° 13' 03.52" South Latitude (UTM 50M 255681 9865315).

RESULTS AND DISCUSSION

This research aims to design an effective Waste Water Treatment Plant (IPAL) system in the special port area of PT. Telen Orbit Prima is located in Montallat, North Barito Regency, Central Kalimantan Province. The data analyzed in this research includes land topography, hydrological characteristics, and water quality throughout the year. The results of this research provide important information for designing IPALs that comply with environmental conditions and applicable regulations.

Relatively gently sloping land topography

The discovery of relatively moderately sloping land topography in the port area is a key aspect in IPAL planning. The moderately sloping topography provides significant advantages in terms of developing wastewater treatment infrastructure. With relatively flat land, settling pond construction is easier and more cost efficient (Safriani et al., 2017). In addition, this topography allows for better organization of the WWTP compartments, maximizing wastewater storage capacity. Apart from facilitating physical development, moderately sloping topography can also reduce the risk of soil erosion and changes in water flow which can affect the performance of the IPAL (Prisanto et al., 2015). Therefore, a thorough understanding of the topography of the port area is essential in designing an effective wastewater treatment system. Based on the topography of the land, it is relatively moderately sloping with an elevation of 19 - 35 meters above sea level.

Figure 1. Topographic Map

Runoff Coefficient

The runoff coefficient (C) with a value of 0.6 is very important information in calculating the capacity of the WWTP. This coefficient describes how large a percentage of rainwater will flow into the IPAL. Using accurate coefficients is a crucial step to ensure that the WWTP has sufficient capacity to handle the wastewater produced. If the runoff coefficient is too low, the WWTP may not be able to accommodate the actual water discharge, which can cause overflow and environmental pollution (Qadaryati et al., 2019). Conversely, if the coefficient is too high, the WWTP may be too large and expensive. Therefore, careful calculations to determine the appropriate runoff coefficient are a very important first step in planning an efficient WWTP. It also contributes to environmental safety and maintains water quality around the port area.

Maximum Rainfall Intensity

Information regarding the maximum rainfall intensity in the last 10 years, which reached 3,987.8 mm^3, has a significant impact on WWTP planning. High rainfall can affect the amount of wastewater produced in the port area. With this intensity data, planners can predict and calculate accurately the amount of rainwater which will be the main source of wastewater that must be treated. In addition, this knowledge of maximum rainfall allows the development of WWTPs that have the appropriate capacity to handle the expected wastewater volumes. Thus, rainfall data is a key basis in designing WWTPs that are able to adapt to weather fluctuations and ensure that wastewater management remains effective in various conditions.

Area of the Rain Catchment Area

The area of the port's rain catchment area which reaches 0.3189 km^2 is an important element in identifying the size of the area's contribution to waste water. The larger the catchment area, the greater the amount of rainwater that will flow into the treatment system (Qasim, 2017). Therefore, this data becomes the foundation for calculating the water discharge that will enter the IPAL. Understanding the area of the rain catchment area helps plan and calculate the capacity of the WWTP in accordance with the expected wastewater volume. By assessing the area of the catchment area, a WWTP system can be designed that is able to handle potential wastewater sources efficiently and effectively.

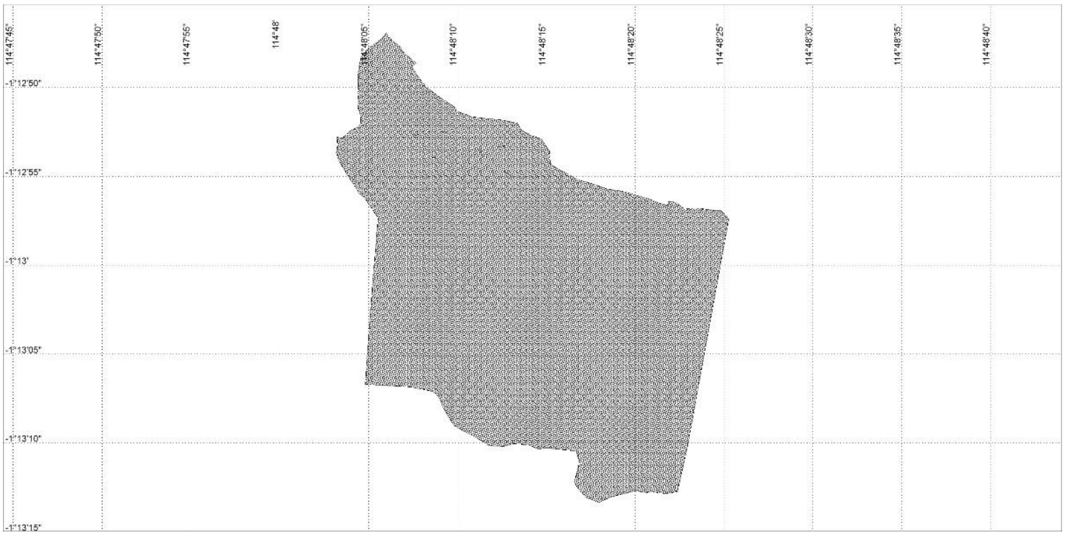

Figure 2. Port Rain Catchment Area Map

Settling Pond Design

The WWTP design which involves one settling pond with nine compartments is the result of careful calculations and topographic data. Data on slope, current speed, depth, compartment area and total volume provide guidelines for the physical construction of a WWTP that meets the expected capacity and water quality. This design allows for gradual and effective wastewater treatment, with compartments that function to filter, settle and clean wastewater. The use of these compartments also ensures that the WWTP has the ability to cope with variations in rainfall and contributes to maintaining environmental water quality in accordance with applicable environmental regulations. The overall design of the settling pond reflects a holistic approach to wastewater management in the PT port area. Telen Orbit Prima.

Figure 3. Map of Compartment 1

Figure 4. Map of Compartment 2

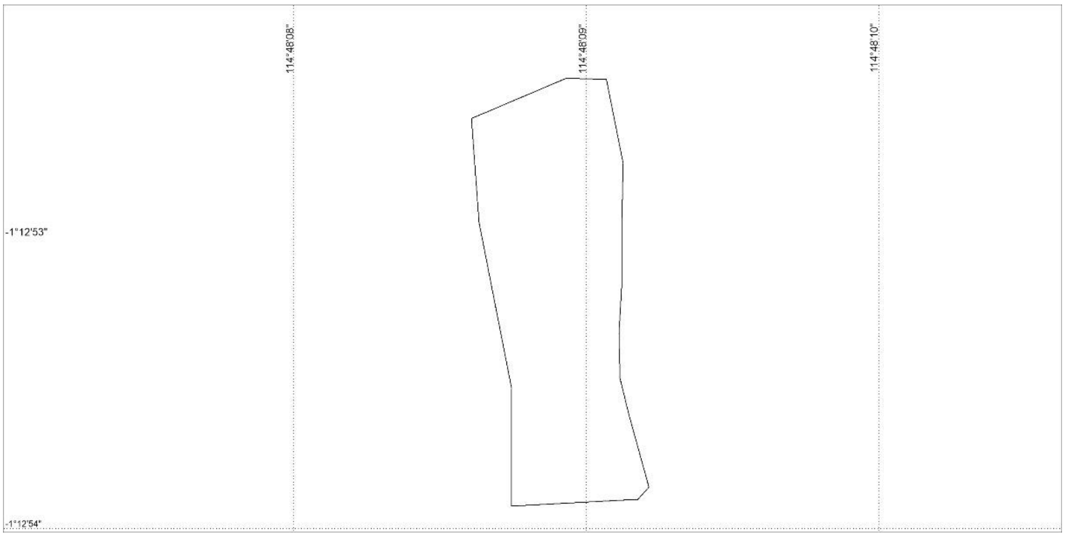

Figure 5. Map of Compartment 3

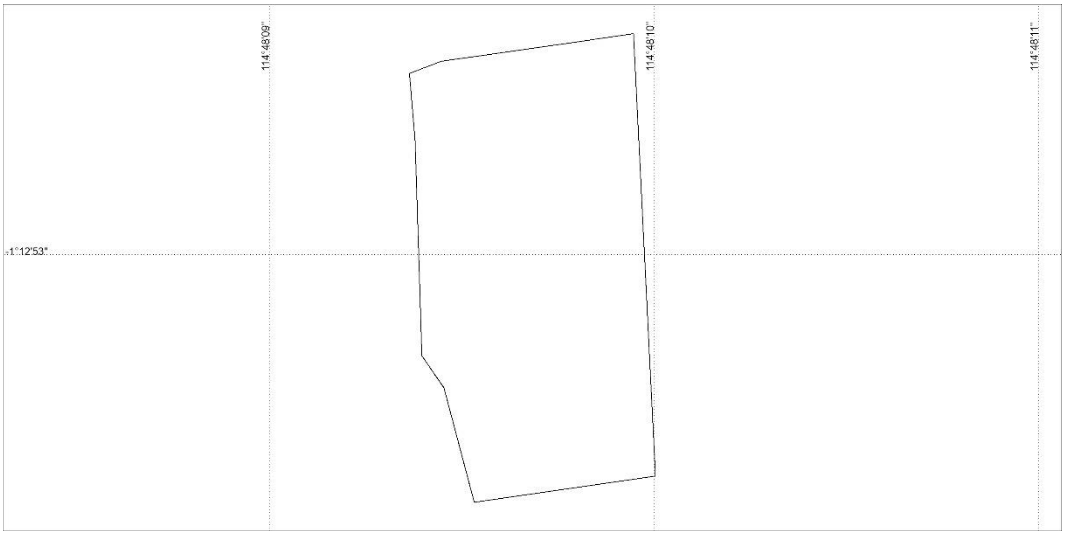

Figure 6. Map of Compartment 4

Figure 7. Map of Compartment 5

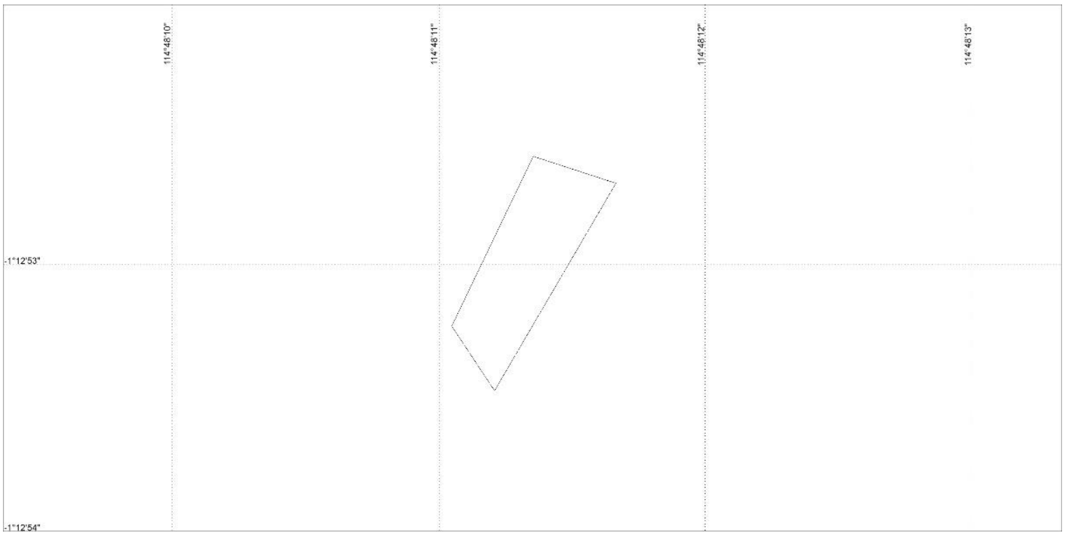

Figure 8. Map of Compartment 6

Figure 9. Map of Compartment 7

Figure 10. Map of Compartment 8

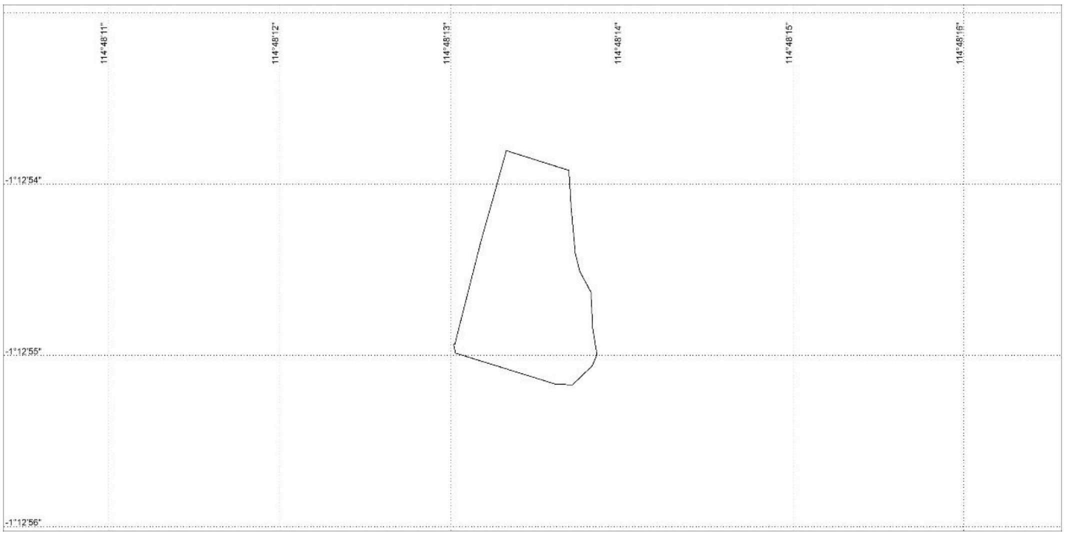

Figure 11. Map of Compartment 9

The results of measurements and mapping in all compartments reveal a number of key information that is essential in planning Waste Water Treatment Plants (IPAL) in the port area. First, the slope of the compartment reaches 2°, indicating very suitable conditions for optimizing wastewater settling and treatment. The average current speed in the compartment reached 0.89 meters per second, ensuring sufficient water movement to maintain particle deposition. The average depth reaches 3 meters, allowing for efficient filtration and settling. The total area of the compartment reaches 5,368.48 m², providing sufficient space to handle significant wastewater volumes. And more importantly, the total compartment volume is around 16,105.44 cubic meters, making the WWTP have a capacity that far exceeds requirements, providing very important flexibility in handling fluctuating wastewater discharge, especially during periods of intense rain. All this information summarizes that the WWTP compartment design is based on careful data and represents a solid infrastructure to manage wastewater with efficiency and effectiveness (M. Wahyudin et al., 2021).

Table 1. Pool Dimension Measurement Results (Compartment)

Compartment	Length (m)	Width (m)	Area (m^2)	Depth (m)	Volume (m^3)
1	41,71	28.82	1.202,08	3,00	3.606,24
2	41,60	13,32	554,30	3,00	1.662,90
3	43.30	13,86	600,00	3,00	1.800,00
4	35,41	17,45	617,90	3,00	1.853,70
5	30,51	7,45	227,30	3,00	681,90
6	27,63	8,09	223,80	3,00	671,40
7	48,69	12.21	594,60	3,00	1.783,80
8	41,31	15,05	621,80	3,00	1.865,40
9	37,45	19,40	726,70	3,00	2.180,10
		Total	**5.368,48**		**16.105,44**

WWTP Capacity vs. Runoff Water Discharge

The findings of the research emphasize a significant disparity between the designed Wastewater Treatment Plant (WWTP) capacity, which stands at 16,105.44 m³, and the anticipated runoff water discharge capacity of 212.12 m³. This disparity, however, is far from a mere numerical contrast; it holds paramount importance for the effective management of wastewater in the coal mining port area. The substantial surplus capacity within the WWTP design stands as a robust safety net, assuring the operational resilience of the facility under varying weather conditions, particularly during periods of fluctuating rainfall. This surplus capacity not only safeguards against potential overflows but also plays a crucial role in maintaining consistent and reliable treatment of wastewater (I. Wahyudin et al., 2018). Furthermore, it represents a proactive approach that aligns with the principles of environmental responsibility, ensuring that the facility is well-prepared to meet the challenges of dynamic environmental conditions and regulatory compliance, underscoring the commitment to safeguarding both the local ecosystem and the sustainability of PT. Telen Orbit Prima's mining operations. In conclusion, the significant excess in WWTP capacity is a proactive and positive step towards achieving robust and environmentally conscious wastewater management in the coal mining port area.

Water Quality

Apart from considering the capacity and infrastructure of the WWTP, this research also pays special attention to the quality of the water that will be released from the treatment system. Water quality analysis is carried out both during the dry season and after rain, taking important parameters such as pH, Total Suspended Solids (TSS), iron (Fe), and manganese (Mn) into consideration. The results of the dry season analysis show that the water pH ranges from 6.24 to 6.54, which is still in accordance with environmental quality standards (pH 6-9). Although TSS is slightly above the standard limits (220-280 mg/l compared to 200 mg/l), minor improvements in wastewater processing may be required to ensure better water quality is achieved.

After the rain, the analysis results showed that the pH of the water ranged from 5.21 to 5.98, slightly below the quality standard limit, which needs attention. TSS, however, exceeded the quality standard limits (380-440 mg/l compared to 200 mg/l), highlighting that post-rainfall produces wastewater with too high a solids concentration. Therefore, handling post-rain wastewater is important to reduce TSS and maintain water quality in accordance with environmental regulations (Hartman, 1987; Islamiaty et al., 2022).

Stockpile and Supporting Facilities at the Port

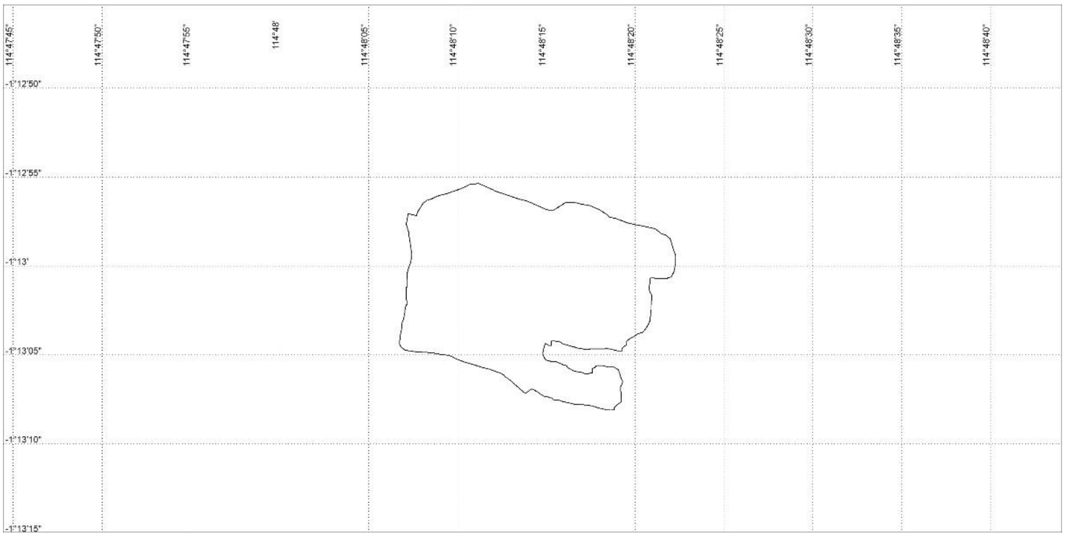

Figure 12. Map of coal stockpile locations in the port area

For geographical location of buildings, other supporting facilities in the port area are as shown in table 22.

Table 2. Location of supporting facility buildings in the port area

Building Facilities Supporting	Location	
	East Longitude (East)	South Latitude (South)
Conveyor	114° 48' 21.61”	1° 13' 01.26"
	114° 48' 21.51"	1° 13' 03.23"
Main Tank	114° 48' 19.36"	1° 13' 09.51"
	114° 48' 20.93"	1° 13' 09.89"
Workshop	114° 48' 23.19"	1° 12' 58.69"
	114° 48' 23.37"	1° 12' 58.45"
Office	114° 48' 04.90"	1° 12' 50.27"
	114° 48' 05.83"	1° 12' 49.46"

Overall, this research provides a holistic view of wastewater management at the PT port. Telen Orbit Prima. By considering topography, hydrological characteristics and water quality, the proposed WWTP design can effectively treat coal mining wastewater and ensure the sustainability of operations while complying with strict environmental standards. A deep understanding of the surrounding environment and regulatory requirements is key to building effective wastewater management solutions, which in turn helps protect local ecosystems and maintain the sustainability of the mining industry.

CONCLUSION

Based on the data that has been analyzed, it can be concluded that the Waste Water Treatment Plant (IPAL) design proposed for the port area of PT. Telen Orbit Prima has a capacity that greatly exceeds the estimated runoff water discharge, namely 212.12 m^3. With the total design capacity of the WWTP reaching 16,105.44 m^3, this provides a guarantee that the WWTP is able to handle variations in wastewater volume that may occur due to weather changes. In addition, the results of water quality analysis show that during the dry season, TSS parameters require special attention to meet environmental quality standards. Meanwhile, after rain, focus must be given to controlling pH and TSS. Therefore, the IPAL design which has been prepared by considering sufficient capacity and monitoring water quality in accordance with environmental regulations is an effective solution in managing coal mining wastewater in this port area. Thus, PT. Telen Orbit Prima has a strong foundation for maintaining the sustainability of its operations, complying with environmental regulations, and maintaining the quality of the environment around mining sites.

REFERENCES

Brad, S., Murar, M., Vlad, G., Brad, E., & Popanton, M. (2021). Lifecycle design of disruptive scada systems for waste-water treatment installations. *Sustainability (Switzerland)*, *13*(9). https://doi.org/10.3390/su13094950

CHRISPIM, M. C. (2021). Resource recovery from wastewater treatment: challenges, opportunities and guidance for planning and implementation. *Frontiers in Neuroscience*, *14*(1).

Fitriyanti, R. (2014). Karakteristik Limbah Cair Stockpile Batubara. *Jurnal Media Teknik*, *11*(1).

Hariyadi, S., Tunjung Murti Pratiwi, N., Krisanti, M., Panji, A., & Yuni Wulandari, D. (2020). Penataan Rancangan Lokasi Instalasi Pengolahan Air Limbah Terpadu Kampus Institut Pertanian Bogor. *Jurnal Ilmu Pertanian Indonesia*, *25*(3). https://doi.org/10.18343/jipi.25.3.449

Hartman, H. L. (1987). Introductory Mining Engineering. *Introductory Mining Engineering.*

Hutagalung, R. F. (2018). Perencanaan Instalasi Pengolahan Air Limbah (IPAL) di Kawasan Pelabuhan PT. Pelindo I Cabang Belawan, Kota Medan. *Tugas Akhir*.

Indrayani, L. (2018). PENGOLAHAN LIMBAH CAIR INDUSTRI BATIK SEBAGAI SALAH SATU PERCONTOHAN IPAL BATIK DI YOGYAKARTA. *ECOTROPHIC : Jurnal Ilmu Lingkungan (Journal of Environmental Science)*, *12*(2). https://doi.org/10.24843/ejes.2018.v12.i02.p07

Islamiaty, A., Saismana, U., & Riswan, R. (2022). Evaluasi Sistem Penyaliran Tambang Pada PT Akbar Mitra Jaya Kecamatan Kintap, Kabupaten Tanah Laut, Provinsi Kalimantan Selatan. *Jurnal Himasapta*, *6*(3). https://doi.org/10.20527/jhs.v6i3.4666

Prisanto, D. E., Yanuwiadi, B., & Soemarmo. (2015). Studi Pengelolaan IPAL (Instalasi Pengolahan Air Limbah) Domestik Komunal di Kota Blitar, Jawa Timur. *J-Pal*, *6*(1).

Qadaryati, N., Praditya, D. T., Hidajat, W. K., & Martiningtyas, I. (2019). Penentuan Lingkungan Pengendapan Batubara Berdasarkan Karakteristik dan Maseral Batubara di PT X, Kabupaten Nunukan, Kalimantan Utara. *Jurnal Geosains Dan Teknologi*, *2*(3). https://doi.org/10.14710/jgt.2.3.2019.107-116

Qasim, S. R. (2017). Wastewater treatment plants: Planning, design, and operation, second edition. In *Wastewater Treatment Plants: Planning, Design, and Operation, Second Edition*. https://doi.org/10.1201/9780203734209

Safriani, M., Cut, D., & Silvia, S. (2017). DESAIN IPAL KOMUNAL UNTUK MENGATASI PERMASALAHAN SANITASI DI DESA LUENGBARO, KABUPATEN NAGAN RAYA, ACEH. *Konferensi Nasional Teknik Sipil 11*.

Syarifuddin, S., Widodo, S., & Nurwaskito, A. (2017). KAJIAN SISTEM PENYALIRAN PADA TAMBANG TERBUKA KABUPATEN TANAH BUMBU PROVINSI KALIMANTAN SELATAN. *Jurnal Geomine*, *5*(2). https://doi.org/10.33536/jg.v5i2.132

Wahyudin, I., Widodo, S., & Nurwaskito, A. (2018). ANALISIS PENANGANAN AIR ASAM TAMBANG BATUBARA. *Jurnal Geomine*, *6*(2). https://doi.org/10.33536/jg.v6i2.214

Wahyudin, M., Subagiyo, L., & Sitorus, S. (2021). Pengaruh Volume Tampung Kolam Settling pond Terhadap Pengelolaan Air Limbah Pertambangan Batubara di PT. XXX, Kalimantan Timur. *Media Ilmiah Teknik Lingkungan*, *6*(1). https://doi.org/10.33084/mitl.v6i1.1398