TECHNICAL STUDY OF PT XYZ SHIPPING FLOW OF COAL BARGE TO INCREASE DWT (DEADWEIGHT TONNAGE) CAPACITY FROM 5,000 DWT TO 10,000 DWT

Pasmika Sima[1]

[1]Geomatics Engineering Postgraduate Study Program, Sepuluh Nopember Institute of Engineering, Surabaya, Indonesia

E-mail: pasmika.sima@yahoo.co.id

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ABSTRACT

Coal is one of the important energy source commodities to carry out industrial activities, which require supporting infrastructure that uses shipping lanes as a means of activity in the delivery of coal from producers to consumers. PT XYZ, in this case as a coal producer, has allocated one of the areas used for coal loading facilities from one of the coal mining located in Gurimbang Village, Sambaliung District, Berau Regency, East Kalimantan Province by using the Berau river channel to the transshipment location in Muara Pantai, Pulau Derawan District, Berau Regency. PT XYZ has obtained a Terminal Permit for Own Interests in the Working Environment and Interest Areas of Tanjung Redeb Port to Support Business Activities in the Coal Mining Sector PT XYZ "TUKS" through the Decree of the Director General of Sea Transportation Number: BX-144/PP 008 concerning Approval Terminal Management for Own Interests in the Work Environment Area and Interest Area of Tanjung Redeb Port to Support Business Activities in the Coal Mining Sector with a capacity of 5,000 DWT. Based on the results of the study of the TUKS flow plan, the position of the general shipping lane, the bathymetry survey of the barge path, the depth of the TUKS pool, the planned loading and unloading volume, the dimensions of the ship that will dock and unload, the frequency of ship visits, the availability of Shipping Navigation Assistance Facilities (SBNP), as well as observations at several points that will become obstacles in shipping navigation, it can be concluded that the development/increase of the DWT TUKS Gurimbang capacity of PT XYZ to support operational activities is still safe enough to be increased to a payload capacity of 8,000 MT with a maximum draft of submerged ships/barges at a depth of -4.70 meters. Therefore, this research can be continued for the preparation of technical review documents as a requirement to fulfill PM 89 of 2018 concerning Norms, Standards, Procedures, and Criteria for Electronically Integrated Business Licensing for the Transportation Sector in the Sea Sector in the process of adjusting DWT (Dead Weight Tonnage) at the Terminal for Self Interest/TUKS PT XYZ in Gurimbang Village.

Keyword: TUKS, DWT, SBNP, Ship Draft

Introduction

Background

Coal is an important energy source commodity for carrying out industrial activities, which require supporting infrastructure using shipping lanes as a medium for sending coal from producers to consumers.

PT XYZ, as a coal producer, has allocated one of the areas used for coal loading facilities from one of the coal mining sites located in Kampung Gurimbang, Sambaliung District, Berau Regency, East Kalimantan Province, by using the Berau river channel to the transshipment location in Muara Pantai District. Derawan Island, Berau Regency.

PT XYZ has obtained a terminal permit for its own interests in the working environment area and the environmental interest area for Tanjung Redeb Port to support business activities in the coal mining sector of PT XYZ Private Interest Terminal (TUKS/Terminal Untuk Kepentingan Sendiri) through the Decree of the Director General of Sea Transportation Number: BX-144/PP 008 concerning

approval terminal management for own interests within the working environment area and the interest area for Tanjung Redeb Port to support business activities in the coal mining sector.

The approval of the TUKS Permit in Gurimbang Village is limited to the size of barges/vessels mooring, namely 5,000 DWT. To support operational activities and to increase production capacity, it is necessary to increase the barge/ship mooring capacity to 10,000 DWT.

It is necessary to study the flow of ships/barges to comply with the regulations in force in the Minister of Transportation Regulation Number 89 of 2018 concerning Norms, Standards, Procedures and Criteria for Electronically Integrated Business Permits in the Transportation Sector in the Sea Sector and the Minister of Transportation Regulation Number PM 12 of 2021 concerning Standards Business Activities and Products in the Implementation of Risk-Based Business Licensing in the Transportation Sector in order to find out whether PT XYZ Kampung Gurimbang's TUKS deserves to be upgraded or not and the purpose of this study is to maintain the safety of public shipping lanes.

Research Objective

a. Provision of development planning guidelines and or adjustments as well as operational loading and transfer areas between ships, including feasibility, adjustment plans, design plans, and movement plans in the context of coal distribution activities;
b. To find out the feasibility of the DWT (Dead Weight Tonnage) capacity building plan at the Private Interest Terminal (TUKS) PT XYZ Kampung Gurimbang, which is reviewed based on water spatial aspects, port technical including bathymetry, economic and financial surveys, environmental baseline, and shipping safety;
c. Fulfillment of one of the requirements for a construction permit and or adjustment as well as operation of the PT XYZ ship/barge transshipment area

Research Benefit

a. For the Marine Department and PT XYZ Licensing Department, the research results are expected to be useful input for obtaining DWT Capacity Building Permit Approval at TUKS PT XYZ Kampung Gurimbang so that what is planned can be achieved;
b. For the writer, it is hoped that the entire series of activities and research results can further strengthen the mastery of the scientific functions learned while participating in the lecture program in Geomatics Engineering at the Faculty of Engineering ITS Surabaya;
c. For tertiary institutions, research results are expected to become useful academic documents to be used as a reference for academics.

Literature Review

- Jauhari Alafi, Firmanto Hadi, Setyo Nugroho. Web Programming Based Coal Transport Operation Simulation Design (Case Study: Silting in the Barito River), where the process of transporting coal through the Barito River uses a barge to be then transited to the mother vessel. The obstacle experienced by barges is that during the dry season, the water level of the Barito River drops dramatically, especially in areas near the river's headwaters. When this happened, the river, which normally could be passed by barges with a capacity of up to 5,000 tons, could only be passed by the barge if it reduced its load to 2,000 tons. The barges couldn't get through even at the lowest water level. From the simulation results, there were no significant changes in helping to increase coal production at PT XYZ;
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Methodology

Research Location

The location of this study is from the TUKS pond of Gurimbang Village through the river shipping channel of Berau Regency – Transshipment Point, which is geographically located between 01°58'0"N - 02°13'30"N and 117°30'0"E - 118°20 '0"BT.

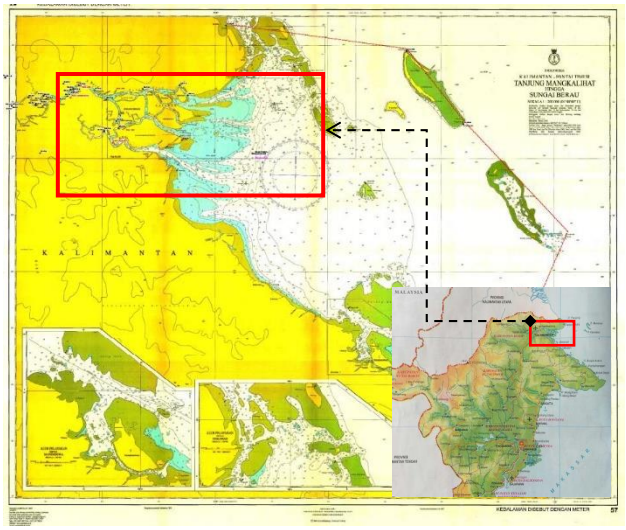


Figure 1. Research Location

Data and Tools

Data

The data used in this study are:

1. Map of the Berau Regency shipping lanes for 2019
2. Map of the depth/bathymetry of Kalimantan-East Coast of Tanjung Mangkalihat to the Berau river Scale 1: 200,000 issued by the Indonesian National Armed Forces Navy, Hydro-Oceanographic Office in 2007
3. Tidal data by Dishidros TNI AL November 2021
4. Bathymetry measurement data by SGI Department November 2021
5. Other supporting data such as from Pelindo IV Makassar Tanjung Redeb Branch, Sucofindo, Class II KUPP Tanjung Redeb Berau Regency and PT XYZ

Tools

The equipment used in this study was 1 unit of Lenovo Yoga 7 14ITL5 Core i7-1165G7 16GB 1TB SSD 14" Win11 OHS 2021 Laptop and spatial data processing software.

Research Flowchart

Stages of the research carried out so that the research can run systematically, clearly, and directly according to the research framework. The stages of this research are divided into 6 (six) stages: problem identification stage, data collection stage, data processing stage, analysis and interpretation stage, evaluation stage, and conclusion drawing stage.

1. The initial stage carried out was the stage of problem identification through field observations and based on secondary data. In addition, a literature review was also carried out related to the problems to be studied to obtain supporting information and theories. This information and theory are obtained from books, final assignments, journals, and articles that support solving the problems contained in the research;
2. The second stage is the data collection stage. At this stage identification of existing conditions is carried out starting from TUKS to Transshipment and collecting the required data related to the issues discussed;
3. The third stage is the data processing stage. At this stage, the data obtained at a later stage is processed to be used as input in the existing model as well as for the needs of analysis and interpretation
4. In the analysis and interpretation stage, an analysis of Marine, SGI, and Project data is carried out. The analysis begins with identifying shipping lanes, shipping navigation obstacles, the position of TUKS facilities, the distance of TUKS to general shipping, and pool depth. Then, an analysis is carried out on the recommendations for improvements proposed to obtain the right time to load and unload coal. The results of the simulation carried out are also analyzed to find out the output that can be produced from the simulation carried out. The analysis is carried out by considering the output produced and the costs required for each improvement scenario.
5. Evaluation Stage is carried out by the Tanjung Redeb Class II Port Administration Unit Office Technical Team by conducting field observations, starting from the port pool/TUKS to the Transshipment, which will later be included in the Minutes signed by the Head of KUPP and the PT XYZ. Furthermore, PT XYZ submitted an application to the Ministry of Transportation, Directorate General of Sea Transportation, to obtain a DWT Capacity Building Permit at TUKS Gurimbang. After the permit is obtained, a re-evaluation is carried out by the KUPP, and PT XYZ is also required to implement the provisions in the permit.
6. The conclusion stage is the last stage of the final project research. The conclusion-drawing stage

contains the conclusions obtained based on the data processing, analysis, and interpretation that has been carried out. Suggestions related to the research results are also given to provide recommendations for improvements to the scope of the research.

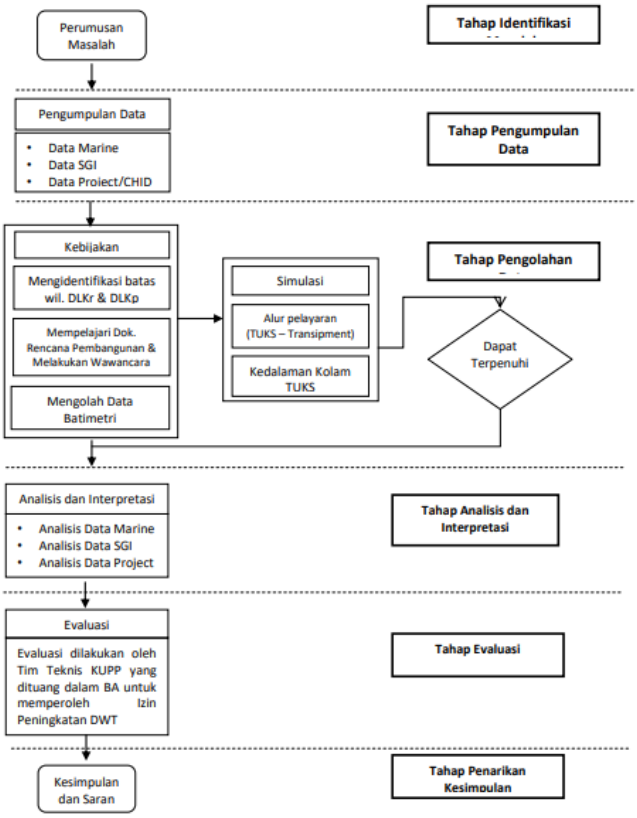


Figure 2. Research Flowchart

Result and Discussion

The determination of the Working Area (*Daerah Lingkungan Kerja*/DLKr) and Interest Area (*Daerah Lingkungan Kepentingan*/DLKp)

The determination of the Working Area (Daerah Lingkungan Kerja/DLKr) and Interest Area (Daerah Lingkungan Kepentingan/DLKp) of the loading transfer area between ships of PT XYZ Coal is carried out in the following steps:

1. Identify the boundaries of the existing operational work area of PT XYZ's intership loading transfer area which is carried out by:
   a. Studying the PT XYZ development and development plan document, which technically contains the existing conditions and future operational needs as the person in charge of activities in the territorial waters of the transshipment area between PT XYZ's ships
   b. Identifying the physical boundaries of the waters currently planned for the location of the PT XYZ intership loading area
   c. Conducted interviews and discussions with several related parties, including:
      1. KUPP Tanjung Redep
      2. PT XYZ
2. Planning the boundaries of the Working Environment Area (DLKr) and Interest Areas (DLKp) of the PT XYZ Coal inter-ship loading transfer area following the needs of the short-term development plan and the input of port users until an agreement is obtained between the stakeholders on the inter-ship transfer area ships of PT XYZ, including:
   a. Direktorat Jenderal Perhubungan Laut, Kementerian Perhubungan
   b. KUPP Tanjung Redep
   c. PT XYZ

The following is a map of PT XYZ's DLKr/DLKp TUKS Gurimbang.

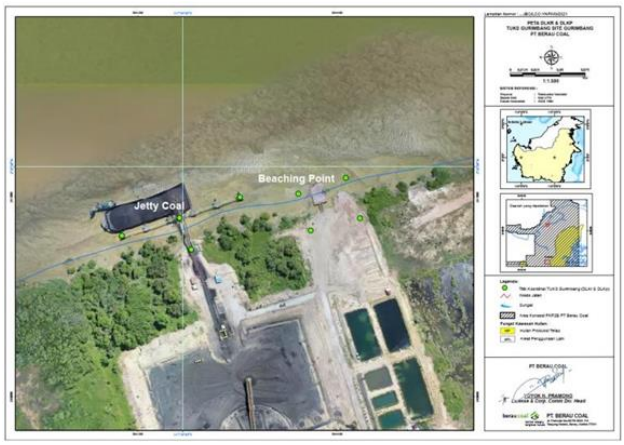


Figure 3. Gurimbang Map of DLKr and DLKp TUKS Gurimbang

Determination of the in and out flow starting from the outer buoy (Muara Pantai) to PT XYZ's Gurimbang TUKS

Determination of the in and out flow starting from the outer buoy (Muara Pantai) to PT XYZ's Gurimbang TUKS will be submitted as follows:

a. The shipping route from Muara Pantai to TUKS Gurimbang via Suaran and Lati is a general shipping route;
b. There are 3 (three) points that become obstacles due to the limited depth of the waters, namely Kelapa – Kelapa, Sukan and Beribit. As in the following figure 4

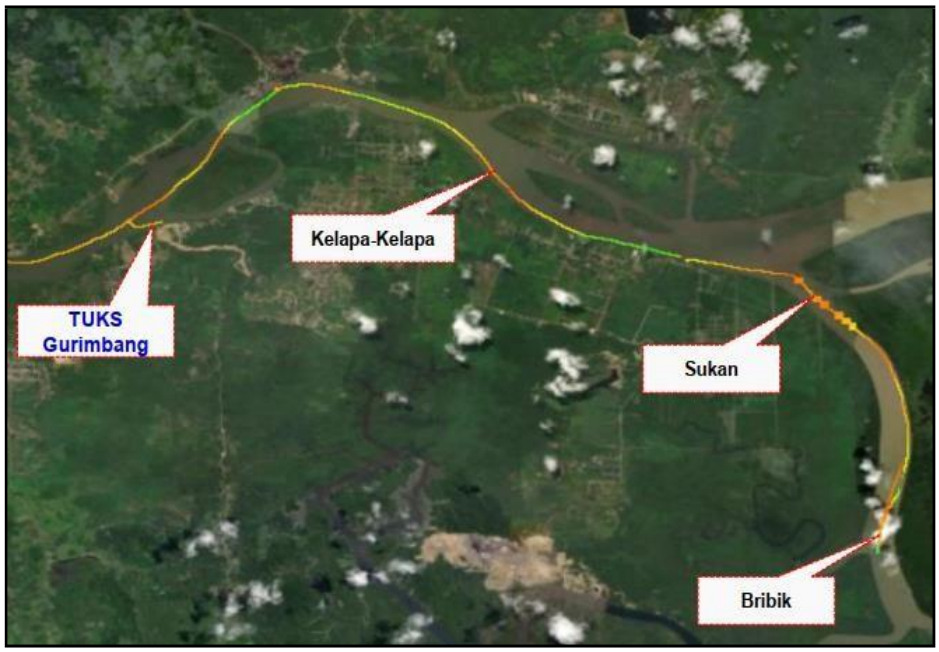


Figure 4. Barge Routes and Locations of Obstacles

Table 1. The results of bathymetry measurements of the TUKS Gurimbang pond and obstacles in the shipping channel

Location	Bathymetry Results (MSL)		MSL	Tidal correction factor				UKC	Calculation of barge draft							
	Max	Min		HHWL	MHWL	MLWL	LLWL		HHWL		MHWL		MLWL		LLWL	
									Min	Max	Min	Max	Min	Max	Min	Max
Jetty Gurimbang	-4.26	-5.77	1.40	3.03	2.41	0.38	-0.23	0.30	-5.59	-7.10	-4.97	-6.48	-2.95	-4.45	-2.33	-3.84
Kelapa-Kelapa	-3.91	-5.74	1.40	3.03	2.41	0.38	-0.23	0.30	-5.24	-7.07	-4.63	-6.45	-2.60	-4.43	-1.98	-3.81
Sukan	-5.14	-6.47	1.40	3.03	2.41	0.38	-0.23	0.30	-6.74	-7.08	-5.85	-7.18	-3.82	-5.15	-3.21	-4.45
Beribik	-6.26	-15.10	1.40	3.03	2.41	0.38	-0.23	0.30	-7.59	-16.43	-6.97	-15.81	-4.95	-13.78	-4.33	-13.17

HHWL = Higher High Water Level; **MHWL** = Mean High Water Level; **MLWL** = Mean Low Water Level; **LLWL** = Lowest Low Water Level;
MSL = Mean Sea Level; **UKC** = Under Keel Clearance
Source: SGI Department PT XYZ, 2021

$$ht_i = Z_0 + \sum_1^n H_n \cos[\varpi_n t_i + g_n]$$

$$ht_i = Z_0 + \sum_1^n H_n [\cos(\varpi_n t_i)\cos(g_n) - \sin(\varpi_n t_i)\sin(g_n)]$$

$$A_n = H_n \cos(g_n)$$

$$B_n = H_n \sin(g_n)$$

$$ht_i = Z_0 + \sum_1^n A_n \cos(\varpi_n t_i) - \sum_1^n B_n \sin(\varpi_n t_i)$$

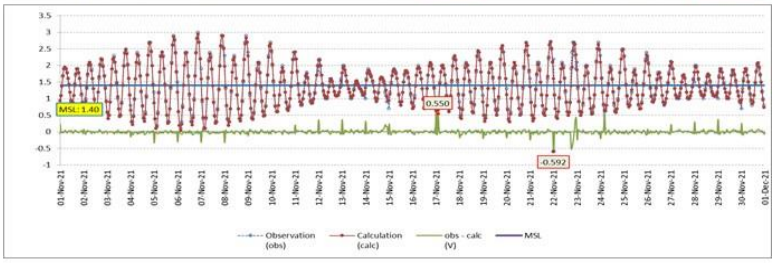
$$H_n = \sqrt{A^2_n + B^2_n}$$

$$g_n = arctg\left(\frac{B_n}{A_n}\right)$$

$$\begin{bmatrix} ht_1 \\ \dots \\ ht_x \end{bmatrix} = \begin{bmatrix} 1 & \cos(\varpi_1 t_1) & -\sin(\varpi_1 t_1) & \dots & \cos(\varpi_9 t_1) & -\sin(\varpi_9 t_1) \\ 1 & \dots & \dots & \dots & \dots & \dots \\ 1 & \cos(\varpi_1 t_x) & -\sin(\varpi_1 t_x) & \dots & \cos(\varpi_9 t_x) & -\sin(\varpi_9 t_x) \end{bmatrix} \begin{bmatrix} Z_0 \\ A_1 \\ B_1 \\ A_2 \\ B_2 \\ \dots \\ A_9 \\ B_9 \end{bmatrix}$$

http://www.math.stonybrook.edu/~tony/tides/harmonic.html

No	Constituents	Symbol	Description	Period (hour)	ω (rad/hour)	A	B	g° phase	H=Amplitude (m)
0.	Average water level	Z_0		-	-				1.3961
1.	Main lunar constituent	M_2	semi diurnal	12.4206	0.50587	-0.6522	-0.2502	200.9870°	0.6985
2.	Main solar constituent	S_2		12.0000	0.52360	0.2433	0.2788	48.8913°	0.3700
3.	Lunar constituent, due to Earth-Moon distance	N_2		12.6582	0.49637	0.0189	-0.1104	279.7231°	0.1120
4.	Soli-lunar constituent, due to the change of declination	K_2		11.9673	0.52503	-0.0274	0.1401	101.0642°	0.1427
5.	Soli-lunar constituent	K_1	diurnal	23.9346	0.26251	0.1563	-0.0238	351.3442°	0.1581
6.	Main lunar constituent	O_1		25.8194	0.24335	-0.1426	-0.1147	218.8066°	0.1830
7.	Main solar constituent	P_1		24.0658	0.26108	-0.0186	0.0275	124.0096°	0.0332
8.	Main lunar constituent	M_f	quarterly	6.2103	1.01174	-0.0191	0.0608	107.4135°	0.0637
9.	Soli-lunar constituent	MS_4		6.1033	1.02947	0.0086	0.0212	67.9868°	0.0229



	Symbol	Calculation			Elev.	HHWL	MHWL	MSL	MLWL	ISWL	LLWL	LAT
Higher High Water Level	HHWL	$Z_0+(M_2+S_2+K_2+K_1+O_1+P_1)$	2.9816	≈	3.0	0.0	0.6	1.6	2.6	0.0	3.2	3.4
Mean High Water Level	MHWL	$Z_0+(M_2+K_1+O_1)$	2.4357	≈	2.4	-0.6	0.0	1.0	2.0	0.0	2.6	2.8
Mean Sea Level	MSL	Z_0	1.3961	≈	1.4	-1.6	-1.0	0.0	1.0	0.0	1.6	1.8
Mean Low Water Level	MLWL	$Z_0-(M_2+K_1+O_1)$	0.3565	≈	0.4	-2.6	-2.0	-1.0	0.0	0.0	0.6	0.8
Indian Spring Water level	ISWL	$Z_0-(M_2+S_2+K_1+O_1)$	-0.0135	≈	0.0	-3.0	-2.4	-1.4	-0.4	0.0	0.2	0.4
Lowest Low Water Level	LLWL	$Z_0-(M_2+S_2+K_2+K_1+O_1+P_1)$	-0.1894	≈	-0.2	-3.2	-2.6	-1.6	-0.6	0.0	0.0	0.2
Lowest Astronomical Tide	LAT	Z_0-(all constituents)	-0.3881	≈	-0.4	-3.4	-2.8	-1.8	-0.8	0.0	-0.2	0.0

Figure 5. Results of a bathymetric survey on barge shipping lanes

Table 2. Planned coal loading volume at TUKS Gurimbang PT XYZ

TUKS Location	Coal load plan		Fuel unloading plan		Material B/M Plan & Other Support Units (Number of Ship)
	Volume (MT)	Number of ships	Volume (KL)	Number of Ship	
Gurimbang	5,500,000	± 917	900,000	± 72	± 36

*) B/M Plan for Coal and Fuel, refers to the average annual plan of PT XYZ

**) Material B/M plan and other support units refer to the average number of ships entering TUKS to carry out B/M activities

Source: PT XYZ Marine Department II Quarterly Report, 2021

Table 3. The dimensions of the ship are in accordance with the plans for the unloading berth at the TUKS Gurimbang pool

TUKS Location	Jetty Coal		Fuel unloading plan		Beaching Point	
	Dimension (Type)	DWT	Dimension (Type)	GT	Dimension (Type)	GT
Gurimbang	300 feet	±7,800	230 feet	1,200	230 feet	1,300

Source: PT XYZ Marine Department II Quarterly Report, 2021

Table 4. Vessel/Barge Immersion Draft measuring 270 Feet and 300 Feet for certain loads

Payload (MT)		5,200	6,000	6,000	6,800	7,000	7,200	7,400	7,600	7,850	8,000
Immersion Draft (Mtr)	270 ft	4.01	-	-	-	-	-	-	-	-	-
	300 ft	3.40	3.78	4.06	4.15	4.25	4.34	4.43	4.52	4.63	4.70

Source: Independent Surveyor, 2021

c. The position of the TUKS Gurimbang facility (Jetty Coal and Beaching Point) is quite safe relative to the general shipping lanes for ships going in and out of the Gurimbang upstream; it is quite broad;
d. The distance of the Gurimbang TUKS facility to the general shipping lane is as far (± 300 meters) from the direction of Gurimbang Village and ± 900 meters from the direction of Tanjung Redeb.

The depth of the TUKS Gurimbang column and obstacles in the Ship/Barge Shipping Channel

Based on the bathymetry results carried out in the TUKS Gurimbang area of PT XYZ and several points on the barge shipping lanes that become obstacles and PT XYZ's TUKS area development plan, generally still deep enough and safe for ships to exercise berthing and offloading as well as loading and unloading activities in the TUKS scope area. The results of the bathymetry of the TUKS Gurimbang pool and shipping lanes are shows in table 1.

From table 1 above the smallest depth in Kelapa-Kelapa with a depth of -4.63 meters at the average height of high water (tide) in one annual period (Mean High Water Level).

Results of a bathymetric survey on barge shipping lanes

The bathymetry survey on the barge shipping channel starts from TUKS Gurimbang to Sukan Beribit. Measurements were carried out on November 1, 2021, from 10.00 WITA to 16.00 WITA. Then tidal data was obtained from DISHIDROS TNI AL (MUARAN SUNGAI BERAU). From the results of calculating the characteristics of the tides, the mean sea level value is 1,391 meters.

In the following, spatial data is presented, which is overlaid with bathymetry data on the shipping route from TUKS Gurimbang to Sukan Beribit. Then made per section the locations to be able to see the depth on the barge lane.

Based on the results of the bathymetry survey at each location, the smallest depth was obtained at the Kelapa-Kelapa location, which was -4.459 meters. The Kampung Sukan location is -4.377 meters, and the Beribit location is -4.434 meters.

Marine data analysis results

Loading and Unloading Volume Plan

Based on the planned target of coal production at the Gurimbang site in 2022, namely 5,500,000 MT per year, it is predicted that the number of

ships/barges with a load of 6,000 DWT will be ± 917 units of ships/barges. This data can be seen in table 2.

Maximum Ship Size

Barges of 300 Feet are the largest barges, and these are widely used to carry large loads, weights, and large volumes. This transport ship can transport 7,800 to 8,000 MT (depending on conditions and type of cargo).

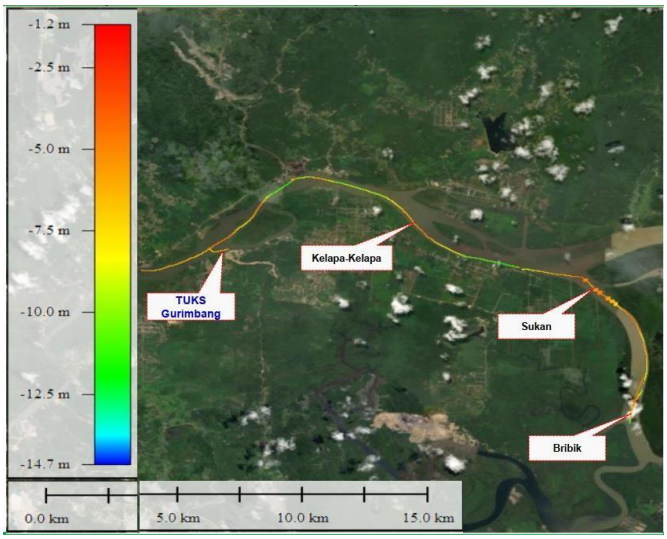


Figure 6. Bathymetry Measurement from TUKS Gurimbang to Sukan, Beribit

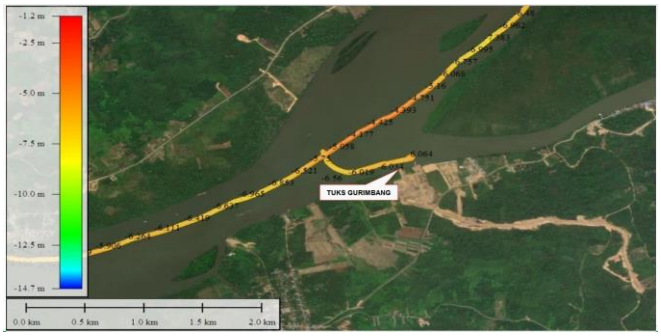


Figure 7. Bathymetry Results at the Gurimbang TUKS Location

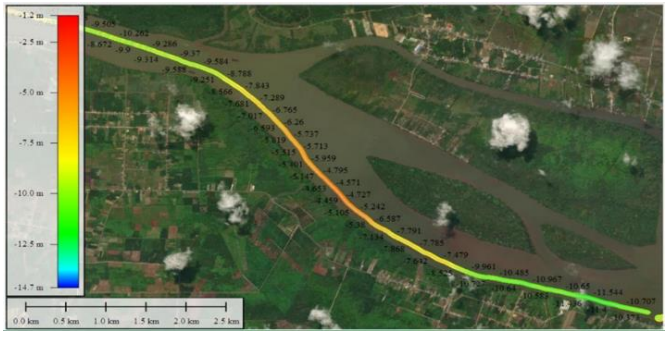


Figure 8. Bathymetry Results at Kelapa-Kelapa Locations

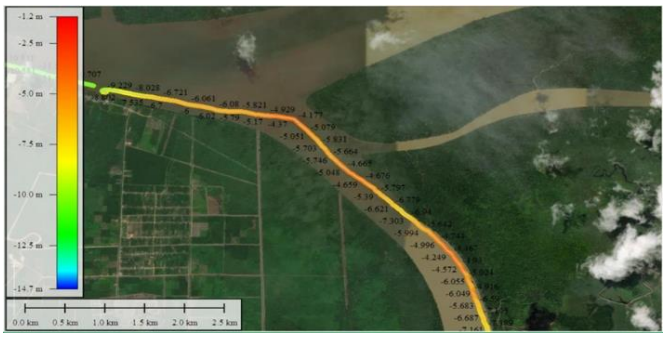


Figure 9. Bathymetry Results at the Kampung Sukan Location

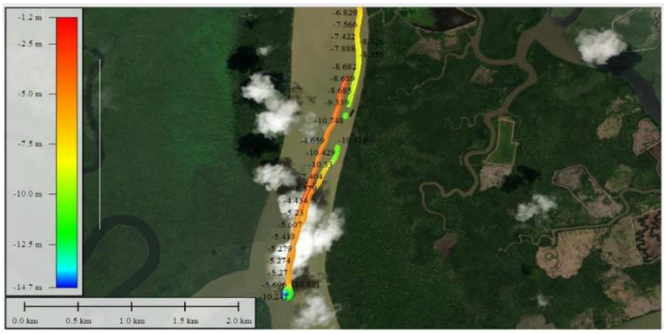


Figure 10. Bathymetry Results at Berbite Locations

Figure 11. Barge with a size of 300 Feet

Frequency of Ship Visits

The frequency of ship visits that enter the TUKS Gurimbang area can be seen in table 2.

Ship/Barge Immersion Draft

The ability of ships/barges of several types/sizes to accommodate loads at the same displacement draft will always be different. The larger the ship/barge, the more cargo can be accommodated on the same displacement draft.

Based on table 3.4 above, the draft barge with a capacity of 7,850 MT is -4.63 meters and 8,000 MT -4.70 meters.

Barriers to Navigation

The obstacles that will be faced by the navigator while sailing in/out of the TUKS Gurimbang PT XYZ

area are 3 (three) locations, namely Kelapa-Kelapa, Sukan, and Beribit. These obstacles are due to the limited depth of the waters, the density of water traffic, the existence of residential areas along the river, and several points used by the community as a place to raise fish (cages).

Needs for Navigational-Shipping Auxiliary Facilities

The shipping-navigation aids (Sarana Bantu Navigasi-Pelayaran/SBNP) that have been provided and installed by Pelindo IV Makassar Tanjung Redeb branch on the general shipping channel (Muara Pantai – Tanjung Redeb) are currently safe enough to be used as a reference in driving ships safely to their destinations. The SBNP that are already available in the channel at each point are as follows: Kelapa – kelapa, Sukan, Beribit, Lunsuran Naga, Segitiga Suaran, Buoy Hijau, Buoy Luar.

Figure 11 shows several SBNPs installed along the shipping lane from TUKS Gurimbang to the Transshipment Point.

Figure 12. Distribution of SBNP in the shipping channel of the Berau River – transshipment point

Conclusion

Based on the results of research regarding the technical review of PT XYZ's coal ship/barge shipping lanes in order to increase DWT capacity to support the achievement of the 5,500,000 MT coal production target, the following conclusions are drawn:

1. Based on the studies presented above, starting from the plan for the in and out of TUKS Gurimbang to the transshipment point, the position of general shipping lanes, bathymetry surveys for ship/barge lanes, pond depth in the TUKS area, planned loading and unloading volumes, dimensions of ships that will dock and unload - loading (B/M), frequency of ship visits, availability of The shipping-navigation aids (Sarana Bantu Navigasi-Pelayaran/SBNP), as well as observations at several points that will become obstacles in shipping navigation, it can be concluded that the development/improvement of PT XYZ's DWT TUKS Gurimbang capacity to support increased production coal and operational activities are still safe enough to be increased.
2. Based on the bathymetry results in the TUKS area, a depth of -4.97 was obtained, and on the shipping navigation route, the smallest depth was obtained, namely in Kampung Sukan, with a depth of -4.377 meters. From Independent Surveyor data, in this case, PT Sucofindo, it was explained that the cargo capacity on ships/barges is still safe to load up to a cargo capacity of 8,000 MT at a maximum immersion depth of -4.70 meters.
3. Thus, this research can be continued for the preparation of technical review documents as a condition for fulfilling PM 89 of 2018 concerning Norms, Standards, Procedures, and Criteria for Electronically Integrated Business Licensing in the Transportation Sector in the Sea Sector in the process of increasing the capacity of DWT (Dead Weight Tonnage) at PT XYZ Kampung Gurimbang's Own Interest Terminal to a load of 8,000 DWT.

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