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BATHYMETRY MAPPING STUDY AS A CONSIDERATION IN DETERMINING SHIPPING CHANNEL IN PRAMUKA ISLAND WATERS, SERIBU ISLANDS, DKI JAKARTA

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ABSTRACT

Bathymetry is a method or technique in determining sea-depth or seabed profile from the result of sea-depth analysis. Bathymetry data is an important data used as shipping channel consideration, especially in Pramuka Island Waters, Seribu Islands, DKI Jakarta. Determining shipping channel in Pramuka Island Waters is really important as the reference for secure sea traffic. The purpose of this study is to know bathymetry condition used as consideration in determining shipping channel in Pramuka Island Waters, Seribu Islands, DKI Jakarta. This reasearch was conducted in August, 4th – 6th 2016 on waters and dock of Pramuka Island, Seribu Islands, DKI Jakarta. The materials used as objects of this study are tidals, bathymetry and seabed morphology in Pramuka Island, Seribu Islands, DKI Jakarta. This research used case study method, i.e., research methods conducted intensively and detailed on a case, can be environment, certain situation to reveal or to understand something and the result can not be used in other areas. Case study in this research is knowing sea-depth. In this case, the result of this research which are bathymetry and shipping channel, cannot applied in other areas. Data processing using software Surfer 9.0, Arc Gis 10.3 and Microsoft Excel. The result of this research indicate that sea-depth in research location have depth between -0,7 until -38,6 m. Seabed morphology in Pramuka Island Waters was included in sloping category, with the slope value of 2,57% untill 10,12%. Tidal type is diurnal type with Formzahl value 3,34. Consideration of shipping channel due to vessel traffic is channel from North Jakarta direction and from other islands direction heading Pramuka Island.

Key words: *bathymetry, shipping channel, pramuka island waters*

INTRODUCTION

Pramuka Island is one of The Seribu Archipelago which is the center administrative of the district government of The Seribu Islands. Pramuka Island itself is an inhabited island that began to develop the area for tourism in recent years because of the natural beauty around this island and the friendly locals. Pramuka Island has an area of about 9 hectares and was includedinto KelurahanPanggang Island, District of North Seribu Islands, Jakarta. During its development, the Pramuka Island should be good taken in the process of maintenance. Pramuka's quay is certainly a backrest for ships that docked. By making safe shipping lanes for people and ecosystems, bathymetry mapping in Pramuka Island needs to be done as a consideration for the shipping channels in The Waters of Pulau Pramuka.

Increased shipping activity in Pramuka Island significantly raises new issues. Activities such as fishing, marine tourism and other activities directly related to shipping activity needs more attention. Irregular utilization waters causing the shipping channelfor fishing boats and ferries passing in the waters of Pulau Pramuka become irregular, especially when docked. This irregularity may endanger passengers who have a destination to the area, also will damage coastal ecosystems that exist on the island resulting in lower productivity of coastal communities in Pramuka Island.

Information about seabed topography in The Waters of Pramuka Island, Seribu Islands, Jakarta needs to be known. In the process of bathymetric mapping,other supporting data are needed, one of which is the tide data. Primarily tidal data used is Mean Sea Level, as a correction for depths data obtained from soundingtools. Through bathymetric mapping, it can be seen how the seabed topography is. By knowing the bathymetric conditions in Pramuka Island Waters, we can make a consideration for shipping channel along with the enhancement in shipping activity in this region.

MATERIAL AND METHOD

Research Materials

The material used in this study included primary data which is sounding data in Pramuka IslandWaters, Kep. Seribu, Jakarta and tidal data during sounding activity. Secondary data is tidal data for 30 days, August 2016 from Geospatial Information Institute (BIG) and the Indonesian Pramuka Island Topographic Map scale 1: 25.000 in 2000 Publication of Coordination Agency for Surveys and Mapping (BAKOSURTANAL).

Research Methods

This study uses the case study method, the method of research conducted intensively and in detail on a case, which can include events, environments, situations that allow to express or understand something and the result can not be used in other areas (Prastowo, 2011).

Data Collection Methods

Direct tide observations at the same time with bathymetric measurements, performed every 30 minutes, while the one month tide data from the Tanjung Priok observation station obtained from instituteGeospatial Information Institute.

Purposive Sampling Method used in the determination of sounding line. Sounding data collection activities are conducted in accordance with the Indonesian National Standard (SNI) hydrographic survey using singlebeam echosounder tool.

Processing and Data Analysis Methods

Tide data is processed using the admiralty method and produce tidal components. This tidal components then used to determine Z0, MSL, HHWL, LLWL and type of the tide.

Bathymetry data acquisition process produces data called fix point that has information about the position (x, y) and depth (z) observed simultaneously. Bathymetry measurement results corrected for the position of sea level (MSL, Z0, and TWLt) at the time of measurement and correction of sinking distance transducer (transducer correction) in order to obtain actual depth.

The slope of the seabed is obtained by calculating the slope using bathymetric contour map from the bathymetry data processing. A cross section of research sites created using *ArcGIS 10.3* software which is divided into three parts, the cross-section line namely A-B-C. Measurement of slope conducted on bathymetric map using Wentworth Method. Meanwhile the slope process visualization used manual techniques, which is interegation technique.

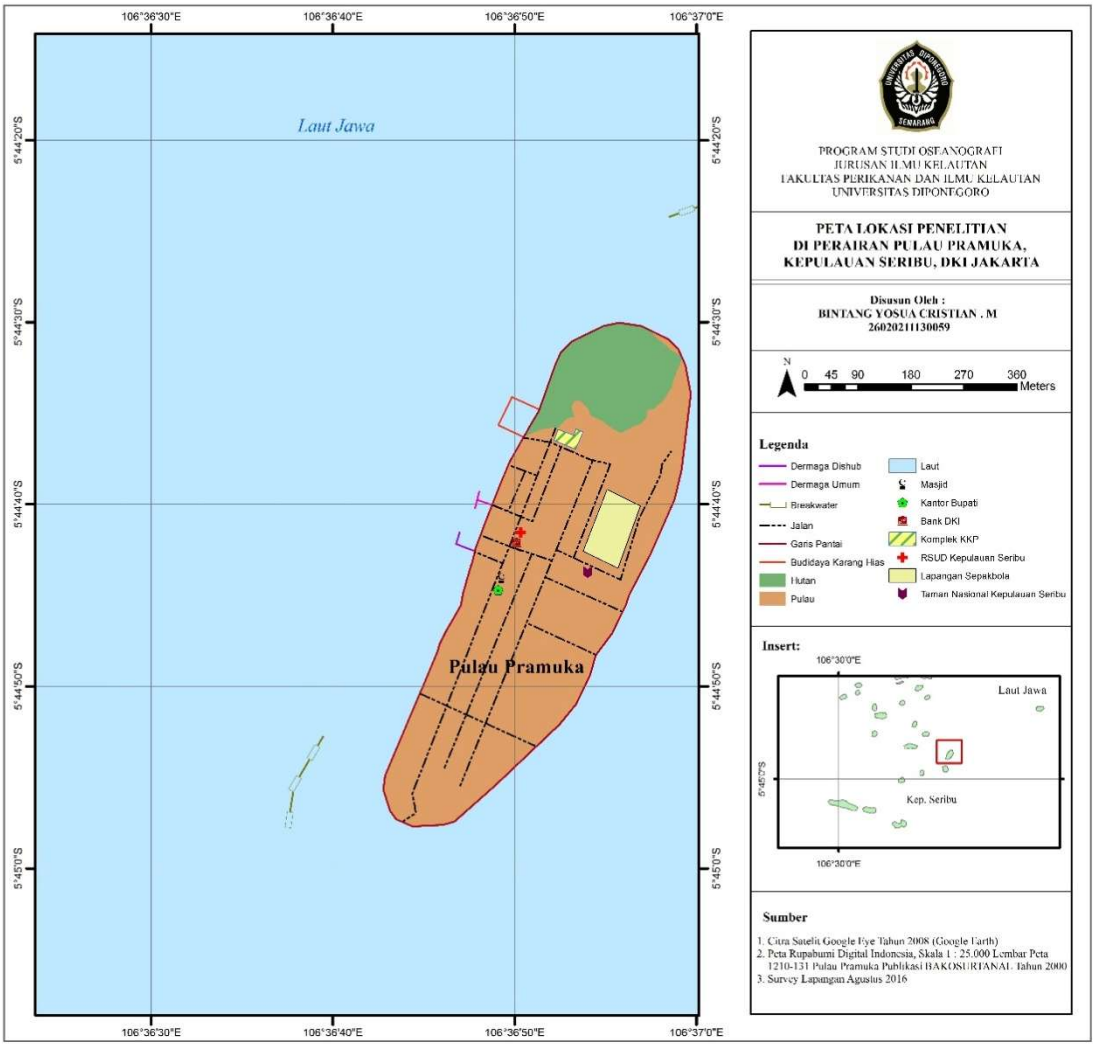

Figure 1. Reseacrh Location Map

RESULT AND DISCUSSION

Tides

Based on the tides data analysis, tides types of Jakarta is a diurnalconstituents with Formzahl value of 3.34. The mean water level relative to the local datum (Z0) 170.61 cm high, mean sea level (MSL) 184.51 cm, highest high water level (HHWL) 224.3 cm, and lowest lowwater level is (LLWL) 137.4 cm as shown in Figure 2.

Bathymetry

Bathymetry measurements carried out in the Pramuka Island Waters, Seribu Islands, Jakarta by using the singlebeam echosounder tool *Garmin GPSmap 585*. The study produced

bathymetric data, which are sounding time (date and time), the coordinates position (xy data), depth data (z data) legibled on the echosounder screen. Depth data legibled on the echosounder screen was an uncorrected depth data on tides and transducer draft.

Sounding point is the interpretation of the coordinates position and depth data measured in this study. From the result of processing data using *ArcMap 10.3* software, the sounding dots form a particular pattern to be used as the determination of the depth contour lines.

Depth data from the *singlebeam echosounder* should be corrected by transducer draft correction, and sea level at the same time of sounding to obtain the actual depth value. Then it is interpolated using the *Krigging* method on *Surfer 9* to produce the depth contour lines. Bathymetric map can be seen in Figure 3.

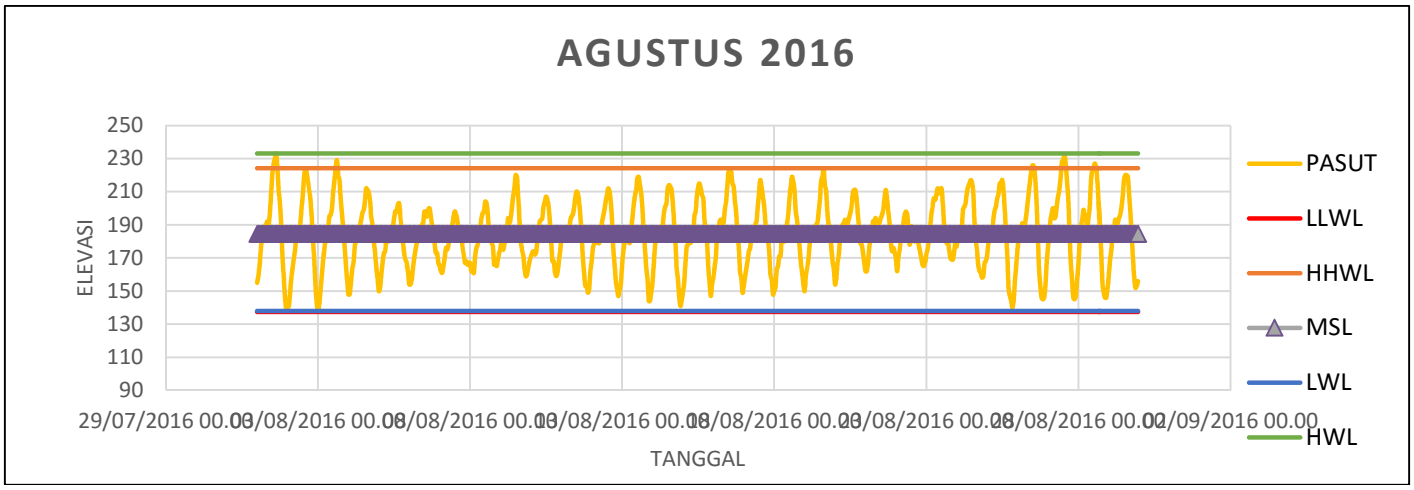

Figure 2. Tidal Chart in August 2016

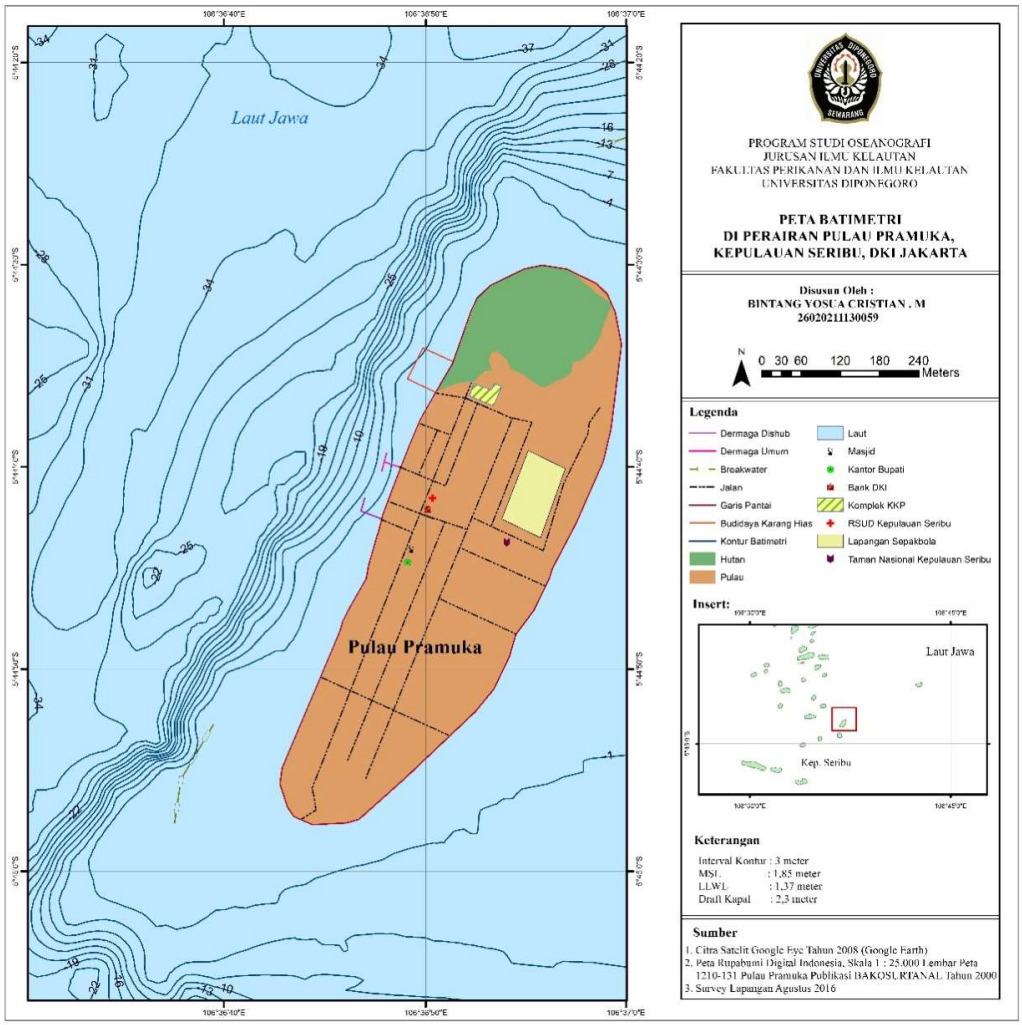

Figure 3. Pramuka Island Bathymetric Map

Seabed Sectional Morphology

The calculation of the water depth profile aims to obtain slope values of the sea floor. Value sloping sea floor includes three segments, A-A ', B-B', and C-C 'shown in Figure 4. Determination of the location/segments based on location sharing on the assumption that location is the place that represents the area of research and research purposes.

Seabed profile determined by a contour map (Figure 3) can generate slope values calculated by *Wentworth* equation (1930), from the value it can be determined using Van Zuidam (1983) slope classification.

Shipping Channel Map

Shipping channel map obtained from the bathymetry map that has been analyzed. Considerations determining the shipping channel (Figure 5) reviewed from depth factor and vessels draft in Pramuka Island Waters. Shipping channel is in accordance with the ship traffic covers from the North Jakarta and also from the other islands to the Pramuka Island. The channel is made to avoid sandbar areas and steep seabed first, and then directed toward the Pramuka Island.

The biggest pioneer ship types used toward Pramuka Island is a type of motor passenger ship with capacity of 114 passengers and 100 tonnes cargo (225 people when unladen), with a total length (Length Overall / LOA) 42 m; water line length (Length Between perpendiculars / LBP) 38 m; and loaded (draft) of 2.3 m. Black line is visualized as the direction of the incoming ships to Pramuka Island Waters. This navigation channel can be used as inflow and outflow from Pramuka Island Waters region.

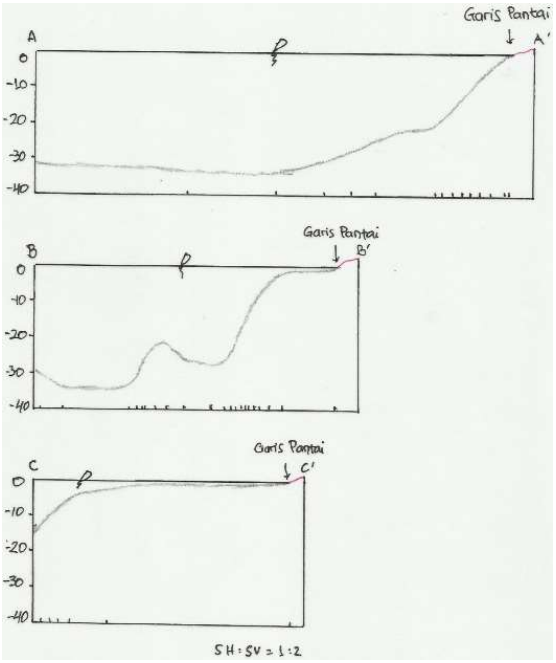

Figure 4. Seabed Profile of Pramuka Island

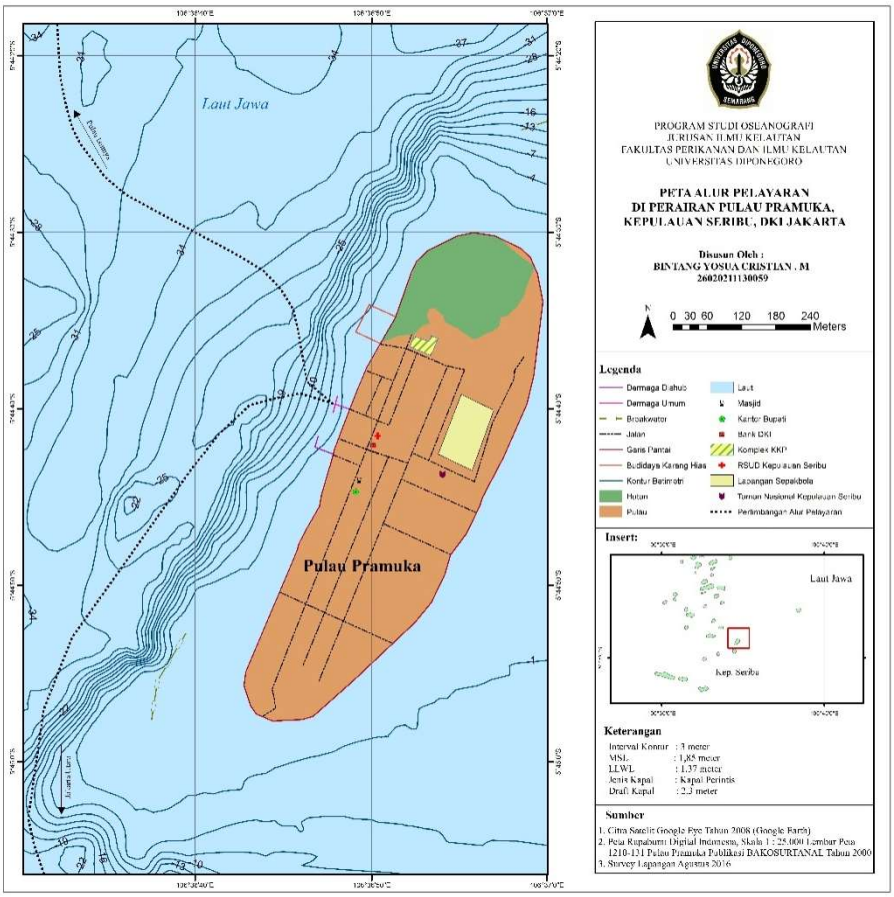

Figure 5. Shipping Channel Map

Discussion

Tide data used in this study is the result of tidal observations for 29-day sequences in Tanjung Priok, Jakarta. The data is processed using Admiralty method and generate constant tidal harmonics values. Harmonic tidal constants, semi diurnal or middle consituent is M2, S2, N2, K2 and diurnal harmonic constants are K1, O1, P1. The dominant harmonic constant value in the waters of Jakarta is K1 tidal waters, which means it is more affected by the declination of moon and sun., with amplitude value 29.77 cm. The other main component of the diurnal constituent amplitude value is O1 (AO1 = 12.39 cm) and P1 (AP1 = 9.82). Meanwhile the main semi-diurnal of tidal constituent M2 (AM2 = 7.14) cm, S2 (AS2 = 5.49), N2 (AN2 = 2.34) and K2 (AK2 = 1.26). Based on the analysis of the amplitude value comparison, it can be seen that there is a constituent value combination between diurnal and semi-diurnal, although more in a diurnal dominance. This is in accordance with the type of Jakarta tidal waters, which is diurnal with Formzhal value of 3.34, where in one day occurred one high tide and one low tide. Determining the type of tide is known from Formzhal value based on a comparison of the sum of diurnal tidal main components (K1 and O1) with a semi-diurnal tidal components (M2 and S2) are classified in Formzhal value. (Pariwono (1985) in Ongkosongo and Suyarso (1989).

Depth data retrieval method with anacoustic method using singlebeam echosounder generate data that appears on the screen such as coordinates, depth values, time measurement and speed of the ship when the measurements was conducted. Pramuka Island Waters is largely sandbar, so it is not all affordable to do sounding uses echosounder tool. The data obtained by measurement with GPS forms coordinates and depth values. The depth value obtained from the echosounder measurement results is not the actual depth value. To obtain the actual depth value, it must be corrected again using vertical data (MSL, Z0, and TWLt). Corrections were made because at the time of measurement, the elevation of sea level is changing caused by the tides and the position of the lied transducer must be corrected for the adjustment of the transducer draft (distance sinking transducer from water level), as well as the weight of the ship must be noted to ensure that the transducer does not appear on the surface of the water even affected by sea wave. The next correction is a tidal correction, where the correction aims to determine the position of the sea level at the time of sounding. The data have been corrected used as input material for making bathymetric contour using the *Surfer 9* software. Sounding results in the fix point form (Figure 3) shows that the distances between measured sounding points tend to be more tenuous and distorted than the path of sounding interval plan. This is caused because the vessels used to perform sounding activity have limited movement ability and maneuverability of the sailing masterwas limited, backed by current and wave conditions which cause the movement of the vessel was unstable.

Bathymetric contour map presented in Figure 4, where the value of the contour interval is 3m with a minimum value 0 as the contours of the coastline and the maximum value is -37m. In the southwest and south side of the island there is a closed curve with a value of -1 far enoughfrom the island, it is because the area is a sandbar area. In the area on the southwest side, at a depth between -4m to -19m highly visible that the contour is increasingly tight and it shows that the area is categorized as steep, according to the statement by Sandy (1988) that if the contour has a tight distance, slopes will be steeper. But on the west side to the north, at -1 to -25 m depth contour conditions have started regular and sloping morphology. From the calculation of seabed slope done by taking a random distance can be seen that the results varied from 4.16%, 10.12% and 2.57%. This value illustrates that the seabed morphology in Pramuka Island Waters, Seribu Islands, Jakarta included in the category of slightly tilted. This was reinforced by the classification table slope value according to Van Zuidam (1985) is in the range of 2% -7% included in the category of slightly tilted and 7% -15% included in the category tiltedwith high magnitudes.

In this study, it has been known the value of depth, largest ship draft, seabed morphology and characteristics of the waters. Through those data, shipping channel is made in the territorial Pramuka Island Waters, Seribu Islands. Shipping channel is in accordance with vessel traffic in that area, covering the channel from North Jakarta and from the other islands toward the Pramuka Island Waters, Seribu Islands. Before entering the area of Pramuka Island Waters, on the shipping channel from the North Jakarta, there is an open water. But seen from bathymetric data, when approaching Pramuka Island from North Jakarta, in the south side, there is a fairly wide sandbar. So as avoiding a shipwreck on the way to Pramuka Island from the North Jakarta, the shippping channel directed a bit away from Pramuka Island prior to the southwest Pramuka Island, then ship directed to maneuver straight parallel island and eventually switched to the northeast toward the dock. This is in accordance with the provisions trace navigation channel (Triatmodjo, 1996), which states that wherever possible alignment grooves, it must follow a straight line. Shipping channel from the other islands to Pramuka Island, starting from the northwest Pramuka Island, where the islands are located, such as: Karya Island and Panggang Island. Then with a little oblique, shipping channels directed towards the Pramuka Island. This is because reviewing bathymetric data, there is a steep water depth, so that the channel directly made oblique passing by the steep depth waters.

Bathymetry map also combined with data from the biggest ship's draft anchored in Pramuka Island. Ship stop point is at a depth about 1m - 4m. Shipping accidents that often occured around Thousand Islands is the shipwreck because it is on the sandbar area. Besides have considered aspects of bathymetry, shipping channel created in this study also has been made safe to avoid the sandbar area around Pramuka Island, Seribu Islands, DKI Jakarta.

CONCLUSION

The results of the bathymetric mapping with sounding process in the Pramuka Island Waters, Seribu Islands, Jakarta included in the category of shallow water with depths between -0.7m to -38.6m. Pramuka Island Waters morphology, Seribu Islands are included in the category of slightly tilted, with a slope value of 4.16%, 10.12% and 2.57%. Formzahl value 3.34 indicates that the type of tidal waters is diurnal type. Consideration of shipping channel in the Pramuka Island Waters Consideration of shipping channel due to vessel traffic

is channel from North Jakarta direction and from other islands direction heading Pramuka Island.

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