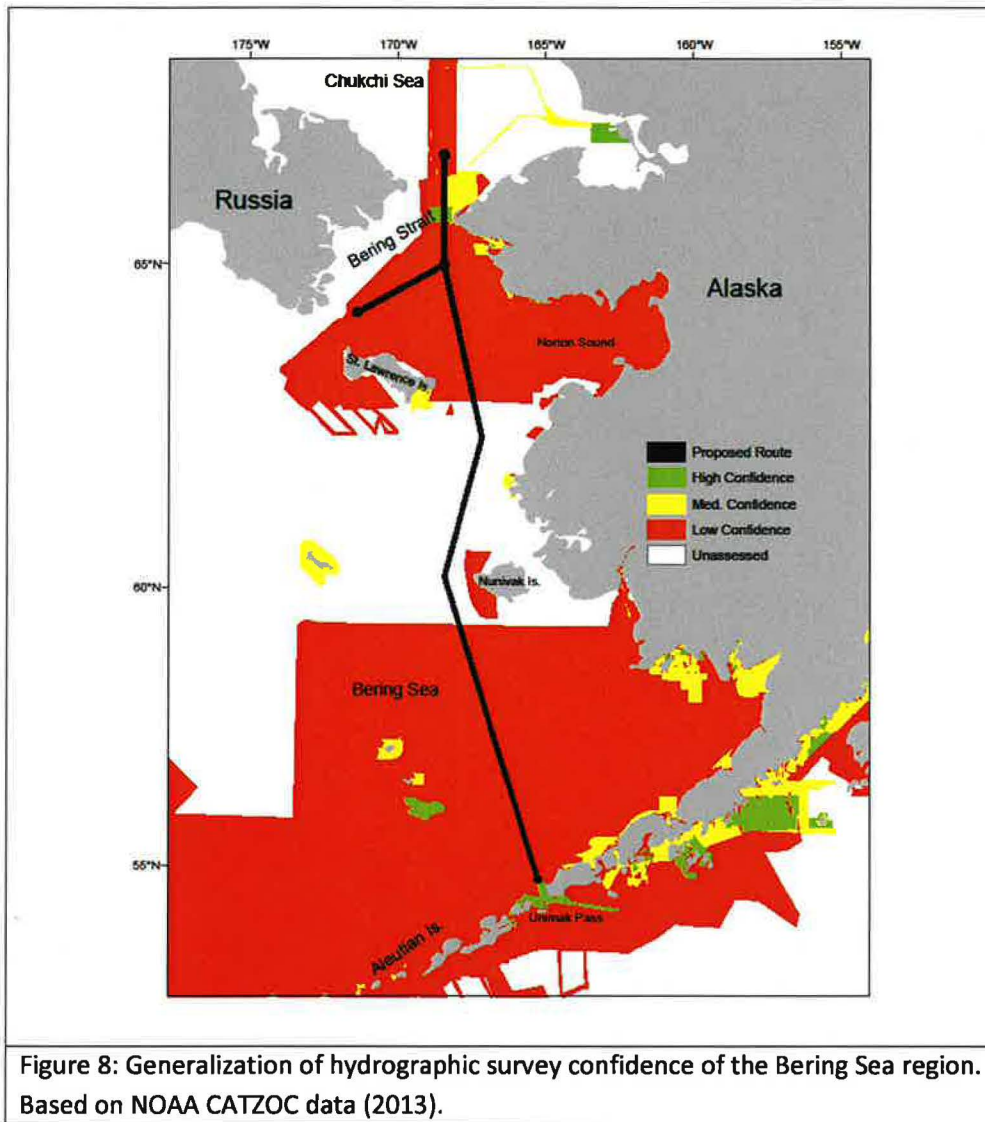


Appendix B - Hydrographic Quality Analysis

As the Coast Guard moved the PARS process towards developing and recommending specific routing measures, it became clear that one of the major concerns was outdated hydrographic data on the nautical charts covering the PARS study area. The Coast Guards efforts to design and propose a route was impeded by not having reliable hydrographic data on which to base decisions. The Coast Guard could not recommend a vessel routing system knowing that the stated depths on the nautical charts may be inaccurate with potential dangers to navigation and shoal water unidentified.

The eastern Bering Sea, which makes up the majority of the study area, is a relatively shallow body of water with average depths ranging from 20 to 250 feet. These shallow depths offer minimal under keel clearances as compared to the waters surrounding the western Aleutian Islands and North Pacific Ocean where offshore water depths are well over 3,000 feet in depth. The shallow depths of the eastern Bering Sea are especially problematic for mariners because some nautical charts for this area are utilizing hydrographic data obtained over 100 years ago with a leadline at spacing intervals in excess of a mile apart. The shallow water of the Bering Sea along with the outdated hydrographic quality caused the Coast Guard to take a precautionary approach in the development of routing systems for the area.

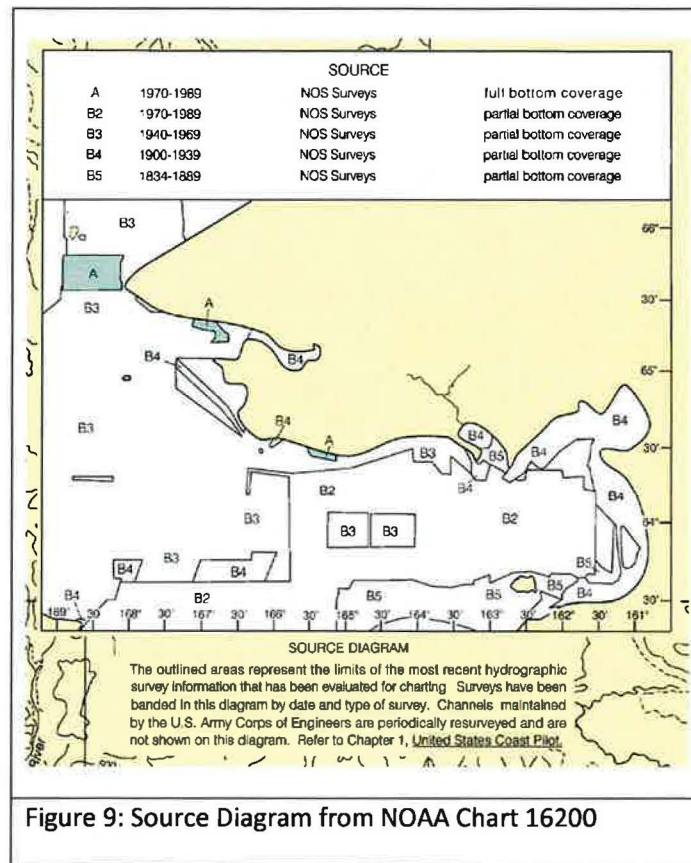
A map depicting the hydrographic quality for the region is below in Figure 8. Varying levels of confidence in hydrographic survey information are known as “Category of zone of confidence in data” or CATZOC. Areas depicted by the color **red** indicate areas with low hydrographic confidence ratings, which mean that large depth anomalies may be expected. Areas depicted by the color **yellow** indicate areas with medium hydrographic confidence ratings, which mean that uncharted features are not expected, but may exist. Areas depicted by the color **green** indicate areas with high hydrographic confidence ratings, which mean that all significant seafloor features have been detected. Taken in totality, the map shows the majority of the Bering Sea is not well surveyed and of low hydrographic confidence.



Nautical charts produced by NOAA’s Office of Coast Survey are based upon the best available hydrographic data. The underlying data may be very recent and obtained using modern multibeam sonar equipment (depicted above in green) or it may be quite old and based upon outdated survey methods such as leadline or single beam echo sounder technology (depicted above in red). A single nautical chart may contain hydrographic source data of varying degrees of age and accuracy. Most paper and electronic charts contain inset diagrams to assist mariners in assessing hydrographic survey data and the associated level of navigation risk in a particular area. Paper nautical charts contain a source diagram and electronic navigation charts (ENC) have a Zone of Confidence (ZOC) diagram. These diagrams graphically represent the extent of hydrographic surveys within the area of the chart and possess an accompanying table of related survey quality categories.

The figure below is an example of a source diagram taken from NOAA chart 16200, depicting the Bering Strait region. Contained within chart 16200 are five different categories of hydrographic quality that range in age from 1834 to 1989 and categorized as “B5” to “A” respectively. In plain language, an “A” would indicate the survey quality for the area is of a high confidence. “A” corresponds to the green areas in the previous figure, “B2” indicates moderate confidence and corresponds to yellow areas in the previous figure. “B3”, “B4” and “B5” indicate low confidence and correspond to red areas in the previous figure.

Mariners transiting this area would need to be cognizant of these variations in survey quality and choose a route that contains an acceptable level of risk for their vessel and transit requirements. Risk planning for navigation through waters with low quality hydrographic data should include comparing the vessels draft to the charted depths and considering the age of the underlying hydrographic data, knowing that older survey data may be less accurate.



The task of surveying the Bering Sea in its entirety to modern hydrographic standards has not yet been performed number of reasons. The Bering Sea is a 700,000+ square mile expanse of water and would consume decades of hydrographic survey resources. Many areas of the Bering Sea are not frequented by vessels with deep drafts, which necessitate a higher confidence in nautical charts and pose higher risks in the event of a vessel running aground. However, in some locations such as the

Bering Strait, the same changes in vessel traffic types and volume that are the driving force behind the Coast Guard's Bering Strait PARS are also providing impetus for efforts to complete additional hydrographic surveys. As vessel traffic has increased and changed in the Bering Sea and Arctic waters, NOAA has responded by producing new nautical charts, adding chart inserts of larger scale and applying surveyed resources to higher traffic areas. Recently, hydrographic survey work has been performed in the highest priority areas as resources allow, focusing on areas expected to have depths of less than 60 feet that see higher volumes of traffic by commercial vessels, in particular passenger vessels. There is some degree of synergy achieved by completing a PARS in this area, as it helps to inform and prioritize areas for hydrographic survey work and production of new charts.

After the Coast Guard developed the potential vessel route in 2012, Coast Guard vessels transiting the area followed the potential route in an effort to identify any areas with water depths of less than 60ft. Over the course of 2012 and 2013, the Coast Guard did not identify any such locations and began to develop confidence that the proposed route was a viable option. To ensure that the route was truly viable and of sufficient depth, the Coast Guard coordinated with NOAA to survey the proposed route to modern standards and identify any unknown hazards or obstructions. Over the course of 2014 and 2015 the route was cooperatively surveyed by NOAA and USCG vessels. In early 2016, NOAA confirmed that they had processed the survey data and identified no hazards to navigation or depths of less than 60 feet. This confirmed the proposed route as a viable and continuous navigation corridor extending from Unimak Pass through the Bering Sea, Bering Strait and on to the Chukchi Sea.

During the course of processing this survey data, NOAA discovered many locations where actual depths differed substantially from currently charted depths. Figure 10 shows where NOAA found depth inconsistencies greater than 12 feet; with smaller discrepancies omitted for clarity. Red points indicate areas found to be shallower than charted depths and blue points indicate areas found to be deeper than charted depths. The sheer number of instances where charting inaccuracies were found demonstrates the importance of having modern survey data available for any proposed ship routing measure.



Figure 10: Depth differences in excess of 12ft as compared between existing nautical chart depths and updated hydrographic survey of the proposed route. Red indicates depths shallower than charted and blue indicates deeper depths than charted. Image provided by NOAA.