

**Analysis of Recent Shoreline Revisions to the
2005 Edition of Dutch Nautical Chart NL 2218**

Summary of Findings:

This report assesses recent shoreline changes made to the 2005 edition of Dutch nautical chart NL 2218. This new edition is credited jointly to the Hydrographer of the Royal Netherlands Navy and the Maritime Authority of Suriname. The specific area of interest of this report is the high-tide and low-tide shorelines in the immediate vicinity of Vissers Bank, an area which has been highlighted on **Figure 1**.

Dutch nautical chart NL 2218 is one of five nautical charts covering coastal areas of Suriname that the Dutch Hydrographic Office routinely publishes. A search of Library of Congress holdings for earlier printings of chart NL 2218 revealed three prior editions for the years 1961, 1969 and 1995. Unfortunately, the 1995 edition was of no value for analyzing coastal changes to Vissers Bank because it had an inset map placed directly over top of this offshore region. The 1969 edition had no insets blocking the coastlines in the Vissers Bank area, and it provided a good number of depth soundings on the bank and in the area just beyond the low-tide coast. This edition also corresponded very closely with the coastal depictions shown on British, U.S. and other Dutch nautical charts. The 1961 edition, while unencumbered by insets, did not contain the same level of bathymetric information that the 1969 edition contained, so I have therefore relied on the 1969 edition of NL 2218 as the most informative prior edition for purposes of analyzing coastal changes that have been made in the Vissers Bank vicinity.

The 1969 edition of NL 2218 established the low-water shoreline in the vicinity of Vissers Bank between 5°58'00"N and 6°00'30"N latitude, a depiction that is shared by two other Dutch nautical charts, NL 2014 and NL 2017, as well as NIMA chart 24370 and British chart 517. Recent changes on the 2005 edition of NL 2218 now show the low-tide coast in this area as extending more than four kilometers further north in some areas.

This review studied the pertinent bathymetric information displayed on nautical charts of the area, with special attention given to the specific changes that were made to the 2005 edition of NL 2218. The new coastal configuration was also compared to recent SPOT satellite imagery to determine if the changes made to the coastal configuration in this area were warranted.

Having completed this review, I have been unable to find any basis for extending the low-tide coast in this area beyond the general locality where it was previously established in 1969. Recent SPOT satellite imagery does not support this change, nor do the new depth soundings that have been taken in the near shore area off of Vissers Bank.

The following Technical Report details findings that indicate that the low-tide shoreline is not positioned correctly on the 2005 edition of NL 2218 in the general locality of Vissers Bank.



Thomas D. Rabenhorst
Director of Cartographic Instruction
University of Maryland Baltimore County

2005 Edition of Dutch Nautical Chart NL 2218

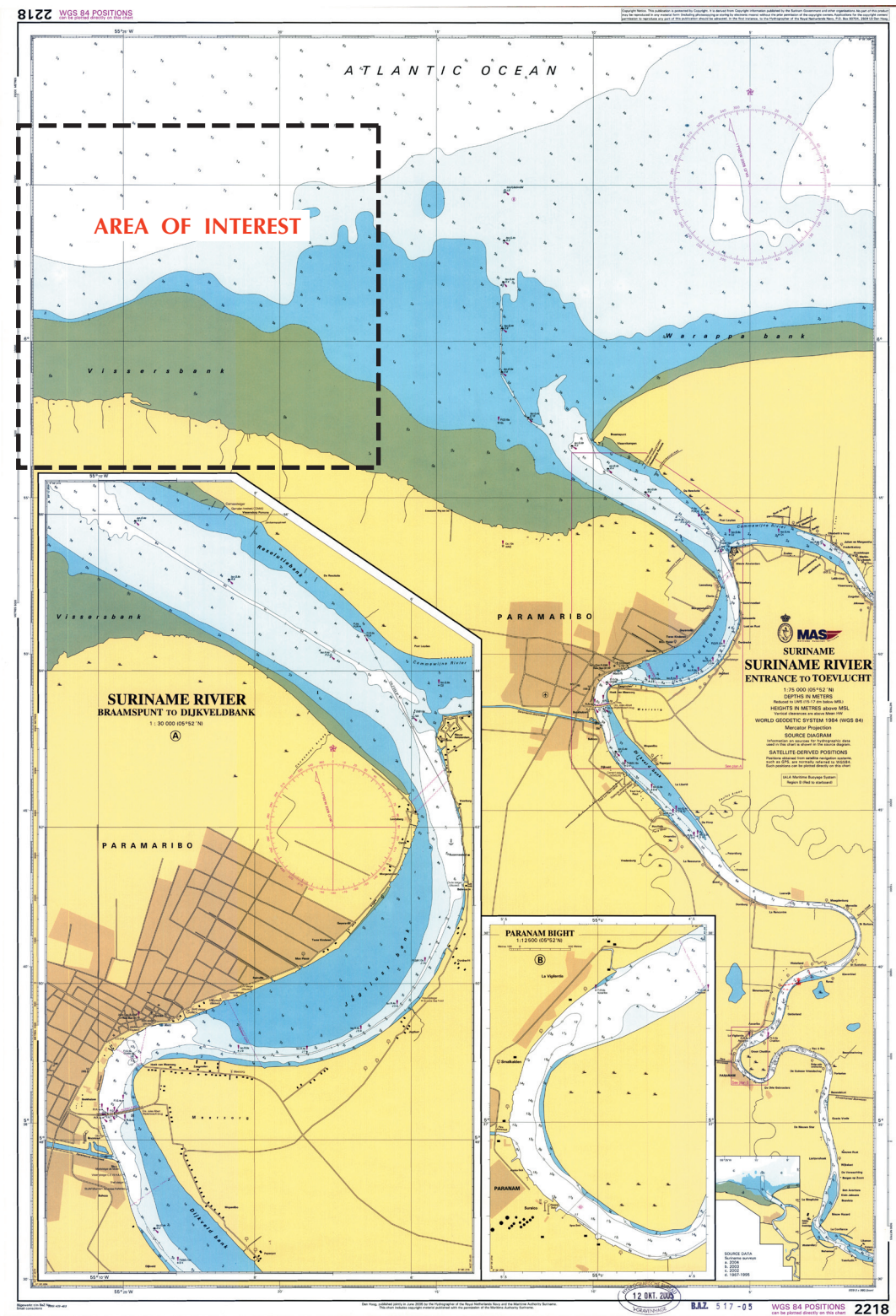


Figure 1

Analysis of Recent Shoreline Revisions to the 2005 Edition of Dutch Nautical Chart NL 2218

Introduction:

In June 2005 the Maritime Authority of Suriname published a newly revised version of Dutch nautical chart NL 2218. In addition to other less noticeable changes, the low-water shoreline that defines the northern reaches of Vissers Bank was dramatically repositioned northward, in some areas by as much as 4.0 kilometers, from the previously established position.

A change of this magnitude is surprising given the advanced state of nautical mapping techniques in the late 1960's. Absent any catastrophic changes to the coastal area that might be caused by violent physical processes such as earthquakes, land slides, lava flows or such, coastal changes seldom result in movements of this magnitude over such relatively short periods of time.

In reviewing the 2005 edition of NL 2218 in context with other nautical charting in the area and with available satellite imagery, a number of inconsistencies become readily apparent. These points are discussed below.

1) When the 2005 edition of NL 2218 is superimposed on the 1969 edition, a datum shift of high-tide coastline becomes readily apparent. This transformation to the WGS-84 datum would also move the established low-tide coast in similar fashion, thus shifting the starting point for measuring the movement of the low-tide coastline on the 2005 edition 400 meters further south.

In almost direct contradiction to the seaward movement of the low-tide coast in the Vissers Bank area, the high-tide coast portrayed on the new 2005 edition of NL 2218 has been uniformly offset in a landward direction by approximately 400 meters, as can be seen in **Figure 2**. This shift is most likely attributable to a transformation to the WGS-84 datum. The 1969 edition of NL 2218 did not provide the datum upon which the chart was based, but given the geographic location and date of publication a likely candidate would have been the 1956 Provisional South American Datum (PSAD-56). Regardless of the datum used in 1969, the shift appears to be due south for approximately 400 meters.

It is important to account for the coastal realignment caused by the datum transformation, as this will affect the actual distance calculations describing the movement of the low-tide coast on the 2005 edition of NL 2218. **Figure 2** illustrates the difference between the two charts and how the offset affects the distances acquired from the charts. In the same way the datum shift affects the high-tide coast from 1969, it would also move the established low-tide coast 400 meters to the south.

The green dashed line shows the shifted location of the 1969 low-tide coast, as it would have appeared on the 2005 edition of NL 2218 after applying the datum transformation. As **Figure 2** clearly illustrates, this new position for the low-tide coast would place it 3.05 kilometers out from the high-tide coast in the central region of

Vissers Bank. From there, it can be seen that the 2005 edition of NL 2218 places the new low-tide coast just over four kilometers beyond the previously established position in 1969.

2) When the low-tide coast shown on the 2005 edition of NL 2218 is superimposed onto recent SPOT satellite imagery, the new low-tide coast is positioned north of the apparent coastline by more than 5.0 kilometers in some areas.

The low-tide coast shown on the 2005 edition of NL 2218 is not supported by recent multi-spectral SPOT satellite imagery. Remotely sensed data, such as satellite imagery, is one of the most reliable means to establish accurate shoreline positions. The infrared band 3 of the multi-spectral SPOT imagery is especially useful in determining the land/water boundary, a topic that I discuss in more detail in **Attachment 1**.

Figure 3 is a SPOT satellite image, that was obtained on October 25, 2004 at 14:02:34 GMT (10:02:34 local time in Suriname), when the predicted tide was 1.95 feet above the low water level. Hourly tidal movements for the mouth of the Suriname River during March 2004 are shown in **Figure 4**. This chart helped to determine that the tidal level was on the rise at the time that the image was taken. Closer analysis of the chart shows that low tide for the morning of March 25, 2004, had been reached approximately one hour before, at roughly 9:00:00 local time.

The land/water boundary is clearly defined in this Band 3 SPOT image. The imagery resolution is 20 meters per pixel, which provides more than enough detail to clearly discern linear features such as coastlines. For the purpose of comparison, the low-tide shorelines from both the 1969 edition of NL 2218 and the 1985 edition of NIMA 24370 have been superimposed onto the imagery as green and yellow lines respectively. The low-tide coast from the 2005 edition of NL 2218 has also been superimposed as a dashed red line. One can easily observe that the apparent coast obtained from the SPOT imagery is found between the high-tide coastline and the two low-tide coasts from the earlier charts (namely, the 1969 edition of NL 2218 and the NIMA chart 24370), and no where near the low-tide coastline as rendered on the new 2005 edition of NL 2218.

The full tidal range in this area is approximately 7.0 feet. At the time the SPOT imagery was taken, the predicted tide was at 1.95 feet above low-tide for the day. The location of the water/shore boundary based on SPOT imagery is shown in **Figure 3**. According to the 2005 edition of NL 2218, more than 4.8 kilometers of ocean bed would have been covered in approximately one hour with an increase in the tidal level of only 1.95 feet. This would leave the remaining 2.3 kilometers to the high-tide coast to be covered with a rise of approximately 5.0 feet in tide level.

In my opinion, it is highly improbable that a tidal rise of approximately 2 feet would cover nearly 5 kilometers on the outer reaches of Vissers Bank when slightly closer to shore 5 feet of tidal rise is required to cover slightly more than 2 kilometers of shelf.

While at odds with the 2005 edition of NL 2218, the SPOT imagery does, however, support the location of the low-tide coast as established on the 1969 edition of NL

2218 and the 1985 edition of NIMA 24370. As **Figure 3** shows, the apparent shoreline on the imagery is in close proximity to the previous depictions of the low-tide coasts, in a location far more proportionate to just one hour of tidal rise.

3) The charting authority has acknowledged its uncertainty in placing the low-tide coast further north of the position shown in the 1969 edition of NL 2218.

The line symbol used to depict the low-tide coast on the 2005 edition of NL 2218 sends a clear message that the charting authority was uncertain as to the new location it was proposing for Vissers Bank. **Figure 5** shows the line symbol in question. One can easily see that a dashed line is used to represent the low-tide coast, along with a green fill on the landward side of the line. **Figure 6**, is a reproduction of a page from *Dutton's Navigation and Piloting*, an authoritative reference volume on navigation and piloting, that shows the meaning attributed to various types of line symbols when used in the context of standard nautical charting practice.^{1/} Examples 1 and 14 from **Figure 6** indicate that dashed lines represent areas where surveys are either inadequate or have not been taken at all. Moreover, example 14 shows that unsurveyed maritime areas would not automatically be depicted as an area that uncovers without depth soundings to support that position. While these mapping symbols represent charting standards for the United States, most international charting authorities follow this general symbol nomenclature.

It is interesting to note that the low-tide coast on the 1969 edition of NL 2218 was shown with a solid line, a clear indication that the charting authority had faith in the position where they were placing it. The fact that the line symbol selected for the low-tide coastline on the 2005 edition of NL 2218 is dashed, clearly implies that the charting authority does not have confidence in their placement of the low-tide coast in this area. At best, the dashed line would indicate that the area has not been adequately surveyed and that the low-tide coast, as depicted, is uncertain.

4) The new soundings taken for the development of the 2005 edition of NL 2218 are inadequate to move the established low-tide coast.

Map 7 shows the soundings that were taken for the development of the bathymetric contours on the 2005 edition of NL 2218. The dashed red line highlights the new low-tide coast for greater clarity. The most striking feature of the soundings array in the Vissers Bank area is the nearly perfect correlation between the position of the low-tide coast as shown on the 2005 edition of NL 2218 and the location of the turnabouts made by the vessel taking the depth soundings. At first glance one might assume that the bottom shoals up where the turnabouts occur, thus indicating the position of the low-tide coast. However, upon closer inspection the actual soundings tell a different story. The soundings were terminated just short of the 2005 low-tide coast regardless of the water depth. Based on the new soundings, the approximate average depth closest to the low-tide coast is 2.6 meters (8.5 feet). One would expect to find readings of less than one meter if this is truly the low-tide coast. **Figure 8** shows that further down the coast, closer to the mouth of the Suriname River, soundings were

^{1/} Maloney, Elbert S., *Dutton's Navigation & Piloting*, Naval Institute Press, Annapolis, Maryland, 1985.