VEGA&CO
BAIRES MARINE SERVICES

Dear All,

In view of the numerous incidents involving vessels running aground in the River Plate VEGA&Co and BAIRES MARINE SERVICES have decided to publish a work for our clients and partners in which we will describe in detail the main causes of these incidents.
We hope you will find the attached report of interest.
Sincerely

Capt. Juan Pablo Presedo
Partner

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River Plate and Parana River Groundings

Insurers and Ship Owners involved in South American trades may well be concerned at the frequency of groundings and incidents involving ships transiting the River Plate and the Parana River Channels. Until now there has not been a specific report addressing these peoples' interests in regard to this ongoing problem.

In this paper, we will attempt to describe the root causes of the problem using examples of recent incidents, including Local Pilots and Experts testimonials and we will suggest actions to mitigate the grounding risk for vessels transiting the River Plate and the Parana River.

The River Plate Bed

The River Plate Pilots often state that ships transiting the river do not float in water but in two different fluids with different densities. The first and upper fluid is fresh water with a relative density close to 1.000 Kg/m3 and the latter is made up of layers of clay which have densities considerably higher than the water.

The vast extension of the River Plated Bed is mostly formed by mud. Consequently, any measuring instruments (such us platforms for tidal measurements) cannot be firmly installed on the River bed due to the nature of the bottom clay layers.

More than twenty years ago when depth surveys were taken using Echo sounders for the first time, a considerable difference was observed between these and depth surveys observed with hand leads.

Clay molecules tend to group together when agitated by external forces; such as the water stream generated from vessels transiting the area. This varies the depth available on that section of the channel. This phenomenon is also known as Quick Clays and it is not unique for the River Plate. The same can be observed also in other Ports such as Zeebrugge and Rotterdam, where it is carefully monitored and extensive and real time information is available for those transiting the area.

Consequently, a joint PIANC-IAPH working group (PIANC, 1997) defined the "nautical bottom" as *'the level where physical characteristics of the bottom reach a critical limit beyond which contact with a ship's keel causes either damage or unacceptable effects on controllability and maneuverability'.* So the nautical bottom is identified as the level that should not be touched by the ship's keel and in case of a hard bottom this is an obvious statement. However, the definition is perhaps more valid in other situations where the bottom can be defined in different ways, for example when the bottom is covered with boulders or sand dunes or in muddy areas where the nautical bottom can be interpreted as the level where the navigable fluid mud ends and the non-navigable seabed begins.

The Argentinean Hydrographic Office (SHN) conducted the Depth Surveys using Echo Sounders and therefore the depths available for the Mariners on the Nautical Charts are usually different to those which can be obtained using a hand lead due to the phenomenon explained above. In fact, studies from the SHN revealed that for some

areas the difference between Echo sounder readings and hand lead soundings were of approximately 1 meter.

Furthermore, during the investigation, it was observed that vessels were decreasing their draft or changing their trim while transiting the same sections of the channels where differences in depth were observed. The investigation concluded that in those areas vessels float in fluids with different densities. In fact the lower part of the hull floats in soft clay and this is the reason why vessels may experience a change in draft and trim while transiting the channel.

The River Plate and Parana River estuary extends to more than 4.000.000 Sq Km. Many other rivers end at the River Plate contributing between 16000 and 23000 Cu meters of water per second.

The Parana River is more than 4000km long and brings with it from Brazil huge amount of clay**,** which ends up at the River Plate which flocculates and deposits on the river bed. Another contributing factor is the quantity of rain and sediments which are also brought to the area from River Plate tributaries. These amounts cannot be calculated and so the location or thickness of the quick clays cannot be assessed accurately.

The River Plate bed and its effects on vessels maneuver

It is a well know fact that vessels' maneuverability change substantially while sailing in restricted and shallow waters. The turning circles are distorted and the tactic diameter of the curves will tend to increase affecting drastically the vessels ability to turn. The response time to rudder orders increases considerably as well. Studies from Dr. Barrass have demonstrated that vessels suffer also significant changes in trim and a reduction of the under keel clearance while sailing in shallow waters due to her interaction with the bottom bed and to some extent with the channels' side banks. These effects are known as 'squat' and 'sinkage' respectively and they may also affect the vessel maneuverability in terms of directional stability and performance.

Capt. Eduardo Gilardoni, who is also a Partner in Baires Marine Services, put the theory and practice together in his last study conducted on MT ONA TRIDENTE in River Plate waters, when he demonstrated that vessel maneuverability was significantly affected while sailing in shallow waters. The turning circles obtained from the tests where compared against those originally provided by the shipyard for open waters. The results showed a clear difference between tactic diameters as well as between the times of response for the same rudder angles.

The times/distance for stopping tend to be shorter in shallow waters, particularly when quick clays are present. Similarly, increases in speed at same engine RPMs are slower than in open waters.

Although inland river navigation is conducted with pilots on board most of the time, it is important to note that Pilots are only responsible for their advisory services and the ultimate responsibility and liability if anything goes wrong will rest on the Master and the Ship owner. In consideration of this, every operator should ensure that Bridge Teams are fully aware of vessels' maneuver characteristics in shallow waters and that they

are actively involved during the vessel transit through restricted waters; they should be monitoring every order given by the Pilot and challenging them if necessary. The Master is ultimately responsible and, although this may seem incorrect, he can and must rectify any order that may put his vessel at risk. **The importance of situational awareness is paramount.**

The River Plate and Parana River Dredging and Aids to Navigation

To measure of the level of interaction for vessels transiting narrow channels, Dr. Barrass and Capt. Gilardoni has classified three types of channels according to the height of their sides in the study "Ship Handling in Restricted Waters".

- Open Channels
- Semi-Open Channels
- Enclosed Channels

The level of interaction will be considerably higher in enclosed channels such as fjords, where the water displaced by the vessel transiting cannot be accommodated somewhere else outside the Channel.

Most of the River Plate and Parana River Channels are of the Semi-Open type. Although, the water can be displaced beyond of the channel sides, the interaction in this case is very significant and the so called 'bank effect' may considerably affect the vessel maneuverability during her transit.

The bank effect can take place when the water flow around a vessel in a narrow channel is unsymmetrical causing pressure differences on the port and starboard side of the vessel. The vessel stern is drawn to the near bank by a lower pressure on the stern (suction) and the bow is pushed to the farther bank by an increase in pressure (cushion). The result is the vessel wants to head towards the farther bank unless a rudder force is applied. Excessive response of the helmsman or over estimated rudder orders combined with this effect may cause a loss of control of the vessel which may finally run aground.

A recent incident resulted in a collision of 3 vessels in the Parana River in front of Campana Port, when a vessel transiting the Channel at higher speed than the one allowed for that segment, experienced a loss of steering due to bank effect and caused a triple collision.

This incident could have been prevented if the vessel had transited the Channel below the maximum regulated speed. It is a well know fact for Masters and Pilots, that the only way to prevent or mitigate the bank effect once experienced is **by reducing the transit speed.**

This incident not only blocked the Access Channel to other traffic causing significant losses but also caused delays to other vessels and so generated major claims that had to be covered by insurers.

The speed issue not only affects the safe navigation of the vessels but it also causes damages to the channels. The water streams generated by large vessels transiting the channel at high speed may cause the collapse of the channel sides. This adds

additional costs to the relevant Authorities to maintain the channel dredging, which are finally charged to Ports and Channels users.

The Navigation Aids services, particularly buoys and beacons installed upriver of Santa Fe port, are not designed to cope with the increasing long barge formations transiting the waterway. This area of the Hidrovia was recently dredged to 10 feet but the buoys and beacons were deployed based on a study which considered initially only 20 barge convoys (Mississippi type). The area is now being transited by 30, 36 and even 42 barge convoys. The Hidrovia users and regional producers are also among those who are requesting additional anchorage areas and improvements in the waterway to cope with the increasing production and exports. The extra transport costs that must be absorbed by the suppliers is a concern in that it is an extra barrier to trade.

The above information shows clearly that transport infrastructure is under stress. This fact is a constant in most of the countries in Latin America, where the increasing volume of trade has exceeded the current capacity of ports and waterways.

The Hidrovia channels have been dredged to allow the transit of vessels with a maximum draft of 32 feet to 36 feet. In addition, vessels with more than 40 meters breadth have been transiting the channels during recent years. PIANC regulations recommend a fairway width of at least 200 meters to accommodate safely two such vessels; the actual width of the fairways is at best approximately 116 meters. As we can see, the number of incidents could be considerably higher than it is under the present conditions.

The Parana River Pilot, Capt. G Delesnyder, who has more than 20 years experience as a Pilot for these areas, stated that at least 6 serious grounding incidents during 2012 and **insufficient width of the Fairway has been identified as a major root cause in practically all of them**.

The expansion of the River Plate and Parana River Channels Fairway is a matter that requires immediate attention from all those involved directly and indirectly in their use. Under the current conditions, Pilots' skill, professionalism and good luck have contributed to avoiding further disasters with huge safety, environmental and commercial impact.

Conclusions:

To summarize the root causes and suggested preventive actions to be taken to prevent groundings,

- **Situational Awareness: Bridge Teams must plan carefully, execute and monitor the river transit and should not hesitate in challenging Pilots orders if they are considered inappropriate.**

- **Nautical Depth, Nautical Bottom and Quick Clays: Bridge Teams must be aware of the difference in depths that may arise in some areas of the River**

- **due to sedimentation and quick clays phenomenon. The charted depth may differ considerably with that shown by the Echo Sounders.**

- **Changes in the Vessel Maneuverability while sailing in shallow and restricted waters: Bridge Teams must be aware that turning circles, response time to wheel orders, speed variations and stopping times can be considerably affected while transiting shallow waters and that these can be further exacerbated by the presence of Quick Clays.**

- **Transverse Currents in some segments of the Channels.**

- **Bank Effect: Bridge teams must be aware of the Bank Effect and take actions to mitigate it, mainly by speed reduction. Navigate the Channels in compliance with the maximum allowable speed, even under commercial pressure.**

- **Fairway Width: As explained before, there are only medium/long term permanent solutions to this problem. In the mean time, users of the channel should be aware of the risks of transiting with fully laden ships with drafts above 32 feet and breadths above 40 metres, (a description which matches Supramax dimensions).**

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