Ex-Tobruk Parbuckling Risk Discussion

1. Parbuckling Procedure

The parbuckling procedure is used to generate enough mechanical advantage (with leverage) to rotate or right a large, heavy object such as a sunken vessel. There are often significant risks associated with parbuckling a vessel, and so it is typically only done in extreme circumstances, such as to eliminate a navigational hazard, salvage to recover scrap values, or body recovery (see below Figure 1).

![Figure 1: Example of parbuckling line routing with airbag support](image)

2. Prior Parbuckling Salvages

A list of previously parbuckled vessels is shown below, with the reason for parbuckling along with the fate of the salvaged vessels. It is important to note than a number of the vessels that were ultimately scrapped were originally intended to be repaired but couldn’t due to parbuckling damage.

<table>
<thead>
<tr>
<th>Vessel Name</th>
<th>Reason to Parbuckle</th>
</tr>
</thead>
<tbody>
<tr>
<td>USS Oklahoma</td>
<td>Salvage – navigational hazard - scrapped</td>
</tr>
<tr>
<td>MV Rocknes</td>
<td>Salvage – rebuilt – never sunk, just capsized and afloat</td>
</tr>
<tr>
<td>RPS Rajah Soliman</td>
<td>Salvage with intent to rebuild, significant damage, scrapped</td>
</tr>
<tr>
<td>USS Oglala</td>
<td>Salvage – rebuilt and put into service after 2 years in shipyard</td>
</tr>
<tr>
<td>RMS Empress of Canada</td>
<td>Salvage – scrapped</td>
</tr>
<tr>
<td>MS Herald of Free Enterprise</td>
<td>Salvage – body recovery - scrapped</td>
</tr>
<tr>
<td>MV Janra</td>
<td>Salvage – scrapped</td>
</tr>
<tr>
<td>MV Republic di Genova</td>
<td>Salvage - repaired</td>
</tr>
<tr>
<td></td>
<td>Salvage – action</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>MSC Napoli</td>
<td>Scrapped</td>
</tr>
<tr>
<td>Larvik Rock</td>
<td>Scrapped</td>
</tr>
<tr>
<td>Nieuwpoort</td>
<td>Body recovery</td>
</tr>
<tr>
<td>Sandy Point</td>
<td>Scrapped</td>
</tr>
<tr>
<td>MS Costa Concordia</td>
<td>Body recovery – Scrapped</td>
</tr>
<tr>
<td>Sep Orion</td>
<td>Navigational hazard – Scrapped</td>
</tr>
<tr>
<td>Sewol</td>
<td>Body recovery</td>
</tr>
<tr>
<td>* Amadeo 1</td>
<td>Wreck removed after recovery then safe refuge scuttled</td>
</tr>
</tbody>
</table>

* The last parbuckle salvage noted in the above table was for the AMADEO 1, a 132m RoRo Ferry that originally grounded in October 2014 in the Kirke Canal in southern Chile. It was parbuckled on 23rd June 2015 after 4 months of preparations, by Resolve Salvage & Fire, to mobilize and/or custom-build tools and equipment for the operation; the operation required equipment from their warehouses in Mobile AL, Fort Lauderdale FL, Singapore and Mumbai primarily consisting of two deck barges (with mounted cranes), two tugs (134 ton and 78 tonne BP tugs), custom-built hydraulic chain pullers and other assorted equipment. The parbuckling was able to use a hold-back system tied to rock anchors on shore, due to its proximity to land, while the floating equipment was used to rotate the vessel. Whether due to damages incurred during the grounding and sinking, perhaps further damages during parbuckling and/or projected costs to repair and return it to service, it was decided to scuttle the wreck in a safe refuge in September of 2015.

3. Primary Parbuckling Risks

Often, the parbuckling effort leads to breaking up of the vessel due to the high and unpredictable loads, which would be acceptable in a scrapping scenario. The primary risks associated with parbuckling along with the possible outcome of such a procedure include:

a. Local Structural failure/tearing
b. Sudden buoyancy loss with uncontrolled vessel movement
c. Structural deformation/failure due to longitudinal stress
d. Structural deformation/failure due to torsion stress
e. Dragging of vessel on the seafloor
f. Weakened structure due to prior salvage-related modifications
g. Increased operational risk to equipment and personnel
h. Rendering the vessel unsafe for recreational diving

i. Significant risk that the vessel will not be vertically uprighted

4. **Explanation of Primary Parbuckling Risks**

a. **Local structural failure/tearing** (see Figure 2) occurs frequently as ship hulls and structures are not designed to take the loading required for parbuckling. The cables/chains/slings end up cutting through the hull plates and structure until they release enough load or encounter enough structure to support the stresses. These cuts, tears and deformation of the hull can lead to follow-on structural failures during the parbuckling process, or during later lifts or vessel use.

![Figure 2: Tearing of hull structure due to cables/chains/slings on the parbuckled vessel Sewol](image)
b. **Sudden buoyancy loss with uncontrolled vessel movement** can occur as a loaded cable suddenly tears through structure. This sudden tearing unloads the cable, but almost instantly loads up the other cables and can result in a domino effect of cables snapping. This creates an exceptionally dangerous situation as the cable snapping compounds loading onto the remaining cables and the loads build rapidly and without warning. The snapped cables can cause significant damage to not only the wreck, but also the surface vessels in the immediate vicinity. The wreck can again tip over under these uncontrolled circumstances.

c. **Structural deformation/failure due to longitudinal stress** (see Figure 3) occurs in long vessels with primary structure located at the bow and the stern. Most vessels have increased strength at the extremities where mooring gear and towing gear is typically equipped. This additional structure is significantly reinforced to take loads compared to the relatively thin and weak midbody sections. As the ends of the vessel are lifted or rotated, the midbody encounters a sagging stress that can cause shell plating and bulkheads to buckle, and sometimes even split in half (see Figure 3). Several parbuckling operations have been halted as vessels have split in two or had major cracks open up. Similar to most vessels, the bow and stern areas of the Ex-HMAS Tobruk would have increased structure hence strength for attaching parbuckling connections and wrapping lines (see Figure 4) however loading these areas during parbuckling could cause the vessel to over-stress longitudinally and fail.

![Figure 3: View of longitudinal failure with cracking](image-url)
d. **Structural deformation/failure due to torsion stress** (see below Figure 5) is a possible failure mode due to uneven rotation by twisting the vessel with load lines attached along the vessel's length. The below Figure 5 shows a vessel with lines attached and/or wrapped nearest the higher strength areas of the bow and stern during a parbuckling event to illustrate it being unevenly loaded during the operation hence twisted like a water bottle or soda can. Once the stresses cause the material to move off-plane, the torsion effects could rapidly twist the hull causing structural collapse and catastrophic failure.

Although the above Figure 4 indicates multiple higher strength areas along the Ex-HAMS Tobruk to attach multiple parbuckling lines, and other hull locations could be reinforced for parbuckling line attachment points, the reality of having multiple lines in an open-water parbuckling (without on shore fixes line anchors) is that the operation becomes more complex the more lines that are used. Multiple
lines from various winches aboard the same or various floating/moored crane barges and/or tugs involved introduces coordination difficulties with increasing likelihood that uneven pulling loads will be applied with a greater risk of over torquing hence failing the vessel's structure.

e. Vessels can be dragged on the seafloor or pivoted (see below Figure 6) on the seafloor by uneven parbuckling. Balancing the rotational loads of the parbuckle with the brake load is an estimate at best. Unknown and uneven forces on the vessel, stiction in the seabed, suction loads due to seabed embedment, currents, and any synchronization effects from the winches will cause the wreck to move and/or pivot during the parbuckle process. Some wrecks, such as the Utah, have dragged and pivoted dangerously causing structural failure that led to the parbuckle process being abandoned. The wreck can tip over unpredictably in this circumstance. A wreck poorly aligned into the current will also cause significant scouring leading to long term instability of the wreck on the seabed (see Figures 6 and 7 below).

Figure 6: Wreck sliding/rotating on seabed
f. **Weakened structure due to prior salvage-related modifications** - the Ex-HMAS Tobruk has undergone structural reductions and modifications inside the hull to allow for cleaning, dismantling, flooding and diver access. They mainly consisted of large, square cut holes which have heavily compromised and weakened the structural integrity of the vessel especially in regard to longitudinal and torsion effects. Therefore the cost of parbuckling would probably have to include reinforcement of the vessel in its present in place condition on-bottom and/or an added structural cradle to protect and support the vessel during a parbuckling operation.

g. There is an **increased risk of equipment failure and personnel injury during with parbuckling operations**. As previously mentioned, parbuckling often requires reinforcement to avoid local loading with deformation, cutting and tearing of the vessel’s structure where operational lines and connectors (i.e. cables, chains, slings, shackles, padeyes, etc.) are in close contact with a vessel’s structure. If a single line and connector were to fail, there is the risk of a domino failure with other lines and connectors that may incur impact and increased loads.
The prior described risk (see the above section labeled “d.” above) of over twisting the vessel while parbuckling increases when having to manage/coordinate an operation requiring multiple pieces of equipment (i.e. crane barges, tugs, winches, lines, etc.) and a large number of personnel. Therefore special attention to ensuring the safety of parbuckling operation is required along with added cost to protect equipment and personnel (along with the vessel being parbuckled if the vessel will be utilized for some purpose other than scrapping or scuttled in deep waters).

h. Finally, due to possible structural weakening of the vessel from parbuckling it is possible that the vessel can rendered unsafe after parbuckling for recreational diving. Even a parbuckling that resulted in little to no structural damage may still render the wreck unsafe for diving due to a new orientation into the predominant currents; the orientation may also cause scouring in the seabed underneath the hull causing the vessel to tip over again.

If an initial parbuckling attempt were to fail and weaken the vessel, then the options may be to leave the wreck as-is and close off areas of the wreck to make it safe for divers, perhaps try to reinforce the areas of the wreck or to build a structure to attach to it so as to provide structural support as the parbuckling effort is tried again. All additional parbuckling options and efforts would add additional costs and severely limit the wreck use.

i. Finally, it will be difficult to upright the vessel to any specified vertical position without. Any final position obtained by parbuckling will have to be acceptable and within a wide degree range to avoid continued efforts that could put parbuckling equipment and personnel at risk as well as further structurally weaken the vessel rendering more unsafe for divers.

5. Concluding Remarks

5.1. The risk to the structural integrity of the Ex-HMAS Tobruk throughout and after a parbuckling exercise is significant. The potential for damage is high, and any of this damage may render the wreck unsuitable and unsafe for recreational diving.

5.2. In addition, even a parbuckling that resulted in little to no structural damage may still render the wreck unsafe for diving due to a new orientation into the predominant currents. The orientation may also cause scouring in the seabed underneath the hull causing the vessel to tip over again. There is also significant risk that the wreck will not be righted by parbuckling to an orientation agreed beforehand to be satisfactory.
5.3. Such a situation could render the parbuckling procedure completely ineffective with a potential need to not only attempt to right the vessel again, but also remediate damage to the seabed and wreck and/or to make it safe for recreational diving, if possible at all. If the parbuckling were to fail due to whatever reasons, then any efforts to retry up-righting could be extremely costly and probably still leave the vessel in a weaker unsafe condition for diver use.

5.4. The prior described concerns would be completely valid despite carrying out significant engineering efforts, our past experience and safety measures in place. The unknowns of wrecks and the risks in parbuckling cannot be understated and the consequences can be extreme and could endanger the personnel and equipment involved in such an operation.

5.5. It is practically impossible to reliably calculate, but a contingency of between 30% and up to more than several hundred percent should be added to the initial parbuckling cost estimate (i.e., around AUD6 million) - to allow for these significant-risk and high-consequence outcomes. To be prudent, a cost of around AUD20 million should therefore be considered as a possible outcome of an attempt to parbuckle Ex-HMAS Tobruk to an upright position, and even then it may fail to result in a safe recreational dive-wreck.
20 September 2018

Project Manager – ex-HMAS Tobruk and Artificial Reefs
Great Barrier Reef – Marine – Coastal - Islands
Queensland Parks and Wildlife Service
Department of Environment and Science

Indicative Quotation- Parbuckling ex HMAS Tobruk

We are writing to you to advise that we have completed our initial estimations for the parbuckling of the ex- HMAS Tobruk.

As part of this we have used basic details of the ship and concluded 3 engineered options to parbuckle the ship upright on location.

Of these 3 options, we have calculated a time and cost model to complete such a project. The option that has been chosen as preferred, is based on the vessel being parbuckled upright using Ardent's chain pullers fitted to a barge. The ship and barge would also require hold back wires being fitted to prevent the ship from sliding in the sand seabed whilst being parbuckled, and the barge holding position.

To firm up a proposal to provide certainty of solution, we would require;

1. Drawings of the vessel
2. Details of modifications made to scuttle the vessel
3. Seabed survey
4. Soil analysis to determine the use of either anchor or suction piles for hold back anchors and barge mooring selection.
5. Dive survey of current wreck condition.
6. If possible, the plan used for scuttling and any root cause analysis why the vessel did not orientate itself correctly on the seafloor.
7. Site permit restrictions (wildlife monitoring, vessel traffic, night operations, noise, etc.).
The estimation of cost to successfully complete this project is US$14.1M, or AUD$19.3M at today’s exchange rate.

From contract signing, we would need 4 months to deliver the parbuckling spread to vessel site. In this time, we would perform the following;

8. Project Management and Engineering
9. Hazard Identification Risk Assessment
10. Subcontract of Marine Assets
11. Design and fabrication of bespoke rigging brackets (if required)
12. Rig-up and mobilisation of all vessels, personnel and equipment to site
Ex-HMAS Tobruk: Assessment of the suitability of the vessel’s resting orientation for recreational scuba and technical diving.


Copyright exists on this document.
This report is the sole property of TC-IBC and the Queensland Government. The report cannot be reproduced in whole or part without written permission. Academic reference is permissible with acknowledgement to the source.
# Table of Contents

1.0. Introduction ....................................................................................................... 1  
2.0. Executive summary ........................................................................................... 2  
3.0. Underwater survey description .......................................................................... 4  
3.1. Dive data summary ........................................................................................... 4  
3.2. Report methodology ....................................................................................... 4  
4.0. Observations and recommendations regarding specific sites surveyed ............ 5  
4.1. Port side hull .................................................................................................. 5  
4.2. Port side hatches .......................................................................................... 6  
4.3. Bridge area ................................................................................................... 8  
4.4. Deep penetrations into hull .......................................................................... 9  
4.5. Ships funnel area ....................................................................................... 10  
4.6. Forward crane area .................................................................................... 11  
4.7. Aft loading door area ................................................................................ 11  
4.8. Propeller area ............................................................................................. 12  
4.9. Tank deck .................................................................................................... 13  
4.10. Helipad area ............................................................................................... 14  
4.11. Bow ........................................................................................................... 15  
5.0. Additional observations and comments........................................................... 15  
6.0. A brief comparison to other vessels positioned on their side ......................... 17  

## Appendix

1.0. Implications of the diver training agency standards and the Queensland Government’s Recreational Diving, Technical Diving and Snorkelling Code of Practice, 2018 ................................................................................................................. 19  

## Photos

1.0. Port side hull ...................................................................................................... 5  
2.0. Deck # 2 railing .............................................................................................. 5  
3.0. Deck # 2 railing exit point .............................................................................. 5  
4.0. Deck # 2 corridor ........................................................................................... 6  
5.0. Port side hatch ................................................................................................ 6  
6.0. Cabin entrance ............................................................................................... 7  
7.0. Secured area ................................................................................................... 7  
8.0. Large port side hatch .................................................................................... 8  
9.0. Bridge .......................................................................................................... 8  
10.0. Deep penetration .......................................................................................... 9  
11.0. Ships funnel ................................................................................................. 11  
12.0. Forward crane area ...................................................................................... 11  
13.0. Aft loading door .......................................................................................... 12  
14.0. Aft loading door secured area .................................................................... 12  
15.0. Starboard propeller ..................................................................................... 13  
16.0. Port propeller .............................................................................................. 13  
17.0. Tank deck .................................................................................................... 14  

18.0. Helipad area ........................................................................................................14
19.0. Juvenile Silver Sweet Lip ..................................................................................16
20.0. Unidentified growth ..........................................................................................16
1.0. Introduction:

This document represents a report commissioned by the Queensland Parks and Wildlife Service. The report findings are the result of a review of the literature surrounding the sinking of ex-HMAS Tobruk, appraisal of architectural drawings, diver training agency standards, The Queensland Government’s ‘Recreational Diving, Technical Diving and Snorkelling Code of Practice 2018’ (hereafter: “Code of Practice”) and an underwater survey of the vessel in its present condition on the seafloor off Hervey Bay, Queensland.

Specifically, this document reflects the findings and associated recommendations regarding the suitability of the vessel in its present orientation for safe, enjoyable recreational scuba and technical diving. It is not the scope of this document to give either a description or account of the sinking of the ex-HMAS Tobruk or input on structural features other than those that may impact safe and enjoyable recreational diving and/or impact the general attractiveness to recreational divers.
2.0. Executive Summary:

Clearly the intention was to have ex-HMAS Tobruk rest on the sea floor in an up-right position and consequently steps were taken to secure the wreck as safe and enjoyable dive in tune with that orientation. It is important to note however that the diving literature reveals that several ‘world-class’ vessels rest on their side and that vessel orientation does not seem to have an overly negative impact on general diveability and potential enjoyment for visitors (i.e. the vessels utility as a dive destination).

Therefore, in terms of the possible negative impact on attractiveness and marketability related to the ex-HMAS Tobruk resting on her starboard side, the consequences of such are viewed by this researcher as questionable, and more likely will not exist on any great scale. That is, the dive industry literature and tourism reports indicate that there is no direct relationship between the diver visitation numbers and the resting orientation of other wrecks sunk either deliberately, by storm or as consequences of human conflict. Features such as general accessibility, safety and the actual history of the vessel seem to be, and are, more important to divers. In summary, the present orientation of the ex-HMAS Tobruk is most likely to result in a different dive to that originally expected, but none-the-less, just as potentially enjoyable than she would have been in the original planned orientation.

The researcher has had recent experience regarding negative domestic and international reports that the Great Barrier Reef “is dead”. Most of these reports have been blown out of proportion and relate to the coral bleaching on the GBR. The consequences of such has caused tourism operators, associated NGOs and the Great Barrier Reef Marine Park Authority considerable time and financial investment to provide an objective opinion of the Reef’s condition. Therefore a similar element of caution exists when reporting to media and the dive industry the outcome of the sinking of the ex-HMAS Tobruk. That is, on-going criticism from various sources of the result of sinking could potentially, significantly and unjustifiably reduce visitations as could be the case with the GBR.
It is suggested that rather than dwell on the change in orientation of the ex-HMAS Tobruk, stakeholders should be encouraged to focus, and report, that dives on the vessel will be similarly enjoyable and extremely attractive to divers as originally planned. That is, slightly different, still very enjoyable and extremely worth a visit.

**Conclusion**

Given appropriate consideration of observations and recommendations in this report, the overall finding is the ex-HMAS Tobruk remains a highly suitable and extremely attractive wreck dive. Additionally, in her present orientation, ex-HMAS Tobruk offers a venue for those involved in training of advanced, wreck and technical diving.
3.0. Underwater survey description

An underwater survey was conducted on the 7th September 2018 by Terrence Cummins, of TC-IBC together with divers from Queensland Parks and Wildlife Service. Cummins’ suitability for this project is summarised in the report’s appendix under the heading of: ‘researcher profile’.

Apart from personal observations during the underwater survey, Cummins used a GoPro camera to video several sections of the vessel during his diving. The dive characteristics, findings, some recommendations and possible conclusions are provided.

3.1. Dive data summary:

Total number of survey dives: 2
Total time spent on all dives during survey: 1 hour and 7 minutes
Total video footage time of dive: 37 minutes, 35 seconds
Average depth during survey: 15 m
Maximum depth reached on survey: 22 m
Area covered during survey: Full length of the port side and deck of vessel from stern to bow and penetrations into several areas with ambient light.

3.2. Report methodology

The report methodology involved 6 parts as follows:

Part # 1: Literature review
Part # 2: Analysis of vessel architectural drawings
Part # 3: Direct underwater observation of the 11 most likely sites visited by divers.
Part # 4: Construct field notes
Part # 5: Analysis of video
Part # 6: Summarise observations and make recommendations from literature review, observations, field notes and video footage.
4.0. Observations and recommendations regarding specific sites surveyed:

4.1. Port side hull.

This is a primary area for safe entry level diving. It has full ambient light and totally, free of all obstructions. Swimming under the railing of deck 1 (shown on the left and below the diver in photo # 1) does not present any challenges or dangers.

Similarly, descending and swimming under the railing of deck 2 (shown in photos # 2, # 3 and # 4) does not present any additional challenges to the originally planned orientation as there are numerous and readily available exits points as shown in photo # 3.

Observations and recommendations:

Some current flow was apparent through the vessel on the first dive. This will help the vessel to stay comparatively clean and would be consistent with that expected in the originally planned orientation of the vessel. The current experienced on the hull was not considered
beyond the swimming ability of a certified diver. Nevertheless, dive operators will need to brief all divers on the importance of starting the dive into any current and returning to the surface line with the current thus avoiding areas where there is significant current moving through the vessel (i.e. during tidal flow periods).

The present orientation of the vessel does not present any safety issues other than those that would have been anticipated in the originally intended orientation of the vessel. The potential dive experience in this section is considered to remain potentially very enjoyable, especially for those that do not have the skills to penetrate deeper into the vessel.

4.2. Port side hatches.

In consideration of the vessels present orientation, several hatch opening on the port side are now exposed to ‘direct’ sunlight whereas these would have received ‘indirect’ sunlight if the vessel was up-right on its keel. In some cases this makes these entry / exit ways even more appealing than they would have been in the originally planned vessel orientation.

The port side hatches remain as large openings with good ambient light coming in from several directions. For example, photo # 5 shows ‘direct’ and ‘indirect’ ambient light entering the vessel at this point, from several directions, thus allowing
divers with appropriate levels of training to enter and exit through the same point, or in some cases, similar hatches further along the vessel. That is, there remains good potential for easy penetration of port hatches and ‘swim-throughs’ of large open spaces which in turn have good ambient light and entry / easy access (e.g. on Number 2 and Number 3 decks).

Several small cabin areas (photo # 6) have large entry / exit points with good ambient light. No potential hazards were detected that may have been caused by a change in the vessels orientation to that originally planned.

Potentially dangerous areas (e.g. possible areas of entanglement, or those making it difficult for a diver to turn-around) are sealed off as shown in photo # 7. Areas allowing penetration of the vessel are defined as ‘overhead environments’ and dive operators must reference related dive protocols set by the diver training agencies and the Code of Practice.

Observations and recommendations:

The entry / exit points remain as large openings as shown in photo # 8. These areas still have considerable ambient light and are cable of allowing divers with appropriate levels of training (e.g. certified wreck diver) to enter and exit through the same point. Additionally, these areas remain excellent areas for training ‘wreck divers’ and ‘advanced wreck diving’ under instructor supervision similar to that expected in the original orientation.
The present orientation of the vessel at these referenced points should not negatively impact safety protocols originally established for diving the vessel in an up-right position. It is noted that trained wreck divers will have been made aware of the potential for disorientation when a vessel is not sitting in an up-right position.

4.3. Bridge area.

The entry / exit opening to the bridge are large and there is a lot of ambient light still reaching this area which should easily assist divers finding their way in and out. Glassed areas have started to be clouded with marine growth and while letting light penetrate the area, they currently do not give the false illusion of an exit point.

As photo # 9 shows there is potential for silting in this area that could reduce visibility. However, certified wreck divers should have been trained in dealing with developing adverse conditions (e.g. silting) and a possible increase in disorientation caused by a vessel being on her side.
**Observations and Recommendations:**

On-going assessment of windows may be necessary to confirm light penetration over time. This may lead to possible removal of some glass in the future. However, there is no evidence that glass needs to be removed at this stage from any of the areas surveyed due to changes in vessel orientation from that originally planned. Similarly, no other additional potential hazards were detected to those that could be possibly encountered in the originally planned orientation.

In summary, the present depth of the bridge area and the starboard orientation of the vessel should not cause divers a loss of orientation. Nor should the present orientation of the vessel have a negative impact on attractiveness for divers entering this area of the vessel.

4.4. **Deep penetrations into the hull.**

Possibly the most significant feature of the vessel laying on her starboard side is some of the ‘swim-throughs’ and other areas available for horizontal access planned in the originally planned ‘up-right’ orientation are now descents to greater depths as shown in photo # 10. This is not necessarily a hazard, as in some sections of the vessel this allows light to ‘directly’ penetrate these now deeper sections. However, descending into this section could result in the loss of some ambient light in areas leading off the main, reasonably well-lit, passageways. This could be considered as simply a different type of dive on this part of the vessel rather than a negative aspect caused by the present orientation of the vessel.
Observations and recommendations:

When divers are entering areas with ‘no ambient light’ to clearly illuminate the entry / exit points, proper overhead environment protocols must be used (i.e. proper training, supervision and use of penetration lines and reel).

As mentioned elsewhere in this report, it is noted that divers trained in wreck diving should be well versed in the potential dangers of silting and disorientation. Given the present orientation of the vessel, it is suggested that operators brief divers on these possibilities, especially if it is considered the orientation of the vessel (i.e. resting on starboard side) may cause disorientation when diving deeper and in enclosed sections of the vessel.

Additionally, visibility on the day of the survey allowed the researcher to see down to the sand during a descent to the starboard propeller at 22 meters. It was observed that whilst diving to the sand alongside the vessel, could be a useful activity for deep diver training, the actual bottom of the vessel and the surrounding sand area is quite featureless.

A discussion may be useful in regards to laying permanent lines in certain sections of the vessel where ambient light is not present. However, a counter argument to this proposal is that the presence of such lines may encourage divers without wreck penetration training and skills to enter such areas and thereby exposing themselves to potential risks.

In terms of attractiveness, there does not seem to be any negative impact on the safety or attractiveness of diving in the deeper sections of the vessel, provided divers have the appropriate levels of training and experience to enter these sections of the vessel or to dive to deeper sections outside of the vessel. For example, the diver training agencies provide training to a maximum depths during various courses. This maximum depth varies slightly between agencies from 18 to 20 meters for entry level divers.

4.5. Ships funnel area.

In the originally planned configuration of the vessel the funnel (photo # 11) would have received ‘direct’ ambient light. However, in its present orientation it is now receiving ‘indirect’ ambient light. Conversely, the cabin areas directly under the funnel now have ‘direct’ light penetration and may be even more appealing to divers than they would have been in the originally planned orientation.
Potentially hazardous areas are sealed off and no other potential hazards were detected due to the present orientation. **Observations and recommendations:**

No significant impact on diveability or potential enjoyment of the vessel has been created by the present orientation of the funnel.

### 4.6. Forward crane area.

Light can penetrate directly into the forward crane tower entrance door as seen in photo # 12. No additional potential hazards were detected that have been caused by the present orientation of the vessel. Similarly, no significant impact on diveability or potential enjoyment seems to have been caused by the current orientation of the crane tower of the vessel.

### 4.7. Aft loading door area.

The aft loading door (photo # 13) is free moving and could present a serious hazard if left in its present position. During the survey dive the movement was observed and videoed. The movement was also audible underwater.

**Observations and Recommendations:**

Possibly this is the most disappointing part of the vessel’s current orientation. It is recommended that the door be stabilised (e.g. chained in place, braced and / or welded in position).
If possible, the loading door should be positioned in a ‘fully open position’ to allow access to this part of the vessel. This could be an important step towards countering claims that the current position of the vessel and the aft loading door being shut has potentially decreased its attractiveness for divers with the skills to access the cargo area of Number 3 deck. That is, the creation of an extensive opening with access to the large interior would provide excellent entry / exit points to a large cavern-like area (i.e. the original intention of this section of the vessel).

Therefore, the condition of the aft loading door / ramp needs to be addressed.

On the other hand the tight areas around the loading door are sealed off appropriately (photo # 14).

It is noted the bow loading door was welded up by the Australian Navy during military service.

**4.8. Propeller area.**

The current positioning of the vessel makes access and observation of propellers, propeller shafts and rudders comparatively easy in relatively shallow water. It is the experience of the researcher that many divers will fully enjoy this orientation of a dive on the vessel. That is, in many wreck dives the propellers have been salvaged or are buried under the sand which for some divers seriously removes the attractiveness of the vessel.
In the present orientation both propellers are clearly observable as shown in photos # 15 and # 16. Although more accessible in terms of depth in this orientation than if the vessel was to be up-right, the starboard propeller is in 22 m (photo # 15) and just beyond the ‘safe diving limits’ for those with only entry level training (i.e. maximum depth of 18 to 20 m). However, in the originally planned orientation, both propellers would have been resting on the sand and would have been well outside the safe diving limits of entry level divers. The current positioning of the port propeller increases the access to a significant feature of the vessel for entry level divers. Therefore it appears the present orientation of the vessel will have a positive impact on general diveability and potential enjoyment in this area of the vessel.

**Observation and Recommendations:**

Operators must caution divers to depth limits and cross reference with level of training and experience when diving the propeller area and possibly down to the sand where the starboard side rests on the sand.

**4.9. Tank deck:**

This is an overhead environment now the vessel is on her starboard side. The area looks quite dark and seems initially to have little natural light entering when looking in as shown in photo # 17. However, the opening is large, and on exiting, the area it is revealed that there is a lot of ambient light entering which should easily assist divers finding their way to the exit point.
**Observations and Recommendations:**

Divers should exercise caution and dive with a torch / light when entering this and other areas of the vessel where ambient light is reduced or does not exist. Specifically, in this area of the vessel there appears to be a significant reduction in ambient light caused by the present orientation of the vessel compared to that originally planned.

Given the present depth of the tank deck, the starboard orientation of the vessel and the presence of ‘indirect’ light, should not cause divers visiting this area any serious challenges other than those expected in the original orientation, providing safe wreck diving practices are followed.

4.10. Helipad area.

The helipad area (photo 18) is clearly visible to divers and requires no additional considerations to those that may have been proposed in the original orientation.
4.11. Bow.

There are already signs of marine growth on the hull, especially barnacles and algae. The L 50 is encrusted with growth and was barely recognisable.

Observation and Recommendations:

The L 50 may have to be regularly cleaned as a feature of the vessel’s significance as an ex-military vessel.

5.0. Additional observations and comments:

Additional entry / exit access points may need to be cut in some sections of the vessel to increase ambient light penetration given the change in the vessel’s resting configuration. If deemed necessary, it is recommended that the Authority complete a further more detailed survey of the vessel or use exiting detailed findings of past surveys to determine whether this may be indeed necessary in some sections of the vessel. However, in the context of this report, there seemed no obvious places that additional entry / exit and light penetration points need to be created. Therefore this report offers no recommendations as to where such additional entry / exit and light entry points should be established or may even be necessary.

The researcher would like to suggest that introducing too many artificial openings may reduce the appeal of the vessel to some divers.

As stated elsewhere in this report, in time, some glass windows may need to be removed in the bridge area, especially those areas that may give the impression of being an exit point or if incrustation significantly reduces ambient light penetrating the area.

As mentioned elsewhere in this report, in areas where no ambient light is present, operators may wish to lay permanent line to assist those with relevant qualifications to safely enter and exit. While this will introduce additional levels of safety for those also engaged in advanced levels of training, there is the potential for those without appropriate training and experience to feel that these areas are safely accessible.

Small schools of fish have already started to inhabit the vessel. Additionally, at least 2 species of fish that are the favourites with divers were observed (i.e. common trigger fish and colourful juvenile Silver Sweet Lip as shown in photo # 19).
At least one unidentified species was observed growing on the vessel (photo # 20).
6.0. A brief comparison to other vessels positioned on their side

A review of the dive industry and media literature indicates that there may have been some loss in utility caused by the ex-HMAS Tobruk falling on her starboard side during the sinking process. In response to this assertion the researcher would like to make several general observations:

1. The wreck of the SS President Coolidge in Espiritu Santo, Vanuatu lies on her port side and is considered one of, if not the best recreational wreck dive in the world. That is, the character of the vessel and its resulting attractiveness does not seem to be a function of alignment. Hundreds of divers, at various levels of training and experience, visit the wreck annually.

Reference: https://www.youtube.com/watch?v=agqxyQgbwUk

2. The wreck of the Yongala (located off Ayr, Queensland) is considered one of the best wreck dives in Australia and is also considered to be world class. The vessel lies on her side. Unlike what will be the case with the ex-HMAS Tobruk, it is noted that penetration dives on Yongala is not permitted although many divers at various levels of training and experience still visit and enjoy the wreck annually.


3. The ex-HMAS Tobruk lying on her starboard side actually increases the surface area of diveable space and access to significant features (e.g. port propeller) for entry level divers than it would have provided on its keel. This is a consequence, although not a deliberate intention, of the sinking.

4. The challenges that are more relevant for those that will be diving the ex-HMAS Tobruk than its orientation are safe visitations, especially for those involving access to the interior of the vessel. These include, but may not be limited to:

- Weather and underwater conditions on the day
- The level of diver training and certification
- Diver experience
- Quality of dive planning and briefings
- Underwater guiding and leadership skills and
- Proper dive protocols developed and followed by operators.
5. It is obviously disappointing to some that the ex-HMAS Tobruk did not settle on the sea floor as intended and that some of the provisions for recreational diving have been altered due to her present orientation. A review of the media indicates there could be an attempt to right the vessel. Although the researcher’s experience in salvaging vessels that had run aground (i.e. not sank) and those that had to be fully recovered from underwater is dated (i.e. goes back to experiences in the late 70s and early 80s), it is the opinion of the researcher that the cost of righting the ex-HMAS Tobruk would be astronomical and face significant operational challenges. Such an attempt most probably could not be justified in terms of potential increases in utility (i.e. value to divers and other stakeholders) that could be derived than that now obtainable from its current position on the sea floor.

Additionally, an attempt to right the vessel runs the serious risks of significantly damaging the vessel and rendering her less of an attraction than she is currently.
Appendix One

Implications of the Diver Training Agency Standards and the Queensland Government’s Recreational Diving, Technical Diving and Snorkelling Code of Practice 2018

Although it was not a specific requirement of this project for TC-IBC to provide guidelines regarding the operational activities of vessels visiting the ex-HMAS Tobruk, diver training agency standards and the Code of Practice (https://www.worksafe.qld.gov.au/__data/assets/pdf_file/0004/152329/rec-diving-rec-tech-diving-snorkelling-COP-2018.pdf) highlight several relevant points that can be used to ensure safe diving on the ex-HMAS Tobruk.

Firstly, the entry level recreational diving standards of most diver training agencies with a global reach (e.g. Professional Association of Diving Instructors - PADI, National Association of Underwater Instructors - NAUI, Scuba Schools International - SSI, Scuba Diving International / Technical Diving Instructors – SDI/ TDI and DiveRAID) do not provide divers with entry level certifications (e.g. PADI Open Water Diver) the skills required to enter (i.e. penetrate) a wreck. That is, entry level divers on the ex-HMAS Tobruk may be largely restricted to the outside of the vessel and not permitted to enter areas with significant overhead and / or enclosed environments. Additionally, entry level divers are traditionally trained and certified to dive to a maximum depth of between 18 and 20 meters and therefore deeper sections of the wreck, even on the exterior of the vessel, could be restricted zones for those with only entry level certification.

Secondly, “wreck diving” training programs such as those offered by PADI, SSI SDI and DiveRAID, and the subsequent experience levels of course graduates, only allows for penetration diving where the diver does not lose sight of natural light and exits.

Thirdly, several training agencies do offer additional training for diving where natural light is lost. These programs typically fall under the heading of “Advanced Wreck” and “Technical Diving” and among other training, call for the teaching of reel and guideline use, addressing silting and the causes and consequences of disorientation. Again the diver training agency standards and protocols and the Code of Practice could offer some guidance. Additionally, diver training programs beyond
entry level certification can provide divers with training for dives below 18 to 20 meters (e.g. PADI’s Advance and Deep Diver certifications).

These and other operational restrictions should not necessarily be viewed as a negative or deterrent for diving on the ex-HMAS Tobruk. Quite the opposite is the case. Adherence to the diver training agency training standards, the Code of Practice guidelines for diving in overhead environments, offers an opportunity for dive operators visiting ex-HMAS Tobruk to justify, promote and sell appropriate levels of training. Thus creating, and supporting, the income potential criteria referred to in the original sinking proposal. The local commercial operators and private vessel owners diving the ex-HMAS Tobruk should be encouraged to reference the diver training agency standards and to plan diving activities in accordance with those standards and the level of training and experience of the divers.

Commercial operators should also be encouraged to work together to develop a common ‘Operations Manual’ for ex-HMAS Tobruk visitations and associated diving activities. This may be a necessity under the Code of Practice and therefore operators should contact the Queensland Government Industrial Relations Department (i.e. OHS) for guidance.