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COMMENTS ON THE TMC REPORT

"RENA – FULL WRECK REMOVAL FEASIBILITY APPRAISAL"

Date: 18 August 2014 **Our Ref: 5750/LOCS/NEH/R008**

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EXECUTIVE SUMMARY

The TMC report "Full Wreck removal Feasibility Appraisal" was provided as a supplementary report to the BECA Report "Application for Resource Consent (MV RENA) Background and Consideration of Alternatives". I understand that report does not form part of the Resource Consent documentation and is provided for information only.

The report is a comprehensive report that undertakes a detailed analysis of sectional weights remaining on the Astrolabe Reef. A detailed analysis is undertaken of the existing methodology which provides time scales and exorbitant estimates of removal costs. However, the report does not consider all the options and is dismissive of what LOC believes are viable and cost effective options.

A large emphasis is given to diver safety, correctly I would add, however no thought is given to making the operation diver-less, there is no reason why the operations considered could not be undertaken utilising ROVs (as an example).

Irrespective, it is evident that any operation at site will be time consuming; as a consequence it will also be costly. Consideration must be given to the reasonableness of any removal notices for the remaining wreck sections. Whilst there may be nominal risks to the environment from both TBT and copper clove and that there is possibly a nominal risk to some craft from the bow sections, these risks are certainly manageable. Expending several hundred million more dollars to minimise these negligible risks is a difficult decision that should be carefully considered.

It should be noted that at no time do TMC advise that the Full Wreck Removal cannot be achieved. TMC advise that it may be time consuming and as a consequence expensive but not impossible. I believe this is significant, I agree that the preferred methodology stated in the TMC report is likely to be very time consuming but I think this has been exaggerated; consequently the prices quoted are also on the high side. I am convinced that if this was to go to International tender then solutions would be offered that may prove to be far less costly.

1. INTRODUCTION

1.1 Instructions Received

1.1.1 We are instructed by Sid Wellik, Manager Legal services, Maritime New Zealand (MNZ) to review a report prepared for the owners of M.V. "RENA" entitled "RENA – Full Wreck Removal Feasibility Appraisal" (TMC Report)[1]. The report was prepared for the owner of M.V. "RENA" by TMC (Marine Consultants) Ltd (TMC).

1.1.2 In particular we have been asked to consider and provide expert opinion on the following aspects of the report:

1) A general assessment of the proposed removal techniques:

a. Are these techniques within the range of techniques that would usually be used, or are appropriate for use, in the present circumstances?

b. Will sonar need to be used as part of a removal process and if so, what type and how extensively?

c. Comment on the stated environmental consequences or likely environmental effects of the use of the proposed techniques (for example, likely effects on the physical damage to the reef, to the sea floor, on sediment, and/or on remaining cargo). Please include the effects of additional moorings that might be required on the reef and the likelihood of other parts of the sea floor being used to set down parts of the wreck (as was recently required with the accommodation block, during the removal process) and the effects that these matters have (if any).

d. Comment on the owners' assessment of the operational environment, including the assumed operational delays, and how long the proposed techniques would likely take.

[1] Copy of the TMC report attached as Appendix "A".

e. Assessment of the safety issues that are likely to arise by the use of the proposed techniques, including how dangerous these techniques are.

f. Is the present exclusion zone sufficient for proposed removal techniques? Do they consider it would need to be bigger or could it be smaller?

g. If possible, please comment on likely costs.

2) Are there other techniques, or other types of techniques, that could alternatively be used? If so, please comment on the above matters in a similar way.

1.1.3 To allow us to make a fuller assessment we have been provided with the following documents;

i. Report "APPLICATION FOR RESOURCE CONSENT (MV RENA) – Background and Consideration of Alternatives – Volume Three" prepared on behalf of the owner of M.V. "RENA" by Beca Carter Hollings & Ferner Ltd (BECA) dated 27th May 2014; and

ii. Weekly salvage SITREPs prepared by RENA ICC Manager.

iii. "MARINE MAMMAL ASSESSMENT: proposal to leave the remains of the M.V. "RENA" on the astrolabe reef, prepared by the Cawthron Institute dated 16th May 2014.

iv. RECREATIONAL DIVING ON M.V. "RENA": by D.F. Gorman and S.J. Mitchell, undated.

v. SUPPLEMENTARY REPORT M.V. "RENA". Implications for Recreational Diving after Cyclone LUSI by D.F. Gorman and S.J. Mitchell, dated 25th May 2014.

1.2 Background

1.2.1 The “RENA” ran aground, at a speed of 17 knots, on the Astrolabe Reef at approximately 02:20 hours on 5th October 2011. Preliminary calculations carried out by LOC, and based on the draught of the vessel before and after the grounding, indicated a ground reaction in excess of 9,000 tonnes and therefore it was deemed to be extremely unlikely that the ship could be re-floated without the removal of a significant amount of weight. The vessel also developed a list of approximately 11° to port.

1.2.2 On 11th October a period of bad weather and large seas caused the vessel to move from the original grounded condition with a change of heading of approximately 20º. It is thought that the bow of the vessel remained pinned to the reef during this period with the more buoyant aft section being moved by the heavy swell and rotating about the bow. This resulted in significant damage to the bulbous bow. The list of the vessel also changed from port to approximately 22º to starboard.

1.2.3 During the period of heavy weather a crack developed in way of No. 3 Hold in both the port and starboard side shells. The stern of the vessel rotated an additional 1-2º meaning that the crack on the starboard side opened to approximately 1.7 metres at its widest point. On the port side the crack was overlapping above the waterline and then opened to around 0.15 metres below the waterline.

1.2.4 On 21st October 2011 the vessel was officially declared a constructive total loss and became a wreck, which term is used hereafter.

1.2.5 The wreck was located at a position of 37º 32’.4S, 176º 25’.7E with a heading of 276º True. (The position was provided by Discovery Marine Ltd (DML) who had undertaken single and multi-beam surveys of the reef in the area surrounding the wreck.)

1.2.6 During the initial salvage operation containers were removed from both above deck and partially below deck. However, during the early hours of 8th January 2012 during a period of bad weather, the hull severed in way of the damage in Hold 3. Over the next two days the stern section commenced listing further to starboard until eventually the stern section sank on 10th January 2012, although part of it was visible above the sea surface.

1.2.7 Further bad weather causing movement of the wreck sections occurred in March and April 2012. On the 4th April 2012, the aft section wholly sank beneath the sea surface.

1.2.8 Subsequent to the bad weather it was established that the stern section had sunk on the reef and slid downwards to starboard and aft until coming to rest on the stern at a depth of 74 metres. The section was lying on its starboard side against the reef. The forward end of the aft section was 3.5 metres below the surface. The port bridge wing was some 10 metres below the surface. The fore section remained in place on the Astrolabe Reef. A debris field was created between the fore and aft sections on the Reef from the contents of the cargo holds.

1.2.9 Removal of containers from the forward section continued under the existing Lloyds' Open Form contract until 8th June 2012 when owners terminated the contract. The contractors Smit & Svitzer departed the site on 13th June 2012.

1.2.10 Owners prepared an invitation to tender for the partial removal of the bow section and on 8th August 2012 Resolve Salvage and Fire (RSF) commenced work on the wreck reduction of the above water forward section. The contract was for the removal of the forward section to -1 metre LAT (Lowest Astronomical Tide).

1.2.11 Surveys undertaken by owners' contractors revealed that the wreck itself was beginning to disintegrate. An ROV survey undertaken in August 2012 showed that the port side of the upper accommodation area (in way of the chief engineer's cabin) had begun to collapse.

1.2.12 RSF were subsequently contracted to remove part of the debris from around the wreck and to recover specific cargo that had dispersed around and remained within the wreck itself. In addition, the owners and their P&I Club also contracted RSF to remove the accommodation block from the wreck, and debris from the debris field.

1.2.13 On the 25th July 2013, it was announced that the bow section had been removed to depths greater than -1m LAT, leaving two main pieces on the Reef. In October 2013, the bow section was found to have broken into several smaller sections.

1.2.14 The removal of the upper section of the accommodation block was completed in March 2014. Prior to the removal of the lower decks of the accommodation block, during the week 14-21 March 2014, a tropical cyclone (LUSI) passed close to New Zealand which resulted in a protracted period of unsettled weather and high seas. The resulting high seas caused the remaining wreck sections to move, the aft section rolling further to starboard and bodily slipping down the reef with parts of the wreck section now beyond safe commercial air diving depth, the remnants of the bow section also moving, as did the contents of the debris field.

1.2.15 As a result, it was decided by the owners to abort the further removal of the accommodation block, the contractors, RSF, instructed to target removal of hazards associated with the debris field.

1.2.16 Whilst the work by RSF was ongoing, the owners submitted an application for resource consent on 27th May 2014.

1.3 Scope of Report

Review the report; "RENA – Full Wreck Removal Feasibility Appraisal" prepared by TMC on behalf of the owners of MV "RENA" to consider and provide expert opinion on the specific questions listed in paragraph 1.1.2 above.

1.4 Disclaimer

This report is based on our understanding of the documents itemised in *para* 1.1.2 and 1.1.3; such evidence is contemporaneous in its nature. However, our opinions are based on the information available from these documents and not through our own attendances on site. Consequently, if there are any inaccuracies in these reports provided, they may be reflected in this report.

2. GENERAL PARTICULARS

2.1 The Vessel “RENA”

2.1.1 Motor Vessel “RENA” (ex- “ANDAMAN SEA”, ex – “ZIM AMERICA”) was a fully cellular 7-hold, gearless container carrier which was owned at the material time by Daina Shipping Co of Liberia and operated and managed by Ciel Shipmanagement SA of Greece. The vessel’s keel was laid in October 1989 and she was completed in January 1990. The vessel was built at Howaldtswerke-Deutsche Werft AG (HDW) of Kiel. She was registered in Liberia and classed by the American Bureau of Shipping (ABS) with the following Hull Notation, AB*A1.

2.1.2 The vessel had the following principal dimensions:

Length Overall	:	236 metres
Breadth Moulded	:	32.2 metres
Depth Moulded	:	18.8 metres
Summer Loaded Draft	:	12.001 metres
GT	:	37,209
NT	:	16,454
Summer Deadweight	:	47,230 tonnes

2.1.3 The vessel’s propulsion was provided by a Zaklady Przemyslu Metalowego ‘H Cegielski’ SA – Poznan SULZER 8RTA76 Diesel Engine, developing 29,476 BHP at 98 RPM, driving a fixed pitch propeller. The vessel had a service speed of 21 knots.

2.1.4 The vessel was fitted with seven cargo holds. The vessel had a total capacity of 3,352 twenty foot equivalent units (TEU), split as 1,384 TEU within the holds and 1,968 on deck. In addition, the vessel was originally designed to carry 121 refrigerated units.

2.1.5 Prior to grounding the vessel had onboard 1,368 containers loaded as mixed TEU and FEU (forty-foot equivalent units). Of the containers said to have been onboard, 821 were loaded below deck and 547 were stowed on deck.

2.2 Astrolabe Reef

2.2.1 A brief reference to Astrolabe Reef is made in the New Zealand Pilot (NP51 – 2010 Edition)[2]. The reference is given below:

"***9.95 From a position ENE of "A" Light Beacon (E Cardinal) (37° 36.1'S 176° 10.7'E), at the seaward end of No.1 Reach to Tauranga Harbour, the coastal route leads initially ENE passing clear of Pudney Rock (37° 31'S 176° 19'E), depending on draught. Thence the track either continues ENE to pass N of Volkner Rocks (37° 29'S 177° 08'E) and thence to a position N of Cape Runaway, 41 miles E, or it leads E. The E track passes (with positions from Motiti Island Light (white metal column, 4m in height) (37° 36.4'S 176° 25.1'E)):***

N of Okaparu Reef (3 miles WNW), where the sea breaks in all swell conditions and particularly during NE or N gales, and:

N of Brewis Shoal ($2^{3}/_{4}$ miles NW), which breaks in a moderate to heavy swell from the NE, thence:

Either side of Astrolabe Reef (4 miles N), which breaks in all swell conditions and in fair weather appears like a boat, thence:……."

[2] New Zealand Pilot NP51 Eighteenth Edition 2010, para 9.95.2, page 264

3. THE TMC REPORT

3.1 Executive Summary of the Appraisal

3.1.1 The TMC report contains an Executive Summary (page 5 of 107) which states:

"***This report considers the condition of the wreck as at 29th May 2014 and the methodology, safety, environmental effect and costs of full wreck removal.***"

The summary then defines the wreck as comprising three distinct zones, namely; Forward Section, which is broken into several smaller sub-sections on top of the reef; Aft Section, which has slipped off the eastern side of the reef; and a Debris Field of cargo, containers and ship parts which lie between the forward and aft sections.

The report also advises that; "***The condition of the wreck, the rocky seabed over which the majority of the wreck lies and the normal post removal standard to which a wreck site can be cleaned up, suggest that some pieces of the RENA would remain even after "full wreck removal".***"

3.1.2 The report concludes that the most likely methodology to remove the entire wreck "***would require a combination of chain and manual thermic lance (diver) cutting followed by lifting of large sections by a sheer leg heavy lift vessel.***" It is also stated that; "…***due to the broken up nature of the wreck, there would also be a large element of piecemeal removal of smaller pieces and recovery of debris by grab.***"

3.1.3 The report advises that; "***Much of the wreck lies in deep water whilst some is in very shallow water. The weather and sea conditions at the site are not conducive to wreck removal operations. The shallow water is inaccessible for craft working on the wreck and is subject to surf and surge from the constant Pacific swell. The deep water is beyond the range of normal air diving operations and much of the underwater work would have to be performed by saturation divers. Wreck removal is unpredictable and all diving to perform cutting and rigging on the RENA***

would be dangerous, notwithstanding efforts to control the risks. Whilst it is theoretically possible to perform a full wreck removal of the RENA wreck, it would be a hazardous, prolonged and expensive undertaking."

3.1.4 The executive summary is closed with the following statement:

"***Comparisons with other equivalent sized wreck removal operations across the world show that the RENA is significantly more difficult and expensive than operations that have been undertaken elsewhere. If full removal of the RENA (an unremarkable containership of modest size by modern liner-shipping standards) were attempted the Astrolabe Reef would remain a restricted area for a period of several years, the risk to life would be high and the financial cost would be very high.***"

3.1.5 In comment to the executive summary I would advise that what is being stated by TMC in the whole is correct, the reef area is a difficult area to work, it is by no means unique.

Regarding the statement that the comparison between "***the RENA and other similar sized wreck removal operations show that the RENA is significantly more difficult and expensive than operations that have been undertaken elsewhere***" is somewhat of a bold statement. It could be argued that the removal methodology used to date has proven to be more difficult and expensive. LOC were never party to the full invitation to tender (ITT) for the remediation works on the bow section so are unable to comment on the efficacy or the wording of the tender process or on the analysis of the received bids. It is difficult not to assume that the costs incurred to date are not a result of the tender process and selection.

3.2 <u>TMC Report, Introduction</u>

3.2.1 Within the "General" section of this chapter the report advises that the report "***considers the technical issues relating to full removal of the RENA***" but that "***general matters relating to the environmental, cultural and economic interests are not considered***" as these are dealt with in other reports.

The report then advises that the owner has made an application for resource consent under the Resource Management Act 1991 (RMA) and that the "***owner considers that this application should be assessed on its merits and not by comparison with any other alternative course of action***."

However, I would advise that despite the advice provided by the above statement it would appear that owners have done exactly what they state they do not want to do by providing an assessment of the alternatives.

3.2.2 Contained with paragraph 1.2.1 of the report is the advice that; "***The report is not intended to determine the "best" way to remove the wreck although a number of methodologies are considered in order to illustrate the difficulties that would be encountered.***" I would comment here that if a report is to be commissioned to appraise the feasibility of a wreck removal programme then that report should consider all the options that may be available, I do not believe that the TMC report does this; I believe it is selective in its approach which allows the authors to accommodate a pre-determined conclusion. This is not say that even had all options been reviewed then the conclusion would be any different it may well not be, however the point is that the report does not appraise all the options available for the removal of the RENA wreck.

3.2.3 Paragraph 1.2.2 (page 6 of 107) details the Invitation to Tender (ITT) process, however we are not made aware of the details of the ITT that was issued in respect to the bow reduction programme nor are we advised of the offers received in respect to the ITT.

This section also advises that a report can be prepared by a consultant, which provides the answers to various technical questions, such as: "Can it be done?"; "By what methodology?" and "How much and how long will it take?" However, the TMC report advises that it cannot provide the answer to whether the wreck should be removed in its entirety.

I am unable to agree with TMC on this issue. LOC is often requested to prepare a report on behalf of owners (and their P&I) justifying why a wreck should or should not be removed, dependent upon the circumstances of the case (location, risk, environment etc). This may be prepared in response to a

wreck removal notice or as an initial advice to owners and their P&I Club. I would have thought that this may be one of the reasons why a consultancy would be contracted at the outset.

3.2.4 The remainder of this chapter describes who BECA and TMC are what their various roles have been throughout the protracted RENA operations.

3.3 TMC Report, Definition of Full Wreck Removal

3.3.1 Chapter 2 defines the wreck removal process and defines what remains of the RENA itself. As discussed in the executive summary section of the report, TMC advise the wreck is considered as follows;

1. ***The aft hull section with any cargo remaining within the holds;***
2. ***The forward hull sections; and***
3. ***The debris field (comprising ship parts, containers and cargo) that lies between the two main hull sections.***

3.5.17 Paragraph 2.2 defines full wreck removal as follows; "***as the complete removal of the ship's structure and cargo.***" However, it is claused by adding that a specific limitation is usually contractually defined, such that the contractor is usually required to remove debris greater is size than one metre by one metre.

As such, any wreck removal operation will tend to focus on the substantial removal of the cargo and the main parts of the vessel structure. Recovery of any debris that remains will be defined by the nature of the debris itself, the type of seabed and the water depth.

3.5.18 The following paragraph 2.3 defines what normally cannot be removed, advising that items smaller than the defined $1m^2$ above, are generally not removed. Wreckage can and does become buried, particularly in soft, sandy sea-beds, normally a magnetometer sweep is commissioned to ensure that anything larger than $1m^2$ is located and removed. TMC advise that in their experience it has not been considered practical to remove smaller items of wreckage from the seabed.

This paragraph advises that it is impractical to separate small granular cargoes from sedimentary layers (I assume this reference is to the copper clove cargo) and also refers to paint chips (including the anti-fouling coating)

3.3.4 However, I can advise that whilst not normal it is not unheard of for a regulatory authority to impose far more stringent requirements on a vessel owner. A case in question is the salvage of the container vessel BUNGA TERATAI SATU which grounded on Sudbury Reef, Great Barrier Reef on 2 November 2000. Subsequent to the refloat of the ship, the Great Barrier Reef Marine Park Authority instructed owners to remove any paint chips from the reef to prevent damage to the flora and fauna from the Tributyltin anti-foul paint coating. To achieve this, a contractor was employed for a three-month period to sift the coral sand in the foot-print of the grounding location and remove any loose paint chips that may have become detached during the grounding incident.[3]

3.3.5 TMC define the full wreck removal at paragraph 2.4 as follows:

- ***Removal of all material greater than 1 metre x 1 metre in horizontal dimension or one square metre in area;***
- ***Identification and removal of marine pollutants able to be removed without "dredging" the seabed.***

3.4 <u>TMC Report, Site Characteristics</u>

3.4.1 This section of the report describes in detail Astrolabe Reef and the Bay of Plenty in general, an attachment (Figure 2 Astrolabe Reef (as surveyed in January 2012)) is shown at page 13 of 107, within the report which outlines the various wreck structures on the Astrolabe Reef system.

3.4.2 Paragraph 3.2 provides a detailed analysis of the environmental conditions at the Astrolabe Reef area. A table is provided within the report[4] which shows the monthly and annual total significant wave height exceedence probabilities. Following that table a paragraph advises as follows:

[3] http://www.cedre.fr/en/spill/bunga/bunga.php

[4] TMC Report, Paragraph 3.2, Page 14 of 107, Table 1 Monthly and Annual Exceedence Table.

"***Annually the 0.5m total significant wave height is exceeded approximately 90% of the time leaving 10% of the time available for wave sensitive operations (such as heavy lifting) around the Reef. The 1.0m total significant wave height is exceeded approximately 52% of the time available. This is not inconsistent with actual work experience on-site during underwater wreck removal operations when weather downtime has been consistently between 55% and 59%.***"

3.4.3 A further table within the report[5] records the persistence of significant wave height over different time periods. The statistics show that a 1.0m significant height is not exceeded for a persistence of 72 hours for just 26.19% of the time.

3.4.4 Paragraph 3.2.4 of the report advises that periods of favourable conditions (workable weather) are further reduced when operations require consecutive days of near calm weather (such as the removal of the accommodation block, which required 4 consecutive days of calm). The Metocean data advises that the probability of getting 4 days with a sea state of less than 1m is approximately 21%. This would equate to only 18 periods a year with 4 consecutive days of calm sea conditions.

3.4.5 The statistics provided by TMC within this section do paint a very negative picture of probability for undertaking certain aspects of the wreck removal. However, these statistics refer to sea conditions below 1 metre which is a particularly onerous requirement and is unlikely to be bettered in anywhere other than the most benign of areas. The requirements for sea conditions below 1m significant are only relevant when considering the actual spread at site. This should have been taken into consideration prior to the spread being mobilised, it is clearly NOT the correct spread to undertake this kind of work at this location.

If table 1 is analysed further it will be seen that the annual exceedence for 2m is only 11.66% of the time, if less than 3m is considered then the exceedence drops to only 2.44% of the time.

[5] TMC Report, Paragraph 3.2,3 Page 14 of 107, Table 2 record of Working/Weather Days.

3.5.19 Despite TMC advising that DP Heave –Compensated offshore cranes are not used in the salvage industry, LOC has had recent experience of these being used in the salvage industry (JASCON 25 on WEST ATLAS removal, MICOPERI 30 on COSTA CONCORDIA). These cranes are capable of undertaking substantial lifts in sea conditions of in excess of 2.5 metres significant wave height.[6] It has been LOC's experience that JASCON 25 was capable of lifting several hundred tonnes in significant wave height of 3 metres.

A company in Holland is able to offer a retrofit system to barges that will allow a barge-mounted crane to be used in a heave-compensated arrangement and is capable of undertaking significant lifts in sea conditions of H_s 2 metres.[7]

3.5 TMC Report, Current Status of the Wreck

3.5.1 Chapter 4 of the TMC report describes in detail the wreck and the overview section describes the work undertaken to date and the observed changes to the wreck components.

Paragraph 4.1.4 advises that the bow section reduction programme was completed in July 2013; "***The above water visible part of the wreck was removed to a level one metre below lowest astronomical tide***."

It is the owner's opinion that upon reaching the -1m LAT level the bow reduction works have been completed. However, I have not been able to source any specific data that this figure has been documented. The only references in any of the RMA consent application documents are verbal ones undertaken on behalf of owners. With the passing of cyclone LUSI it is evident that there have been numerous changes to the wreck and that some of these changes may have impacted the -1m LAT claim.

3.5.20 Reference is made to the MNZ weekly SITREP issued on 2 May 2014:

"***Reef Dive: Cushla Loomb (Beca) plus one other (female without proper gear) conducted a snorkel survey on top of the reef; it was reported that***

[6] http://www.google.com.sg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CBsQFjAA&url=http%3A%2F%2Fwww.gustomsc.com%2Findex.php%2Fzoo%2Fbrochures%2Fdoc_download%2F646-oleg-strashnov&ei=hPu9U9nuCsG2uASN6IDwCg&usg=AFQjCNGHPwTBKI7V5inQuMlT2Ct7ygBtuw

[7] http://www.barge-master.com/products/t700-barge-master.html

Ms Loomb was standing on a piece of wreck with her head out of the water; arguably this piece of wreckage is no longer at LAT -1.

This situation backs up reports that some items of Rena wreckage (bow section) has moved around the reef in storm conditions. This statement can be further verified by comparing Rena Bow section Survey conducted in November 2013 (Rosalind Spink SOLIS – Joe Farrell III Resolve Salvage & Fire) and the preliminary ADUS scan completed April 2014."

3.5.21 A further reference to the shifting forward sections is made in MNZ Weekly SITREP dated 09 May 2014;

"***Fore Section (Bow) reduction LAT-1m; completed as per Bow reduction TSC/RSF completion agreement.***

Bow wreckage is known to have moved, and will require further consideration as it no longer meets the LAT-1 threshold. Steel from the bow section can now be more appropriately considered as "scattered items" as the bow is no longer intact, or in one place."

3.5.22 As part of the RMA submission documents, BECA prepared a report, which has subsequently been submitted, entitled; "Social Impact Assessment –Beca –Volume Two Application for Resource Consent (MV Rena) Technical Reports". Within the appendices of this report are various reports commissioned by Beca on behalf of owners to support their consent application.

One such report is the; "Recreational Diving Safety Assessment of the Wreck of the MV Rena, Bay of Plenty, NZ" issued on 9 March 2014 and authored by Professor Des Gorman & Associate Professor Simon Mitchell (Gorman & Mitchell).

At page 33 of this report the following comment is made:

"***In regard to the bow section (A-E), this is largely broken up and, with a single exception; there is little potential for diver harm. The exception***

to this comment is a ~30m corridor (E). This has an entry at 2m and 8m depth."

It should be noted here that the two depths quoted, namely 2m and 8m are provided for by divers, they are not corrected for tide and as such it may well be that the 2m level does not fall within the -1m LAT requirement.

However, of greater concern is the following extract which is taken from the "***Supplementary Report***" issued by Gorman & Mitchell and dated 25 May 2014, written in response to a further dive survey undertaken post cyclone LUSI:

"***In the shallower reaches of the wreck, the wire hazard in the debris field has become worse, with partial uncoiling of many of the previous coils. We remain of the opinion that these need to be removed. The very shallow section of wreck with the long corridor which we commented on in our first report has actually shifted shallower (to about -6 m) making it a greater surge hazard, or perhaps more correctly, further limiting the range of conditions in which it can be safely dived.***"

If the supplementary report advises that; "***The very shallow section of wreck….has actually shifted shallower…***" and that they advise that the 8m depth has now become 6m, it is safe to assume that the previous 2m depth has also shifted shallower by a similar amount and is now just below the surface.

Owners must provide evidence that the forward section meets the -1 metre LAT requirement that the various submissions made as part of the RMA consent application claim.

3.5.5 Chapter 4.2 details the Forward Section. TMC advise that contractors engaged by the owner and TMC had removed the above water structure (Bow Section) to a level 1m below LAT, effectively repeating the information from paragraph 4.1.4 of the report. Further advice states that the remains of the bow section are breaking up and that some sections have moved; "***mostly moving "down slope" into deeper water.***" However, this would

not appear to correspond with the information provided in the Gorman & Mitchell supplementary report.

3.5.6 Paragraph 4.2.3 advises that from a dive survey undertaken in November 2013 the condition of the structure was ascertained and that the bow section had in fact broken into several pieces. The pieces are lying in water depths ranging from 2m to 15m.

I will reiterate what is stated in paragraph 3.5.1 of this report, there is no evidence provided that shows that the -1 metre LAT was ever achieved and furthermore there is no evidence provided that shows that this level has been maintained. In fact the evidence provided in the Beca provided Gorman & Mitchell report and the two MNZ weekly SITREPs would appear to show the opposite and that movement has caused the bow section move into shallower water. Owner and TSC must provide documented evidence that the -1 m LAT was achieved and is being maintained.

3.5.23 A snap shot of an extract taken from the ADUS survey is provided in the TMC report at page 19 of 107 (Figure 4 – ADUS Screenshot (Bow Section Double Bottom and Starboard Side)).

The extract shown below at ***Figure 1*** shows the starboard side of the bow section (coloured RED) and double bottom of the bow section (coloured BLUE). The black area in the top left hand corner of the ADUS screenshot shows an area not surveyed due to shallow water, it can be seen from the screenshot that the upper edge of the starboard side is within the black area (not surveyed), this is the area referenced in the Gorman & Mitchell report and discussed at paragraph 3.5.4 above.

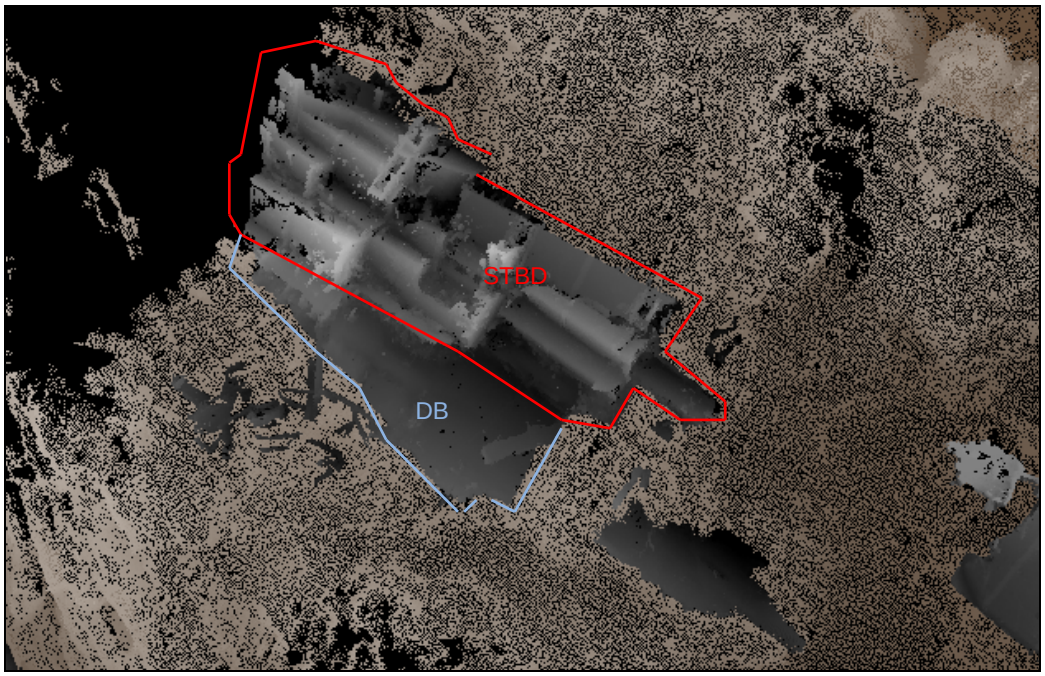

Figure 1. ADUS April 2014 Screenshot of Bow Area.

We know from other figures provided in the TMC report[8] that the forward end of the bow section is contained within a 2 metre contour. From the evidence provided, scanty though it is, I am of the opinion that at least part of the starboard side of the bow section is shallower than the claimed -1 metre LAT.

3.5.8 A table is provided in the TMC report[9] which provides a calculation showing the estimated steel weights of the various component parts that form the "Bow Section". The total weight is estimated at 1419 tonnes, with the largest sectional weights comprising the double bottoms at 674 tonnes and the Starboard side at 446 tonnes.

3.5.9 Paragraph 4.3 of the report refers to the Debris Field. We are advised that field extends in the area between the hull sections over approximately 11,000m^2 and is approximately 90 metres wide and 150 metres long, it lies predominantly in less than 30 metres of water. It should be noted that the reference to the debris field is the principal debris field, the TMC report does also comment on the various other items of debris that have been identified as "possible" debris in the ADUS April 2014 survey.

[8] TMC Report, Paragraph 4.2 Page 18 of 107, Figure 3 – Wreck and Debris Outline (April 2014).
[9] TMC Report, Paragraph 4.2.10 Page 21 of 107, Figure 5 – Summary of Bow Steel Weight Calculations.

3.5.10 At the time of grounding RENA was carrying 1368 containers, of those 1039 have been accounted for, leaving 329 unrecovered. Diver reports from site confirm that there are no intact containers remaining within of adjacent to the wreck sections. The containers have crushed down and become mixed with the container contents forming the bulk of the debris field.

The extent of the principal debris field is shown in the figure below at ***Figure 2*** which is extracted from the TMC report[10]

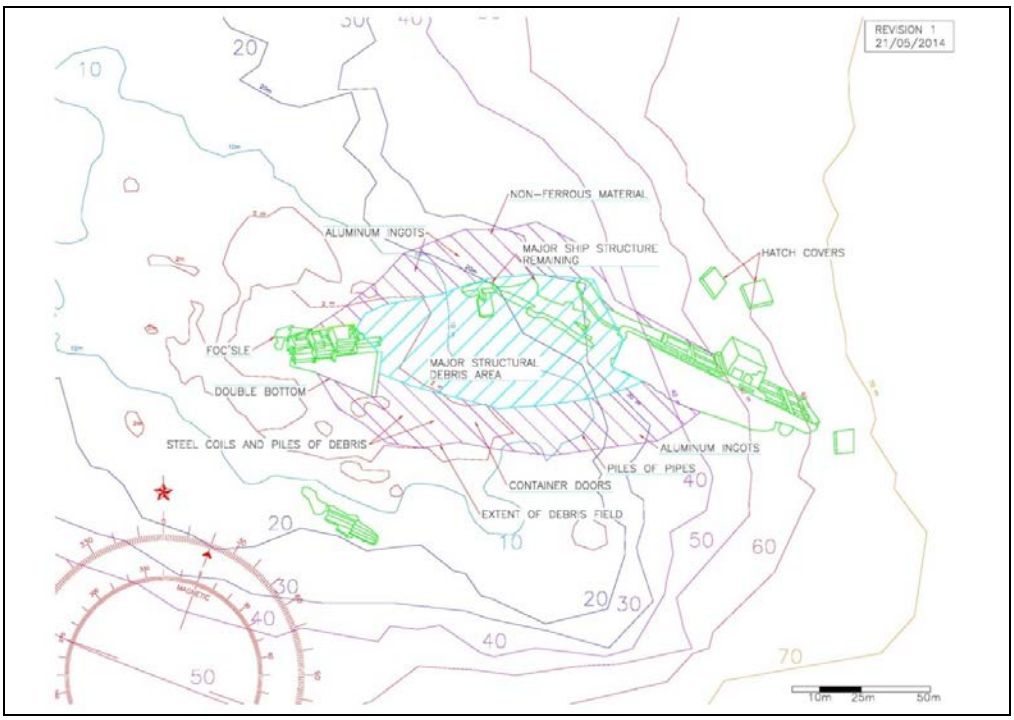

Figure 2: Debris Field, May 2014

The TMC report advises that following the latest underwater surveys, clean-up operations to remove the debris field have commenced. Resources include divers, an electromagnet and an orange peel grab. At the time the TMC report was produced (end of April 2014), 467 tonnes of metallic cargo, 298 tonnes of ship debris and 119 tonnes of non-metallic debris had been recovered. This totals 884 tonnes of mixed debris. TMC estimate there is approximately 4125 tonnes of debris remaining within the debris field. The report advises that in general the debris is considered relatively benign,

[10] TMC Report, Paragraph 4.3.3 Page 22 of 107, Figure 6 – Debris Field, May 2014.

however this would appear to counter the information contained in the Gorman & Mitchell reports, see paragraph 3.5.4 above.

3.5.11 The MNZ Weekly SITREP dated 11 July 2014 advises that the RENA owner and TSC have commissioned a dive company to undertake a "before" and "after" photo mosaic of the debris field which is to be of sufficient quality so as to be accepted by the Courts in order to prove the clean-up operations on site. It is therefore evident that the owner and Club do at least intend to remove the debris field down to a depth of -30 metres.

3.5.12 The TMC report also advises that the side-scan survey undertaken in April 2014 of the level seabed surrounding the Astrolabe Reef revealed a number of possible debris targets. Whilst the various locations have been documented, at the time the TMC report was written no targets have been positively identified as debris. The extract below[11] shows the various targets identified within the ADUs survey as "suspected" debris targets:

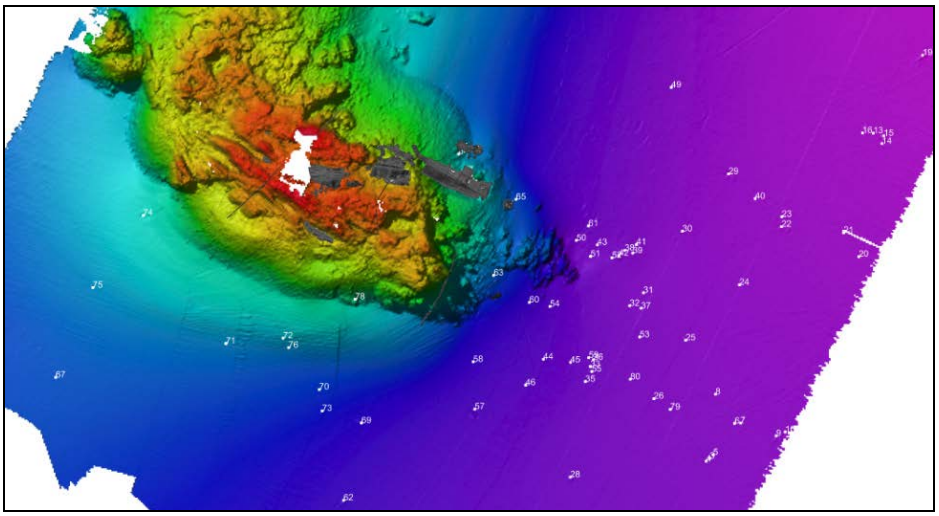

Figure 3: ADUS Side-Scan Sonar Targets (suspected debris field).

Whilst it may be the case that none of the targets shown above have been "confirmed" as debris targets, it can similarly be stated that none have discounted, as such it is highly likely that at least a percentage of these targets do consist of debris. It is well known that items of debris continue to

[11] TMC Report, Paragraph 4.3.6 Page 23 of 107, Figure 7 – ADUS Side-Scan Sonar Targets (suspected debris contacts).

wash on the beaches around the Bay of Plenty after each weather event and that debris is known to have dispersed far and wide around the Bay.

3.5.13 Chapter 4.4 of the TMC report deals with the Aft Section of the wreck. The aft section is fully submerged and laying on its starboard side at 63° with an aft trim of 4°, at its deepest the aft end is at 56 metres water depth. The total estimated weight of the aft section is approximately 10,353 tonnes (prior to any removal), however reference should be made to the table extracted from the TMC report and provided as ***Figure 4*** of this report which shows that the estimated weight remaining of the aft section is 7727 tonnes.

3.5.14 The April 2014 survey shows that Holds number 4 and 5 have collapsed completely. The significant changes to the section are clearly illustrated in the illustration below which shows the position of the section in 2012 (shown is Red) and 2014 (shown in Grey).

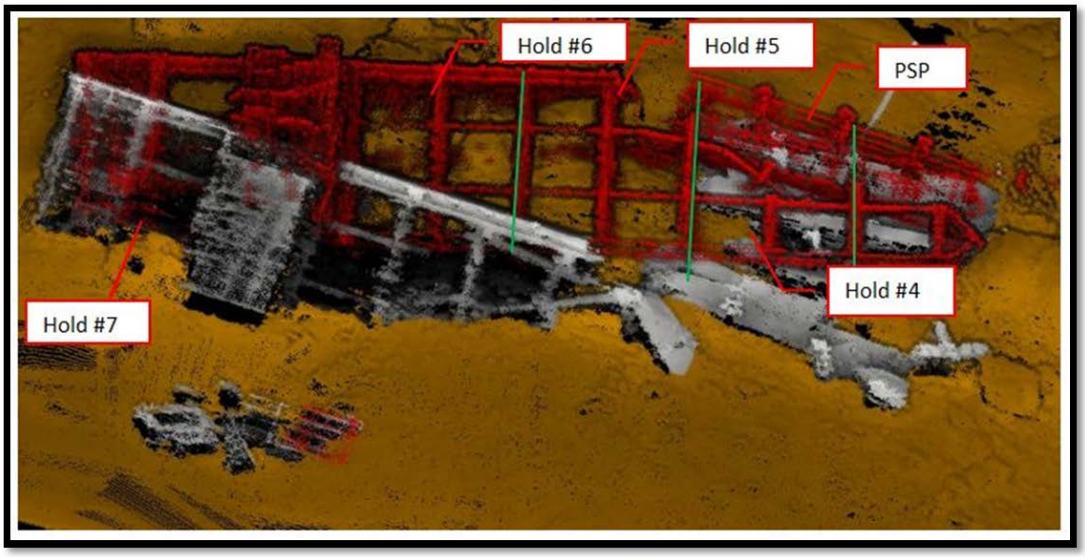

Figure 3: ADUS Survey in 2012 (Red) and April 2014 (Grey).

The survey would appear to show that all longitudinals forward of the accommodation have been compromised and that Hold 7 appears to also be crushing.

3.5.15 Also evident from the survey is the fact that the containers within the cargo holds have all been damaged/crushed and they form part of the general debris contained within the holds.

3.5.16 Still photographs shown in the TMC report clearly show that the rudder and propeller are partially embedded in the seabed and the starboard transom is also embedded.

3.5.17 The last section in this Chapter contains information regarding the weight estimates undertaken by TMC. A table is also provided which shows the calculated weight estimates, this table is contained below at ***Figure 4*** and shows that the weight of the Bow sections is estimated at 1419 tonnes and the Stern Section at 7727 tonnes.

	Section	Totals	Wreck	Hatches	Recovered	Debris	Reference
Forward section	Lt. wt. fr.190 to fwd.	3207.13					Spreadsheet
	Hatch covers 1 to 5	-269.5		269.5			Drawing
	Hull fr.190 to fwd	2937.63					
	Bow reduction	-1263.09			-1263.09		Weigh bridge
	Bow remaining	1674.54					
	Bow pieces RSF estimate	1419	1419				RSF
	Unaccounted bow weight	255.54				255.54	
Hold No.3	Hull fr.170 to 190	940.13				940.13	Spreadsheet
Aft section	Lt. wt fr.170 to aft	10353.52					Spreadsheet
	Accommodation removed	-311.39			-311.39		Weigh bridge
	Port side piece removed	-613.83			-613.83		Weigh bridge
	Hatch covers 6 to C	-520		520			Drawing
	Stern remaining	8908.30					
	Stern remaining ADUS/TMC estimate	7727	7727				See Section 6.1 below
	Unaccounted stern weight	1181.30				1181.3	
	Hatches total			789.5	-668.07	121.43	Drawing
	Debris recovered				-297.89	-297.89	Weigh bridge
	Totals	14500.78	9146		-3154.27	2200.51	

Figure 4: Summary of Steel Weights All Sections.

3.5.18 TMC has estimated that the unaccounted for weights which form the No3 Hold amidship section and the unaccounted for bow and stern weights all sum up to approximately 2200 tonnes of structural steel and that this is entangled and mixed within the debris field.

3.6 Overview Of Wreck Removal Techniques

3.6.1 This chapter presents TMC’s opinions of possible methodologies that could be used to remove the wreck sections of RENA. The report considers various options and methodologies but advises that these are, by necessity, speculative. Wrecks are normally removed by specialist contractors following an ITT for the works. The selected methodology will be the choice of the contractor and approved by the owner, their underwriters and the applicable authority. In the case of RENA there has not been a formal ITT following the bow reduction operation undertaken to date, therefore the TMC report is somewhat speculative itself in its approach to possible methodologies considered. The salvage industry is, by its very nature, inventive, ingenious and creative and is capable of providing engineering solutions for very complex operational requirements. One only has to consider some of the more creative solutions provided in recent years to see that most problems can be overcome (Kursk, Ehime Maru, Prestige to name but a few).

3.6.2 TMC advise that wrecks can be removed utilising one of the following methods:

i. Re-Floating

ii. Lifting as one piece.

iii. Cutting into large sections and lifting.

iv. Piecemeal removal.

Due to the known damages to the wreck, TMC have surmised that buoyancy cannot be restored and it is therefore plain that only lifting methodologies need be considered. Furthermore, due to the nature of the wreck TMC also advise that the cargo and wreck cannot be recovered together and the cargo.

3.6.3 Paragraph 5.2 details cargo removal operations and how these can best be achieved during salvage/wreck removal operations. TMC advise that tried and tested methods include:

- A cargo of iron ore bulk cargo discharged by a combination of slurry pumps and grabs working under-water and discharging to barges for disposal shore;
- A flat tope barge carrying a mobile crawler crane fitted with a grab used to recover a cargo of steel scrap;
- A crane barge used to recover containers.

The report is somewhat simplistic in its approach and does not appear to consider other options for cargo removal. Only the strikingly obvious is reported. Whilst it is evident that craneage is the natural approach to most cargo solutions it is by no means the only method available. DP vessels are becoming increasingly more available and the offshore vessels have highly complex heave compensation systems installed to their cranes which allow the cranes to be operated in quite onerous conditions.

3.6.4 A number of specialist operators have designed and used specialist deep water grabbing equipment that can be deployed and used in extraordinary depths, Deep Tek is one such company, though numerous other companies have developed specialist equipment which can undertake similar work.[12]

3.6.5 As the stern section is lying at 63° list it is unlikely that direct access to the cargo remaining in Holds 5 and 6 can be made. The port side shell plating would have to be removed first to allow direct access by grab to the internal cargo debris. However, this is an achievable option.

3.6.6 I note that TMC details some of the various cargoes at paragraph 5.2.7, of note however is the fact that no mention is made of the Cryolite (sodium hexafluoroaluminate) cargo of which there were 21 containers containing 535 tonnes of Cryolite.

[12] http://www.deeptek.co.uk/about-us/

3.6.7 Paragraph 5.2.8 advises that an orange peel grab is the most effective way of recovering mixed debris cargo, however the grab has a propensity to also grab immovable pieces of wreck and the seabed. Whilst this may be partially correct, the consideration here is using the orange peel grab inside the wreck and not outside the wreck; therefore it is highly unlikely it will attach to the seabed.

3.6.8 Paragraph 5.3 considers wreck cutting techniques, the report advises that the following methods are available:

1) Thermic Lance (Broco) Cutting

2) Chain Cutting

3) Diamond Wire Cutting

4) Tracked high pressure abrasive cutting machines

5) Explosives

6) Gravity shear/chisel

Of note in the methodologies considered are that ALL methods are diver intensive, no consideration has been given to diverless intervention, such as ROV work.

3.6.9 I also note that no consideration has been given to using the large SMIT wreck grab[13]. This grab is ideally suited to this work and has been used very successfully on numerous wreck operations. See ***Figure 5*** below which shows the wreck grab.

[13] http://www.smit.com/uploads/media/Leaflet_SMIT_Salvage_HDW1_October_2009.pdf

Figure 5: SMIT Wreck Grab HDW1

3.6.10 Paragraphs 5.3.1 to 5.3.6 considers the various wreck removal methods that TMC have raised in their opening paragraph of this section. All options are given a negative twist to show that whilst they may work there are untold problems with each and every option. The thermic lance option is negatively advised as being too slow with only 2-3 tonnes sections being cut at a time, this is due to the method selected by the contractor and not down to any other limitation. Therefore the 2-3 tonnes size referred to in the TMC report was due to that particularly methodology at the time, far larger section could have been cut.

3.6.11 Paragraph 5.3.2.2 speculates that the RENA wreck is embedded in rock, however no evidence is provided to show this and this is only speculation at this time. The embedment is used in a justification for not chain cutting the wreck.

3.6.12 Directional drilling is discounted at paragraph 5.3.2.3 due to the rock nature of the seabed and directional drilling only being able to work in sedimentary

sands, no evidence is again provided to support this and the testament is again speculative. This paragraph also advises that drilling would damage the reef, however it is difficult to see how leaving the wreck on the reef would be more beneficial than removing it. Each and every weather event causes the wreck to move on the reef area which undoubtedly causes greater damage to an ever increasingly larger area of the reef itself.

3.6.13 Diamond wire cutting is discounted at paragraph 5.3.3 on the basis that it is impossible to rig the wires for “bottom-up” cutting due to the nature of the seabed and that “top-down” cutting has never been undertaken before. This is incorrect, top-down cutting was successfully used on the KURSK submarine recovery.

3.6.14 Tracked abrasive cutting machines are discounted at paragraph 5.3.4 on the basis that the port shear strake is the only hull area not affected by buckling. This is not supported by any analysis and is simply speculative at this stage.

3.6.15 Explosives are discounted as a wreck removal tool. I tend to agree that the damage caused by explosive cutting is likely to cause more harm than good in respect to RENA. Therefore I am in agreement with TMC that this method should be discounted.

3.6.16 I am unsure whether TMC’s speculative dismissal of using a gravity shear is correct in respect to RENA. However, having experienced this tool on one other wreck I would agree that it has limited usage on the RENA wreck removal operation.

3.6.17 Paragraph 5.4 of the TMC reports considers the various options in respect to lifting the RENA wreck. The section considers the various options for such removal. Smaller piecemeal removal whereby sections of 20-30 tonnes are cut, slung and removed on a non-engineered lift basis. The report then considers undertaking larger, engineered lifts which require a more complex analysis to be undertaken, assessing weight, structural integrity etc.

3.6.18 Paragraph 5.4.7 advises as follows:

"***The ideal crane for removal of an underwater wreck would be able to rotate, have a lift capacity of several thousand tonnes at the greatest height and outreach, able to plumb to the deepest depths with an underwater block and be heave compensated (to cancel out the crane barge motions). The crane would be installed on a stable vessel with a shallow draft, a good motion characteristic and able to position itself accurately without anchors. Unfortunately such properties are not usually available in a single crane vessel and those crane vessels that come close to meeting such criteria are sophisticated offshore vessels that do not engage in the unpredictable business of salvage and wreck removal.***"

Whilst TMC are correct in their statement "***Unfortunately such properties are not usually available in a single crane vessel and those crane vessels that come close to meeting such criteria are sophisticated offshore vessels that do not engage in the unpredictable business of salvage and wreck removal.***" But I would add here whilst not usual, such craft, if available will undertake any work that is offered them. LOC was involved in a very complex wreck removal of a Jack-Up drilling rig that was destroyed in a fire whilst undertaking drilling development wells through a fixed jacket installation. Svitzer Salvage contracted with SEATRUCKS and used the offshore crane vessel JASCON 25 to undertake the work. It is therefore incorrect to state that such vessels are not used in the salvage world.[14]

3.6.19 The report details diving operations at paragraph 5.6, comparisons are made between air and saturation diving. The section is summarised at paragraph 5.6.3.5 where it is stated:

"***In general, diving operations of all types result in a high exposure to risk. Notwithstanding the risk management strategies used by Contractors to minimise the dangers to divers, underwater heavy salvage diving on a deep water wreck remains a hazardous occupation.***"

[14] http://www.seatrucksgroup.com/l/library/download/9330/West-Atlas-Australia

I am in complete agreement with the statement made by TMC, which makes it all then more surprising that given these risks, no consideration has been given to the use of ROVs to make this a diverless operation.

3.6.20 Paragraph 5.7 of the TMC reports considers the various vessel types that may be available to undertake wreck removal work. The larger HLV available on the market are generally used for specialist installation work in the offshore energy sector, however as advised at paragraph 3.6.18 above they have, on occasion been used in specialist salvage operations. The TMC report advises that most HLV operate whilst anchored, however it has to be said that whilst this is generally the case an ever increasing amount of lifting work is being undertaken whilst the HLVs are operating in DP mode. The larger cranes are usually booked well in advance and are unlikely to be readily available in the salvage market (i.e. short term notice). However, without testing the market it is speculative to state that they are NOT available.

3.6.21 This section also considers dive support vessels (DSV) which are usually used as the mother ship for saturation diving. The comments made in the TMC report are somewhat speculative and statements such as "***unwillingness to risk operating a multi-million dollar vessel close to a ree***f" are unhelpful. No supporting evidence is provided to show where this statement has come from. In fact, the offshore DVL and HLV vessels are normally operating within extremely limited confines adjacent to ultra-high value assets such as offshore platforms. Therefore it is somewhat misleading to make comments like they are "unwilling" to risk operating close to a reef.

3.6.22 The report also considers using jack-up platforms for removal. However, the report advises that these are not commonly used and are somewhat limited. TITAN Salvage[15] owns and operates two jack-ups which they use predominantly in pure salvage/wreck removal work. Their web site advises as follows:

"***The Karlissa-A and Karlissa-B jack-up barges operate in the most demanding marine environments. The barges, which have a combined total of 1,880 meters of clear deck space, can jack in depths of up to 50***

[15] http://www.titansalvage.com/News-and-Media/Press-Releases/TITAN-s-Jack-Up-Barges-Karlissa-A-and-Karlissa-B-on-scene-at-the-Vinca-Gorthon-wreck-removal

meters. The Karlissa-B has a 272 metric tonnes capacity platform ringer crane. The barges can load over 900 metric tonnes and are adaptable to accommodate upwards of 1,350 metric tonnes of vertical lift or 130 metric tonnes of lateral pull utilizing TITAN pullers."

Both of these units have been used extensively in wreck removal operations around the world and they are ideal for operations in demanding marine environments. Weather down time is minimised as they are not subject to the vagaries of adverse sea conditions.

3.6.23 Paragraph 5.8 of the report considers the various contractors that may be suitable for undertaking this kind of work. The list provided is not absolute, Fukada Salvage are one of Japan's biggest wreck removal contractors and are very capable of undertaking this kind of work, I note that they are not included on the list.

The report apparently dismisses marine civil engineering and offshore installation contractors who are "***unlikely to have the appropriate experience***". COSTA CONCORDIA wreck removal is being undertaken by a joint venture partnership between TITAN Salvage and Micoperi, Micoperi are a large offshore installation contractor. Others who may be considered are is Saipem who, to our knowledge have had involvement in a number of salvage operations to date.

The report further advises that; "***The pool of suitable international contractors able to undertake the full removal of a large wreck like the RENA in a geographically remote region, such as New Zealand, is small and would be considerably less than the number of contractors in the list above.***" I am unable to agree with this statement, it is my opinion that the majority of the contractors listed in the TMC report and some not included in the list would be only too keen to bid on a wreck removal such as RENA. If the job pays, all of the contractors would be interested.

3.6.24 Environmental protection considerations are covered in the report. The two areas of concern raised by TMC are the TBT and copper clove cargo. I am particularly interested in paragraph 5.10.4 which considers the TBT as follows:

"***Parts of the hull sections have antifouling paint applied which when disturbed will release further paint flakes into the environment which will end up in sediments. There is TBT present on the ship's aft section. The TBT has all been sealed by subsequent paint layers applied since 2005 when it became illegal to use TBT based anti-fouling. A leach layer will have built up preventing any release of TBT into the water column from any exposed edges. However there is the potential for TBT to get into the environment through paint flakes such as would be released with abrasion or further salvage involving cutting. It is therefore considered that cutting, as would be required for full wreck removal, will release more antifouling paint flakes into the environment.***"

I struggle to understand the logic that follows this statement. Surely removal of the source of the problem is the solution, despite assurances that not doing anything is the best way forward, it is known that the wreck moves each time there is a major weather event, such movement is well documented. Each time the wreck moves the hull is abraded against the seabed which inevitably will release more paint into the environment by smearing than ever could be imagined through cutting.

3.6.25 We are also advised at paragraph 5.10.6 that the location of the one container holding 21 tonnes of copper clove within hold 6 is not known. However, some small pockets of this cargo have been seen within Hold 6, therefore it is reasonably safe to assume that the rest of this cargo remains within the hold.

3.6.26 The report also advises that further wreck removal will inevitably damage the reef further, this a moot argument. The documented evidence shows that the wreck is continuously moving with each weather event, therefore each movement is likely to cause irreparable damage to the reef structure. I do not deny that removal will cause some further reef damage but I am unable to state that this is worse than what will occur if the wreck is allowed to remain in situ. The report advises that any moored craft will inevitably damage the reef. However no thought seems to have been given to DP craft or utilising "suspended" moorings which would ensure any anchor chains are kept free of the reef surface.

3.6.27 Finally at paragraph 5.10.10 TMC advise as follows:

"***Complete removal will not (and does not according to international experience) result in the return of the site to a pristine state. The damage caused by the grounding where the reef has already been damaged cannot be returned to a pre-collision condition. Nor will it remove the existing contaminants that have already discharged and are present in the environment as a result of the grounding and subsequent break-up of the ship. Full wreck removal may cause the release of additional contaminants to the environment.***"

The logic seems to be that removal may cause some additional contamination so the solution is to leave it. By leaving it you are ensuring that, in time, the self-same additional contaminants will inevitably leach into the environment.

3.7 Aft Section Removal

3.7.1 Two methods are considered for the removal of the aft sections. Both involve piecemeal removal. The first option considers chain cutting the wreck into 29 separate sections and utilising a 1500 tonnes SWL sheerleg (moored craft). This method is scheduled to take 513 days, allowing for weather downtime (estimated at 45%-60%) the total exposure time is increased to between 933 and 1283 days. The cost estimate provided for this methodology is between US$314 million and US$432 million and does not include mobilisation and demobilisation of assets estimated at an additional US$6million to US$8million.

3.7.2 The second methodology considered is a smaller scale piecemeal removal lifting around 50 tonnes per lift, which equates to some 200 lifts. The work platform is envisioned as a jack-up rig and the cutting will be undertaken by divers. TMC have estimated a timescale using this method of around 1035 days, allowing for weather downtime this is increased to between 1882 and 2588 days (up to 7.1 years). Costs are estimated at between US$552 million and US$759 million, this price does not allow for mobilisation.

3.8 Forward Section Removal

3.8.1 Chapter 9 of the report considers removal of the forward section. The report advises that parts of the forward section are surrounded by shallow water and that it is likely that the water is too shallow to allow access by the sheerleg. Therefore it is proposed that a pull barge would be used to first drag the sections into deeper water. Once in deeper water they would be rigged by divers and prepared for lifting. The sections would then be lifted onto a transportation barge for onward disposal.

The timescale provided for this work is estimated at 176 days, however allowing for weather downtime (on the basis of 57% downtime) the total exposure time is increased to 410 days. The cost estimate for this operation is given as approximately US$79 million on the basis of a day rate of US$193k/day.

3.8.2 It is speculated that it may be possible to mobilise a larger sheerleg with a greater outreach which may be able to reach the double bottoms without necessitating first dragging them to deeper. I notice no consideration has been given to utilising one of the numerous offshore DP heave-compensated cranes.

3.9 Debris Field Removal

3.9.1 RSF who have been engaged by owners to undertake the bow reduction and accommodation removal are presently modifying their existing spread to be utilised for removing the debris field. The sheerleg RMG500 is being demobilised from site.

The removal method utilises a large 8-point spread-moored cargo barge. The barge is to be fitted with two crawler cranes, a dive spread and a bunded area to receive the debris.

The drawing at ***Figure 6*** below shows the planned mooring spread. The barge will use soft lines which will be connected to the anchor/chains. This will allow the spread to be moved around the debris field using the mooring winches fitted to the barge. Despite TMC's concerns at damaging the reef using anchors, this is the method being utilised.

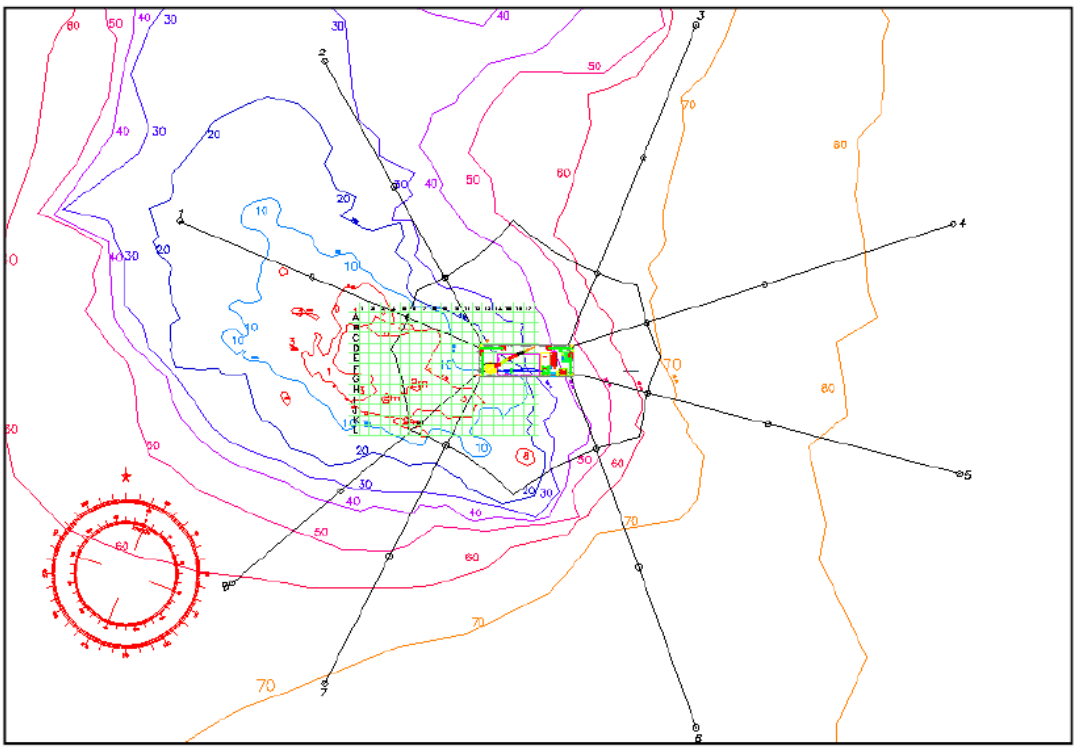

Figure 6: Debris Removal Barge Mooring Arrangement.

The removal operation will be undertaken systematically. The debris field has been sub-divided into a datum grid. The grid system is used in conjunction with a Hypack (navigation) software package already installed on the barge. Each of the grids forms a 10m x 10m box. The navigation software will be used to position the LARS (Diver launch and recovery system) exactly within the grid reference.

Owners are also preparing a before and after photo mosaic which will show the debris field before and after removal, see paragraph 3.5.11 above.

3.9.2 The barge will also be fitted with an orange peel grab and an electromagnetic grab. It is estimated that the largest sectional weights to be lifted during this phase will be around the 25-30 tonnes mark with heaviest being no more than 40 tonnes. Anything larger would have to be cut by the divers. The report advises that as an alternative the sheerleg could be used to lift larger wreck sections, however as the sheerleg is in the process of being demobilised this alternative no longer exists. The orange peel grab will be fitted with lights and camera which should improve visibility whilst grabbing.

Upon completion of the removal operations using the orange peel grab, the electro-magnetic grab will be used to sweep over the area to remove any smaller pieces of ferrous material, the electro-magnetic will also be fitted with lights and a camera to improve efficiency.

3.9.3 It is anticipated that the debris removal operation will take approximately 110 days, on the basis of 40% weather downtime it is expected that this will be increased to around 184 days on site. The cost of the operation is estimated at around US$29.5 million on the basis of spread costs of approximately US$160k/day.

3.10 Debris Field Removal

An additional section in the report compares the RENA with other well-known wreck removal operations and considers whether similar methodology used on those wrecks could be considered for the RENA removal. The report is the concluded as follows;

- No wreck removal operation, however thorough, can return the Astrolabe Reef to its pre-RENA condition. The damage that occurred to the reef might be mitigated but it cannot be undone.

- The wave height is generally the governing factor for undertaking operations at the Astrolabe Reef. Wave statistics predict that under the existing operational limits work cannot be undertaken for 52% of the time.

- Full wreck removal would be a very long operation, it is certain that the reef would remain a restricted area for several years if full wreck removal were undertaken.

- Working at the reef area is potentially hazardous. Working at depth increases those hazards and diving operations become increasingly more risky. Two diving incidents have occurred during the wreck reduction programme to date. Full wreck removal would expose the divers to even greater risks.

- The wreck removal is technically difficult because of the shallow reef area, the offshore location, the deep water (where part of the wreck lays), the sloping wreck site, the condition of the wreck and the prevailing open ocean weather conditions. The RENA is not directly comparable to other large wreck removals undertaken in recent years.

- The total cost for full wreck removal is estimated to be between US$425million and US$546 million, however due to the uncertainties with the condition of the wreck, the weather and rates for contractor’s work these figures should be regarded with a degree of caution. The estimated cost is in addition to approximately US$300 million already spent to date on the salvage, SCOPIC costs and the wreck and debris removal. It is for others to decide if this represents a reasonable expenditure for the return however the can be judged against international norms.

- The total cost of salvage, SCOPIC and wreck removal for the eighteen most expensive wrecks dealt with by the International Group of P&I Clubs (excluding the COSTA CONCORDIA at the most expensive and the RENA as the second most expensive) in the period 20112 to 2012 is US$1,297, 956,250. These eighteen wrecks occurred in locations that were less technically challenging than those at the Astrolabe Reef. The costs already expended on the RENA exceed the mean salvage and wreck removal costs of US$72.1 million for these eighteen cases by about US$228 million. The third most expensive case (i.e. after the RENA and COSTA CONCORDIA) is reported to have cost just US$177.4 million.

4. COMMENTS

4.1 General

I have been asked to comment on a number of specific issues relating to the TMC report, as follows:

1) *A general assessment of the proposed removal techniques:*

a. Are these techniques within the range of techniques that would usually be used, or are appropriate for use, in the present circumstances?

b. Will sonar need to be used as part of a removal process and if so, what type and how extensively?

c. Comment on the stated environmental consequences or likely environmental effects of the use of the proposed techniques (for example, likely effects on the physical damage to the reef, to the sea floor, on sediment, and/or on remaining cargo). Please include the effects of additional moorings that might be required on the reef and the likelihood of other parts of the sea floor being used to set down parts of the wreck (as was recently required with the accommodation block, during the removal process) and the effects that these matters have (if any).

d. Comment on the owners’ assessment of the operational environment, including the assumed operational delays, and how long the proposed techniques would likely take.

e. Assessment of the safety issues that are likely to arise by the use of the proposed techniques, including how dangerous these techniques are.

f. Is the present exclusion zone sufficient for proposed removal techniques? Do they consider it would need to be bigger or could it be smaller?

g. If possible, please comment on likely costs.

2) *Are there other techniques, or other types of techniques, that could alternatively be used? If so, please comment on the above matters in a similar way.*

In response to the questions asked of me I would comments as follows.

4.2 A General Assessment of the Proposed Removal Techniques

4.2.1 *Are these techniques within the range of techniques that would usually be used, or are appropriate for use, in the present circumstances?*

TMC have placed a large amount of emphasis on the downtime that has been experienced at site. A statistical analysis of the Metocean data shows that the experienced downtime closely matches that as predicted. However, I would advise that this is only relevant to the craft being utilised at site. The moored barges and small sheerlegs are very susceptible to sea conditions of more than 1 metre, the 57% weather downtime is rapidly improved if the spread is capable of working in 2 metre, 2.5 metres or even 3 metres (exceedence 11.66%, 5.39% and 2.44%) accordingly. Clearly the selection of the correct spread is essential to maximise the available time on site. The selection of craft that are specifically vulnerable to conditions above 1 metre was a mistake.

Despite that fact that the exceedence figures have been known from the beginning the owners and TMC have continued operations using craft that are vulnerable and not suited to work at the Astrolabe Reef.

It would appear that craft more suited to the conditions at site have been expressly dismissed as it not normal for such craft to be used in salvage operations.

However, TMC have provided a good report that does consider a number of other options and they have also provided an in-depth analysis of remaining weights etc on site.

4.2.2 *Will sonar need to be used as part of a removal process and if so, what type and how extensively?*

Owners have already contracted ADUS to undertake a detailed survey of the wreck and surrounding area. The equipment used, namely Multi-Beam Echo-Sounders and Side-Scan SONAR are industry standard equipment and have been proven to safe to use within the marine environment. It is unlikely that the equipment will be used again unless it is a requirement of the RMA consent application to prove certain things have been accomplished.

4.2.3 *Comment on the stated environmental consequences or likely environmental effects of the use of the proposed techniques (for example, likely effects on the physical damage to the reef, to the sea floor, on sediment, and/or on remaining cargo). Please include the effects of additional moorings that might be required on the reef and the likelihood of other parts of the sea floor being used to set down parts of the wreck (as was recently required with the accommodation block, during the removal process) and the effects that these matters have (if any).*

It is proposed in the TMC report that apart from removal of the debris field the remains of the wreck sections (both bow and stern) will be left in their present condition. The selected methodology for the debris field removal relies on an eight-point moored barge. It is therefore likely that the reef area will be subject to some additional damage caused by the mooring system utilised. The additional damage will be limited to the eight anchor positions and the area covered by the contact points made by the anchor chain. It is unlikely that any other damage will occur from the nominated spread.

4.2.4 *Comment on the owners’ assessment of the operational environment, including the assumed operational delays, and how long the proposed techniques would likely take.*

I think that estimates provided by the owner are relevant to the spread being nominated. I think that the estimate is on the high side (not unrealistic in salvage and wreck removal operations. However, I believe that the lack of consideration of utilising an offshore DP heave compensated crane vessel paints a false impression. I believe that IF such a craft were available that the work could be undertaken in a much shorter time frame. A fuller analysis would have to be undertaken and this may best be done by testing the market. Experience has shown that these craft can be used ion salvage and

wreck removal work and that they are capable of working safely in conditions far exceeding the 1 metre sea state being quoted as the limiting factor at Astrolabe Reef.

4.2.5 *Assessment of the safety issues that are likely to arise by the use of the proposed techniques, including how dangerous these techniques are.*

Owners have only considered diving operations at site. There does not appear to be any consideration of undertaking a diverless operation. Whilst it is accepted that ROV operations may result in added engineering costs it is surprising that this option has not been considered.

It is agreed that dive work is not without its risks. The three incidents at site to date prove that even with strict safety regimes in place, diving at depth is not without risk.

4.2.6 *Is the present exclusion zone sufficient for proposed removal techniques? Do they consider it would need to be bigger or could it be smaller?*

The existing exclusion zone is more than sufficient for the proposed debris removal work. It may be that it could even be reduced to one mile.

4.2.7 *If possible, please comment on likely costs.*

The costs quoted in the report seem to be incredibly high. The day rates for quite simple barge based spreads seem to be extremely high. The total costs quoted are excessive as they are influenced by the 57% weather downtime. I believe that the work could be achieved using a high tech advanced spread for substantially less than the figures being quoted.

However, considering the nominated spread, the weather downtime and Metocean data the figures quoted are relevant to the work scope.

4.3 <u>Are There Other Techniques, Or Other Types of Techniques, That Could Be Used?</u>

4.3.1 As previously advised I believe that the work could be achieved using a high end spread. LOC are aware that JASCON 25 is capable of undertaking substantial lifts in sea states of H_s 3 metres. This would result in only 2.44%

downtime. As such despite the high day rate for such a craft, the outreach, lifting capacity and the workability would almost certainly result in a nominal period on site and as a consequence a reduced total cost.

5. CONCLUSIONS

5.1 The TMC report is an extensive and substantive report that goes into great details on the analysis of the remaining wreck sections.

5.2 Despite the report considering other options, I do not believe it considers all options. The dismissal of utilising a high-end offshore crane is unreasonable. We are aware that such vessels are available and are definitely are capable of achieving the correct result in this type of work.

5.3 The TMC report focusses on the risks of employing divers throughout the work scope. No effort has been given to engineering out this problem and utilising ROVs (as an example).

5.4 I believe that time scales and the prices being quoted for the work are both on the absolute upper limit. I am convinced that if owners were to go the market for this work that offers would be received way below those being quoted.

5.5 That said, it is still worth considering the reasonableness of any demand to remove the wreck. As its stands it is unlikely that the wreck sections pose any risk to the environment, such risks, namely from the TBT, are manageable through monitoring. The nominal risk to navigation posed by the bow section is manageable through suitable issuing notices to mariners. With the debris field removed I believe that the wreck poses no real risk to users of the reef.

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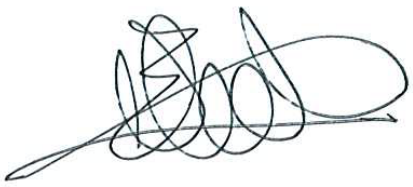

Nick Haslam
Group Director Shipping services

LOC Group Ltd

Appendix A

TMC Report “RENA – Full Wreck removal Feasibility Appraisal”