Shire Of Esperance

Esperance Tanker Jetty Remediation Options Review

Independent Peer Review

November 2016

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Appendices

1. Introduction

The Tanker Jetty, located at the western end of the Esperance foreshore, is an important part of the Esperance Community. The jetty was opened in 1935 and has well exceeded its design life.

The existing jetty is recognised as a Heritage structure and is valued by the community. Previous assessments have been undertaken by BG&E and BMT JFA to review the current condition and propose remediation options with the latest option provided by Bonacci in October 2016.

The Shire of Esperance (the Shire) has engaged GHD to undertake an independent review of the remediation options for the existing Tanker Jetty proposed by BMT JFA and Bonacci. The specific reports for review were:

- BMT JFA (2015) Esperance Jetties Condition Assessments: Condition Assessment and Maintenance Strategy Report, prepared for Shire of Esperance, reference R-J15028-1, Revision 1, dated 26/10/2016; and
- Bonacci Infrastructure, Tanker Jetty Esperance Remediation Report, prepared for the Jetty Group Incorporated, reference B4222, Revision B, dated 11/10/2016.

GHD were requested by the Shire to undertake the following tasks:

- Review the feasibility of the Bonacci proposal from an engineering perspective only;
- Provide comment on the heritage value of the Bonacci proposal;
- Undertake detailed costings of the Bonacci proposal;
- Undertake detailed costings of the BMT proposals;
- Comment on the life expectancy of the retained materials from the original jetty in the Bonacci proposal;
- Provide comparative whole of life cost estimates of GHD's concept designs; and
- Comment on the construction programs proposed by BMT JFA and Bonacci for the remediation works.

The findings of these reviews are outlined in this report.

It is noted that the Shire requested GHD to approach both BMT JFA and Bonacci independently to obtain copies of the above mentioned reports. This was undertaken and the BMT JFA report was provided directly to Heather O'Keeffe via email from Justin Fifield on 26/10/2016. Bonacci (Mr Terry Memory) was approached via telephone on 26/10/2016, however declined to provide the report directly without their client, the Jetty Group Incorporated, permission. Mr Memory did verbally confirm that Revision B, dated 11/10/2016 was the latest revision of the report provided to the Jetty Group Incorporated, which was in turn provided to the Shire of Esperance and passed on to GHD for the purposes of this review.

For the purposes of transparency, full copies of both reports reviewed are included in Appendix C for reference.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Shire Of Esperance and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD's subconsultant RBB has prepared the cost estimates set out in 5 of this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD and RBB*.*

The Cost Estimate has been prepared for the purpose of comparison of options and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

2. Overview of Proposals

Repair proposals for the existing Tanker Jetty have been proposed by BMT JFA (2015) at the request of the Shire of Esperance and Bonacci (2016) at the request of the Jetty Group Incorporated.

BMT JFA proposed a number of options in report reference R-J15028-1 Rev 1, dated 26/10/2016, including:

- Option 1 – Repair whole Tanker Jetty to a safe level of structural integrity
- Option 2 – Repair half of the Tanker Jetty (demolish from Pier 88 to 143)
- Option 3 – Replace pile frames (steel piles)
- Option 4 – Demolish whole Tanker Jetty
- Option 5 – Demolish whole Tanker Jetty and replace with a 250m long option

Bonacci have proposed two reconstruction options in report reference B4222 Rev B, dated 11/10/2016, namely:

- Baseline option

A solution to preserve the jetty in its current position and its current length by replacing the entire substructure with new material whilst retaining the original superstructure, deck curvature and physical location.

In order to achieve this, it is proposed to install steel piles in vertical pairs 1.2m offset from the existing timber piles, install a new steel headstock, retain the existing timber stringers and timber deck and replace the existing concrete deck. The original timber piles and remaining substructure would subsequently be removed.

- Baseline with improved aesthetic and heritage considerations

This option is similar to the baseline option, however will seek to retain the raker pile configuration as per the existing jetty, using either timber or steel piles.

Further details on all proposed options are available in the relative reports in Appendix C.

3. Engineering Assessment of Bonacci Proposal

GHD have undertaken a high level engineering review of the two proposals provided by Bonacci with a view to outlining potential risks or clarifications required if the option was to proceed. Independent calculations have not been undertaken unless explicitly noted below. Comments are specific to both options unless noted otherwise.

1. The return period and wave height (significant, max, etc.) have not been provided in Section 9.1 of the report. The wave condition is required to be justified as a 50-year design life for a marine structure requires a 1 in 500 year wave height to be considered for the load in accordance with AS4997 (Guideline for Design of Marine Structures), Table 5.4;
2. A live load assumption of 5kPA is consistent with pedestrian and occasional light maintenance vehicle use and is considered acceptable. This is in accordance with Table 5.1 of AS4997;
3. We note that a 1.2m offset from the existing headstocks/piles is proposed. There are two considerations here – geotechnical impact on piles and structural loading on the stringers, described further below:
   i) The potential geotechnical risk is dependent on whether the existing piles are being removed or cut off at seabed level or above, as per the current demolition proposal. If the piles are being removed, where a new pile is installed within 1.5m of an existing pile location, we generally request the void to be backfilled with a low strength cementious grout to 1m below seabed level to ensure no adverse geotechnical impacts on the installed pile. If the existing piles are being left in place, which is preferable from a heritage archaeology perspective, there is a risk that if they deteriorate in the future, this will leave a subsurface cavity which may impact on the installed piles from a stability perspective and would need to be monitored and managed; and
   ii) From a structural perspective, the load on the stringers has now been transferred from the previous joint location above the headstocks to a point approx. 1/3 of the stringer span length. The proposed stringer splice connection therefore needs to be a moment transfer connection, not just a shear restraint. This should be confirmed and detailed calculations provided as it is a high risk to the viability of the restoration. Moving the new headstocks/piles to 1.5m away from existing location may be preferable from a geotechnical perspective; but will need to be managed structurally.
4. In addition to the structural comments outlined in item 3.ii), the splice detail for the stringers is noted as a 6mm aluminium plate with M20 stainless steel bolts. From a durability perspective, aluminium plate may not be ideal for a marine environment and the plate itself is quite thin – confirmation should be provided that all steelwork (including aluminium) will comply with corrosion protection requirements for a 50-year service life. For example, in this case, with 3mm corrosion, there would be no plate section remaining. In addition, the dissimilar metals of the plate and bolts will need to be managed;
5. The nominated corrosion loss of 3mm is considered acceptable and conservative – 2mm would also be acceptable for the marine environment in Esperance;
6. The pile installation for both vertical and raked piled will need to be via a barge or water based plant as the existing deck is unlikely to support the construction loads;
7. The sleeved pile/headstock connection is acceptable as it is assumed that the structural load will be transferred from the sleeve through the grout to the pile;

8. It is noted that the intention is to undertake the headstock installation in advance of the pile installation with the headstock secured to the underside of the jetty deck via clamps. Given that the deck and substructure will have less strength away from the existing pile bents, with the minimum strength experienced at midspan, confirmation is required that the existing deck structure has been checked to ensure that it can manage the increased weight of the headstocks prior to load being taken up by the piles, as well as absorb the construction load experienced during piling;

9. It is proposed that the existing deck be jacked to level where required once the new piles are driven. There are some locations where the deck is sloping up to 320mm across the width and it is not clear how well the jacking methodology will work in these instances. Further information is required to understand this proposal, using the case above as an example;

10. It is not clear how the timber stringers will connect to the steel headstocks, which is considered high risk as this connection will provide the lateral restraint to the headstock system. Currently the timber stringer appears to sit directly on the capping plate which is then welded to the steel crosshead. This detail needs to be confirmed and explained to ensure load restraint and transfer is achieved. Similarly, the stringer to timber decking and timber decking to concrete decking connections are not clear and need to be confirmed;

11. The existing design has corbels at the headstock locations to spread the load being applied to the stringers at this point. The reconstruction design has the stringers rested on or connected to the new steel headstocks, without any consideration of strengthening at these locations. This leads to the risk of the timber stringers crushing, particularly as they reach the end of design life, which may be in advance of the overall structure. Calculations are required to be provided, as per the requirements of Clause 3.2.6 of AS1720.1, to confirm that there is sufficient strength to manage the anticipated bearing loads without crushing;

12. The condition of the original deck timbers is questionable as it is likely that deterioration of the timbers has occurred due to the concrete deck trapping water and accelerating the process. While section 9.3.4 of the report notes that the deck timbers are not required from a strength perspective as the concrete deck will take the live load, the concern is that, based on the details provided, it would appear that the timber deck will play a role in load transfer from the concrete deck to the timber stringers and substructure, therefore the condition of the timbers is important to ensure ongoing structural viability. This is also a risk from a maintenance perspective if the timbers deteriorate further in the future, which will impact on the concrete deck;

13. The new concrete deck is proposed as 130mm (120mm on drawings), with the existing deck only being 80mm (noted as 100mm on drawings). This increase in deck thickness is considered manageable, provided that it has been considered in determination of the dead load of the structure and subsequent structural connections;

14. It is not specified whether the new concrete deck will be precast or cast insitu. If cast insitu, the risk of marine contamination during the pour will need to be carefully managed. Precast panels provide for faster on site construction, though may not be possible in this instance if the panel widths are not uniform in size, due to deck curvature;

15. The pile size for the baseline option (vertical piles) is provided as 323mm dia steel piles, with 9mm wall thickness. We have undertaken a preliminary check and this shows that this size pile is close to capacity. It is recommended that a larger pile size be considered (previous concepts for redesigned have proposed 508mm dia.) and the wall thickness of any steel pile is 12.7mm as a minimum, which is typical for marine design;

16. For the raked pile option, it is noted that either steel or timber could be used. The timber pile is nominated as 280mm diameter in F27 treated hardwood from Koppers, which is considered reasonable. Note that a design life of only 30 years is achieved unless the pile is wrapped – further comments on this below;
17. A Seashield Services 60 wrap system is proposed to cover the timber piles. The issue with using a wrap tape system is that it is easily damaged and often require a high level of maintenance to ensure ongoing integrity. A jacket or sleeve system is recommended to provide a higher level of protection with reduced maintenance, noting that a sleeve is probably not possible with the proposed headstock and construction sequence, however a jacket is still potentially feasible;
18. Environmental risk of CCA treated piles should be considered;
19. The driveability of the timber piles will require steel shoes, which are not indicated on the drawings (noting concept level);
20. Section 9.3.5 notes a design life of 30-50 years depending on the degree of maintenance provided. Design life should be set as a defined value, the range provided in section 9.3.5 is the expected service life based on the proposed elements. The actual design life considered in the structural assessment and determination of loads should be provided; and
21. An option of replacing the existing gangway has been proposed by Bonacci. This is supported to enable maintenance vehicle access in the future.

Overall, there are a lot of queries which would need to be answered prior to confirming whether the proposed reconstruction works are feasible or not. Note that of the original materials, only the timber stringers and timber decking are proposed for reuse, with a question mark around the feasibility of this.

3.1 Risk Assessment

In addition to and as a summary of the issues raised above in the engineering assessment, specific risks to be considered if proceeding with the Bonacci proposal are as follows:

- Existing deck planks found to be too rotten upon removing concrete slab to act as permanent formwork for new slab;
- Existing deck Cannot get certified by Engineer/designer, leading to need to remove/replace;
- Structure partially collapses during reconstruction;
- Stringers too rotten to take new deck plank fixings or have insufficient strength without the corbels at headstock connections or are too rotten to take fixings for proposed splice plates;
- Environmental impact of concrete saw slurry when cutting up old slab or placing new insitu slab (if proposed);
- Ability of new structure to take lateral loads given no obvious connection between stringers and headstocks;
- Pile sizes proposed are possibly under sized – preliminary capacity check on the 323mm diameter pile with 9mm wall thickness, shows the loads on the pile are close to capacity;
- Wave loads are possibly calculated too low, leading to under designed member sizing; and
- The Bonacci basis of cost estimate has not clarified whether over-the-top or marine-based construction has been considered. This may lead to significant cost implications.

4. Heritage Considerations of Bonacci Proposal

GHD requested Hocking Heritage Studio to provide commentary on the Heritage component of Bonacci's infrastructure proposal. Their full commentary is included in Appendix B, with the findings summarised here.

The significance of the Tanker Jetty, Esperance is set out in the Statement of Significance in the Register Documentation for entry of the place into the State Register of Heritage Places. The two options presented by Bonacci for the remediation of the existing jetty have been assessed against the adopted Statement of Significance to determine the Heritage outcome and implications of each option, with the outcomes summarised in Table 1.

It is important to understand the difference between the *restoration* and *reconstruction*, as defined by the Burra Charter:

- Restoration: returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material; and
- Reconstruction: means returning a place to a known earlier state and is distinguished from restoration by the introduction of new fabric.

Therefore, the two options presented by Bonacci are considered *reconstruction* options rather than *restoration*, in accordance with the definitions above.

Table 1 Heritage Assessment- Bonacci Proposal

Statement of Significance	Heritage Outcome – Option 1	Heritage Outcome – Option 2
The place is a rare and good representative example of a substantially intact timber jetty on the coast of Western Australia; as one of the four (now three) computable structures remaining in Western Australia	The structure would be retained in its existing location but would no longer be regarded as a substantially intact timber jetty due to the introduction of the steel substructure. Its physical comparison to Busselton Jetty and One Mile Jetty, Carnarvon would become tenuous, though historically would still form part of the timber jetty construction in Western Australia between 1832 and 1942.	The structure would be retained in its existing location. The use of timber in the works would enable it to remain as a timber jetty, however, due to the alterations in construction method, it would not be regarded as a substantially intact jetty as its proportions, placements of piles and steel structure would result in an altered appearance and construction form.
It has aesthetic significance due to its considerable size, scale and construction. Its visibility from the town of Esperance and its strong presence in the seascape ensures its landmark	Option 1 would retain the structure in its current location, scale and size and therefore maintain its strong presence in the seascape and remain a local landmark. The change of fabric from timber to steel and the change	Option 2 would retain the structure in its current location, scale and size and therefore maintain its strong presence in the seascape and remain a local landmark. The new piles will be timber with a steel sleeve over the top

status and contributes to the Esperance community's sense of place.	of construction method from raked piles to vertical piles would be greatly detrimental to the aesthetic value of the Jetty and also remove or obscure its original construction methods, for which it is valued. Changes in fabric are often acceptable in instances where a place of cultural heritage significance is being conserved but the introduction of such should not be to the detriment of the significance of the structure. The Tanker Jetty, Esperance was constructed as a timber jetty and should remain as such. Introduction of alternative materials should be limited and should contribute to the strengthening of the timber structure rather than replacement of the timber structure. Retention of the existing timber piles in addition to the new steel piles would confuse the legibility of the structure and clutter the space to the underside of the Jetty. This proposal would erode much of the heritage significance attributed to the Tanker Jetty Esperance.	section of the piles and a new steel headstock being installed. The piles will be installed at the traditional 1:8 rake. Although there will be an impact on the aesthetic appearance due to the introduction of the steel components and the construction method will have been altered, the aesthetic outcome is closer to the original and therefore has a better heritage outcome. No mention was made in this option as to whether the existing timber piles would be retained or removed.
The place is valued by the community as it has been the site of commercial, social and recreational pursuits since its construction and for its association with the period of economic growth in the region in the 1930s and the development of local industries at that time.	The works would not impact on this value.	The works would not impact on this value.
The place is significant for bringing employment to	The works would not impact on this value.	The works would not impact on this value.

many workers in the vicinity during the period of economic depression in the 1930s and is associated with the government's efforts to employ destitute men in the variety of jobs during this time.		

Positive heritage outcomes are summarised below:

- Retention of the Tanker Jetty, Esperance in its original location and its current scale and length;
- Continuation of Tanker Jetty, Esperance to be used in a recreational manner by the community and visitors; and
- Retention of a local landmark.

Negative heritage outcome are listed below:

- Substantial loss of existing fabric;
- Altered aesthetic;
- Altered construction methodology;
- Loss of authenticity; and
- Disturbance of potential archaeology.

As a summary, the proposals submitted by Bonacci have a low to moderate heritage outcome.

5. Cost Estimate Comparisons

GHD have engaged quantity surveyors Ralph Beattie Bosworth (RBB) to undertake an independent cost review of the proposed options by BMT JFA and Bonacci. RBB's full report is provided in Appendix A, with a summary provided here.

In order to compare the options, RBB have prepared independent estimates for four different options relating to the proposed remediation of the Tanker Jetty:

- Repair whole Tanker Jetty (BMT JFA and Bonacci);
- Repair Shoreward Half of Tanker Jetty (demolish outer half) (BMT JFA);
- Re-pile whole structure (retain half caps and deck superstructure) (BMT JFA); and
- Demolition of the existing structure (BMT JFA).

The relative cost estimates (net construction cost only) are provided in Table 2 and Table 3.

Table 2 RBB/Bonacci Cost Comparison

Ref	Scope	RBB	Bonacci
3	Full jetty repair, new vertical piles	$11,230,000	$7,111,756

Table 3 RBB/BMT JFA Cost Comparison

Ref	Scope	RBB	RBB (with escalation)*	BMT JFA
1	Repair whole jetty	$10,930,000	$13,230,000	$12,816,600
2	Repair half jetty/demo half	$7,360,000	$9,060,000	$10,212,621
3	Full jetty repair, new vertical piles	$11,230,000	$13,430,000	$14,571,877
4	Demo entire jetty	$2,950,000	N/A	$4,471,976
5	New half jetty, demo outer half	$9,480,000	N/A	$11,199,000

Note that when costing the BMT JFA estimates independently, where details were not known, for example proposed pile size or deck remediation options, the proposed sizes from the Bonacci report were adopted for ease of comparison.

*With respect to the BMT JFA costs, these were costed over a 10 year time period. In order to be able to compare with Bonacci options, the RBB costs considered remediation works being undertaken as a capital, one off exercise, rather than spread over a period. Values for escalation if the BMT JFA options were still to be undertaken over the 10 year period are provided in Appendix 1 and have been added to the RBB estimate for the relative options.

5.1 Whole of Life Cost Considerations

Section 4 of RBB's report discusses the whole of life cost proposed by Bonacci, which is considered to be flawed and does not provide a likely whole of life cost assumption. RBB propose instead that a long term average consideration of 2% per annum of the replacement capital cost of the jetty needs to be added for every year of effective life, following completion of

the defects liability period. This is a general guide and the reality is likely to be lower than this, dependant on the level of maintenance assumed in the original design, quality of construction, etc.

Based on this assessment, if you have a capital cost of a structure of $5,000,000, then this equates to $100,000/year for every year following the defects liability period (typically one year), so over a 50 year design life, a whole of life maintenance cost consideration is $4,900,000. Key items and proposed timeframes for maintenance activities are indicated below:

- Cathodic protection systems – allow for full replacement at 25 years;
- Inspection of marine structures – every 5 years;
- Inspection of marine furniture – every 3 years;
- Painting of above water water zones – at 20-25 years, then every 10-15 years thereafter;
- Protective coating systems – repair every 5-10 years; replacement of tape systems after every 15-20 years;
- Repair and maintenance of timber elements – every 5 years, with full replacement after years (note that this is for exposed timber such as decks, wrapped piles are likely to require less maintenance; and
- Replacement of FRP – every 20 years.

For the GHD concept options proposed in report reference 61/35002/158889 Rev 0, dated 3/10/2016, if considering a 100m long jetty, then based on the 2% rule, the anticipated maintenance cost over 50 years could be considered as per Table 4.

Table 4 GHD Concept Options Whole of Life Cost

Option	CAPEX	Maintenance/year	Whole of Life Cost
Traditional (Option 1)	$3,000,000	$60,000	$5,940,000
Contemporary/Iconic (Option 3)	$4,500,000	$90,000	$8,910,000

Using this same theory, the estimated whole of life costs for the Bonacci and BMT JFA full repair options are considered below in Table 5, as well as RBB's estimate of the same, for an assumed 50 year design life.

Table 5 Full Repair Whole of Life Cost

Option	CAPEX (Net Construction Cost Only)	Maintenance/year	Whole of Life Cost
RBB	$11,230,000	$224,600	$22,235,400
BMT JFA	$14,571,877	$291,437	$28,852,290
Bonacci	$7,111,756	$142,235	$14,091,277

6. Construction Program Review

6.1 Bonacci

In their proposal, Bonacci have proposed the following indicative program, based on funding being secured in advance:

- 1 month for Design and Consultation;
- 1 month for approvals and Shire Council ratification;
- 1 month for tender period;
- 1 month for tender review, negotiations and contract award;
- 1 month post award before the Contractor is mobilised to site, plus commencement of early procurement activities;
- 9 months construction, but open a 170m long section every 3 months.

They have allowed for 6 weeks of inclement weather within the construction timeframe.

The viability of the program is somewhat contingent on how the Shire intends to undertake the works – traditional design consultancy and call tenders for construction or award as a design and construction tender. Either way, 1 month for design and consultation seems insufficient to allow for development of tender design from the design as it currently stands, as well as the appropriate reviews and community consultation – it is recommended that this is likely to take closer to 2-3 months, depending the consultation and review requirements and whether it is a D&C contract or design only. Given the sensitivity of this site to the community, extensive consultation is likely to be required. The design period would be pushed out further if geotechnical investigations are required prior to undertaking the piling works (allow at least 1 month pre-design).

Experience with government tender processes leans more towards a 3 month period for tender period, review submissions, negotiate and award, then the 2 month period indicated by Bonacci.

The mobilisation period appears reasonable, if considered in isolation to procurement of materials. The lead time for procurement of steel piles is typically 12 weeks to site for standard sizes, longer if non-standard. The headstocks will all need to be fabricated for the works, which is likely to require a minimum of 12 weeks before they are available on site for installation. Any precast elements will typically require 12-20 weeks and will require accurate survey prior to provision of shop drawings for review and approval due to the potentially uneven nature of the jetty alignment and the need to account for the curvature.

The overall assessment of 9 months for on site construction is considered achievable. Public safety will need to be considered if allowing for the jetty to be reopened progressively.

6.2 BMT JFA

It is difficult to provide a comparison to Bonacci's program as BMT JFA have staged effectively maintenance and upgrade activities over a 10 year period. Indicative timeframes for each option proposed have been summarised in Table 6.

Table 6 BMT JFA Construction Timeframes

Option	Indicative Timeframe	Comments
Option 1 – Repair whole Tanker Jetty to a safe level of structural integrity	Initial works within a 12 month period, with subsequent ongoing maintenance and demolition at the end of 10 years (2025)	12 months to do the proposed repairs appears to be a reasonable estimate. Demolition at year 10 is assumed to be based on proposed extension of lifetime from repairs.
Option 2 – Repair half of the Tanker Jetty (demolish from Pier 88 to 143)	Initial works within a 12 month period, with subsequent ongoing maintenance and demolition of half the jetty in initial period and the remaining half at the end of 10 years (2025)	12 months to do the proposed repairs and demolish half of the jetty appears to be a reasonable estimate. Demolition at year 10 is assumed to be based on proposed extension of lifetime from repairs.
Option 3 – Replace pile frames (steel piles)	Repiling works to occur in 3 month period with demolition of jetty at the end of 10 years (2025)	Repiling of the whole jetty over a 3 month period is considered optimistic as the option will require geotechnical investigation upfront (minimum 1 month), procurement and installation and remediation works post piling. A 9-12 month period is considered more reasonable.
Option 4 – Demolish whole Tanker Jetty	A 3 month period is indicated	3 months is considered reasonable to demolish the existing jetty provided no significant weather delays are incurred.
Option 5 – Demolish whole Tanker Jetty and replace with a 250m long option	The demolition of existing and design and tendering of the new option are proposed in the same 3 month period. Construction of the new jetty (250m only) is proposed to occur over the subsequent 3 month period.	The timeframes appear quite tight for the same reasons as outlined in review of the Bonacci program. An overall period of 12 months for the demolition, design and reconstruction is considered more reasonable, noting requirements for community consultation, tendering, reviews, procurement and weather delays. There are opportunities for the demolition and design to run concurrently, which may assist in condensing the program.

Appendices

Appendix A – RBB Cost Estimates

ESPERANCE JETTY REMEDIATION

PROPOSED COST REVIEW REPORT

REV 0

FOR

4TH NOVEMBER 2016

Ralph Beattie Bosworth
Construction Cost Consultants

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QUALITY MANAGEMENT

Revision	Prepared By	Checked By	Issue Date
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CONTENTS

1. EXECUTIVE SUMMARY

RBB has been engaged by GHD to review 'Esperance Jetties Condition Assessments – Condition Inspection and Maintenance Strategy Reports' by BMT JFA Consultants and 'Tanker Jetty, Esperance Remediation Report' by Bonacci Infrastructure report.

In order to undertake the review RBB has prepared estimates for different options relating to remediation of Esperance Tanker Jetty:

- Repair whole Tanker Jetty
- Repair Shoreward Half of Tanker Jetty (demolish the outer half)
- Re-pile whole structure (retain half caps & deck superstructure)
- Demolition of existing structure

RBB has also commented on the Whole of Life estimate provided by Bonacci Infrastructure.

The below table outlines the overall comparison between RBB estimates, BMT JFA and Bonacci estimates. Please refer to comments in Appendix 1 relating to BMT JFA totals reflected below.

Table 1.

REF	SCOPE	RBB $	BMT JFA $	BONACCI $
1	Repair whole jetty	$10,930,000	$12,816,600	N/A
2	Repair half jetty/demo half	$7,360,000	$10,212,621	N/A
3	Fully jetty repair, new vertical piles	$11,230,000	$14,571,877	$7,111,756
4	Demo entire jetty	$2,950,000	$4,471,976	N/A
5	New half jetty, demo outer half	$9,480,000	$11,199,000	N/A

Note: The above figures are Net Construction Costs only.

The intention of this report and associated estimates is to provide an estimated total project cost (including Contingencies, Professional Fees and Escalation) which subsequently will be used to compare the Order of Cost Estimates provided by BMT JFA Consultants and Bonacci Infrastructure

Within this report, RBB provide the following:

- Cost Report
- Basis of Estimating
- Elemental Preliminary Estimate – Appendix 1

Refer to Section 6 for the estimate inclusion and exclusions.

RBB's report does not comment on the buildability and the engineering solutions for the Tanker Jetty remediation options and the practicality of each option. RBB report solely focuses on the cost aspect of the remediation and/or replacement Jetty options.

2. REVIEW OF BMT JFA CONSULTANT REPORT

The BMT JFA report outlines the assessment outcomes as well as the remediation / maintenance strategy for the jetty. In addition to the assessment and the remediation strategy BMT JFA also provide maintenance or remediation costing for the tanker jetty. BMT JFA estimate is based on the rectifying the following defects that they've identified with the tanker jetty:

- Cracking and deterioration of deck planks;
- Rot and deterioration of deck planks;
- Rot and deterioration of stringers;
- Rot and crushing of corbels;
- Rot and crushing of end distance on half caps;
- Splitting of pile tops;
- Surface and underwater teredo worm and rot damage to piles;
- Corrosion and section loss of bolts and other steelwork;

BMT JFA report has identified the overall condition of jetty elements in the 'Critical Element (Pile and Half Cap) Condition Rating WSCAM Heat Map' schedule. Within the schedule each element is given an appropriate risk rating that in turn results in a rectification / remediation strategy.

BMT JFA Consultants have outlined the following potential 'Jetty Maintenance Strategies' and associated estimated costs, outlined in their report under their 'Appendix D':

Table 2.

REF	REMEDIATION STRATEGY / SCOPE	BMT JFA ESTIMATE $	REVISED TOTAL $	RBB ESTIMATE $	DIFFERENCE $
1	Repair whole tanker jetty	$17,288,576	$12,816,600	$10,930,000	($1,886,600)
2	Repair shoreward half of tanker jetty	$13,178,842	$10,212,621	$7,360,000	($2,852,621)
3	Re-pile whole structure (retain half caps and deck superstructure)	$19,043,853	$14,571,877	$11,230,000	($3,341,877)
4	Demolition of existing structure	$4,471,973	$4,471,976	$2,950,000	($1,521,976)
5	Replacement steel and concrete jetty (includes demo of existing structure)	$11,199,000	$11,199,000	$9,480,000	($1,719,000)

The 'Revised Total' in the above table has primarily resulted from deducting $4,471,976 for the 'Jetty Demolition' for Options 1 and 3 and $2,966,221 for 'Jetty Demo' Option 2. This is further commented on under points 2.1 to 2.3 inclusive of this report.

2.1 OPTION 1 – REPAIR WHOLE TANKER JETTY

According the BMT JFA report cost schedule 'Sch-J15028-1' "Full Jetty" the total cost to repair the whole tanker jetty is $17,288,576 (refer Appendix 2). The schedule reflects $4,471,976 for the 'Demolition of half of jetty (including electricals)' in year 2025. Considering that this estimate should be for the repair / remediation works for the whole jetty RBB has excluded the demolition cost noted above. This in turn results in a revised total of $12,816,600 which can be used for a 'like for like' comparison between BMT JFA and RBB estimates.

RBB estimate for Option 1 is $10,930,000 which consequently is $1,886,600 under the BMT JFA estimate.

BMT JFA estimate for this option includes $2,000,000 for 'All Bolts' to be replaced in 2017 and $2,000,000 in 2018. RBB believes that this is high.

Within the body of BMT JFA's report on pg. 32 for Option 1, BMT JFA reports comments that *"…With works carried out over the majority of 2016 expected, and the mobilisation of significant marine plant required, an order of cost estimate for the repairs is $4m with further works over the subsequent 2 years in the order of $6m to deal with the lower priority backlog repairs…".* Therefore a total of $10 million. This total contradicts the schedule. RBB believes that $10 million figure noted in the text of the report is a more representative figure than the $12,816,600 noted above.

2.2 OPTION 2 – REPAIR SHOREWARD HALF OF TANKER JETTY (DEMO OUTER HALF)

The BMT JFA report cost schedule 'Sch-J15028-1' "Half Jetty" reflects the total cost to for these works to be $13,178,842 (refer Appendix 3). In addition to the 'Demolition of Half Jetty' in 2016, the schedule reflects additional $2,966,221 for the 'Demolition of half of jetty (including electricals)' in year 2025. RBB has excluded the additional demolition cost noted above for year 2025. This in turn results in a revised total of $10,212,621 which can be used for a 'like for like' comparison between BMT JFA and RBB estimates.

RBB estimate for Option 2 is $7,360,000 which consequently is $2,852,621 under the BMT JFA estimate.

There are differences between RBB and BMT JFA estimate, however the major difference is under the 'All Bolts replacement costs. BMT JFA estimate for this option includes $1,000,000 for 'All Bolts' to be replaced in 2017 and $1,000,000 in 2018. RBB believes that this is high.

As noted under item 2.1 of this report, within the body of their report BMT JFA on page 33 have stated that their order of cost estimate for these works is $8 million. This total contradicts the total reflected in Appendix 3 and the revised total of $10,212,621 reflected under Table 2. RBB believes that $8 million figure noted in the text of the report is a more representative figure for the required works.

2.3 OPTION 3 – RE-PILE WHOLE STRUCTURE (RETAIN HALF CAPS AND DECK)

The BMT JFA report cost schedule 'Sch-J15028-1' "Repile" reflects the total cost to for these works to be $19,043,853 (refer Appendix 4). The schedule reflects $4,471,976 for the 'Demolition of half of jetty (including electricals)' in year 2025. Considering that this estimate should be for the re-piling remediation for whole jetty, RBB has excluded the demolition cost noted above for year 2025. This in turn results in a revised total of $14,571,877 which can be used for a 'like for like' comparison between BMT JFA and RBB estimates.

RBB estimate for Option 3 is $11,230,000 which consequently is $3,341,877 under the BMT JFA estimate.

There are differences between RBB and BMT JFA estimate, however the major difference is under the 'All Bolts replacement costs. BMT JFA estimate for this option includes $2,000,000 for 'All Bolts' to be replaced in 2017 and $2,000,000 in 2018. RBB believes that this is high.

2.4 OPTION 4 – DEMOLITION OF EXISTING STRUCTURE

The BMT JFA report cost schedule 'Sch-J15028-1' "Replace" reflects the total cost to for these works to be $11,199,000 (refer Appendix 5). However this total includes costs for the new jetty. In order to compare like for like RBB has utilised the figure of $4,471,976 for the demolition for the jetty reflected under Option 3 (ref Appendix 4).

RBB estimate for Option 4 is $2,950,000 which consequently is $1,521,976 under the BMT JFA estimate. In addition to the cost schedule BMT JFA report states on pg. 34 that the demolition cost is estimated to be $4.8 million. RBB believes this to be high.

2.5 OPTION 5 – REPLACEMENT STEEL AND CONCRETE JETTY (INCLUDES DEMO OF EXISTING STRUCTURE

As noted under Option 4 above, the BMT JFA report cost schedule 'Sch-J15028-1' "Replace" reflects the total cost to for these works to be $11,199,000 (refer Appendix 5). This cost is for the demolition of existing jetty and the construction of a new 250m long concrete and steel 'half jetty'.

RBB estimate for Option 5 is $9,480,000 which consequently is $1,719,000 under the BMT JFA estimate. RBB believes that BMT JFA estimate is high.

3. REVIEW OF BONACCI INFRASTRUCTURE ESTIMATE

Similar to the BMT JFA report, the Bonacci report outlines the assessment outcomes as well as the remediation / maintenance strategy for the jetty. Bonacci have provided two options for the Jetty remediation:

- Option 1 – Baseline Case; This option 'preserves' the jetty in its current location by introducing new vertical steel piles, new headstocks and stringer splice plates, deck remediation, deck furniture and services and the removal of existing piles.

- Option 2 – Improved Aesthetic and Heritage Case; Unlike Option 1, Bonacci have proposed to utilise timber piles instead of using the steel piles. In addition to this the timber piles would be 'driven' on rake similar to the way existing piles have been installed.

  Bonacci have only provided a cost estimate for Option 1 which reflects a total of $7,111,756, refer Appendix 6. RBB's estimate for this option is $11,230,000 which is $4,118,244 higher than Bonacci's estimate.

  In RBB's opinion Bonacci's estimate's costs are low in the following areas:

  - Preliminaries;
  - New Piling works;
  - Deck Remediation;

  Bonacci estimate is $7,460,121 lower in comparison to BMT JFA estimate total of $14,571,877.

4. WHOLE OF LIFE

There appears to be a belief that both reports provide a whole of life comparison. However, both are flawed for the purpose of considering the whole of life cost for different reasons.

The Bonacci Report, (see attached – Appendix 7), considers the whole of life costs in a superficial way. It considers some of the more obvious likely areas of works at a high level but does not consider much of the scope including lighting, handrails, ladders, signage etc. We may presume the timber repairs section considers replacement of bolts etc. but there is little clarity. The numbers included are very round and do not appear to be based on a vigorous assessment of need.

Additionally the assumptions, and hence, application of inflation (3%) and NPV discount rate (6%) appear inappropriate. Whilst inflation and NPV discount rate not necessarily directly linked, there is a long term relationship and we do not consider that the long term differential would be double. These are the critical assumptions as the entire calculation is based on these factors. As such we do not believe the Whole of Life estimate presented is a true reflection of the likely cost over the period.

The BMT JFA report does not appear to be a whole of estimate at all but rather is a capital work / remediation project cash flowed over a ten year period. It appears to only consider the remediation work and not ongoing maintenance works that need to occur regardless of the remediation works. For example, remediation work carried out in year 1 will be required to be maintained and will certainly incur cost to do so independent of the actual initial capital cost. This has not be factored or considered.

Neither report provides a true consideration of the likely whole of cost for the replacement or remediation work options.

A detailed consideration of the likely whole of cost is not part of this report. However, RBB considers that a long term average consideration should be made for approximately 2% per annum of the replacement capital cost of the jetty needs to be added for every year of the effective life in addition to the capital works costs associated with the replacement or remediation works. In the case of the remediation works this needs to be considered as an immediate cost, in the event of a replacement then this would commence at the end of the defects liability period following completion of the new structure. It should be noted that this is very high level consideration as a general guide only.

5. BASIS OF RBB ESTIMATES

In preparing this Cost Report, RBB has relied on the following information:

- Esperance Jetties Condition Assessment – Condition Inspection and Maintenance Report; revision 26th October 2016;
- Tanker Jetty, Esperance Remediation Report; revision 11th October 2016;

RBB has provided the highest level of accuracy possible based on the information above. In doing so, RBB have addressed the following:

- Assessment of preliminary costs.
- Quantification / preparation of MTOs (where practical) encompassing all elements of the scope of work.
- Application of unit rates and prices.
- Assessment of levels of confidence of level of design and application of appropriate contingencies.
- Assessment of appropriate Contingency allowances
- Assessment of likely professional fees associated with project management, design of all necessary disciplines, administration & inspections and relevant disbursements for the full duration of the project.

Preliminary Costs

RBB have made assessment of the likely cost of the contractor's preliminaries, as follows:

Included within the estimate are the following site facility allowances within the preliminary costs:

- Site Offices
- Site ablutions
- Client office
- Storage and laydown areas
- Site fencing and gates
- Temporary amenities; water, power and communications
- Site cleaning and disposal of waste
- Delivery management
- Mobilisation and Demobilisation
- General overheads
- Insurances and the like

Assessment of costs associated with the contractor's mobilisation and demobilisation of staff, facilities and equipment to and from site. Costs have been based on rates and prices from past similar projects, current rates for contractor's personnel, site facilities, temporary scaffolding, site plant, periodic & final cleaning and the like.

Allowances for site base administration include:

- Administration staff
- Document control
- Delivery management
- General labour for cleaning and the like

Allowances for 100% involvement of construction supervision staff, as follows:

- Construction manager
- Non-productive supervisors / inspectors
- Contract administrator

Quantification / MTO

Generally the estimates have been calculated by preparing MTO's from available information by quantifying individual items of work taken from the drawings provided.

In structuring the estimate, it is industry standard practice to quantify individual items of work on an elemental basis where practical. When working methodically through these elements, it is ensured that the full scope of works is addressed when building-up an estimated profile of the project.

The preparation of such MTO's is taken from the appropriate drawings whilst taking into account other documents to ensure the measurement of correct items of work.

Unit Rates / Prices

Unit rates are applied to the MTO's to generate a total cost for the relevant item.

All rates and prices are in Australian Dollars.

These rates have been derived from a combination of results from the following:

- Results from recently tendered projects.
- In-house database of cost information for typical material / items.
- Build-up from first principles (labour, plant, material, transportation).
- Knowledge and experience of the estimator.

In general, for building works, unit rates applied to work items are composite "all-in rates". This is typical for the building construction industry and is a method of pricing widely used by building contractors and their sub-contractors alike.

Where possible, RBB have used rates and prices determined from competitive tenders from recent projects. The intent is to apply as accurate and up to date unit rates / prices as possible.

Levels of Confidence and Contingency

In general it is considered that the structural design component reflected under Bonacci report for Option 1 is fairly advanced however, other engineering aspects such as electrical works component design is very preliminary.

Given this, RBB consider the estimate to provide a level of confidence in the region of ± 30% accuracy in accordance with the documentation provided. In addition to the above RBB has provided an allowance to provide a P90 equivalent level of confidence.

Design contingency of 7.5% has been allowed to accommodate the following:

- Quantity Growth
- Design Development
- Specification changes

Construction contingency of 5% has been allowed to accommodate the following:

- Errors or unforeseen design issues in construction documentation
- Latent conditions
- Changes in design

Client contingency of 5% has been allowed to accommodate the following:

- Potential client instigated changes
- Other increases associated directly with client costs

It is noted that the tender results would be reliant on the tenderers interpretation of the documentation and measurement of their MTOs.

RBB have applied a 5% construction contingency to the estimate to accommodate unforeseen scope increases during the construction phase of the project.

Design / Professional Fees

RBB have made an assessment of design / professional fees based on the locality of the project, complexity, anticipated duration and the project feeable value. The design / professional fees are for the following (from project commencement to final completion):

- Full design of all disciplines (for the pre-contract design phase and post contract involvement) for the following disciplines:
    - Civil engineer
    - Structural engineers
    - Electrical services engineer
- Project management

- Site inspections
- Contract administration
- Disbursement (travel, etc)

This assessment takes into account larger than normal consultant disbursements owing to the locality of the project.

Escalation

Escalation cost is considered differently in both the BMT JFA and Bonacci reports. This is primarily due to the proposed methodologies but there are flaws with how this has been applied.

In both cases there is mismatch between construction / remediation works and maintenance works. This is discussed further under 'Whole of Life'.

Escalation as it relates to the replacement construction costs and the remediation works is a factor of when those works will be under taken. There are two components to consider. Firstly is the true construction cost escalation based on the principal that the cost of construction increases over time as related to, but not a directly linear relationship to inflation.

The second component relates to additional preliminaries costs associated with an extended construction program. That is, the project in direct cost such as supervision, mobilisation and demobilisation of plant etc. increase by undertaking the works over a longer period as the works become less efficient. This means that undertaking the works as a single capital works project is likely to be cheaper than undertaking the works as an extended program of rolling works.

The RBB and Bonacci estimates consider the works as a single capital works program. The BMT JFA estimate appears to consider the remediation works as a rolling program over ten years without transparent consideration of the either of these escalation effects.

Should the client wish to consider these works as a rolling program rather than a single contract then a considerable escalation cost applies. RBB calculate this to be in the order of:

- Repair Whole Jetty Opt 1: $2,300,000
- Repair Half Jetty Opt 2: $1,700,000
- Full Jetty Remediation Opt 3: $2,200,000
- Demo existing Jetty $0
- New half Jetty, demo half $0

This is based on a 10 year programme as per the BMT JFA report, refer Appendices 2, 3 and 4.

Other Costs / Client Costs

Client own costs (i.e. management, direct purchased equipment and the like) are currently unknown by RBB and thus a provisional allowance of $100,000 has been reflected in all RBB estimated options.

6. INCLUSIONS / EXCLUSIONS

Inclusions

This cost report includes for the scope of works provided in the documentation listed in section 3. Basis of Estimate and includes:

- Contractor mobilisation, demobilisation, preliminaries, temporary works, supervision, inductions and margins
- Full scope of works
- Design, construction and client contingencies
- Consultant design and project management / supervision fees and disbursements
- Traffic Management
- Professional fees
- Authority fees and charges

Exclusions

The following items have been excluded from this cost report:

- Services other than stated above
- Site remediation / removal of hazardous or toxic materials
- Financing costs
- Environmentally Sustainable Design Initiatives in Excess of Statutory Requirements
- Additional costs for alternative procurement methodologies
- Operational costs
- Cost allowance for staging of the works
- Escalation

APPENDIX 1

COST PLAN No 1

ORDER OF COST ESTIMATES
REV 0

SHIRE OF ESPERANCE
ESPERANCE TANKER JETTY REMEDIATION
COST PLAN No. 1
ORDER OF COST ESTIMATE REV 0
JOB NO: 18571

QUALITY MANAGEMENT

4-Nov-16

Revision	Prepared By	Checked By	Issue Date	Comments
0	Sadmir Ceric	Mark Hampson	4-Nov-16	

SHIRE OF ESPERANCE
ESPERANCE TANKER JETTY REMEDIATION
COST PLAN No. 1
ORDER OF COST ESTIMATE REV 0
JOB NO: 18571

MAIN SUMMARY

4-Nov-16

REF	SCOPE	RBB $	BMT JFA $	BONACCI $	COMMENTS
1	REPAIR WHOLE JETTY - RBB ESTIMATE / BMT JFA OPT 1	10,930,000.00	12,816,600.00	N/A	BMT JFA Option 1 reflects a total of $17,288,576. This total is inclusive of $4,471,976 demolition costs, ref. Appendix 2. In order to compare 'like for like' we have excluded the 2025 demo component, hence the total of $12,816,660.
2	REPAIR HALF JETTY, DEMO HALF - RBB ESTIMATE / BMT JFA OPT 2	7,360,000.00	10,212,621.00	N/A	BMT JFA Option 2 reflects a total of $13,178,842. This total is inclusive of $2,966,221 demolition costs in year 2025, ref. Appendix 3. In order to compare 'like for like' we have excluded the 2025 demo component, hence the total of $10,212,612.
3	FULL JETTY REMEDIATION - NEW VERTICAL PILES - RBB ESTIMATE	11,230,000.00	14,571,877.00	7,111,756.00	BMT JFA Option 3 reflects a total of $19,043,853. This total is inclusive of $4,471,976 demolition costs in year 2025, ref. Appendix 4. In order to compare 'like for like' we have excluded the demo component, hence the total of $14,571,877.
4	DEMOLITION EXISTING JETTY - RBB ESTIMATE / BMT JFA OPT 4	2,950,000.00	4,471,976.00	N/A	It is unclear which BMT JFA costing schedule addresses the Demolition of the existing jetty as a 'stand alone' option or option 4. RBB has reflected the $4,471,976 total found in BMT JFA schedules for Option 3 (ref. comments above)
5	NEW HALF JETTY - NEW VERTICAL PILES - RBB ESTIMATE / BMT JFA OPT 5	9,480,000.00	11,199,000.00	N/A	

NOTES

6 This estimate is based on the following information received from GHD:
Esperance Jetties Condition Assessment, Condition Inspection & Maintenance Stragegy Report; by BMT JFA Consultants; 26/10/16
Tanker Jetty, Esperance Remediation Report; by Bonacci Infrastructure; 11/10/2016

7 No allowances have been made for the following:
Escalation
Financing costs
Removal of hazardous materials

8 This estimate assumes that the works shall be competitively tendered.

9 This estimate assumes that accommodation for site personnel will be sourced locally (no allowances have been made for a construction camp).

10 Refer to the main body of the estimates for works included.

11 This estimate is based on preliminary information and all costs should be considered indicative.

12 Given the preliminary nature of the information, the following contingencies have been allowed for:
Design Contingency 7.5%
Construction Contingency 5%
Client Contingency 5%

13 Professional fees have been allowed at 12%

4-Nov-16

REPAIR WHOLE JETTY - RBB ESTIMATE / BMT JFA OPT 1

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	MOBILISATION & PRELIMINARIES					
1	Mobilisation & Demob	Item	1	540,000.00	540,000.00	
2	Supervision and attendance	Item	1	650,000.00	650,000.00	
3	General overheads	Item	1	290,000.00	290,000.00	
4	Insurances; allowance	Item	1	70,000.00	70,000.00	
5	Accommodation and messing; allowance	Item	1	140,000.00	140,000.00	
6	Miscellaneous provision	Item	1	20,000.00	20,000.00	1,710,000.00
	DECK REMEDIATION					
4	Removal of existing concrete deck	m2	2,343	45.00	105,435.00	
5	New 130mm concrete dec, 4.57m wide	m2	2,343	120.00	281,160.00	
6	New HW edge kerb (120x35)	m	1,030	60.00	61,800.00	
7	Kerb brackets	No	900	60.00	54,000.00	502,395.00
	DECK FURNITURE & SERVICES					
8	Supply & install hydrib light, 6m HDG hinged pole	No	6	18,750.00	112,500.00	
9	Alum. Handrail & posts northern side	m	515	320.00	164,800.00	
10	Alum. Handrail & posts southern side	m	515	320.00	164,800.00	
11	Fish cleaning station + water supply	No	1	15,000.00	15,000.00	
12	Bench seating along jetty	No	10	1,200.00	12,000.00	469,100.00
	PILE REPAIR					
13	Wrap submerged length of pile in zipped jacket and grout	No	214	16,500.00	3,531,000.00	
14	Apply strapping to pile top above water	No	12	1,300.00	15,600.00	
15	Remove redundant / broken piles; provisional quantity	No	10	5,000.00	50,000.00	
16	New timber piles installed	No	10	12,000.00	120,000.00	3,716,600.00
	HALF CAPS REPAIR					
17	Allowance to repair connection between pile and half caps	No	100	1,500.00	150,000.00	
18	Bracing to limit pile movement; allowance	Item	1	175,000.00	175,000.00	325,000.00
	CORBEL REPAIR					
19	Allowance to repair existing corbels; provisional quantity	No	67	1,500.00	100,800.00	
20	Allowance to replace corbels N/S; provisional quantity	No	179	4,000.00	716,800.00	817,600.00
	STRINGER REPAIR					
21	Allowance to replace all stringers (5No locations - 2No stringers per location)	No	10	3,200.00	32,000.00	32,000.00
	REPLACE BOLTS					
22	Allowance to replace all bolts; provisional quantity	No	2,000	375.00	750,000.00	
23	Allowance to epoxy repair any rot; provisional allowance	Item	1	500,000.00	500,000.00	1,250,000.00
	MISCELLANEOUS WORKS					
24	Replacement of existing aluminium gangway	Item	1	Excluded	Excluded	
25	Sundry fitments; allowance	Item	1	50,000.00	50,000.00	

4-Nov-16

REPAIR WHOLE JETTY - RBB ESTIMATE / BMT JFA OPT 1

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
26	Wayfinding and signage; allowance	Item	1	15,000.00	15,000.00	
27	Electrical works; allowance	Item	1	50,000.00	50,000.00	
28	Bollards; allowance	Item	1	15,000.00	15,000.00	130,000.00
29	**SUB-TOTAL**				**8,952,695.00**	**8,952,695.00**
	PROFESSIONAL SERVICES (CONTRACTOR)					
30	Professional design fess	Item	1	179,100.00	179,100.00	
31	Cathodic protection design	Item	1		Included	
32	Pile testing; allowance	Item	1	5,000.00	5,000.00	184,100.00
	CONTRACTOR CONTINGENCY					
33	Contingency allowance; latent conditions	Item	1	268,600.00	268,600.00	
34	Contingency allowance; weather	Item	1	223,800.00	223,800.00	
35	Contingency allowance; scope creep	Item	1	223,800.00	223,800.00	
36	Contingency allowance; to P90 design	Item	1	1,074,300.00	1,077,005.00	1,793,205.00
37	**NET CONSTRUCTION COST**				**10,930,000.00**	**10,930,000.00**
38	Design Contingency			7.5%		820,000.00
39	Construction Contingency			5%		550,000.00
40	Client Contingency			5%		550,000.00
41	Client Costs and Disbursements; allowance					100,000.00
42	Authority fees and charges; allowance					50,000.00
43	Professional Fees; allowance			12%		1,480,000.00
44	**ESTIMATED TOTAL COMMITMENT (excl GST)**					**14,480,000.00**
45	GST			10%		1,448,000.00
46	ESTIMATED TOTAL COMMITMENT (incl GST)					15,928,000.00

4-Nov-16

REPAIR HALF JETTY, DEMO HALF - RBB ESTIMATE / BMT JFA OPT 2

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	MOBILISATION & PRELIMINARIES					
1	Mobilisation & Demob	Item	1	290,000.00	290,000.00	
2	Supervision and attendance	Item	1	350,000.00	350,000.00	
3	General overheads	Item	1	160,000.00	160,000.00	
4	Insurances; allowance	Item	1	40,000.00	40,000.00	
5	Accommodation and messing; allowance	Item	1	80,000.00	80,000.00	
6	Miscellaneous provision	Item	1	20,000.00	20,000.00	940,000.00
	DEMOLITION WORKS					
7	Extra over for mobilisation/demob of equipment for demolition; allowance	Item	1	250,000.00	250,000.00	
8	Remove existing concrete deck, including timber stringers, half caps and corbels complete	m2	1,172	225.00	263,700.00	
9	Remove existing piles	No	112	5,000.00	560,000.00	
10	Sundry demolition allowance	Item	1	100,000.00	100,000.00	1,173,700.00
	DECK REMEDIATION					
11	Removal of existing concrete deck	m2	1,172	45.00	52,717.50	
12	New 130mm concrete dec, 4.57m wide	m2	1,172	120.00	140,580.00	
13	New HW edge kerb (120x35)	m	513	60.00	30,780.00	
14	Kerb brackets	No	450	60.00	27,000.00	251,077.50
	DECK FURNITURE & SERVICES					
15	Supply & install hydrib light, 6m HDG hinged pole	No	3	18,750.00	56,250.00	
16	Alum. Handrail & posts northern side	m	258	320.00	82,400.00	
17	Alum. Handrail & posts southern side	m	258	320.00	82,400.00	
18	Fish cleaning station + water supply	No	1	15,000.00	15,000.00	
19	Bench seating along jetty	No	5	1,200.00	6,000.00	242,050.00
	PILE REPAIR					
20	Wrap submerged length of pile in zipped jacket and grout	No	107	16,500.00	1,765,500.00	
21	Apply strapping to pile top above water	No	12	1,300.00	15,600.00	
22	Remove redundant / broken piles; provisional quantity	No	5	5,000.00	25,000.00	
23	New timber piles installed	No	5	12,000.00	60,000.00	1,866,100.00
	HALF CAPS REPAIR					
24	Allowance to repair connection between pile and half caps	No	100	1,500.00	150,000.00	
25	Bracing to limit pile movement; allowance	Item	1	175,000.00	175,000.00	325,000.00
	CORBEL REPAIR					
26	Allowance to repair existing corbels; provisional quantity	No	34	1,500.00	50,400.00	
27	Allowance to replace corbels N/S; provisional quantity	No	90	4,000.00	358,400.00	408,800.00
	STRINGER REPAIR					
28	Allowance to replace all stringers (5No locations - 2No stringers per location)	No	6	3,200.00	19,200.00	19,200.00

4-Nov-16

REPAIR HALF JETTY, DEMO HALF - RBB ESTIMATE / BMT JFA OPT 2

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	REPLACE BOLTS					
29	Allowance to replace all bolts; provisional quantity	No	1,000	375.00	375,000.00	
30	Allowance to epoxy repair any rot; provisional allowance	Item	1	300,000.00	300,000.00	675,000.00
	MISCELLANEOUS WORKS					
31	Replacement of existing aluminium gangway	Item	1	Excluded	Excluded	
32	Sundry fitments; allowance	Item	1	50,000.00	50,000.00	
33	Wayfinding and signage; allowance	Item	1	15,000.00	15,000.00	
34	Electrical works; allowance	Item	1	50,000.00	50,000.00	
35	Bollards; allowance	Item	1	15,000.00	15,000.00	130,000.00
36	**SUB-TOTAL**				**6,030,927.50**	**6,030,927.50**
	PROFESSIONAL SERVICES (CONTRACTOR)					
37	Professional design fess	Item	1	120,600.00	120,600.00	
38	Cathodic protection design	Item	1		Included	
39	Pile testing; allowance	Item	1	5,000.00	5,000.00	125,600.00
	CONTRACTOR CONTINGENCY					
40	Contingency allowance; latent conditions	Item	1	180,900.00	180,900.00	
41	Contingency allowance; weather	Item	1	150,800.00	150,800.00	
42	Contingency allowance; scope creep	Item	1	150,800.00	150,800.00	
43	Contingency allowance; to P90 design	Item	1	723,700.00	720,972.50	1,203,472.50
44	**NET CONSTRUCTION COST**				**7,360,000.00**	**7,360,000.00**
45	Design Contingency			7.5%		552,000.00
46	Construction Contingency			5%		370,000.00
47	Client Contingency			5%		370,000.00
48	Client Costs and Disbursements; allowance					100,000.00
49	Authority fees and charges; allowance					50,000.00
50	Professional Fees; allowance			12%		998,000.00
51	**ESTIMATED TOTAL COMMITMENT (excl GST)**					**9,800,000.00**
52	GST			10%		980,000.00
53	ESTIMATED TOTAL COMMITMENT (incl GST)					10,780,000.00

4-Nov-16

FULL JETTY REMEDIATION - NEW VERTICAL PILES - RBB ESTIMATE

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	MOBILISATION & PRELIMINARIES					
1	Mobilisation & Demob	Item	1	550,000.00	550,000.00	
2	Supervision and attendance	Item	1	660,000.00	660,000.00	
3	General overheads	Item	1	290,000.00	290,000.00	
4	Insurances; allowance	Item	1	70,000.00	70,000.00	
5	Accommodation and messing; allowance	Item	1	150,000.00	150,000.00	
6	Miscellaneous provision	Item	1	50,000.00	50,000.00	1,770,000.00
	NEW PILING WORKS					
7	Supply & fabrication of 323 dia x 9 steel piles (224 No)	t	264.10	2,100.00	554,601.60	
8	Installation of 323 dia x 9 steel piles	m	3,584	660.00	2,365,440.00	
9	Surface treatment (marine epoxy)	m2	1,792	99.00	177,408.00	
10	Zinc anode CP system (supply & install)	Item	1	174,400.00	174,400.00	
11	Geotech investigation	Item	1	250,000.00	250,000.00	3,521,849.60
	NEW HEADSTOCK + STRINGER SPLICE PLATES					
12	200x100x9 RHS headstock; supply and install (112 No)	t	20.69	7,500.00	155,175.00	
13	89x6 SHS Btm chord; supply and install; (112 No)	t	4.94	7,500.00	37,050.00	
14	89x6 Braces; supply and install; (224 No)	t	9.88	7,500.00	74,100.00	
15	Dia. 406x9.5 pile sleeve; supply and install (224No)	t	50.0	7,500.00	375,000.00	
16	Marine epoxy finish	m2	1,373	132.00	181,236.00	
17	Supply & install alum. String splice plates	No	275	550.00	151,250.00	
18	Re-levelling of deck; allowance	Item	1	120,000.00	120,000.00	
19	Remove half caps	No	224	650.00	145,600.00	
20	Remove corbels	No	560	250.00	140,000.00	
21	Remove existing timber piles	No	224	5,000.00	1,120,000.00	2,499,411.00
	DECK REMEDIATION					
22	Removal of existing concrete deck	m2	2,343	45.00	105,435.00	
23	New 130mm concrete dec, 4.57m wide	m2	2,343	120.00	281,160.00	
24	New HW edge kerb (120x35)	m	1,030	60.00	61,800.00	
25	Kerb brackets	No	900	60.00	54,000.00	
26	Replace/reposition rotten stringers; provisional	No	48	3,500.00	168,000.00	670,395.00
	DECK FURNITURE & SERVICES					
27	Supply & install hydrib light, 6m HDG hinged pole	No	6	16,500.00	99,000.00	
28	Alum. Handrail & posts northern side	m	515	320.00	164,800.00	
29	Alum. Handrail & posts southern side	m	515	320.00	164,800.00	
30	Fish cleaning station + water supply	No	1	15,000.00	15,000.00	
31	Bench seating along jetty	No	10	1,200.00	12,000.00	455,600.00
	MISCELLANEOUS WORKS					
32	Replacement of existing aluminium gangway	Item	1	Excluded	Excluded	
33	Ladders; provisional	No	20	5,000.00	100,000.00	
34	Sundry fitments; allowance	Item	1	50,000.00	50,000.00	
35	Wayfinding and signage; allowance	Item	1	15,000.00	15,000.00	
36	Bollards; allowance	Item	1	15,000.00	15,000.00	180,000.00

SHIRE OF ESPERANCE
ESPERANCE TANKER JETTY REMEDIATION
COST PLAN No. 1
ORDER OF COST ESTIMATE REV 0
JOB NO: 18571

4-Nov-16

FULL JETTY REMEDIATION - NEW VERTICAL PILES - RBB ESTIMATE

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
37	**SUB-TOTAL**				**9,097,255.60**	**9,097,255.60**
	PROFESSIONAL SERVICES (CONTRACTOR)					
38	Professional design fess	Item	1	280,000.00	280,000.00	
39	Cathodic protection design	Item	1		Included	
40	Pile testing; allowance	Item	1	30,000.00	30,000.00	310,000.00
	CONTRACTOR CONTINGENCY					
41	Contingency allowance; latent conditions	Item	1	272,900.00	272,900.00	
42	Contingency allowance; weather	Item	1	227,400.00	227,400.00	
43	Contingency allowance; scope	Item	1	227,400.00	227,400.00	
44	Contingency allowance; to P90 design	Item	1	1,091,700.00	1,095,044.40	1,822,744.40
45	**NET CONSTRUCTION COST**				**11,230,000.00**	**11,230,000.00**
46	Design Contingency			7.5%		842,000.00
47	Construction Contingency			5%		560,000.00
48	Client Contingency			5%		560,000.00
49	Client Costs and Disbursements; allowance					100,000.00
50	Authority fees and charges; allowance					75,000.00
51	Professional Fees; allowance			12%		1,513,000.00
52	**ESTIMATED TOTAL COMMITMENT (excl GST)**					**14,880,000.00**
53	GST			10%		1,488,000.00
54	ESTIMATED TOTAL COMMITMENT (incl GST)					16,368,000.00

SHIRE OF ESPERANCE
ESPERANCE TANKER JETTY REMEDIATION
COST PLAN No. 1
ORDER OF COST ESTIMATE REV 0
JOB NO: 18571

4-Nov-16

DEMOLITION EXISTING JETTY - RBB ESTIMATE / BMT JFA OPT 4

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	MOBILISATION & PRELIMINARIES					
1	Mobilisation & Demob	Item	1	400,000.00	400,000.00	
2	Insurance & Project Management	Item	1	130,000.00	130,000.00	530,000.00
	DEMOLITION WORKS					
3	Remove existing concrete deck, including timber stringers, half caps and corbels complete	m2	2,343	225.00	527,175.00	
4	Remove existing piles	No	224	5,000.00	1,120,000.00	1,647,175.00
	PROFESSIONAL SERVICES (CONTRACTOR)					
5	Civil & structural input	Item	1	200,000.00	200,000.00	200,000.00
6	**SUB-TOTAL**				**2,377,175.00**	**2,377,175.00**
	MISCELLANEOUS WORKS					
7	Sundry demolition allowance	Item	1	100,000.00	100,000.00	100,000.00
	CONTRACTOR CONTINGENCY					
8	Contingency allowance; latent conditions	Item	1	118,900.00	118,900.00	
9	Contingency allowance; weather	Item	1	59,400.00	59,400.00	
10	Contingency allowance; scope creep	Item	1	59,400.00	59,400.00	
11	Contingency allowance; to P90 design	Item	1	237,700.00	235,125.00	472,825.00
12	**NET CONSTRUCTION COST**				**2,950,000.00**	**2,950,000.00**
13	Design Contingency			7.5%		221,000.00
14	Construction Contingency			5%		148,000.00
15	Client Contingency			5%		148,000.00
16	Client Costs and Disbursements; allowance					100,000.00
17	Authority fees and charges; allowance					50,000.00
18	Professional Fees; allowance			12%		403,000.00
19	**ESTIMATED TOTAL COMMITMENT (excl GST)**					**4,020,000.00**
20	GST			10%		402,000.00
21	ESTIMATED TOTAL COMMITMENT (incl GST)					4,422,000.00

4-Nov-16

NEW HALF JETTY - NEW VERTICAL PILES - RBB ESTIMATE / BMT JFA OPT 5

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
	MOBILISATION & PRELIMINARIES					
1	Mobilisation & Demob	Item	1	600,000.00	600,000.00	
2	Supervision and attendance	Item	1	600,000.00	600,000.00	
3	General overheads	Item	1	240,000.00	240,000.00	
4	Insurances; allowance	Item	1	60,000.00	60,000.00	
5	Accommodation and messing; allowance	Item	1	120,000.00	120,000.00	
6	Miscellaneous provision	Item	1	100,000.00	100,000.00	1,720,000.00
	DEMOLITION WORKS					
7	Extra over for mobilisation/demob of equipment for demolition; allowance	Item	1	250,000.00	250,000.00	
8	Remove existing concrete deck, including timber stringers, half caps and corbels complete	m2	2,343	225.00	527,175.00	
9	Remove existing piles	No	224	5,000.00	1,120,000.00	
10	Sundry demolition allowance	Item	1	100,000.00	100,000.00	1,997,175.00
	NEW PILING WORKS					
11	Supply & fabrication of 323 dia x 9 steel piles (120. No)	t	141.48	2,100.00	297,108.00	
12	Installation of 323 dia x 9 steel piles	m	1,920	660.00	1,267,200.00	
13	Surface treatment (marine epoxy)	m2	960	99.00	95,040.00	
14	Zinc anode CP system (supply & install)	Item	1	93,400.00	93,400.00	
15	Geotech investigation	Item	1	150,000.00	150,000.00	1,902,748.00
	NEW HEADSTOCK + STRINGER SPLICE PLATES					
16	200x100x9 RHS headstock; supply and install (60 No)	t	11.08	7,500.00	83,100.00	
17	89x6 SHS Btm chord; supply and install; (60 No)	t	2.65	7,500.00	19,875.00	
18	89x6 Braces; supply and install; (120 No)	t	5.29	7,500.00	39,675.00	
19	Dia. 406x9.5 pile sleeve; supply and install (104No)	t	26.8	7,500.00	200,850.00	
20	Marine epoxy finish	m2	736	132.00	97,152.00	
21	Supply & install alum. String splice plates	No	138	550.00	75,625.00	516,277.00
	NEW DECK					
22	New 130mm concrete dec, 4.57m wide; including deck support structure	m2	1,175	850.00	998,750.00	
23	New HW edge kerb (120x35)	m	500	60.00	30,000.00	
24	Kerb brackets	No	450	60.00	27,000.00	1,055,750.00
	DECK FURNITURE & SERVICES					
25	Supply & install hydrib light, 6m HDG hinged pole	No	6	16,500.00	99,000.00	
26	Alum. Handrail & posts northern side	m	250	320.00	80,000.00	
27	Alum. Handrail & posts southern side	m	250	320.00	80,000.00	
28	Fish cleaning station + water supply	No	1	15,000.00	15,000.00	
29	Bench seating along jetty	No	10	1,200.00	12,000.00	286,000.00
	MISCELLANEOUS WORKS					
30	Demo existing aluminium gangway	Item	1	20,000.00	20,000.00	
31	Ladders; provisional	No	20	5,000.00	100,000.00	
32	Sundry fitments; allowance	Item	1	50,000.00	50,000.00	
33	Wayfinding and signage; allowance	Item	1	15,000.00	15,000.00	

4-Nov-16

NEW HALF JETTY - NEW VERTICAL PILES - RBB ESTIMATE / BMT JFA OPT 5

Ref	Scope	Unit	Quantity	Rate	Sub-Total	Total
					$	$
34	Bollards; allowance	Item	1	15,000.00	15,000.00	200,000.00
35	**SUB-TOTAL**				**7,677,950.00**	**7,677,950.00**
	PROFESSIONAL SERVICES (CONTRACTOR)					
36	Professional design fess	Item	1	240,000.00	240,000.00	
37	Cathodic protection design	Item	1		Included	
38	Pile testing; allowance	Item	1	30,000.00	30,000.00	270,000.00
	CONTRACTOR CONTINGENCY					
39	Contingency allowance; latent conditions	Item	1	230,300.00	230,300.00	
40	Contingency allowance; weather	Item	1	191,900.00	191,900.00	
41	Contingency allowance; scope	Item	1	191,900.00	191,900.00	
42	Contingency allowance; to P90 design	Item	1	921,400.00	917,950.00	1,532,050.00
43	**NET CONSTRUCTION COST**				**9,480,000.00**	**9,480,000.00**
44	Design Contingency			7.5%		711,000.00
45	Construction Contingency			5%		470,000.00
46	Client Contingency			5%		470,000.00
47	Client Costs and Disbursements; allowance					100,000.00
48	Authority fees and charges; allowance					75,000.00
49	Professional Fees; allowance			12%		1,284,000.00
50	**ESTIMATED TOTAL COMMITMENT (excl GST)**					**12,590,000.00**
51	GST			10%		1,259,000.00
52	ESTIMATED TOTAL COMMITMENT (incl GST)					13,849,000.00

APPENDIX 2

BMT JFA 'Sch-J15028-1' "Full Jetty"

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Full Jetty	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											Total
No. Units	Item	Condition	Activity	Report Ref	Priority																	
				R-J15028-1																		
Piles (Below Water)																						
2	54N, 93N	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$52,000															
10	53S, 58S, 66N, 70S, 71S, 74N, 91N, 101N, 112N, 129S	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$210,000															
18	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S, 89S, 96N, 96S, 105S, 110S, 118N, 120S, 121S, 131S, 137N	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months		$360,000														
199	All piles		Dive inspection including cleaning		4	6 Months		$39,800							$39,800							
163	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months				$2,608,000												
			Demolition of half of jetty (including electricals)																	$4,471,976		
Piles (Above Water)																						
12	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months				$48,000		$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000			
Half Caps		Combined																				
1	95S Both	13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$14,000					$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000			
10	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both, 93S Both, 94S Both, 133N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$90,000															
29	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 50N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both, 91N Both, 92N Both, 95N Both, 101S Both, 102N Both, 114N Both, 116N Both, 125N Both, 133S Both, 132N Both, 135S Both, 136S Both, 137N Both, 140N Both, 141S Both, 142N Both	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months		$174,000														
10	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both, 98S Both, 108S Both, 119S Both	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months				$90,000		$90,000										
50			Bracing to limit pile bent movement			24 - 48 Months						$500,000	$500,000									
Corbels																						
3	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$12,000					$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000			
8	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate	$32,000															
24	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months		$60,000														
4	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$8,000		$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
Stringers																						
5	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$125,000				$125,000			$125,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$2,000,000	$2,000,000									
			Design of Repairs				$80,000	$80,000				$50,000										
			General Quantative and Inspections				$80,000	$80,000	$80,000	$80,000	$80,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000		
							$ 570,000	$ 793,800	$ 80,000	$ 2,959,000	$ 80,000	$ 2,978,000	$ 2,838,000	$ 463,000	$ 377,800	$ 338,000	$ 463,000	$ 338,000	$ 338,000	$ 4,671,976	$ 17,288,576	

APPENDIX 3

BMT JFA 'Sch-J15028-1' "Half Jetty"

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Half Jetty	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											
No. Units	Item	Condition	Activity	Report Ref	Priority																	Total
				R-J15028-1																		
Piles (Below Water)																						
1	54N,	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$26,000															
6	53S, 58S, 66N, 70S, 71S, 74N,	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$126,000															
8	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S,	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months		$144,000														
111	All piles		Dive inspection including cleaning		4	6 Months		$22,200							$22,200							
96	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months				$1,440,000												
			Demolition of half of jetty (including electricals)							$2,966,221											$2,966,221	
Piles (Above Water)																						
12	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months				$48,000		$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000			
Half Caps		Combined																				
0		13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$0					$0										
6	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$54,000															
13	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both,	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months		$78,000														
7	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both,	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months				$63,000		$63,000	$63,000	$63,000	$63,000	$63,000	$63,000	$63,000	$63,000			
25			Bracing to limit pile bent movement			24 - 48 Months						$250,000	$250,000									
Corbels																						
2	35N, 41N	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$8,000					$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
3	51N, 52N, 84S	7	Replace corbel.		5	Immediate	$12,000															
10	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N,	6	Bolt corbel together at split / split end(s).		4	6 Months		$25,000														
2	53N, 85S,	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$4,000		$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000			
Stringers																						
2	63N-64N, 72N - 74N,	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$50,000				$50,000			$50,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$1,000,000	$1,000,000									
			Design of Repairs				$80,000	$80,000				$50,000										
			General Quantative and Inspections				$50,000	$50,000	$50,000	$50,000	$50,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000		
							$ 356,000	$ 399,200	$ 50,000	$4,621,221	$ 50,000	$1,543,000	$1,493,000	$ 293,000	$ 265,200	$ 243,000	$ 293,000	$ 243,000	$ 243,000	$ 3,086,221	$ 13,178,842	

APPENDIX 4

BMT JFA 'Sch-J15028-1' "Repile"

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Repile	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											
No. Units	Item	Condition	Activity	Report Ref	Priority																	Total
				R-J15028-1																		
Piles (Below Water)																						
1		7,6,5 &4	Steel piles Plant Mob/Demob	Section 3.2	5	Immediate		$1,613,900														
224	All Piles	7,6,5 &4	Piling					$3,321,900														
			Geotechnical Investigation					$250,000														
			Design of Pile and Connections					$304,251														
			Contract Management					$330,000														
			Construction Supervision					$121,701		$0												
			Demolition (including electricals)																	$4,471,976		
Half Caps		Combined																				
224	All Half Caps	13	Bracket Connection Good Timber to new steel piles					$2,763,125				$0										
								$0														
										$0		$0	$0	$0	$0	$0	$0	$0	$0			
												$0	$0									
Corbels																						
3	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$12,000					$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000			
8	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate	$32,000															
24	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months		$60,000														
4	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$8,000		$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
Stringers																						
5	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$125,000				$125,000			$125,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$2,000,000	$2,000,000									
			Design of Repairs				$40,000	$40,000				$40,000										
			General Quantative and Inspections				$40,000	$40,000	$40,000	$40,000	$40,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000		
							$ 124,000	$ 8,844,877	$ 40,000	$ 173,000	$ 40,000	$ 2,160,000	$ 2,120,000	$ 245,000	$ 120,000	$ 120,000	$ 245,000	$ 120,000	$ 120,000	$ 4,571,976	$ 19,043,853	

APPENDIX 5

BMT JFA 'Sch-J15028-1' "Replace"

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME																	
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance																	
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																			
	Revision	A	Replace	By	JF		Jetty Maintenance Programme																	
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025				
							Q4	Q1	Q2	Q3	Q4													
No. Units	Item	Condition	Activity	Report Ref	Priority																			Total
				R-J15028-1																				
Demolition																								
1		7,6,5 &4	Plant Mob/Demob (includes equipment for demolition & construction)					$1,614,000																
224	All Piles + Substructure + Deck Concrete + Services	7,6,5 &4	Demolition (including electricals)	3.2	5	Immediate		$2,900,000																
1			Demolition Supervision and Contract Management					$278,000																
Preliminary	Pre Construction Works																							
			Community Consultation?																					
1			Geotechnical Investigation					$250,000																
1			Detailed Design					$320,000																
1			Contract Management and Project Tendering					$103,000																
Construction																								
120			Piles 120No,						$1,780,000															
60			Crossheads 60 No.						$1,184,000															
180			Concrete slabs with FRP mesh infill						$1,347,000															
1			Handrail, Kerbing, ladders and services (water + electricals provisional)							$590,000														
1			Low level platform							$300,000														
			Shade area							$90,000														
			Construction Supervision						$300,000	$53,000														
							$ -	$ 5,465,000	$ 4,611,000	$ 1,123,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,199,000			

APPENDIX 6

BONACCI – CAPITAL COST ESTIMATE

High Level Cost Estimate Breakdown		
Item	Cost	
Mobilisation and Preliminaries	$	467,150
New Piling works	$	2,044,336
New Headstocks and removal of existing bents	$	2,442,720
New ConcreteDeck & Stringer repair	$	397,698
New Deck furniture and lighting	$	324,560
Professional Services	$	250,000
Total	**$**	**5,926,464**
Contingency (20%)	$	1,185,293
Budget Estimate	**$**	**7,111,756**

Figure 4: Capital Cost Summary.

Cost	Description	No. off	Unit price	Unit weight kg/m	Unit length m	Total weight kg
	Mobilisation and Preliminaries					
$ 287,658	Mobilisation and demobilisation	1	287,658			
$ 127,168	Insurance and Project Management	1	127,168			
$ 52,324	Existing Services removal	1	52,324			
	New Piling works					
$ 2,044,336	Dia. 323 x 9 Pile (avg. length 16m)	224	9,127	73.7	16.000	264,141
	Marine epoxy finish to 3m below bed level (Interzone 954)	item				
	Surveyor costs	item				
	Zinc anode CP System (supply and installed)	item				
	Labour and Installation costs	item				
	New Headstock + stringer splice plates					
$ 2,442,720	200x150x9 RHS Headstock	112	21,810	37.7	4.900	20690
	89x6 Btm Chord	112		14.6	4.900	8012
	89x6 Braces	224		14.6	3.000	9811
	Dia. 406x9.5 Pile Sleeve	224		93.0	2.400	49997
	Marine epoxy finish	item				
	Supply and install Alum. String splice plates	275		4.05	1.2	1337
	Re-leveling of deck	item				
	Removal of existing substructure below stringer level	item				
	Labour and barges	item				
	Deck Remediation					
$ 50,000	Removal of existing concrete deck	item				
$ 100,425	New 130mm concrete deck, 4.57m wide	515	195			
$ 52,273	New HW edge kerb (120x35)	1030	50.75			
$ 27,000	Kerb brackets	900	30			
$ 168,000	Replace/reposition rotten stringers	48	3500			
	Deck Furniture and Services					
$ 79,200	Supply and Install Hydrib light, 6m HDG hinged pole	6	13,200			
$ 109,180	Alum. handrail and posts northern side	515	212	3.025	515	1558
$ 109,180	Alum. handrail and posts southern side	515	212	3.025	515	1558
$ 15,000	Fish Cleaning station + water supply	1	15000			
$ 12,000	Bench seating along jetty	10	1200			
	Professional Services					
$ 200,000	Civil and Structural Design	item				
$ 20,000	CP Design	item				
$ 15,000	Pile PDA testing, 4 No. test	item				
$ 15,000	Timber strength testing	item				
$ 5,926,464	**Total**					
$ 1,185,293	Contigency	20%				
$ 7,111,756	**Grand total**					

APPENDIX 7

BONACCI – WHOLE OF LIFE ESTIMATE

Whole of Life Costing

	Capital Costs		Maintenance				Sub-Total Summary		NPV Assessment					
Year	Cost	Description	Inspections	Paint Repair (sub-structure)	Timber repair (superstructure)	Anode inspection (Dive team)	Capital Exp	Maintanence Sub total	Cap Ex + Maintanence	Contingency (20%)	Cap Ex + Maintanence+ Contigency	+ Inflation @ 3% pa	Discount @ 6% pa	NPV
1	$ 5,926,464	Jetty Rehabilitation					$ 5,926,464	$ -	$ 5,926,464	$1,185,293	$ 7,111,756	$ 7,111,756	100%	**$ 7,111,756**
2							$ -	$ -	$ -	$ -	$ -	$ -	94%	**$ -**
3							$ -	$ -	$ -	$ -	$ -	$ -	89%	**$ -**
4							$ -	$ -	$ -	$ -	$ -	$ -	84%	**$ -**
5	$ 60,000	Fab Inspection/access frame	$ 63,000			$ 50,000	$ 60,000	$ 113,000	$ 173,000	$ 34,600	$ 207,600	$ 233,656	79%	**$ 185,077**
6							$ -	$ -	$ -	$ -	$ -	$ -	75%	**$ -**
7							$ -	$ -	$ -	$ -	$ -	$ -	70%	**$ -**
8							$ -	$ -	$ -	$ -	$ -	$ -	67%	**$ -**
9							$ -	$ -	$ -	$ -	$ -	$ -	63%	**$ -**
10			$ 63,000	$ 75,000	$ 200,000		$ -	$ 338,000	$ 338,000	$ 67,600	$ 405,600	$ 529,216	59%	**$ 313,242**
11							$ -	$ -	$ -	$ -	$ -	$ -	56%	**$ -**
12							$ -	$ -	$ -	$ -	$ -	$ -	53%	**$ -**
13							$ -	$ -	$ -	$ -	$ -	$ -	50%	**$ -**
14							$ -	$ -	$ -	$ -	$ -	$ -	47%	**$ -**
15			$ 63,000	$ 75,000	$ 200,000	$ 50,000	$ -	$ 388,000	$ 388,000	$ 77,600	$ 465,600	$ 704,262	44%	**$ 311,496**
16							$ -	$ -	$ -	$ -	$ -	$ -	42%	**$ -**
17							$ -	$ -	$ -	$ -	$ -	$ -	39%	**$ -**
18							$ -	$ -	$ -	$ -	$ -	$ -	37%	**$ -**
19							$ -	$ -	$ -	$ -	$ -	$ -	35%	**$ -**
20			$ 63,000	$ 75,000	$ 200,000		$ -	$ 338,000	$ 338,000	$ 67,600	$ 405,600	$ 711,222	33%	**$ 235,068**
21							$ -	$ -	$ -	$ -	$ -	$ -	31%	**$ -**
22							$ -	$ -	$ -	$ -	$ -	$ -	29%	**$ -**
23							$ -	$ -	$ -	$ -	$ -	$ -	28%	**$ -**
24							$ -	$ -	$ -	$ -	$ -	$ -	26%	**$ -**
25			$ 63,000	$ 75,000	$ 200,000	$ 50,000	$ -	$ 388,000	$ 388,000	$ 77,600	$ 465,600	$ 946,469	25%	**$ 233,758**
26							$ -	$ -	$ -	$ -	$ -	$ -	23%	**$ -**
27							$ -	$ -	$ -	$ -	$ -	$ -	22%	**$ -**
28							$ -	$ -	$ -	$ -	$ -	$ -	21%	**$ -**
29							$ -	$ -	$ -	$ -	$ -	$ -	20%	**$ -**
30		Significant timber replacement	$ 63,000	$ 75,000	$ 1,000,000		$ -	$ 1,138,000	$ 1,138,000	$ 227,600	$ 1,365,600	$ 3,218,126	18%	**$ 593,927**
31							$ -	$ -	$ -	$ -	$ -	$ -	17%	**$ -**
32							$ -	$ -	$ -	$ -	$ -	$ -	16%	**$ -**
33							$ -	$ -	$ -	$ -	$ -	$ -	15%	**$ -**
34							$ -	$ -	$ -	$ -	$ -	$ -	15%	**$ -**
35		Significant timber replacement	$ 63,000	$ 75,000	$ 1,000,000	$ 50,000	$ -	$ 1,188,000	$ 1,188,000	$ 237,600	$ 1,425,600	$ 3,894,604	14%	**$ 537,111**
36							$ -	$ -	$ -	$ -	$ -	$ -	13%	**$ -**
37							$ -	$ -	$ -	$ -	$ -	$ -	12%	**$ -**
38							$ -	$ -	$ -	$ -	$ -	$ -	12%	**$ -**
39							$ -	$ -	$ -	$ -	$ -	$ -	11%	**$ -**
40			$ 63,000	$ 75,000	$ 100,000		$ -	$ 238,000	$ 238,000	$ 47,600	$ 285,600	$ 904,503	10%	**$ 93,214**
41							$ -	$ -	$ -	$ -	$ -	$ -	10%	**$ -**
42							$ -	$ -	$ -	$ -	$ -	$ -	9%	**$ -**
43							$ -	$ -	$ -	$ -	$ -	$ -	9%	**$ -**
44							$ -	$ -	$ -	$ -	$ -	$ -	8%	**$ -**
45			$ 63,000	$ 75,000	$ 100,000	$ 50,000	$ -	$ 288,000	$ 288,000	$ 57,600	$ 345,600	$ 1,268,854	8%	**$ 97,713**
46							$ -	$ -	$ -	$ -	$ -	$ -	7%	**$ -**
47							$ -	$ -	$ -	$ -	$ -	$ -	7%	**$ -**
48							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
49							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
50							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
Total	**$ 5,986,464**		**$ 378,000**	**$ 375,000**	**$ 1,800,000**	**$ 150,000**	**$ 5,986,464**	**$ 2,703,000**	**$ 8,689,464**	**$1,737,893**	**$ 10,427,356**	**$ 13,454,706**		**$ 8,984,324**

Appendix B – Hocking Heritage Assessment

HOCKING HERITAGE STUDIO

30 October 2016

Heather O'Keeffe
GHD
99 Hay Street
Perth
WA6000

Dear Heather

Tanker Jetty, Esperance
Heritage Comment on Bonacci Infrastructure's Proposals

Bonacci Infrastructure have provided information on alternative solutions that they claim would enable the *Tanker Jetty, Esperance* to be retained and therefore preserve its cultural heritage significance. Hocking Heritage Studio has been requested to provide heritage comment on these proposals and to determine what the heritage impact would be if such a proposal were implemented.

As European Heritage consultants, Hocking Heritage Studio acknowledge that there may be Aboriginal significance attached to the jetty but our comment is solely related to the impact of the proposal on the European heritage significance.

As a heritage listed place, the Tanker Jetty, Esperance is subject to the provisions of the Heritage of Western Australia Act 1990 and management of heritage places is guided by the principles and processes of the Burra Charter. Both the legislation and the guidance seek to conserve places of cultural heritage significance.

Bonacci Infrastructure propose two options to retain *Tanker Jetty, Esperance*:

Option 1: Baseline case
A cost effect solution to preserve the Jetty in its current position and at its current length. This proposal will:

- 'Preserve the jetty at its current length for use by the Esperance community and for tourism;
- Replaces the entire sub-structure with new material to address the Shire Council's primary safety, liability, insurance and maintenance concerns; and
- Retains the original superstructure, the deck curvature and the Jetty's physical positon for Heritage and Indigenous significance.'

The principle of this option is saving money but retaining the Jetty in its existing configuration. The timber piles would be replaced with new steel piles installed at a vertical rather than the traditional and existing 1:8 raked pile. This solution also requires that the new sub-structure bents be located 1.2m away from the existing bents to aid construction. The existing bents would become redundant and could be removed. This option further requires the existing stringer joints to be modified to allow

for the insertion of a 1.2m aluminium splice plate across each stringer joint, thus allowing for the retention of any sound jarrah stringers.

Any deteriorated stringers are to be replaced with a retrofitted aluminium beam located out of clear view thus preserving the existing aesthetic or replacement by a new compound hard wood stringer.

The existing concrete deck top is to be removed and replaced with a 130mm concrete walking surface, approximately 30mm deeper than the current deck. The existing concrete deck top has been poured onto a membrane which allows for easy removal allowing the existing hard wood timber boards to remain extant, though they will not function in a structural manner.

Option 2: Improved aesthetic and heritage case

This proposal seeks to improve the heritage outcome of the works and is based on Option 1. In Option 2, however, the replacement piles would be placed at the 1:8 rake angle as per the existing piles and the piles would be hardwood timber although steel tubular piles could also be used. Bonacci are recommending that the timber piles be fully wrapped to extend the projected lifespan of the piles to up to 75 years. Although timber piles would be used, a steel structure would still be required.

Additional works

In addition to the above two options, Bonacci Infrastructure are also recommending the replacement of the existing aluminium gangway leading from the foreshore to the jetty and constructing a wider gangway entry from salvaged jetty timber.

Assessment of heritage impact:

The significance of Tanker Jetty, Esperance is set out in the Statement of Significance in the Register Documentation for entry of the place into the State Register of Heritage Places:

- The place is a rare and good representative example of a substantially intact timber jetty on the coast of Western Australia, as one of only four comparable structures remaining in Western Australia;
- It has aesthetic significance due to its considerable size, scale and construction. Its visibility from the town of Esperance and its strong presence in the seascape ensure its landmark status and contributes to the Esperance community's sense of place;
- The place is valued by the community as it has been the site of commercial, social and recreational pursuits since its construction and for its association with the period of economic growth in the region in the 1930s and the development of local industries since that time; and
- The place is significant for bringing employment to many worked in the vicinity during the period of economic depression in the 1930s and is associated with the government's efforts to employ destitute men in a variety of jobs during this time.

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Therefore, if the above proposals are considered against the adopted Statement of Significance, there is some positive heritage outcome as the jetty would be retained in its original location and at its current length and therefore part its landmark status would be retained. It could continue in its function as a recreational facility and continue to contribute to the local community's sense of place. Whilst those are admirable outcomes, the actual proposals for 'retention' of the jetty require invasive and significant alterations that would have an impact on the cultural significance of the *Tanker Jetty, Esperance*.

The basis for retention of the jetty is founded on the needed to replace the entire substructure of the jetty. Piles have previously been replaced maintaining the important aesthetic of the structure, albeit in a slightly different location but contained within the width of the deck. Alterations have occurred ie. the concrete decking, the loss of the end section of the jetty and the construction of the aluminium gangplank access onto the jetty but in essence, the original construction method and aesthetic of the structure can still be seen. The two options for retention by Bonacci Infrastructure will have a detrimental impact on this aesthetic quality of the jetty.

Option 1 seeks to introduce a completely new steel substructure with vertical piers with the option of retaining or removing the existing timber substructure. Due to the alternative placement of the steel substructure, the original construction method and aesthetic of the jetty becomes confused and cluttered. Complete removal of the redundant timber substructure leaving only the new steel substructure would also remove a key aesthetic of the jetty and therefore irreparably harm the cultural heritage significance of the *Timber Jetty, Esperance.*

Option 2 proposed by Bonacci Infrastructure would still replace the entire substructure of the jetty but would do so in a manner more in keeping with the current aesthetic. The current timber piles would be replaced with treated timber piles but would still require a steel sleeve and frame which again would still have a negative impact on the aesthetics.

The new piles and new headstock proposed will effectively increase the width of the substructure. The proposals being considered appear to locate the new piers on the outer edge of the headstock which would create a new aesthetic and construction method to the jetty.

Although the proposals seek to retain the jetty in its original location, scale and current length, the extent of the works are described as reconstruction rather than restoration due to the significant amount of new material being introduced. The Burra Charter defines restoration and reconstruction as follows:

> Restoration: returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material.
>
> Reconstruction: means returning a place to a known earlier state and is distinguished from restoration by the introduction of new fabric.

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- It is proposed that all the timber piles and headstocks are to be replaced, with the option of retaining the existing though they will serve no function but will require on-going maintenance.
- The new piles and headstocks will be located at a new location and will be of greater width than the existing, changing the aesthetic
- The introduction of steel will impact on the traditional timber aesthetic of the jetty
- Approximately half of the stringers will need replacing.
- It is claimed that the timber deck can be retained but the existing non-original concrete top is to be replaced with a deeper concrete top.

In terms of heritage outcome, the proposals submitted by Bonacci Infrastructure have a low to moderate heritage outcome.

Positive heritage outcome:

- Retention of *Tanker Jetty, Esperance* in its original location and its current scale and length
- Continuation of *Tanker Jetty, Esperance* to be used in a recreational manner by the community and visitors
- Retention of a local landmark

Negative heritage outcome:

- Substantial loss of existing fabric
- Altered aesthetic
- Altered construction methodology
- Loss of authenticity
- Disturbance of potential archaeology

Statement of Significance	Heritage Outcome – Option 1
The place is a rare and good representative example of a substantially intact timber jetty on the coast of Western Australia; as one of one four (now three) computable structures remaining in Western Australia	The structure would be retained in its existing location but would no longer be regarded as 'a substantially intact timber jetty' due to the introduction of the steel substructure. Its physical comparison to Busselton Jetty and One Mile Jetty, Carnarvon would become tenuous, though historically would still form part of the timber jetty construction in Western Australia between 1832 and 1942.
It has aesthetic significance due to its considerable size, scale and construction. Its visibility from the town of Esperance and its strong presence in the seascape ensure its landmark status and contributes to the Esperance community's sense of place	Option 1 would retain the structure in its current location, scale and size and therefore maintain its strong presence in the seascape and remain a local landmark. The change of fabric from timber to steel and the change of construction method from raked piles to vertical piles would be greatly detrimental to the aesthetic value of the Jetty and also remove or obscure its original construction methods, for which it is valued. Changes in fabric are often acceptable in

	instances where a place of cultural heritage significance is being conserved but the introduction of such should not be to the detriment of the significance of the structure. The *Tanker Jetty, Esperance* was constructed as a timber jetty and should remain as such. Introduction of alternative materials should be limited and should contribute to the strengthening of the timber structure rather than replace the timber structure. Retention of the existing timber piles in addition to the new steel piles would confuse the legibility of the structure and clutter the space to the underside of the Jetty. This proposal would erode much of the heritage significance attributed to the *Tanker Jetty, Esperance*.
The place is valued by the community as it has been the site of commercial, social and recreational pursuits since its construction and for its association with the period of economic growth in the region in the 1930s and the development of local industries at that time	The works would not impact on this value
The place is significant for bringing employment to many workers in the vicinity during the period of economic depression in the 1930s, and is associated with the government's efforts to employ destitute men in a variety of jobs during this time.	The works will not impact on this value

Statement of Significance	**Heritage Outcome – Option 2**
The place is a rare and good representative example of a substantially intact timber jetty on the coast of Western Australia; as one of one four (now three) computable structures remaining in Western Australia	The structure would be retained in its existing location. The use of timber in the works would enable it to remain as a timber jetty however due to the alterations in construction method, it would not be regarded as a 'substantially intact' jetty as its proportions, placement of piles and steel structure would result in an altered appearance and construction form.
It has aesthetic significance due to its considerable size, scale and construction. Its visibility from the town of Esperance and its strong presence in the seascape ensure its landmark status and contributes to the Esperance community's sense of place	Option 2 would retain the structure in its current location, scale and size and therefore maintain its strong presence in the seascape and remain a local landmark. The new piles will be timber with a steel sleeve over the top section of the piles and a new steel headstock being installed. The piles will be installed at the tradition 1:8 rake. Although there will be an impact on the aesthetic appearance due to the introduction of the steel components and the construction method will have been altered, the aesthetic outcome is closer to the original and therefore

	has a better heritage outcome. No mention was made in this option as to whether the existing timber piles would be retained or removed.
The place is valued by the community as it has been the site of commercial, social and recreational pursuits since its construction and for its association with the period of economic growth in the region in the 1930s and the development of local industries at that time	The works would not impact on this value
The place is significant for bringing employment to many workers in the vicinity during the period of economic depression in the 1930s, and is associated with the government's efforts to employ destitute men in a variety of jobs during this time.	The works will not impact on this value

Although there is some heritage merit to Option 2, the works still require a substantial replacement of fabric. Some of the fabric being replaced is already non-original but there would be a loss of remaining original fabric and a high degree of introduced new material.

The archaeology of the seabed was not mentioned nor any indication as to how the existing piers would be removed from the seabed and whether a structural footprint of their location would be retained.

Whilst accepting that the jetty would remain in its original location and be of the same scale and size as the existing, the jetty would be largely rebuilt in either of these options and essentially be a new jetty. The works would be maintaining a landmark and a jetty that could still be used for recreation but the physical structure would be altered and authenticity of the structure would be much reduced.

Option 2 would have a marginally higher heritage outcome than total demolition and rebuild but the difference would be negligible.

Yours sincerely

G. L. Smith

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Appendix C – Reviewed Reports

Bonacci

BMT JFA

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Tanker Jetty, Esperance Remediation Report

Prepared for
The Jetty Group Incorporated

DOCUMENT HISTORY

ISSUE	REVISION	DATE	AUTHOR	REVIEWER
Revised Draft	B	11/10/2016	TJM	DH
Draft	A	22-09-2016	TJM	DH

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1 INTRODUCTION

Bonacci Infrastructure (Bonacci) was engaged by The Jetty Group Inc. following the decision of the Esperance Shire Council to invite Contractors to tender for the demolition of the Tanker Jetty, which located on the Esperance shoreline. The Jetty is 81 years old and is heritage listed, as it is one of only three (3) timber jetties left in Western Australia. The Jetty was closed to public assess, by the Council, last November following the release of a Condition Assessment report prepared by BMT JFA, on behalf of the Council.

2 PROFESSIONAL BACKGROUND AND QUALIFICATIONS

My name is Mr Terry James Memory. My CV is attached in Appendix D. I have 25 years' experience as a structural engineer, predominantly in the design and construction industry, but I also have academic experience and have on numerous occasions been engaged as an expert consultant/witness. I am a member of the following organisations:

- Member of the Institution of Engineers Australia (MIEAust)
- Chartered Profession Engineer (CPENG)
- Register Member of the Board of Profession Engineers Queensland (RPEQ)
- Register Member of the Board of Building Practitioners North Territory (Aust.)
- Member of the New Zealand Institute of Professional Engineers (IPENZ)

I am a principal and company Director of Bonacci Infrastructure whose registered office is Level 3, 51 Alfred Street, Fortitude Valley, QLD 4006, Australia.

My primary area of expertise lies in the design of civil infrastructure including marine works, mining and resources, bridges, tunnels and large scale water treatment facilities. A particular area of interest is the numerical modelling of soil and its interaction with structural elements and the subsequent design of those structural elements. Also attached, in Appendix C, are Bonacci Infrastructure company brochures dedicated to our speciality areas of Marine and Mining, and Construction Engineering.

3 DISCLOSURE OF INTEREST

Prior to preparing this report, I have had no involvement with the proposed demolition or preservation of the Tanker Jetty.

4 TERMINOLOGY

Throughout this report, engineering terminology is used to describe the Jetty and its condition or technical concepts. Below is a short list and explanation of these engineering terms.

- **Piles**: refers to the current HW timber piles that support the Jetty
- **Headstock**: refers to the horizontal structural element that both supports the Jetty Deck and is connected to the top of the piles.
- **Jetty Bent or Bent**: refers to the "frame" that is comprised of two piles and a headstock and on this Jetty are spaced at 4.6m along the length of the Jetty.
- **Corbel**: refers to the 1.5m long HW timber element that is horizontal and located above the piles and below the main deck. Its structural function is to reinforce the area above the pile by facilitating the spread of the pile load up through the corbel to the deck timbers.
- **Deck Stringers or Stringers**: refer to the main horizontal HW timbers that span from headstock to headstock. On this Jetty, each stringer is 9.2m long and each stringer spans two bays.

- **HW Decking**: refers to the HW deck planks that are laid across the stringers and are currently covered by a concrete deck.
- **Substructure**: refers to all the elements below the underside of the stringer
- **Superstructure**: refers to all the elements above the underside of the stringers, inclusive of the stringers.

Below is an image of a typical bent, showing the piles, headstock beam (connected to the pile via the halfcap joint), the timber corbel on the headstock and the stringers above the corbel. This particular images also shows one of the very few bents that still have the original (1935) timber piles still attached.

5 JETTY OWNERSHIP AND MAINTENANCE

The BMT JFA report cited above in the introduction did not condemn the structural integrity of the entire Jetty, however, it did highlight and warn of serious structural concerns that required immediate rectification. Additionally, the report highlighted the requirement for ongoing maintenance after the initial repair works.

In regard to Jetty maintenance, we understand that in 1987 the Esperance Port Authority contributed to and facilitated the replacement of 72No. original timber piles with new timber piles. Likewise, we understand that in 1990, the same process was repeated whereby another 148No. piles were replaced, courtesy of the Port Authority. Therefore, in 1990 a total of 220 piles had been replaced. The jetty currently utilises 224 piles.

With regard to ownership, the State Government of Western Australian is the owner of the Jetty. However, in August 1990 the Esperance Shire Council entered into a Licensing agreement with the State Government whereby the Shire was licensed to maintain and use the jetty. That is, the Shire Council accepted the responsibility to maintain and use the jetty as its' own and upon executing this licensing agreement. The State paid to the Shire Council a sum of $150,000 as part of the agreement. The terms and conditions of the license are clearly defined and include the following:

- to use the full amount of the said sum ($150,000) for the purpose of the restoration and repair of the Jetty Structure and the beautification of the adjoining foreshore and not to use any portion of the said money for any other purpose whatsoever.
- to forthwith establish a trust fund and to pay the whole of the said sum into that trust fund.

- To actively seek financial assistance and support from the private sector for the cost of restoration repairs and maintenance of the Jetty structure
- Forthwith to prepare and submit to the Minister for approval a written detailed program of the works to be carried out by the Licensee to fully restore the Jetty structure to a state of good safe and substantial repair order and condition.
- At its own expense to put and keep and maintain the jetty structure in a state of good and substantial repair order and condition at all times.
- Not to make any alteration in or addition to the Jetty structure or any part thereof with the written consent of the Minister first
- To insure the Jetty in an amount not less than two million dollars ($2,000,000)....
- At its own expense to restore the Jetty structure in accordance with the above referenced program of works and to carry out all restoration work on the Jetty Structure to the satisfaction and approval of the Minister.
- That upon the termination of this license by the Minister the Licensee (Shire Council) shall if requested by the Minister within 1 month thereafter remove from the licensed area the Jetty Structure including all piles and other parts below the water level….

It is therefore quite clear that the Shire Council entered into an agreement whereby they became solely responsible for both the full restoration of the Jetty and its ongoing maintenance. Given the current state of the Jetty it is reasonable to concluded that the Shire Council has demonstrably failed to fulfil the terms of their License agreement.

To our knowledge, the Council has not undertaken any planned and regular program of Jetty maintenance since it acquired responsibility to do so, in August 1990. Rather, intermittent repair works have been undertaken in response to localised structural failures or imminent failures. Below is a chronology of Jetty works expenditure by the shire Council since 1990.

Year	Total Expenditure	
1989/90	$	22,570
1990/91	$	-
1991/92	$	33,247
1992/93	$	11,070
1993/94	$	348,848
1994/95	$	-
1995/96	$	-
1996/97	$	-
1997/98	$	-
1998/99	$	-
1999/00	$	-
2000/01	$	9,536
2001/02	$	4,779
2002/03	$	22,804
2003/04	$	10,932
2004/05	$	15,159
2005/06	$	15,780
2006/07	$	6,881
2007/08	$	9,426
2008/09	$	37,728
2009/10	$	149,065
2010/11	$	131,647
2011/12	$	40,197
2012/13	$	29,104
2013/14	$	214,851
2014/15	$	37,913
2015/16	$	66,837
Total	**$**	**1,218,374**

Shire Council Expenditure on the Jetty Structure since 1990

The above total figure of $1.2M is approximately divided into $600K on capital improvements, $300K on general maintenance and $300K on reports and studies. On average, the Shire Council has spent only $11,000 p.a. on general maintenance of the Jetty.

In 2010 the Shire Council commissioned a detailed structural investigation report which was in turn used for a 2011 structural assessment report. The both the 2010 and the 2011 reports highlighted the need for regular maintenance, and areas of specific concern. In 2013 we understand that six (6) of the thirteen (13) pile identified in the 2010/2011 reports were sleeved and grouted – this being a relatively crude technique to prolong the life of a rotted timber pile. In 2013 another report was commission, by a different consultant, and again this report highlighted the need for immediate repair and maintenance. To our knowledge no serious efforts were made to repair or maintain the jetty, save for perhaps the application of protective tapes to slow the deterioration of piles below the water line. In 2015 a fourth report was commissioned and based on this report the Jetty was closed and structurally condemned by the Shire Council. Presently, the Jetty has two areas of severe and localised neglect. Being in bent 94, where a corbel timber has been dislodged and the deck has sagged approximately 300mm and bent 82 which is missing a pile. The Shire Council has temporarily propped the deck at bent 82, however, the circumstances surrounding the relatively recent removal of the pile are unclear.

6 HISTORICAL AND INDIGENOUS SIGNIFICANCE

The Tanker Jetty was constructed in 1935 and is now 81 years old. The name is derived from the fact that a key functional aspect of the Jetty was the transmission of petroleum between vessels and the adjacent fuel tank farm located on the shoreline. Originally, the Jetty was a commercial facility servicing the Esperance harbour. The Jetty itself was originally in excess of 872m long, complete with a Jetty Head for berthing vessels and a locomotive rail line from shore to Jetty head. The Jetty head was lost to deterioration some years ago and more seaward bents have been lost in the same manner and following a ship collision incident. Currently, the Jetty extends to bent 143, of the original 192 bents.

The recent foreshore redevelopment has also necessitated the demolition of the shore end of the Jetty, such that bent 31 is now the first remaining bent of the Jetty. An aluminium gangway presently spans the foreshore to bent 31, to enable access onto the Jetty. Currently the Jetty is comprised of 112 x 4.57m spans, on 113 twin pile bents. The Jetty is currently 512m long, configured as a graceful arch into the harbour.

During my trip to Esperance, I noticed and read the storyboards erected as part of the recent foreshore redevelopment. At the Jetty itself, the storyboards celebrate the Jetty via large-scale images of the Jetty's construction in 1935. Whilst I did not walk the entire length of the foreshore redevelopment, the apparent absence of any reference to the local indigenous heritage, acknowledgment or recognition was surprising to me.

The Jetty does have indigenous significance, however, it is not something to celebrate, rather to acknowledge and respect. In the past, the Jetty was the landmark delineating the boundary between colonial and indigenous communities and now known colloquially as the "line of sorrow". That is, historically, after night fall indigenous peoples were not permitted past the Jetty and thereby not permitted to enter the township of Esperance. Rather, they were to base themselves at Bandy Creek. Whilst this historical fact is clearly an anathema to any modern society, it is nevertheless a significant reminder of the prejudices and wrongs done in this country under the name of colonialism. I therefore submit that preservation of the Jetty and the documenting of this historical fact, via a storyboard at the Jetty, is a necessary and respectful acknowledgment of the past. To this end, I would suggest and encourage The Jetty Group to seek guidance from the local indigenous community, indigenous leaders and anthropologists.

7 PREVIOUS REPORTS

Since taking over the Jetty's maintenance, the Esperance Shire Council has commissioned several reports relating to the Jetty. These include:

Dec 2015…. "Esperance Jetties Condition Assessments – Condition Inspection and Maintenance Strategy Report", by BMT JFA, for Shire of Esperance

Sept 2014… "Esperance Tanker Jetty Replacement Concept Design and Costing", by BMT JTA, for Shire of Esperance

Sept 2013… "Esperance Jetties Condition – Jetty Condition Assessment Update", by BMT JFA, for Shire of Esperance

June 2011… "Esperance Tanker Jetty Structural Assessment – Structural Analysis Report", by BG&E, for Shire of Esperance

Oct 2010….. "Esperance Tanker Jetty Structural Assessment – Detailed Inspection Report", by BG&E, for Shire of Esperance

The 2015 report identifies the need for immediate repair to the Jetty, particularly at bent 94, where the corbel has both rotted and dislocated such that it is completely ineffective. The deck has subsequently and locally dropped the height of the corbel, being 320mm.

The 2015 report does not claim to be exhaustive in its assessment; rather it acknowledges that it has focussed on the areas of greatest concern. Therefore the report, if read in isolation, can inadvertently present the Jetty in a most unfavourable light. For the condition assessment, the BMT JTA report uses the "Wharf Structure Condition Assessment Manual" (WSCAM) published by Ports Australia. This manual recommends a 1-7 scale rating for deterioration, 7 being the worst. The table below is an extract from the manual, describing this rating system.

Condition State	Peak Score	Mean Score	Expected Rem. Life (% of Original Design Life)	Recommended Action
1	<5	0-3	100	No repairs required. Re-inspection at next scheduled inspection may be considered
2	5-14	4-12	55-100	No repairs required. Re-inspection at next scheduled inspection may be considered
3	15-39	13-31	40-55	Planned and preventative maintenance works may be considered.
4	40-69	32-55	25-40	Further testing; reactive maintenance and some minor upgrades may be considered.
5	70-89	56-71	15-25	Structural assessment is recommended. Maintenance; upgrade or rehabilitation works may be considered.
6	90-100	72-90	0-15	Structural assessment is recommended. Rehabilitation or renewal works may be considered.
7	>100	>90	0	Rehabilitation required immediately or replace component/asset.. Structural assessment is recommended where rehabilitation works are to be undertaken

Figure 1: Condition Rating Scale, courtesy of the WSCAM.

An important table in the report is the condition rating of the piles and headstock-pile joint, using the 1-7 scale cited above. This condition assessment is conveniently presented as a colour-coded table and is reproduced below for convenience. The conclusions that can be drawn from the table are thus:

1. With the exception of bents 93, 94, and 95, the southern pile-headstock (halfcaps) are general sound and attract a condition rating of 2-3.
2. The northern side halfcaps have in general suffered more deterioration compared to the southern side. Halfcaps on bents 33-45 and 133 have all attracted a 5-6 rating
3. The majority of piles have not been inspected and have been assigned a condition rating of 4, based on previous inspections. Only the piles in the worst condition have been inspected as part of the 2015 Report and these piles typically attracting a rating of 6-7.
4. The primary area of structural concern is the Jetty sub-structure, as opposed to the superstructure.

Critical Element (Pile and Half Cap) Condition Rating (WSCAM) Heat Map

	Date	South			North		Revision	Status		South			North		
	9/12/2015	East	West			East	West	C	Draft		East	West		East	West	
Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.	Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.
388	Pier 31	2	2	3	4	2	2	823/824	489/490	Pier 88	2	2	4	4	2	2	712/713
391	Pier 32	3	3	4	4	3	3	822/823	491/492	Pier 89	3	3	5	4	3	3	710/711
390/393	Pier 33	2	2	4	4	5	5	820/821	493/494	Pier 90	3	3	4	4	3	3	708/709
	Pier 34	2	2	4	4	5	5	818/819	495/496	Pier 91	2	3	4	6	4	4	706/707
392	Pier 35	2	2	4	4	5	6	816/817	497/498	Pier 92	2	2	4	4	5	3	704/705
396	Pier 36	2	2	5	4	6	5	397/815	499/500	Pier 93	6	5	4	7	2	2	702/703
399	Pier 37	2	2	4	4	6	6	812/813	501/502	Pier 94	6	6	4	4	2	2	700/701
406	Pier 38	2	2	4	4	6	5	810/811	503/504	Pier 95	7	6	4	4	4	4	698/699
	Pier 39	2	2	3	7	3	3	809	505/506	Pier 96	2	2	5	5	2	2	696/697
	Pier 40	2	2	4	4	6	6	404/405	507/508	Pier 97	2	2	4	4	2	2	694/695
	Pier 41	3	3	4	4	4	3	803/806	509/510	Pier 98	3	4	4	4	3	3	692/693
	Pier 42	2	2	4	4	5	3	411/412	511/512	Pier 99	2	3	4	4	3	3	690/691
	Pier 43	2	2	5	4	5	6	801/802	513/514	Pier 100	2	3	4	4	2	2	688/689
	Pier 44	2	2	4	4	5	6	799/800	515/516	Pier 101	3	5	4	6	2	2	686/687
	Pier 45	2	2	4	4	4	4	797/798	517/518	Pier 102	3	3	4	4	3	5	684/685
	Pier 46	2	2	4	4	4	4	795/796	519/520	Pier 103	2	2	5	4	2	3	682/683
	Pier 47	2	2	4	4	3	4	793/794	521/522	Pier 104	3	3	4	4	3	3	680/681
416	Pier 48	3	5	4	4	3	4	791/792	524/525	Pier 105	2	2	5	4	2	3	678/679
	Pier 49	2	2	5	5	4	3	789/790	526/527	Pier 106	3	2	3	4	2	2	676/677
	Pier 50	2	2	4	4	3	4	787/788	528/529	Pier 107	3	2	4	4	2	2	674/675
	Pier 51	2	2	4	4	3	3	786	530/531	Pier 108	4	3	4	4	2	2	672/673
	Pier 52	2	2	4	4	2	2	784/785	532/533	Pier 109	3	3	4	4	3	3	670/671
	Pier 53	2	2	6	4	2	2	782/783	534/535	Pier 110	3	3	5	4	3	3	668/669
423	Pier 54	2	2	4	7	2	2	780/781	536/537	Pier 111	2	2	4	4	2	2	666/667
425	Pier 55	2	2	4	4	2	2	778/789	538/539	Pier 112	3	3	5	6	2	2	664/665
424	Pier 56	3	3	4	5	3	3	776/777	540/541	Pier 113	3	3	4	4	3	3	662/663
429	Pier 57	3	3	4	4	3	3	774/775	542/543	Pier 114	3	5	4	4	2	2	660/661
430	Pier 58	2	2	6	4	3	3	772/773	544/545	Pier 115	2	2	3	4	2	3	658/659
	Pier 59	2	2	4	4	2	2	770/771	546/547	Pier 116	4	4	4	4	3	3	656/657
432	Pier 60	3	3	4	4	4	5	768/769	548/549	Pier 117	3	3	4	4	3	3	654/655
	Pier 61	3	3	3	4	3	3	766/767	550/551	Pier 118	3	3	4	5	3	3	652/653
	Pier 62	2	2	3	4	3	3	764/765	552/553	Pier 119	4	3	4	4	2	2	650/651
440	Pier 63	5	5	4	4	3	5	762/763	554/555	Pier 120	3	3	5	4	3	3	648/649
	Pier 64	2	2	4	4	2	2	760/761	556/557	Pier 121	2	2	5	4	3	3	646/647
	Pier 65	3	2	4	4	3	3	758/759	558/559	Pier 122	2	2	4	4	2	2	644/645
444/445	Pier 66	3	2	4	6	2	2	756/757	560/561	Pier 123	3	3	4	4	3	3	642/643
446/447	Pier 67	3	2	4	4	4	4	754/755	562/563	Pier 124	2	2	4	4	2	2	640/641
448/449	Pier 68	3	3	4	4	3	3	752/753	564/565	Pier 125	3	3	4	4	4	4	638/639
450/451	Pier 69	3	2	4	5	3	2	750/751	566/567	Pier 126	2	2	4	4	2	3	636/637
452/453	Pier 70	2	2	6	4	2	2	748/749	568/569	Pier 127	3	3	4	4	3	3	634/635
454/455	Pier 71	2	2	6	4	5	4	746/747	570/571	Pier 128	2	2	4	4	2	2	632/633
457/458	Pier 72	2	2	4	4	2	2	744/745	572/573	Pier 129	2	2	6	4	2	2	630/631
459/460	Pier 73	4	3	4	4	3	4	742/743	574/575	Pier 130	3	3	4	4	2	2	628/629
461/462	Pier 74	2	2	4	6	2	3	740/741	576/577	Pier 131	2	2	5	4	3	2	626/627
463/464	Pier 75	2	2	4	5	5	5	738/739	578/579	Pier 132	2	2	4	4	4	4	624/625
465/466	Pier 76	3	3	4	4	3	3	736/737	580/581	Pier 133	5	3	4	4	6	6	622/623
467/468	Pier 77	2	2	4	4	2	2	734/735	582/583	Pier 134	3	3	4	4	3	3	620/621
469/470	Pier 78	2	2	4	4	3	3	732/733	584/585	Pier 135	4	4	4	4	3	3	618/619
471/472	Pier 79	2	2	4	4	2	2	730/731	586/587	Pier 136	4	4	4	4	3	3	616/617
473/474	Pier 80	2	2	4	4	2	2	728/729	588/589	Pier 137	3	3	4	5	4	4	614/615
475/476	Pier 81	2	2	4	4	2	2	726/727	590/591	Pier 138	3	3	4	4	3	3	612/613
477/478	Pier 82	3	3	4	4	3	3	724/725	592/593	Pier 139	3	2	4	4	2	2	610/611
479/480	Pier 83	2	2	5	4	3	3	722/723	594/595	Pier 140	3	3	4	4	4	4	608/609
481/482	Pier 84	2	2	4	4	2	2	720/721	596/597	Pier 141	4	4	4	4	2	2	606/607
483/484	Pier 85	2	2	4	4	2	2	718/719	598/599	Pier 142	2	2	4	4	5	3	604/605
485/486	Pier 86	2	3	4	4	3	3	716/717	600/601	Pier 143	2	2	4	4	3	3	602/603
487/488	Pier 87	3	2	4	4	2	2	714/715									

Notes:

1 Condition rating scoring, from 1 (new) to 7 (failed) are in accordance with Ports Australia Wharf Structures Condition Assessment Manual

2 If a cell has a border [ ] this demarcates that the element has been inspected as part of this, if a cell has no border it's condition is approximated based on previous findings inspections or on general condition findings

3 Piles which have not been inspected have been given a condition rating of 4

4 Recently (2013) repaired piles have been given a condition rating of 3

5 Photo numbers relate to the photo files provided as supplemenatry information with this report

Figure 2: Pile and Halfcap Condition Summary, courtesy of the BMT JFA 2015 Report.

8 JETTY INSPECTION

The Jetty was inspected by myself over a two-day period between the 31/08 and 01/09. The Jetty was inspected from both deck level and under the deck, via boat. The inspection was very valuable as it facilitated independent validation of the previously commissioned condition assessments and resulted in the following independent conclusions being made:

a) That the Jetty sub-structure should only be rehabilitated with new materials, as opposed to trying to salvage the existing timber piles or headstocks for structural re-use.
b) Several external stringers have deteriorated to the extent that they needed replacement or strength augmentation. Below are typical examples of stringer that need replacement.

Examples of typical external stringers that require replacement or structural augmentation

c) The internal stringers appear to be in relatively good condition and this is most likely because they are shielded from direct sunlight and salt rich wind. Below are two images showing typical stringers.

Examples of typical internal stringers is relatively sound condition

d) The Jetty deck level is quite irregular and this irregularity should be corrected if the Jetty is rehabilitated.
e) The current concrete deck has sustained cracking and from both a structural and aesthetic point of view should be replaced as part of any rehabilitation regime.

8.1 Addressing Structural Concerns

In regard to the Jetty sub-structure I agree with the sentiment of the most recent Council commissioned report, that immediate rehabilitation is required. I also believe that it is not technically feasible to consider the reuse of any existing piles or headstock for structural purposes. That is, they may be retained or re-used for aesthetic purposes should that be deemed desirable. I am therefore of the opinion that the sub-structure needs to be completely replaced, however, I also believe this can be achieved with reasonable ease and at a cost that much lower than that suggested by the Council. The details of how this could be done are discussed later in Section 9 and the design drawings are contained in Appendix A.

As part of the proposed substructure replacement program, I have also included a construction methodology for re-levelling the deck. This concept is illustrated on Drawing S120 in Appendix A. In practice, this re-levelling task is simply an extra construction activity, undertaken whilst installing the new Jetty bent.

In total there are 48 external stringers that have been identified by myself as requiring replacement or structural augmentation. In section 9 below, I discuss the proposed stringer replacement or strengthening options.

The concrete deck surface is currently laid over the top of the original HW decking and is separated from (debonded) from the HW via a plastic membrane that was placed over the decking, prior to the concrete being poured. Removal of the existing concrete shall therefore be quite easy as it is effectively “loose” on the deck. We recommend that this deck be replaced as part of the rehabilitation program for structural and aesthetic reasons.

8.2 Addressing Community Concerns

The immediate concern for the community is the potential loss of their Jetty. It is easy for critics to dismiss the Jetty as little more than a fishing platform, however, having spoken to several people in the Esperance community it is clear that the Jetty provides the following:

- Yes, it is a fishing platform and also a facility that offers a 500m long promenade or jog route.
- It is an historic and iconic landmark that significantly contributes to the identity of the town and the people who dwell in it.
- It is a constant, that has linked generations along an 81 year timeline and if rehabilitated will continue to do so for generations to come.

On the counter side, should the Jetty be demolished, the following is true:

- There is no coherent or funded plan to rebuild the Jetty. Currently the only publicly released document pertaining to any new Jetty is the BMT JTA Jetty Options Study of Sept 2014 and some 19 pages long. Furthermore, I understand Shire Council do not have funds available for any new Jetty and nor has it made any meaningful commitment to raise funding for a new Jetty.
- The Jetty length option promoted by the Council is notionally 250m, compared to the current Jetty that is 512m long. A 250m long Jetty would end in 3.1m deep water (at LAT) compared to the current termination in 6m deep water (at LAT).
- Should the current Jetty be demolished prior to securing funding for a new Jetty, as is currently the case, there is a lost opportunity cost. This is because the securing of State or Federal funding for the new Jetty will be become increasingly difficult as the community and businesses adjust to not having a Jetty.

8.3 Addressing Council Concerns

As an experienced marine and civil engineer I am quite cognisant of the technical and liability issues faced by the Esperance Shire Council in regard to the Jetty. Presently and given the recent BMT JFA Report it is most likely that the Jetty is uninsurable and this the core reason why the Jetty has been closed. With regard to durability, however, I would suggest that the core issue for the Council is both the current and future liability of the Jetty sub-structure, and in particular the components in the tidal zone or below. This is simply because these elements on a marine structure are always the most vulnerable in terms of deterioration – as evidenced on the Tanker Jetty.

Accordingly, any rehabilitation plan must necessarily address both the current, poor condition of the Jetty's substructure and also the future life of the substructure, in particular the piles. The plan described in Section 9 below does both of these things. Importantly, the plan restores the Jetty's sub-structure to brand new condition with a 30-50 year design life, depending on the maintenance program.

Importantly, the rehabilitation program proposed also enables structural certification of the remediated Jetty and this is essential to facilitate the execution of insurance policies.

8.4 Addressing Heritage Concerns

The Jetty is heritage listed, however, had it not been for the intervention of The Jetty Group this Heritage status would have been passed over to facilitate the Jetty's demolition. Indeed, this report is written as part of a submission to the WA Heritage Council. A key part of any heritage preservation is the preservation of the aesthetic, if not the components themselves. Within this report I recommend that the entire Jetty substructure be replaced and likewise, the entire original superstructure be retained, save for the repaired stringers. This is a compromised position and indeed it could be argued that more could be done to preserve both the aesthetic and materials, relative to the baseline case presented below in Section 9. I agree which this position, however, the greater the preservation, the greater the cost. Notwithstanding the cost argument, I have provided the second proposal which better captures the current Jetty aesthetic, should extra (heritage) funding become available.

9 TECHNICAL SOLUTIONS TO REMEDIATE THE JETTY

Below I present two options for the rehabilitation of the Tanker Jetty. Option 1 is referred to as the baseline case as it represents the most cost-effective solution, but not necessarily the most heritage or aesthetically sensitive solution. This baseline solution has been developed in the absence of any committed rehabilitation funding. It has also been developed as a comparison to the Esperance Shire Council's claim that the Jetty cannot be saved for less than $10M, and moreover, the suggestion that the Council should allocate such funds, should they become real, to the construction of a new, shorter, Jetty.

9.1 Key Design loads

The rehabilitation design proposed herein assumes no vehicles are permitted on the Jetty deck, rather, the design is governed by crowd loading, taken as 5kPa (500kg/m2). Additionally, 10% of this crowd loading has been considered to act simultaneously in the horizontally direction at deck level.

Wave loading on the substructure has also been considered. A design wave with a height of 3m and a period of 7sec was considered. Such a wave would have a crest level just below the underside of the deck at Highest Astronomic Tide (HAT). The lateral force generated on the piles by this wave is equal to the 10% lateral loading cited above.

9.2 The need for design innovation

From a technical point of view the reporting commissioned by the Council to date has failed to effectively address the central issue, which is, *How could the Jetty be rehabilitated?* I don't believe this question has ever been addressed and maybe it has never been asked. In the most recent BMT JFA report there is reference to the fact that the Jetty is already on its second round of piling and the idea of a third round of piling is largely dismissed as impractical. Indeed, I would agree that to re-pile in the same plane as the existing bents would be impractical, so much so that it necessarily means one should look to re-piling in a different location. This is precisely why the solutions presented below and in Appendix A show the new pile bents 1.2m from the existing. Doing this means that the new bents can be installed without interfering with the existing and likewise, the existing bents can be readily removed after the new bents are installed. This idea is the fundamental difference between this report and all previous reports that suggest, or infer, that rehabilitation is not possible or not practical.

9.3 Option 1 – Baseline Case

The baseline case is presented herein as the most cost-effective solution to preserve the Jetty in its current position and at its current length. It is also the solution that seeks to achieve the lowest cost base whilst addressing the key concerns and aspiration of stakeholders. That is, it is a solution that:

- Preserves the Jetty at is current length for use by the Esperance community and for tourism.
- Replaces the entire sub-structure with new material to address the Shire Councils primary safety, liability, insurance and maintenance concerns.
- Retains the original superstructure, the deck curvature and the Jetty's physical position for Heritage and Indigenous significance.

9.3.1 New Pile Configuration

The existing Jetty has piles installed on the incline, known as raked piles. The inclination of the rake is 1:8. Construction of raked piles is significantly more difficult than the installation of vertical piles. This is primarily because the temporary housing required to support a raked pile during its installation is more complex than that required for a vertical. This is because the driving hammer is inclined and also offset from the pile toe - because of the rake. This lateral offset generates temporary lateral loads during the driving operation and these loads need to be resisted by either the Jetty or the barge from which the piling is being undertaken.

The Jetty in its current condition can only sustain very modest lateral loads and would not be able to resist the temporary loads generated by the driving of raked piles without the inclusion of a secondary support system. This means that the cost and time required to install raked piles would be greater, compared to vertical piles. It was on this basis that vertical piles are proposed for the Baseline case.

9.3.2 The argument for a sleeved pile arrangement

The baseline case incorporates a pile sleeve arrangement. This technique is used to minimise fabrication works over water, or put another way, it is a technique used to maximise fabrication onshore, in a controlled workshop environment. The technique seeks to have entire headframe, or headstock in this case, fabricated offsite and to have these units subsequently installed in a "single" operation. The headstock assembly is therefore fitted with tubes that are larger than the piles and the idea is that the entire assembly can be fitted, or slid, over the driven piles. The gap between the pile and sleeve is filled with a concrete grout to bond the two components together. This technique is common in marine engineering and used throughout Australian and the world.

For the Tanker Jetty it is impossible to slide the new headstock over the previously driven piles because the headstock must be fitted under the existing Jetty. The logical solution is therefore to drive

the piles through the sleeve and therefore the headstock assembly must be secured to the Jetty prior to pile installation. I have previously designed a system just like this for the construction of a 140m long temporary bridge in Mackay, Queensland. Below is an image of the suspended headstock frame, complete with sleeves, prior to the piles being inserted (into the sleeves) and driven. In the image below the penultimate bent has the completed pile installed plus a rod suspension system for level adjustment.

Figure 3: Example of a previous program in which piles were driven through a suspend headstock.

The sleeve arrangement is therefore fundamental to the success of the sub-structure rebuild, as it facilitates:

a) High quality offsite fabrication and painting of the entire headstock, with no requirement for welding or painting over water.
b) A temporary piling gate arrangement is not required as the sleeve performs this function.
c) Pile position tolerance is guaranteed as the piles are driven through their permanent headstock.
d) Headstock installation can be advanced ahead of the piling works to ensure this activity is not on the construction programs critical path.
e) Prior to grouting the pile-sleeve assembly, the pile and sleeved headstock can be used to relevel the deck.

9.3.3 New Pile Bent Position

As previous mentioned herein, it is impractical to consider the installation of a new sub-structure bent in the same location as the current bent. It is therefore proposed that the new bents be located 1.2m away from the existing bents. The 1.2m distance was selected for practical reasons to aid in construction and in this sense there is some latitude to alter the dimension should there be an argument to do so.

The proposed design assumes that the existing bents provide no support to the rehabilitated Jetty and therefore the existing bents can be completed removed, if so desired. Presently there is a butt joint between adjacent stringers on every second bent - each stringer spans two bents. Clearly, an existing bent under a stringer joint can't be removed prior to the joint being modified. The modification proposed is the installation of a 1.2m long aluminium slice plate across each stringer joint. The plate does not need to reinstate the flexural capacity of the stringer, rather, its design purpose is to transfer only shear between the two stringers. The splice detail has been developed assuming the stringers are seasoned Jarrah with a joint strength Group classification of JD2. The slice detail is shown on drawing S107.

9.3.4 Superstructure works

The existing HW stringers are generally in good condition, with the exception of several external stringers, which display unacceptable deterioration. These individual stringers have been identified on the rehabilitation drawings and must be replaced, or repaired. The proposal herein includes two options for this repair, either using a retrofitted aluminium beam, that will be hidden from view, or a new compound HW timber member. Both options are equally viable and shown on Drawing S108.

A new 130mm thick concrete walking surface is proposed for the Jetty. The current decking is 100mm thick fibremesh. The new concrete deck has been sized to carry the 5kPa crowd load in full. That is, the existing original HW deck timbers, that shall remain in place, are not required from a strength point of view, rather, they will function only as the soffit form - as they did for the original concrete pour.

9.3.5 Durability

The Baseline case presents a steel sub-structure solution, which is typical for modern marine works in Australia. The durability treatment that has been assumed and costed within this report is as follows:

a) All mild carbon steel has been sized assuming a 3mm corrosion loss all round.
b) A passive zinc anode cathodic protection system for all piles has been assumed and costed.
c) A marine epoxy paint system, such as Interzone 954, to all mild carbon steel has been assumed and costed.

The durability regime listed above is typical for all modern commercial marine infrastructure around Australia, save for the fact that on major infrastructure an impressed current cathodic protection system is used, as opposed to the anode system proposed here. Such a regime is considered to provide a design life of 30-50 years depending on the degree of maintenance provided by the asset owner and the prevailing environmental conditions (water temperature, swell height).

9.4 Option 2 – Improved aesthetic and heritage case

The baseline case was developed to fulfil the requirement for the most cost effective design solution. The aesthetic of vertical piles is, however, not overly sympathetic to the original bent geometry. Accordingly, a second design option is presented, refer drawing S115, which is in principle similar to the baseline case, however, there are two key differences. Those being the piles are installed with the 1:8 rake, as per the current Jetty, and the piles are shown as HW timber piles. Whilst not shown on the drawings, the use of steel tubular piles (instead of HW timber) for this case is very much an option.

The use of unprotected HW timber piles does have the potential to attract durability concerns. The Australian Guidelines for the Design of Maritime Structures, AS4997, suggests that timber piles exposed to marine organisms have an expected duration until the "first maintenance" of 5-10 years. Conversely, if the pile is not exposed to marine organisms the duration to first maintenance is cited as

10-30 years. It is important to appreciate that exposure is not necessarily connected to chemical treatment of the pile. That is, a chemically treated pile may still be vulnerable to marine organism attack, such as the toredo worm. The best protection available for a timber pile is to physical wrap it in a membrane to prevent exposure to the marine organism larvae that migrate through the tidal zone.

The most likely source for HW piles would be the Australian supplier “Koppers”. Kopper’s recommend double H6 chemical treatment for marine piles and suggest that this treatment, in southern (cooler) waters, will achieve a design life of 30 years. If the pile is wrapped with a membrane, they suggest a 75 year design life is achievable.

At this stage we have opted to show a full wrap system for timber piles, to avoid debate over durability issues. The protection system proposed is the Denso “Seashield Series 60 System”, a copy of the supplier’s Brochure is included in Appendix B. A final visible sheath of this wrapping system is black HDPE (plastic). The visible portion of the piles will therefore be black in colour.

9.5 Abutment works and Heritage Opportunity

The current abutment span is a 20m long aluminium gangway onto the existing Jetty. The gangway is approximately 1.9m wide (clear), whereas the Jetty is 4.6m wide. A photo of the gangway-jetty connection is shown below. It has been assumed that this existing arrangement will remain for the baseline case, to minimise costs. However, the opportunity exists to improve upon this somewhat unattractive and relatively narrow entrance onto the Jetty. In particular, I suggest consideration be given to the design of a special feature “Entry span” constructed from or featuring original and salvaged Jetty timber. We suggest the cost of such an entry span (4.6m wide x 20m long) would be in the order of $200,000.

Current aluminium gangway span onto the Jetty

10 REHABILITATION COSTING AND CONSTRUCTION PROGRAM

The baseline case presented in the design drawings (Appendix A) was issued to a third party Marine construction contractor based in Western Australia. This company has provided an independent construction estimate for the project and they are also a contender for executing the works should they proceed. Below is a high level Capital Cost summary followed by a more detailed breakdown. The headline construction cost is $5.9M but a 20% contingency allowance takes the estimate, for budgetary purposes, to $7.1M.

High Level Cost Estimate Breakdown		
Item	Cost	
Mobilisation and Preliminaries	$	467,150
New Piling works	$	2,044,336
New Headstocks and removal of existing bents	$	2,442,720
New ConcreteDeck & Stringer repair	$	397,698
New Deck furniture and lighting	$	324,560
Professional Services	$	250,000
Total	**$**	**5,926,464**
Contingency (20%)	$	1,185,293
Budget Estimate	**$**	**7,111,756**

Figure 4: Capital Cost Summary.

Cost	Description	No. off	Unit price	Unit weight kg/m	Unit length m	Total weight kg
	Mobilisation and Preliminaries					
$ 287,658	Mobilisation and demobilisation	1	287,658			
$ 127,168	Insurance and Project Management	1	127,168			
$ 52,324	Existing Services removal	1	52,324			
	New Piling works					
$ 2,044,336	Dia. 323 x 9 Pile (avg. length 16m)	224	9,127	73.7	16.000	264,141
	Marine epoxy finish to 3m below bed level (Interzone 954)	item				
	Surveyor costs	item				
	Zinc anode CP System (supply and installed)	item				
	Labour and Installation costs	item				
	New Headstock + stringer splice plates					
$ 2,442,720	200x150x9 RHS Headstock	112	21,810	37.7	4.900	20690
	89x6 Btm Chord	112		14.6	4.900	8012
	89x6 Braces	224		14.6	3.000	9811
	Dia. 406x9.5 Pile Sleeve	224		93.0	2.400	49997
	Marine epoxy finish	item				
	Supply and install Alum. String splice plates	275		4.05	1.2	1337
	Re-leveling of deck	item				
	Removal of existing substructure below stringer level	item				
	Labour and barges	item				
	Deck Remediation					
$ 50,000	Removal of existing concrete deck	item				
$ 100,425	New 130mm concrete deck, 4.57m wide	515	195			
$ 52,273	New HW edge kerb (120x35)	1030	50.75			
$ 27,000	Kerb brackets	900	30			
$ 168,000	Replace/reposition rotten stringers	48	3500			
	Deck Furniture and Services					
$ 79,200	Supply and Install Hydrib light, 6m HDG hinged pole	6	13,200			
$ 109,180	Alum. handrail and posts northern side	515	212	3.025	515	1558
$ 109,180	Alum. handrail and posts southern side	515	212	3.025	515	1558
$ 15,000	Fish Cleaning station + water supply	1	15000			
$ 12,000	Bench seating along jetty	10	1200			
	Professional Services					
$ 200,000	Civil and Structural Design	item				
$ 20,000	CP Design	item				
$ 15,000	Pile PDA testing, 4 No. test	item				
$ 15,000	Timber strength testing	item				
$5,926,464	**Total**					
$ 1,185,293	Contigency	20%				
$7,111,756	**Grand total**					

Figure 5: Capital Cost Breakdown.

10.1 Whole of Life Costing

Below is a whole of life, net present value (NPV), costing for the Jetty over the next 50 years. The 50 year whole of life costing for the baseline solution is $9M. As shown in the table, maintenance works are programed every five (5) years and the NPV of these works vary from $100K to $600K on each occasion. Over the 50 year period the total amount allocated to repair and maintenance is $1.9M, meaning on average the annual maintenance budget of approximately $38,000 (NPV) is required.

Whole of Life Costing

	Capital Costs		Maintanence				Sub-Total Summary		NPV Assessment					
Year	Cost	Description	Inspections	Paint Repair (sub-structure)	Timber repair (superstructure)	Anode inspection (Dive team)	Capital Exp	Maintanence Sub total	Cap Ex + Maintanence	Contingency (20%)	Cap Ex + Maintanence+ Contigency	+ Inflation @ 3% pa	Discount @ 6% pa	NPV
1	$ 5,926,464	Jetty Rehabilitation					$ 5,926,464	$ -	$ 5,926,464	$1,185,293	$ 7,111,756	$ 7,111,756	100%	**$ 7,111,756**
2							$ -	$ -	$ -	$ -	$ -	$ -	94%	**$ -**
3							$ -	$ -	$ -	$ -	$ -	$ -	89%	**$ -**
4							$ -	$ -	$ -	$ -	$ -	$ -	84%	**$ -**
5	$ 60,000	Fab Inspection/access frame	$ 63,000			$ 50,000	$ 60,000	$ 113,000	$ 173,000	$ 34,600	$ 207,600	$ 233,656	79%	**$ 185,077**
6							$ -	$ -	$ -	$ -	$ -	$ -	75%	**$ -**
7							$ -	$ -	$ -	$ -	$ -	$ -	70%	**$ -**
8							$ -	$ -	$ -	$ -	$ -	$ -	67%	**$ -**
9							$ -	$ -	$ -	$ -	$ -	$ -	63%	**$ -**
10			$ 63,000	$ 75,000	$ 200,000		$ -	$ 338,000	$ 338,000	$ 67,600	$ 405,600	$ 529,216	59%	**$ 313,242**
11							$ -	$ -	$ -	$ -	$ -	$ -	56%	**$ -**
12							$ -	$ -	$ -	$ -	$ -	$ -	53%	**$ -**
13							$ -	$ -	$ -	$ -	$ -	$ -	50%	**$ -**
14							$ -	$ -	$ -	$ -	$ -	$ -	47%	**$ -**
15			$ 63,000	$ 75,000	$ 200,000	$ 50,000	$ -	$ 388,000	$ 388,000	$ 77,600	$ 465,600	$ 704,262	44%	**$ 311,496**
16							$ -	$ -	$ -	$ -	$ -	$ -	42%	**$ -**
17							$ -	$ -	$ -	$ -	$ -	$ -	39%	**$ -**
18							$ -	$ -	$ -	$ -	$ -	$ -	37%	**$ -**
19							$ -	$ -	$ -	$ -	$ -	$ -	35%	**$ -**
20			$ 63,000	$ 75,000	$ 200,000		$ -	$ 338,000	$ 338,000	$ 67,600	$ 405,600	$ 711,222	33%	**$ 235,068**
21							$ -	$ -	$ -	$ -	$ -	$ -	31%	**$ -**
22							$ -	$ -	$ -	$ -	$ -	$ -	29%	**$ -**
23							$ -	$ -	$ -	$ -	$ -	$ -	28%	**$ -**
24							$ -	$ -	$ -	$ -	$ -	$ -	26%	**$ -**
25			$ 63,000	$ 75,000	$ 200,000	$ 50,000	$ -	$ 388,000	$ 388,000	$ 77,600	$ 465,600	$ 946,469	25%	**$ 233,758**
26							$ -	$ -	$ -	$ -	$ -	$ -	23%	**$ -**
27							$ -	$ -	$ -	$ -	$ -	$ -	22%	**$ -**
28							$ -	$ -	$ -	$ -	$ -	$ -	21%	**$ -**
29							$ -	$ -	$ -	$ -	$ -	$ -	20%	**$ -**
30		Significant timber replacement	$ 63,000	$ 75,000	$ 1,000,000		$ -	$ 1,138,000	$ 1,138,000	$ 227,600	$ 1,365,600	$ 3,218,126	18%	**$ 593,927**
31							$ -	$ -	$ -	$ -	$ -	$ -	17%	**$ -**
32							$ -	$ -	$ -	$ -	$ -	$ -	16%	**$ -**
33							$ -	$ -	$ -	$ -	$ -	$ -	15%	**$ -**
34							$ -	$ -	$ -	$ -	$ -	$ -	15%	**$ -**
35		Significant timber replacement	$ 63,000	$ 75,000	$ 1,000,000	$ 50,000	$ -	$ 1,188,000	$ 1,188,000	$ 237,600	$ 1,425,600	$ 3,894,604	14%	**$ 537,111**
36							$ -	$ -	$ -	$ -	$ -	$ -	13%	**$ -**
37							$ -	$ -	$ -	$ -	$ -	$ -	12%	**$ -**
38							$ -	$ -	$ -	$ -	$ -	$ -	12%	**$ -**
39							$ -	$ -	$ -	$ -	$ -	$ -	11%	**$ -**
40			$ 63,000	$ 75,000	$ 100,000		$ -	$ 238,000	$ 238,000	$ 47,600	$ 285,600	$ 904,503	10%	**$ 93,214**
41							$ -	$ -	$ -	$ -	$ -	$ -	10%	**$ -**
42							$ -	$ -	$ -	$ -	$ -	$ -	9%	**$ -**
43							$ -	$ -	$ -	$ -	$ -	$ -	9%	**$ -**
44							$ -	$ -	$ -	$ -	$ -	$ -	8%	**$ -**
45			$ 63,000	$ 75,000	$ 100,000	$ 50,000	$ -	$ 288,000	$ 288,000	$ 57,600	$ 345,600	$ 1,268,854	8%	**$ 97,713**
46							$ -	$ -	$ -	$ -	$ -	$ -	7%	**$ -**
47							$ -	$ -	$ -	$ -	$ -	$ -	7%	**$ -**
48							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
49							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
50							$ -	$ -	$ -	$ -	$ -	$ -	6%	**$ -**
Total	**$ 5,986,464**		**$ 378,000**	**$ 375,000**	**$ 1,800,000**	**$ 150,000**	**$ 5,986,464**	**$ 2,703,000**	**$ 8,689,464**	**$1,737,893**	**$ 10,427,356**	**$ 13,454,706**		**$ 8,984,324**

10.2 Construction Program (Timing)

With respect to program, different Marine contractors will use different plant and may approach the construction staging in different ways. Nevertheless, there are practical constraints that will be common to all bidders of the work and in this sense a construction program estimate can be developed. Again, I have sought and received external advice concerning construction timelines and offer the following summary for the purposes of preliminary planning. I highlight my expectation that this preliminary program is likely to be reduced in a competitive tender situation.

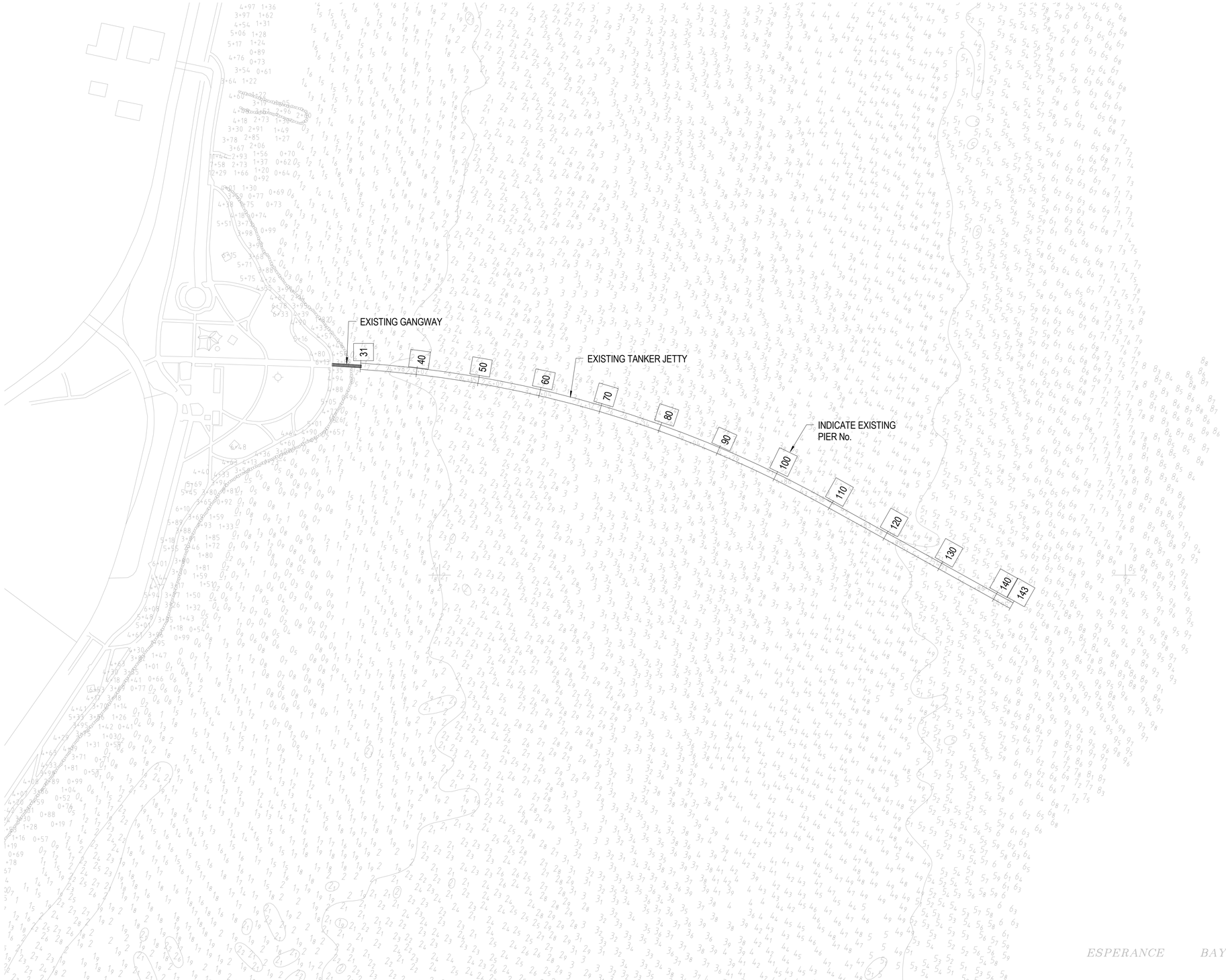
Whilst undertaking water based construction activities, I suggest that the contractor should program the works such that the critical path (a program concept) is the installation and driving of piles. Removal of the existing concrete deck and its replacement should be off the critical path. Likewise, the stringer replacement should be off the critical path and this is done by having a separate work front for this activity. If this is done, the headstock installation could be programmed as the critical path on a 1.5 day cycle time in which all other activities happen in parallel and off the critical path. Doing this brings the core construction program to 34 weeks (28 weeks const. + 6 weeks inclement weather). As per the budget cost estimate, allow for a 20% contingency this means the entire construction program could take up to 40 weeks to complete.

In addition to the above, the Jetty could be progressively opened to the public, in say 3No. x 170m long sections. Below is a high level overall program after funding is secured:

- 1 month for Design and Consultation
- 1 month for Approvals and Shire Council ratification
- 1 month tender period
- 1 month to review tender, negotiations and award.
- 1 month post award before the Contractor is mobilised on site, plus the commencement of early procurement activities (1st batch of piles and headstocks + painting).
- 9 months construction, but open a 170m long section every 3 months

Appendix A: Design drawings

REFERENCE OF PLT SHEET ONLY - DO NOT SCALE DRAWING CONTENT



GENERAL ARRANGMENT - EXISTING TANKER JETTY

SCALE 1 : 1500

Issue	Revision	Date	By	App.
P2	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P1	PRELIMINARY ISSUE	30.08.16	FS	TJM

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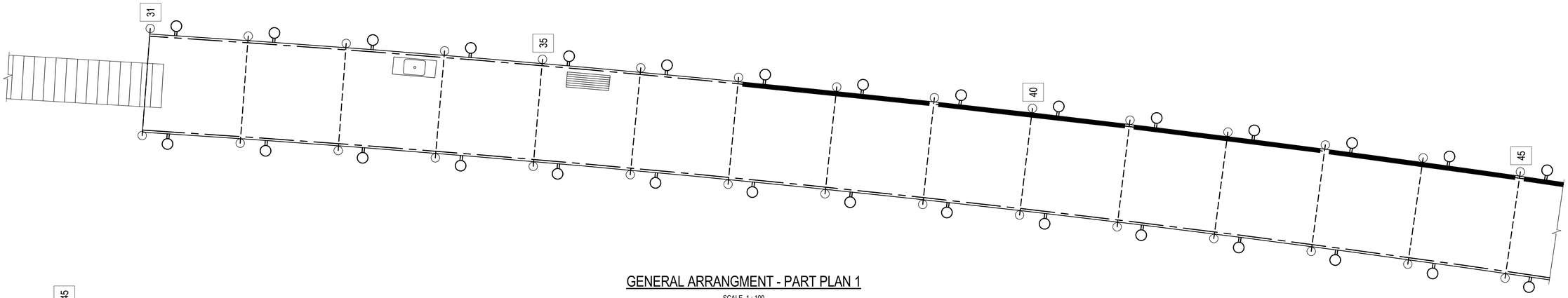
Project
TANKER JETTY
REHABILITATION

Drawing Title
GENERAL ARRANGEMENT PLAN

PRELIMINARY

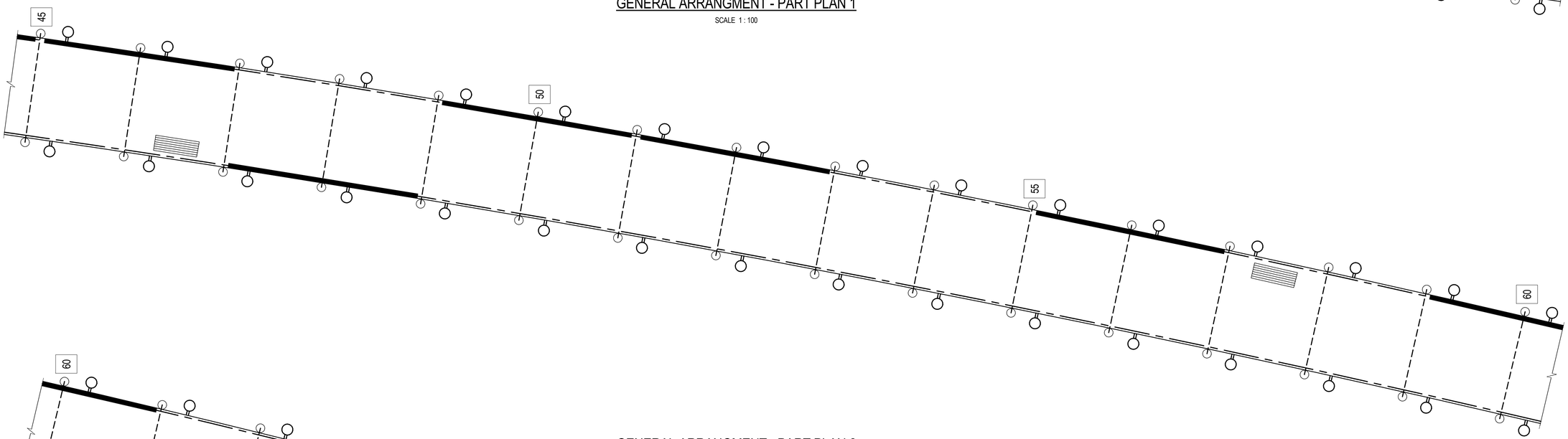
Designed	TJM	Project Director Approved	Date: SEP 2016
Drawn	FS		North
Scale	AS SHOWN	Project Ref: B4222	Drawing No: S101
Date			Issue: P2

Plotted on: 7/09/2016 3:06:00 PM



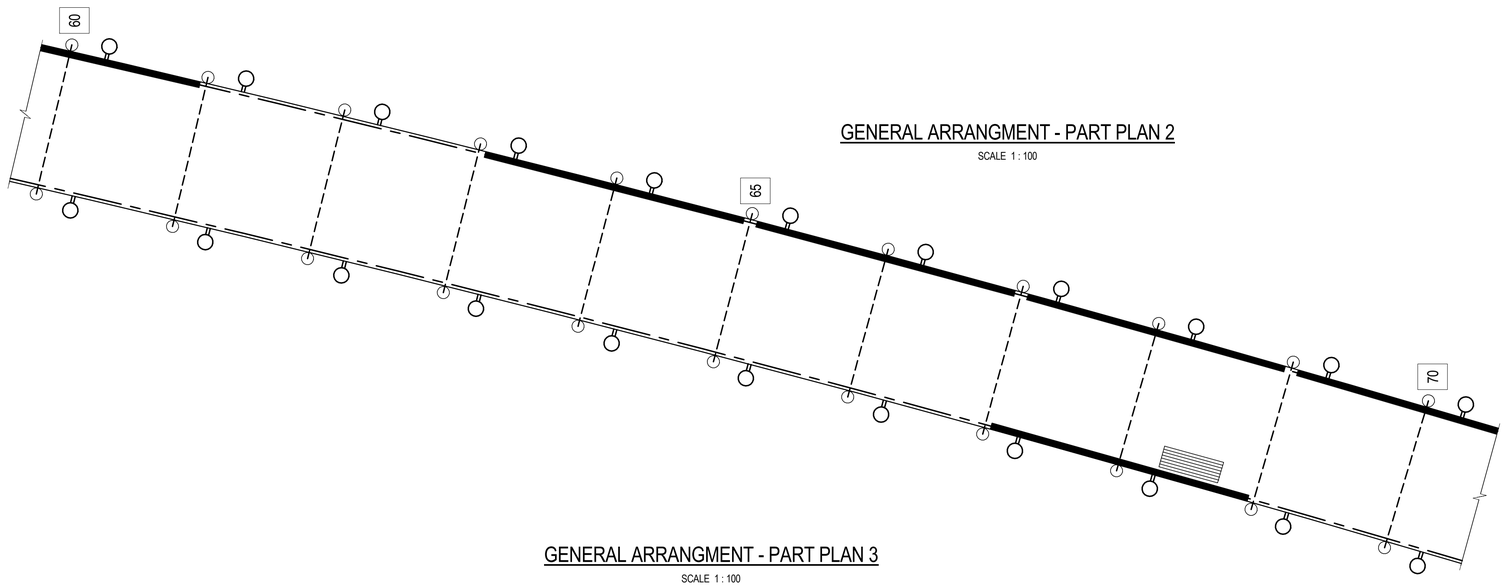
GENERAL ARRANGMENT - PART PLAN 1

SCALE 1 : 100



GENERAL ARRANGMENT - PART PLAN 2

SCALE 1 : 100



GENERAL ARRANGMENT - PART PLAN 3

SCALE 1 : 100

REFER DRG...S103 FOR CONTINUATION

LEGEND:

- DENOTES EXISTING PILES & HEADSTOCKS
- DENOTES NEW PILES & HEADSTOCKS
- DENOTES REPLACEMENT OF EXISTING STRINGER LOCATIONS
- DENOTES HANDRAIL EXTENT
- DENOTES BENCH SEATING
- DENOTES FISH CLEANING STATION

Issue	Revision	Date	By	App.
P3	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P2	PRELIMINARY ISSUE - SECTIONS ADDED	05.09.16	FS	TJM
P1	PRELIMINARY ISSUE	29.08.16	FS	TJM

Issue	Revision	Date	By	App.

Issue	Revision	Date	By	App.

Bonacci Infrastructure
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Project
TANKER JETTY REHABILITATION

Drawing Title
GENERAL ARRANGEMENT PART PLANS - SHEET 1

PRELIMINARY

Designed	TJM	Project Director Approved	Date	North
Drawn	FS		SEP 2016	
Scale	AS SHOWN	Project Ref	Drawing No	Issue
Date		B4222	S102	P3

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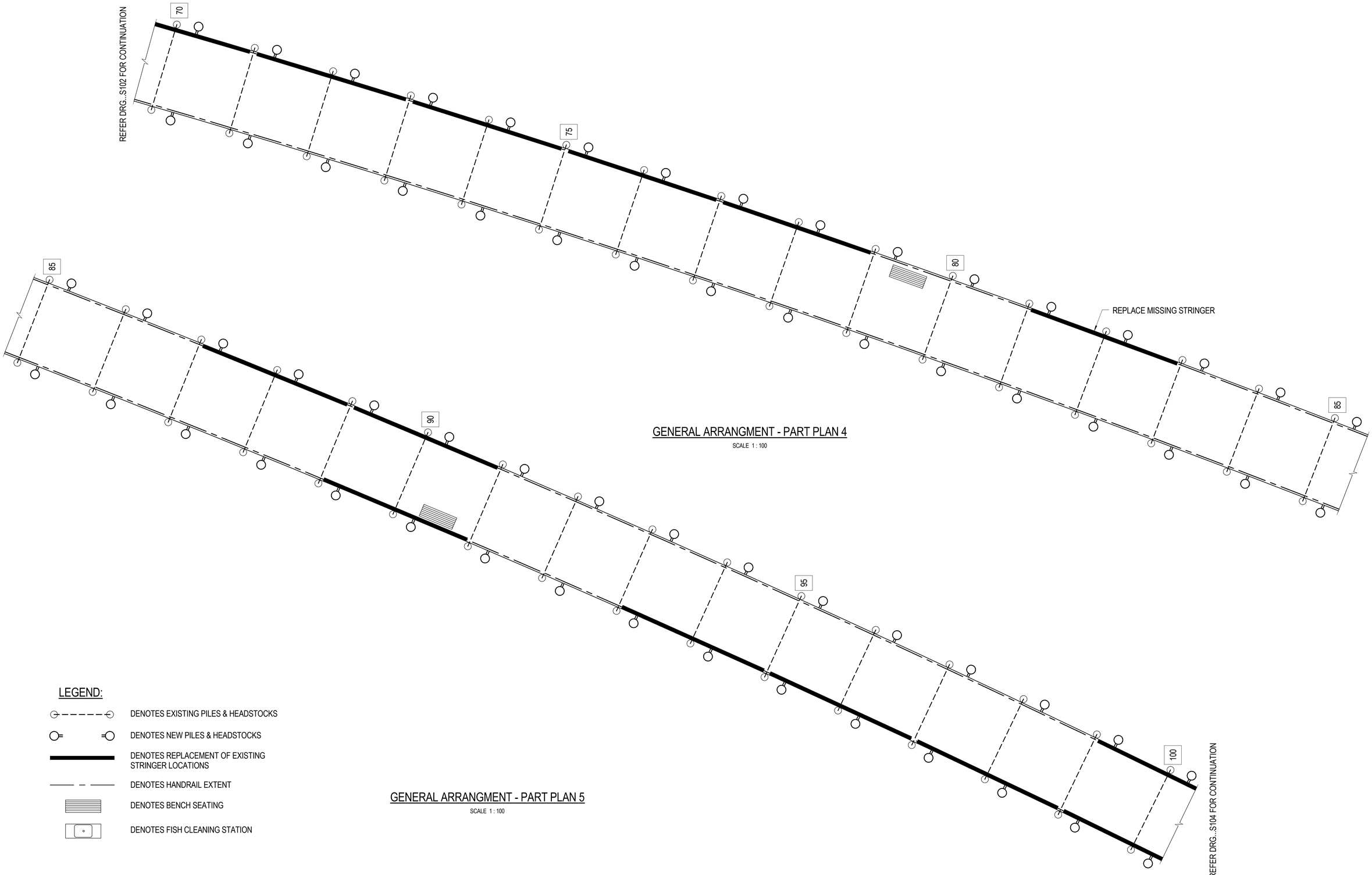

GENERAL ARRANGMENT - PART PLAN 4

SCALE 1 : 100

GENERAL ARRANGMENT - PART PLAN 5

SCALE 1 : 100

LEGEND:

- DENOTES EXISTING PILES & HEADSTOCKS
- DENOTES NEW PILES & HEADSTOCKS
- DENOTES REPLACEMENT OF EXISTING STRINGER LOCATIONS
- DENOTES HANDRAIL EXTENT
- DENOTES BENCH SEATING
- DENOTES FISH CLEANING STATION

Issue	Revision	Date	By	App.
P3	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P2	PRELIMINARY ISSUE - SECTIONS & DETAILS ADDED	05.09.16	FS	TJM
P1	PRELIMINARY ISSUE	29.08.16	FS	TJM

Issue Revision Date By App.

Issue Revision Date By App.

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Project
TANKER JETTY REHABILITATION

Drawing Title
GENERAL ARRANGEMENT PART PLANS - SHEET 2

PRELIMINARY

Designed	TJM	Project Director Approved	Date: SEP 2016
Drawn	FS		North
Scale	AS SHOWN	Project Ref: B4222	Drawing No: S103
Date			Issue: P3

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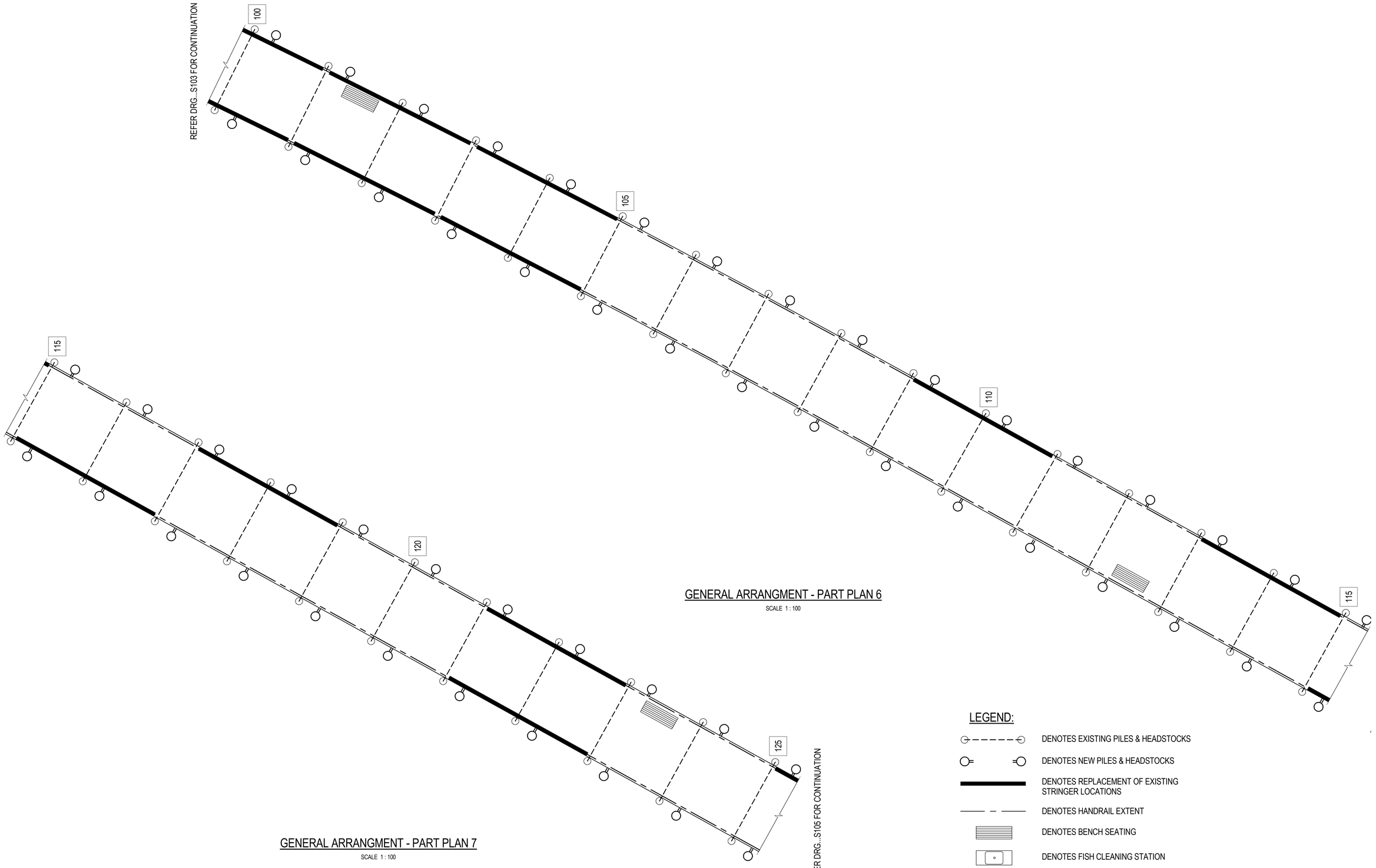

GENERAL ARRANGMENT - PART PLAN 6

SCALE 1 : 100

GENERAL ARRANGMENT - PART PLAN 7

SCALE 1 : 100

LEGEND:

- DENOTES EXISTING PILES & HEADSTOCKS
- DENOTES NEW PILES & HEADSTOCKS
- DENOTES REPLACEMENT OF EXISTING STRINGER LOCATIONS
- DENOTES HANDRAIL EXTENT
- DENOTES BENCH SEATING
- DENOTES FISH CLEANING STATION

Issue	Revision	Date	By	App.
P2	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P1	PRELIMINARY ISSUE	30.08.16	FS	TJM

Issue	Revision	Date	By	App.

Issue	Revision	Date	By	App.

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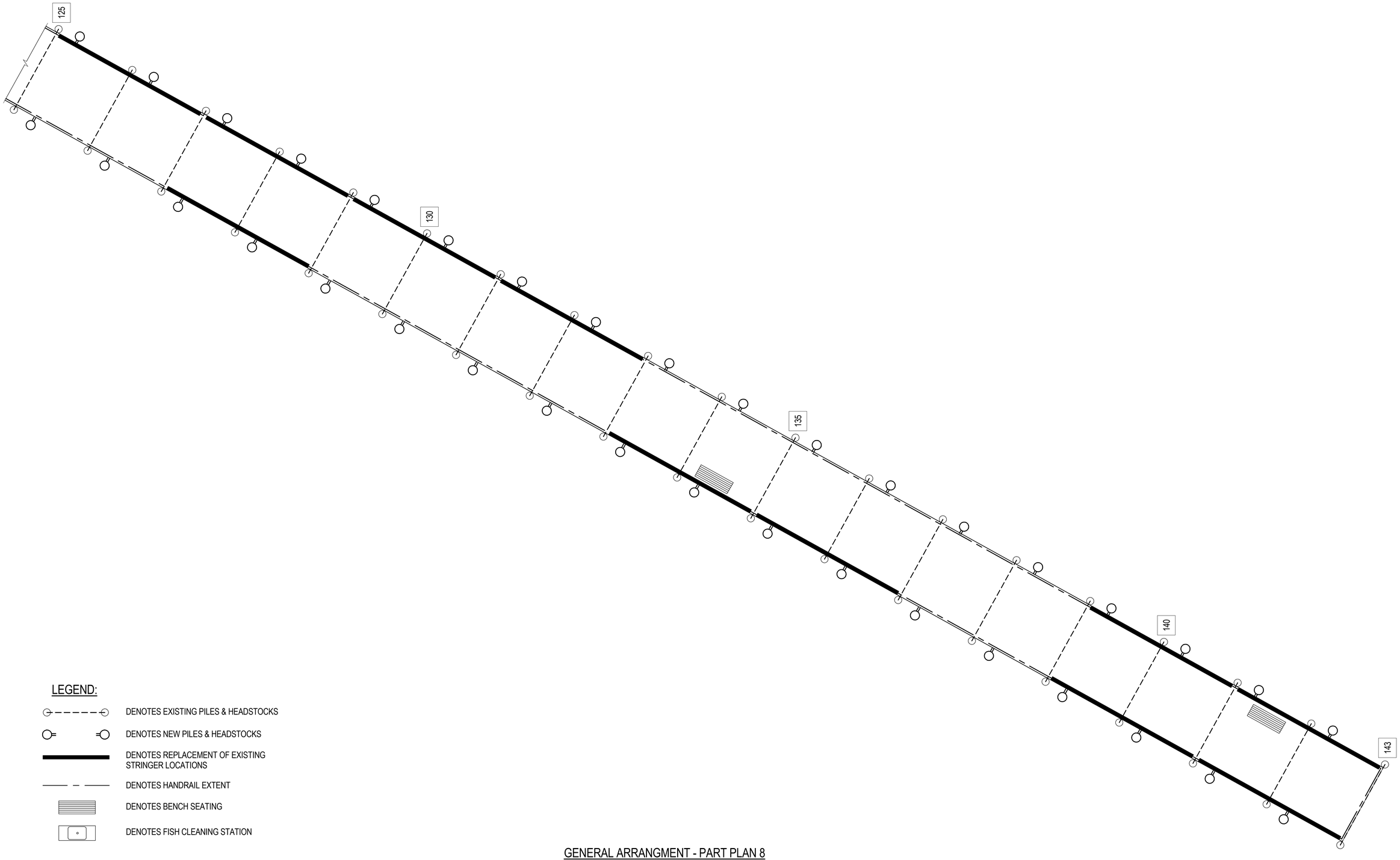
Project
TANKER JETTY REHABILITATION
Drawing Title
GENERAL ARRANGEMENT PART PLANS - SHEET 3

PRELIMINARY

		Project Director Approved	Date	North
Designed	TJM		SEP 2016	
Drawn	FS			
Scale	AS SHOWN			
Date				

Project Ref	Drawing No	Issue
B4222	S104	P2

REFER DRG...S104 FOR CONTINUATION



LEGEND:

- DENOTES EXISTING PILES & HEADSTOCKS
- DENOTES NEW PILES & HEADSTOCKS
- DENOTES REPLACEMENT OF EXISTING STRINGER LOCATIONS
- DENOTES HANDRAIL EXTENT
- DENOTES BENCH SEATING
- DENOTES FISH CLEANING STATION

GENERAL ARRANGMENT - PART PLAN 8

SCALE 1 : 100

Issue	Revision	Date	By	App.
P2	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P1	PRELIMINARY ISSUE	30.08.16	FS	TJM

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Project
TANKER JETTY REHABILITATION

Drawing Title
GENERAL ARRANGEMENT PART PLANS - SHEET 4

PRELIMINARY

Designed	TJM	Project Director Approved	Date
Drawn	FS		SEP 2016
Scale	AS SHOWN	Project Ref	Drawing No / Issue
Date		B4222	S105 / P2

North

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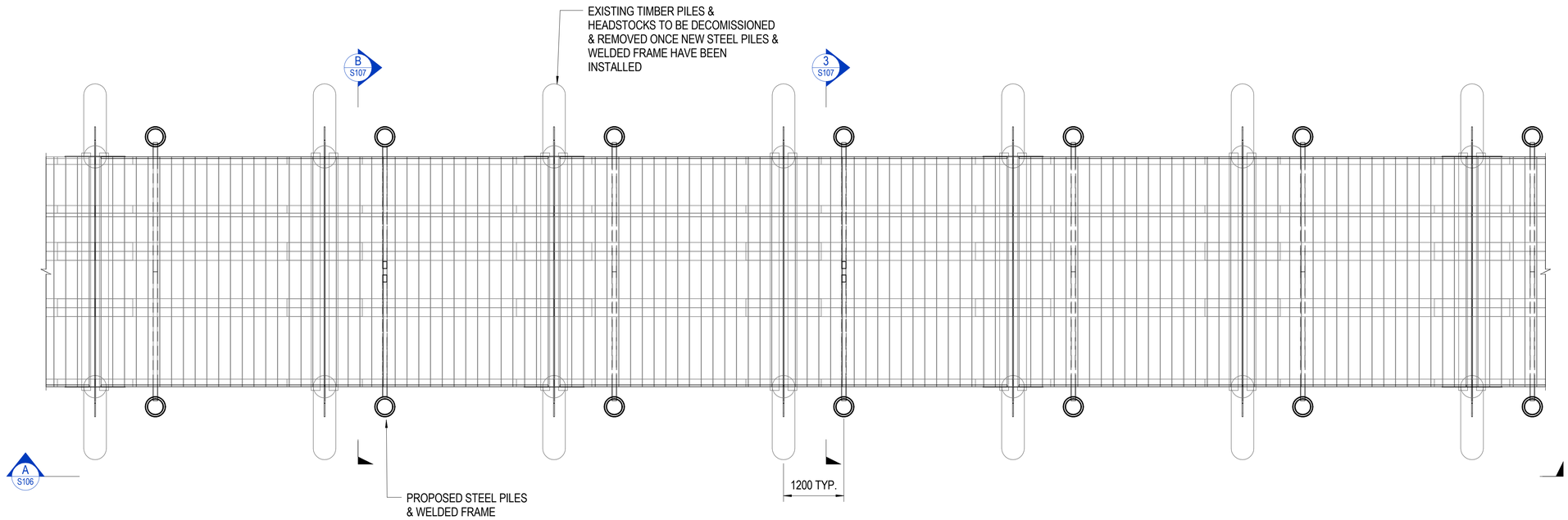
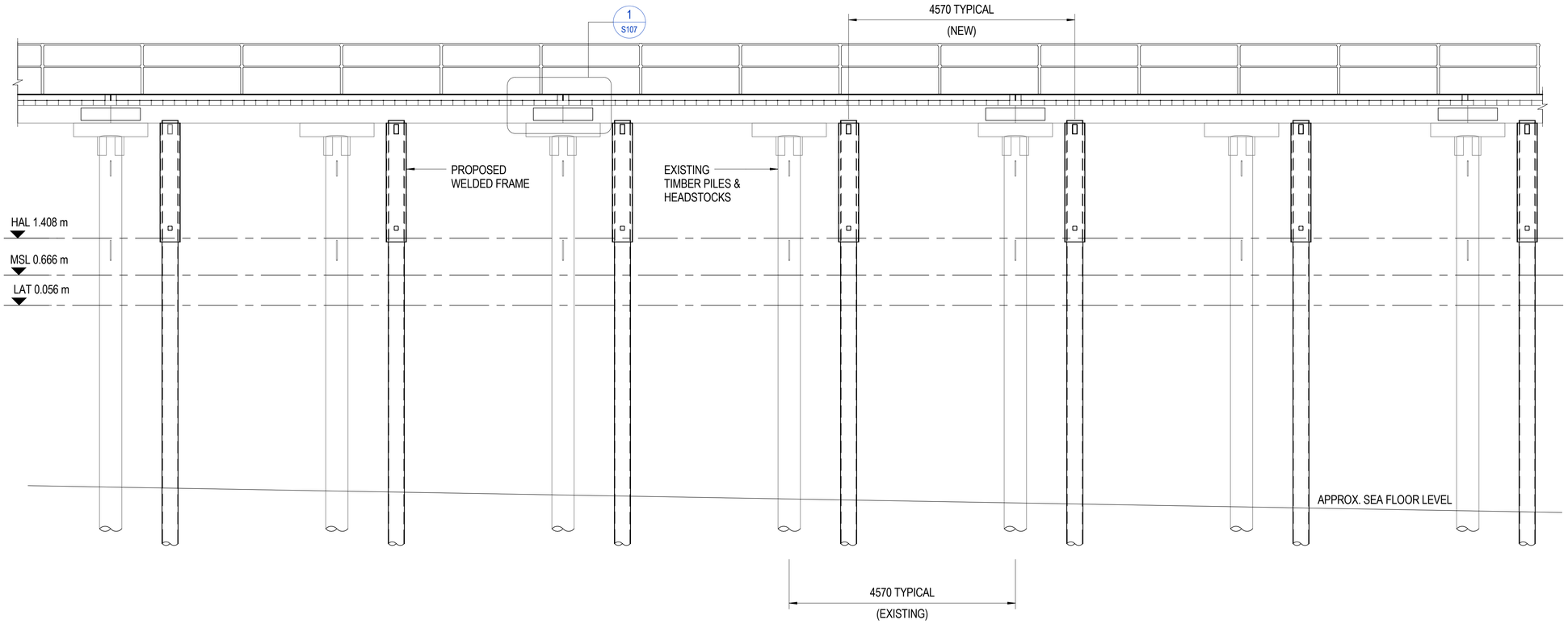


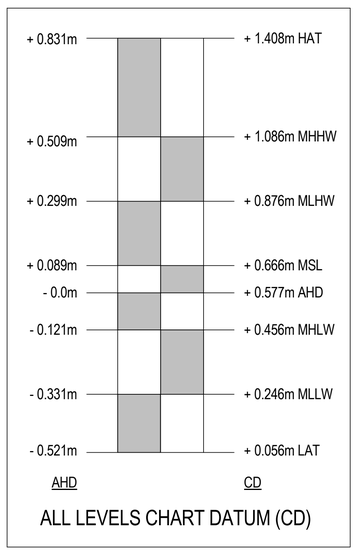
ESPERANCE TANKER JETTY PART PLAN-4.57m OPTION

SCALE 1 : 50



SECTION A S106

SCALE 1 : 50



ALL LEVELS CHART DATUM (CD)

DATUMS & TIDAL DATA

SCALE 1 : 10

Issue	Revision	Date	By	App.
P2	PRELIMINARY ISSUE - REVISED SHEET NUMBERS	07.09.16	FS	TJM
P1	PRELIMINARY ISSUE	30.08.16	FS	TJM

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Project
TANKER JETTY REHABILITATION

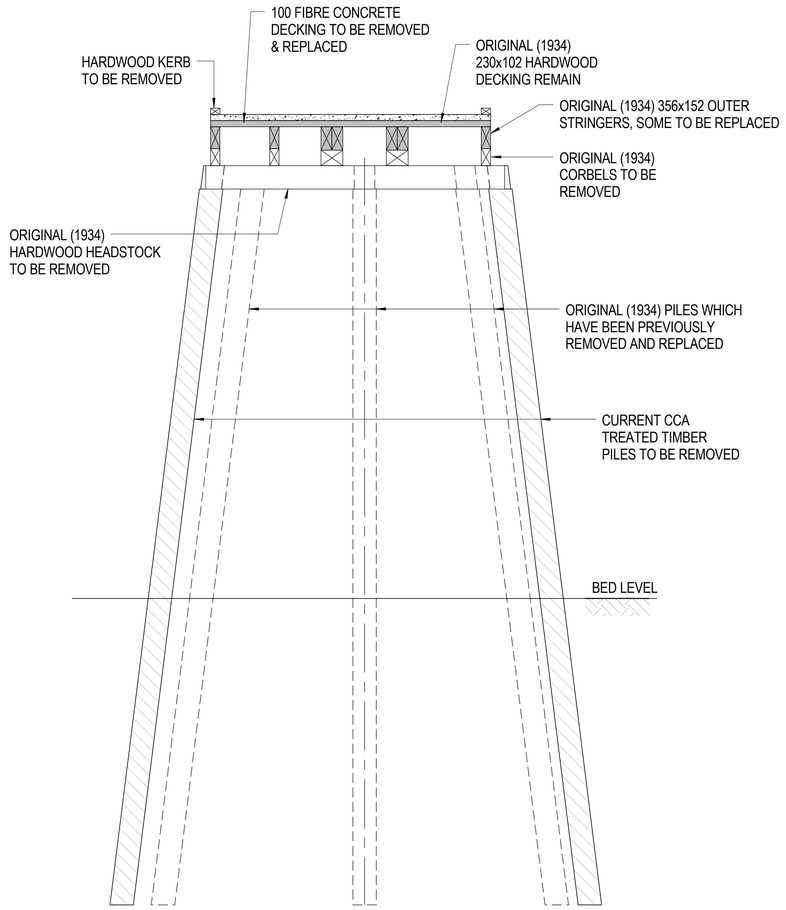
Drawing Title
TYPICAL BENT AT 4.57m CRS PART PLAN & ELEVATIONS

PRELIMINARY

Designed	TJM	Project Director Approved	Date: AUG 2016
Drawn	FS		
Scale	AS SHOWN		
Date		Project Ref: B4222	Drawing No: S106

Issue: P2

Plotted on: 7/09/2016 3:06:09 PM



TYPICAL SECTION THROUGH EXISTING JETTY

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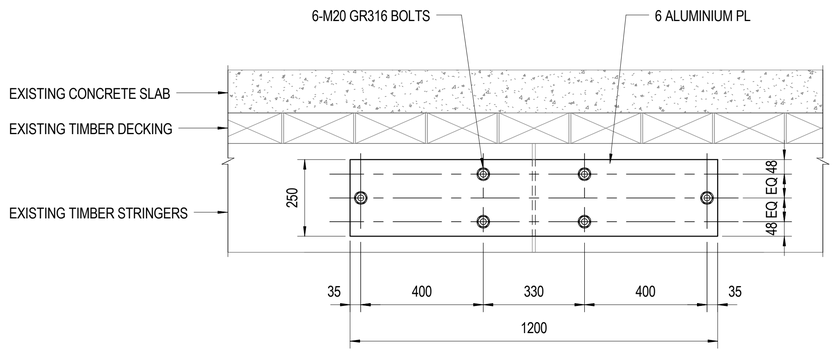
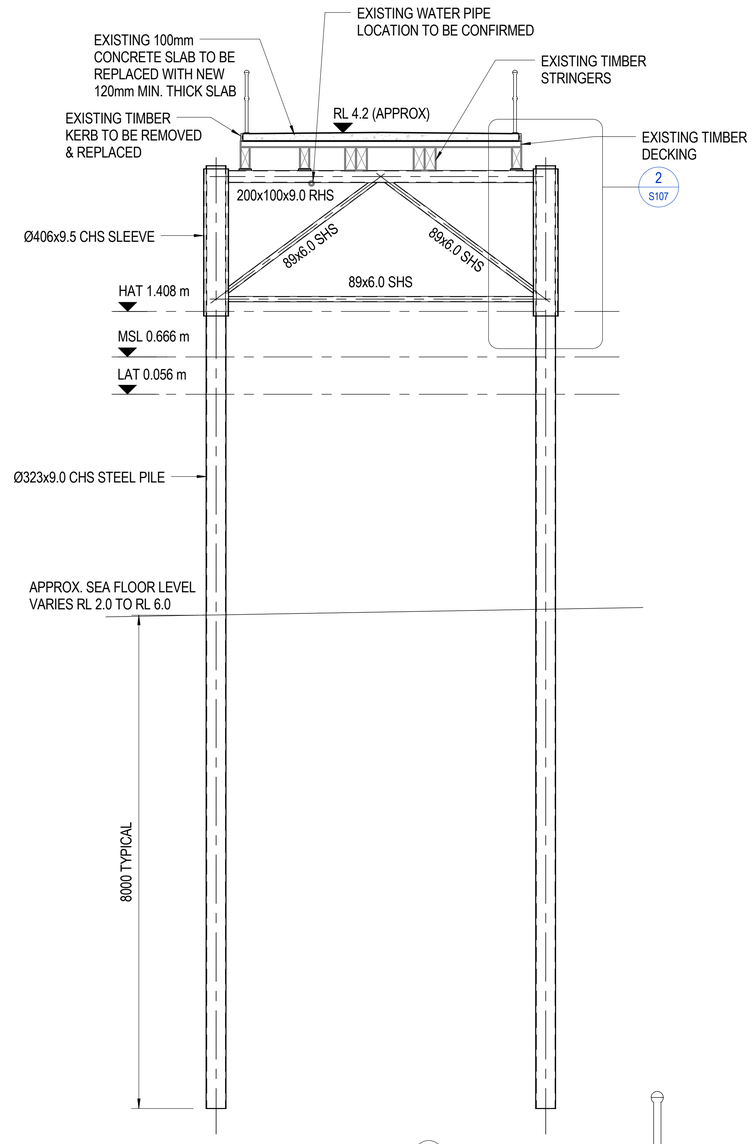


TYPICAL STRINGER SPLICE DETAIL - OPTION 1

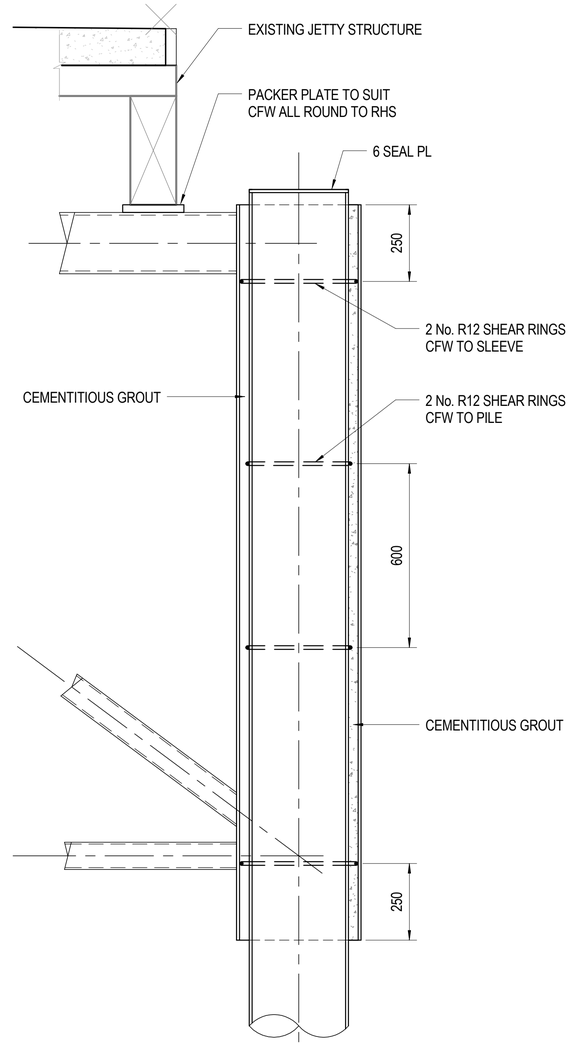
DETAIL 1 / S106

SCALE 1 : 10



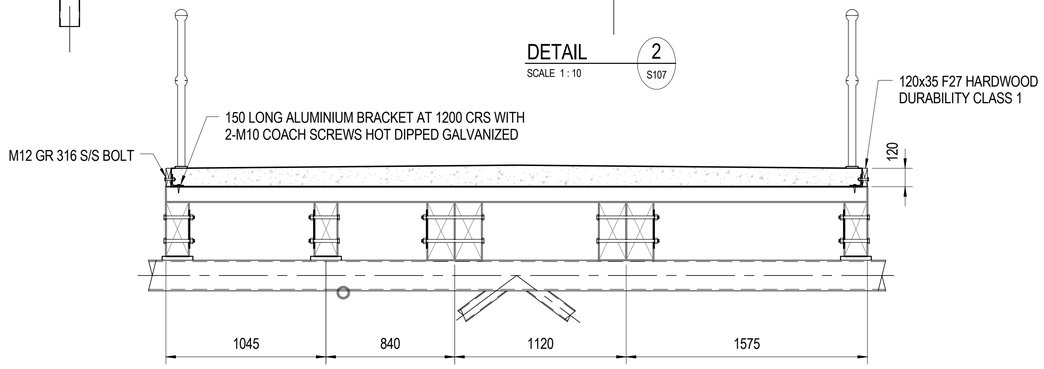
SECTION B / S106

SCALE 1 : 50



DETAIL 2 / S107

SCALE 1 : 10



TYPICAL SECTION THROUGH NEW DECKING WORKS

SECTION 3 / S106

SCALE 1 : 20

Issue	Revision	Date	By	App.
P1	PRELIMINARY ISSUE	07.09.16	FS	TJM

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Project
TANKER JETTY REHABILITATION

Drawing Title
TYPICAL BENT AT 4.57m CRS SECTIONS & DETAILS - SHEET 1

PRELIMINARY

Designed	TJM	Project Director Approved	Date	North
Drawn	FS		AUG 2016	
Scale	AS SHOWN	Project Ref	Drawing No	Issue
Date		B4222	S107	P1

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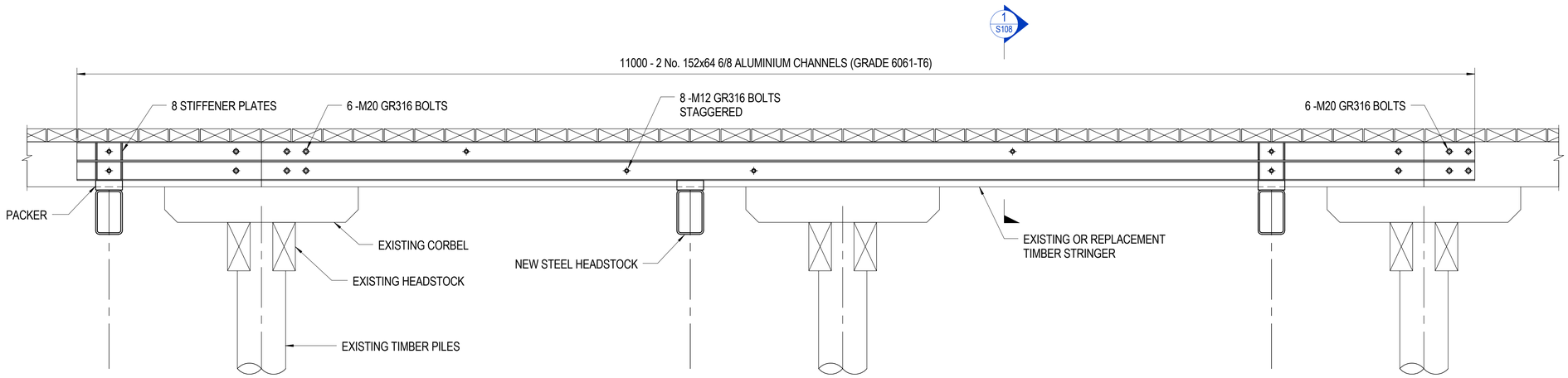
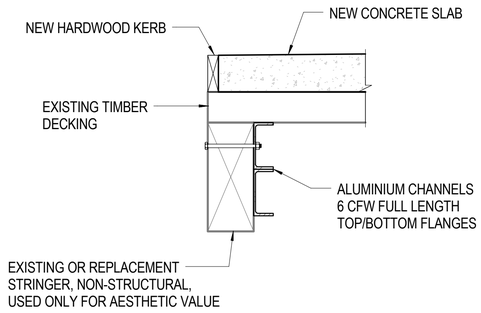
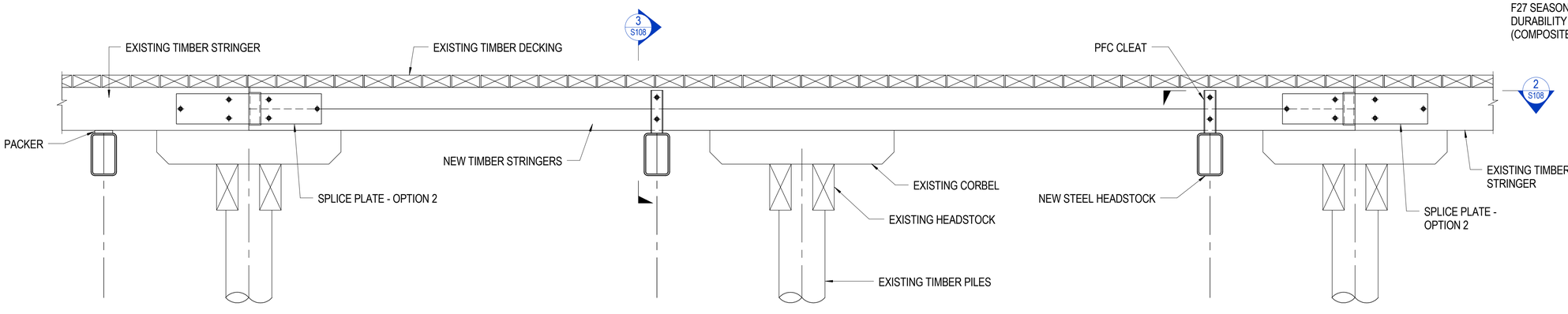


TYPICAL STRINGER REPAIR - OPTION 1

SCALE 1 : 20

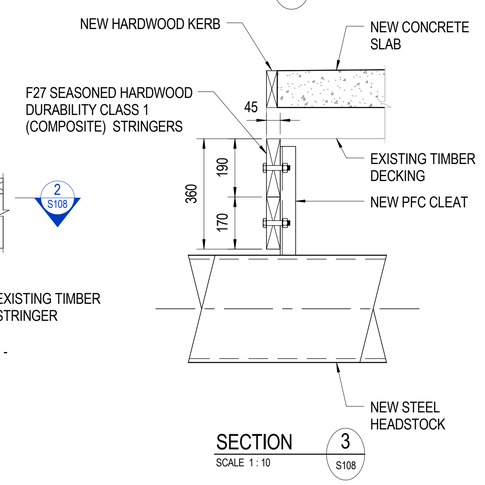


SECTION 1 — S108
SCALE 1 : 10

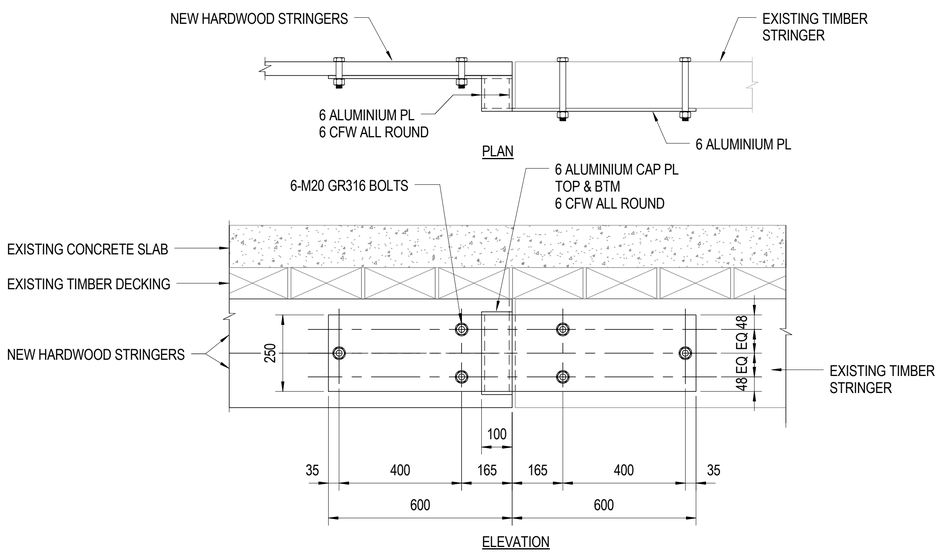


TYPICAL STRINGER REPAIR - OPTION 2

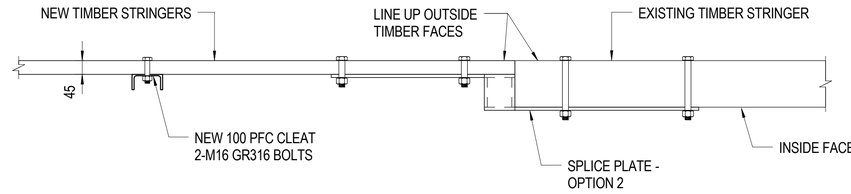
SCALE 1 : 20



SECTION 3 — S108
SCALE 1 : 10



TYPICAL STRINGER SPLICE DETAIL - OPTION 2



SECTION 2 — S108
SCALE 1 : 10

Issue	Revision	Date	By	App.
P1	PRELIMINARY ISSUE	07.09.16	FS	TJM

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Project
TANKER JETTY
REHABILITATION
Drawing Title
TYPICAL BENT AT 4.57m CRS
SECTIONS & DETAILS - SHEET 2

PRELIMINARY

Designed	TJM	Project Director Approved	Date	North
Drawn	FS		SEP 2016	
Scale	AS SHOWN	Project Ref	Drawing No	Issue
Date		B4222	S108	P1

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3D - NEW & EXISTING STRUCTURES - 4.57m OPTION

3D - NEW SUPPORT STRUCTURE - 4.57m OPTION

Issue	Revision	Date	By	App.
P1	PRELIMINARY ISSUE	07.09.16	FS	TJM

Issue Revision Date By App.

Issue Revision Date By App.

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Project
TANKER JETTY
REHABILITATION
Drawing Title
TYPICAL BENT AT 4.57m CRS
3D VIEWS

PRELIMINARY

		Project Director Approved	Date	North
Designed	TJM		AUG 2016	
Drawn	FS			
Scale	AS SHOWN	Project Ref	Drawing No	Issue
Date		B4222	S109	P1

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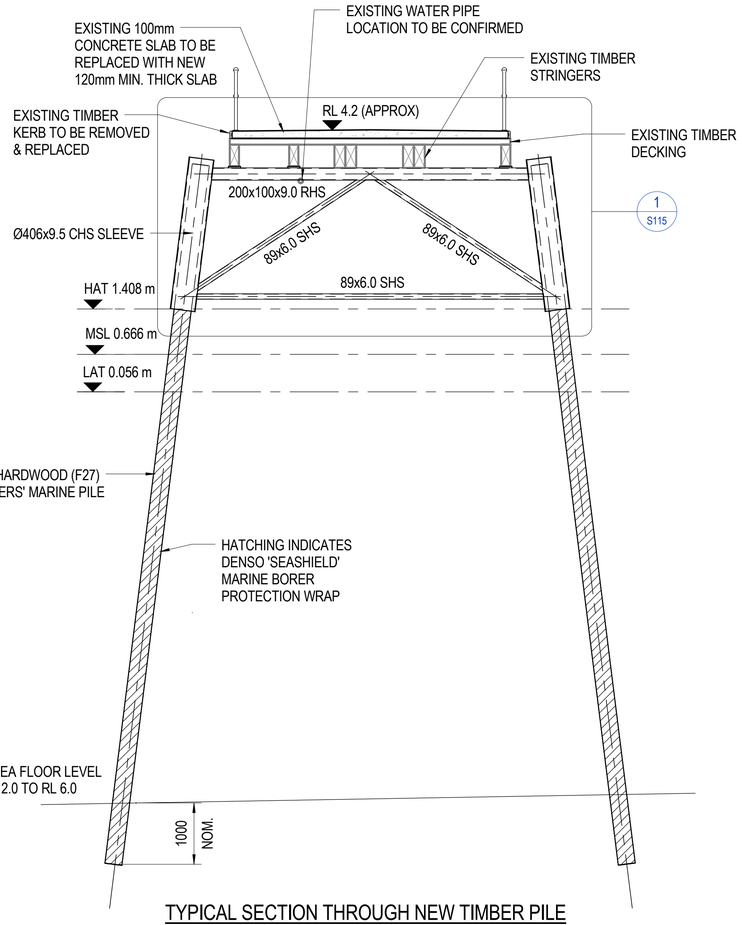
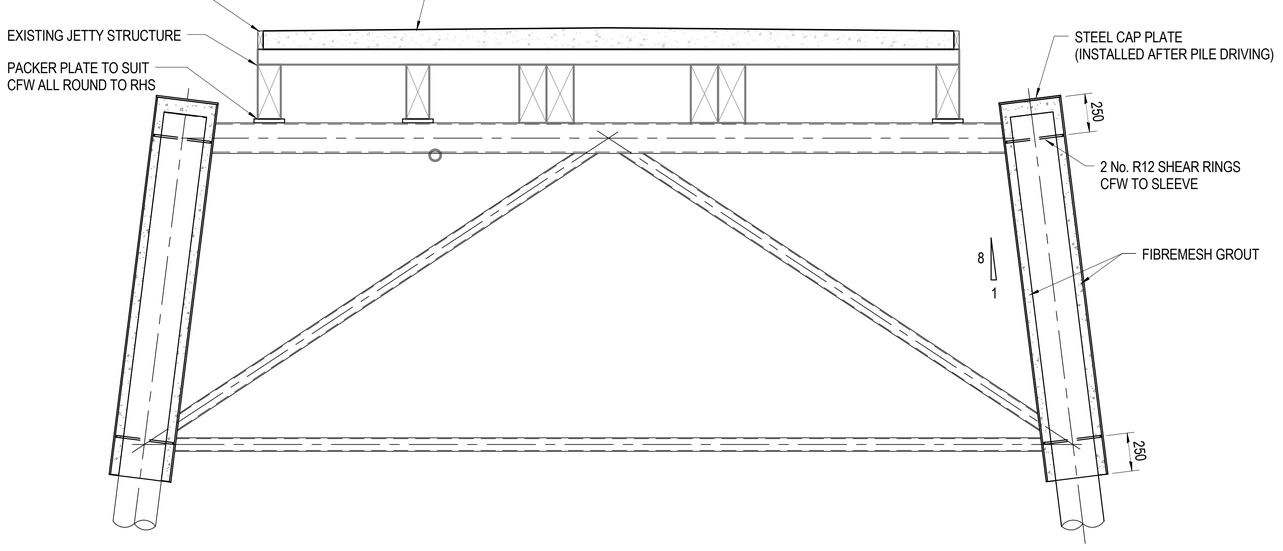


TYPICAL SECTION THROUGH NEW TIMBER PILE CONSTUCTION OPTION

SCALE 1 : 50

3D-NEW SUPPORT STRUCTURE-TIMBER PILE OPTION



DETAIL 1 S115

SCALE 1 : 20

Issue	Revision	Date	By	App.
P1	PRELIMINARY ISSUE	09.09.16	FS	TJM

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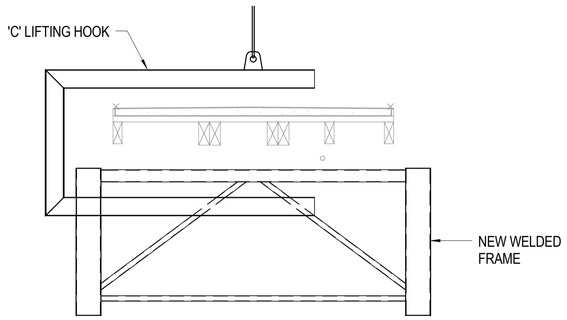
Project
TANKER JETTY REHABILITATION
Drawing Title
TYPICAL BENT AT 4.57m CRS NEW TIMBER PILE OPTION

PRELIMINARY

Designed	TJM	Project Director Approved	Date: AUG 2016
Drawn	FS		North
Scale	AS SHOWN	Project Ref: B4222	Drawing No: S115
Date			Issue: P1

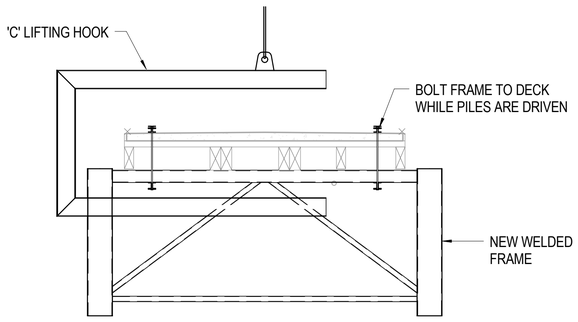
Plotted on: 9/09/2016 5:31:12 PM



STAGE 1

SCALE 1 : 50

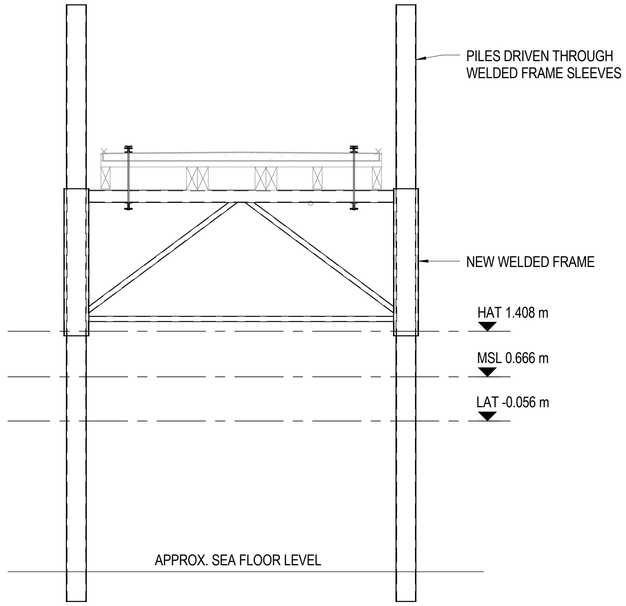
- ATTACH 'C' HOOK TO CRANE.
- ATTACH HOOK TO NEW WELDED FRAME.
- LIFT INTO POSITION.



STAGE 2

SCALE 1 : 50

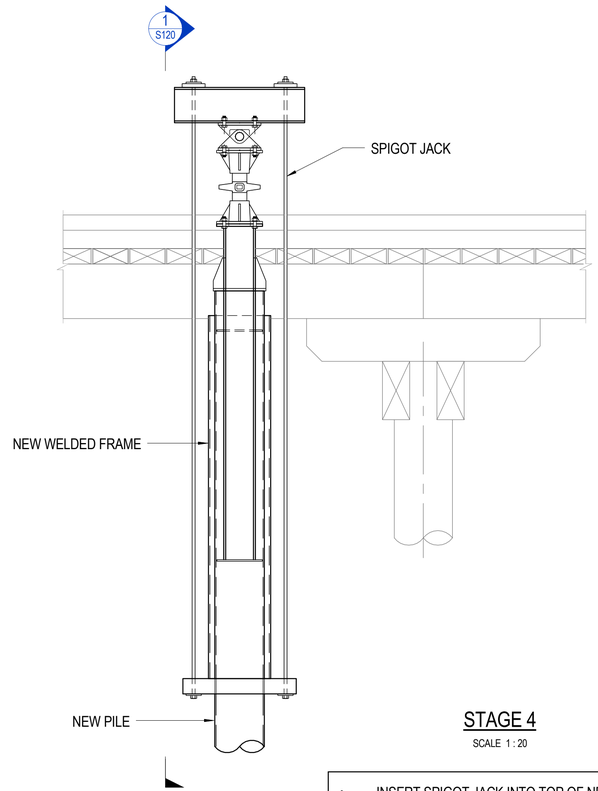
- TEMPORARILY CLAMP NEW WELDED FRAME TO EXISTING STRUCTURE UNTIL NEW WORKS ARE COMPLETED.
- UN-ATTACH & REMOVE 'C' HOOK.



STAGE 3

SCALE 1 : 50

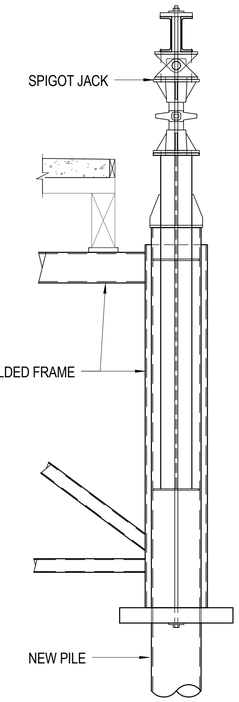
- INSTALL NEW PILES THROUGH SLEEVES IN WELDED FRAME.
- DRIVE NEW PILES UNTIL FOUNDING DEPTH HAS BEEN ACHIEVED.



STAGE 4

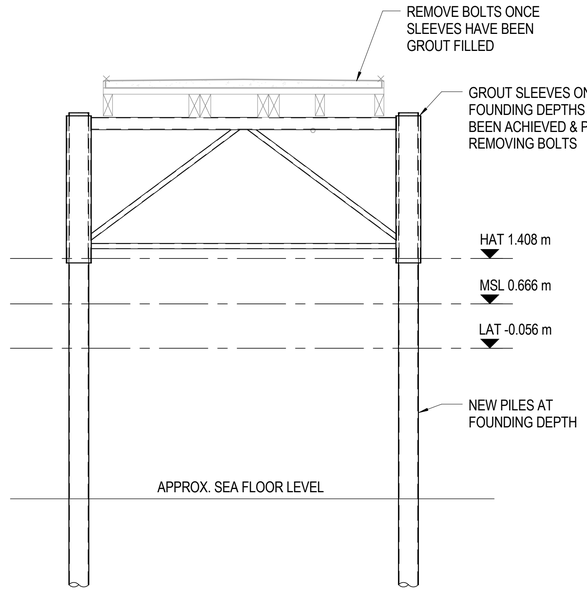
SCALE 1 : 20

- INSERT SPIGOT JACK INTO TOP OF NEW PILE.
- ATTACH JACK.
- ATTACH COLLAR TO BASE OF WELDED FRAME.
- ADJUST JACK UNTIL EXISTING STRUCTURE IS LEVEL.



SECTION 1

SCALE 1 : 20 — S120



STAGE 5

SCALE 1 : 50

- GROUT FILL SLEEVES.
- ATTACH SPLICE PLATES AT EACH DECKING/RAIL BEAM JOINT.
- REMOVE TEMPORARY FIXINGS & CLAMPS TO EXISTING STRUCTURE ONCE GROUT HAS ACHIEVED WORKING STRENGTH.
- DECOMMISSION & REMOVE EXISTING PILES & HEADSTOCKS.

Issue	Revision	Date	By	App.
P1	PRELIMINARY ISSUE	07.09.16	FS	TJM

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Project
TANKER JETTY REHABILITATION
Drawing Title
CONSTUCTION SEQUENCE

PRELIMINARY

		Project Director Approved	Date	North
Designed	TJM		AUG 2016	
Drawn	FS			
Scale	AS SHOWN	Project Ref	Drawing No	Issue
Date		B4222	S120	P1

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Appendix B: Denso Seashield series 60 system

40 YEARS OF MARINE PROTECTION

APPLICATION INSTRUCTIONS

Seashield Series 60 System

for Timber Pile Protection

1. SCOPE:

The Series 60 system consists of Denso Seal T or Marine Piling Tape and Ultraflex 1500 or Densopol 80 tape, Primer, Mastic and Pilemesh outer protection all fastened with Smartband strapping and buckles.
Designed to protect timber piles and surrounding areas from the environment. The tape covers and makes intimate contact with the entire surface of any substrate in the splash or tidal zone.

2. USES:

For splash or tidal zone protection of timber piles which are subject to organism attack in sheltered environments. Easily applied to pilings that have a constant outside diameter (OD) throughout the length of the protection zone. For pilings without a constant OD Denso Seashield primer and mastic can be used to create a profile which enables the use of the system.
Used in sheltered environments by yacht clubs on marinas and mooring berths. By road authorities on bridges and jetties. By local councils on bridges jetties, navigation aids and piers.

▲ ***Figure 1***. *Denso Seashield Series 60 system (excluding Pilemesh) .*

3. EQUIPMENT LIST:

- Wire brush, powered wire brush, scraper, water blasting equipment (optional).
- Brush cleaning solvent, utility knife, cleaning cloth, hand cleaner, barrier cream.
- Diving gear and equipment or overalls, gloves and any other personal protection equipment deemed necessary by the Safety Data Sheets and Job Safety Analysis conducted prior to the commencement of any work undertaken.

4. MATERIALS LIST:

- Denso Seashield Primer.
- Denso Seashield Mastic for filling and profiling irregular surfaces.
- Denso Seal T or Marine Piling Tape corrosion protection layer.
- Denso Ultraflex 1500 or Densopol 80 Tape and Pilemesh for mechanical protection of the system.
- Smartband strapping, buckles and fitting tool supplied by Denso to secure and hold Pilemesh in place.

5. APPLICATION of TAPE SYSTEM:

a) Surface Preparation:

Surfaces to be protected must free from all marine growth, perished timber, previous coatings, dirt etc.
The surface can be prepared by high pressure water jetting and hand tools such as wire brushes and scrapers.
The choice of method will depend on a number of factors and will need to take into account the most practical with regard to site conditions and any environmental constraints imposed due to site location.

Figure 2. *Timber piles protected in the splash zone.* ▶

5. APPLICATION of TAPE SYSTEM (continued):

- Remove all marine growth from the area to be protected .
- Remove any sharp splints. Trim around holes, cavities and sudden changes of profile.
- Wash down surface, seawater will suffice.

Precautions may need to be taken during the preparation process due to environmental concerns. Measures should be taken to minimise the amount of debris being deposited into the marine environment. Local regulations may dictate specific precautions and conditions that need to be met as part of these works. A job site Environmental Management Plan may be available for guidance in these matters.

First Inspection:
When all marine growth has been removed a close examination must be made of the surface area that has been prepared to ensure a thoroughly clean surface without growth, sharp or protruding surfaces is obtained.

b) Priming:

Priming is always required when using Seal T Tape. Marine Piling Tape is regarded as self priming for new substrates. Denso Seashield Primer is applied to the surface area by gloved hand, cloth, roller or brush, at a spreading rate of 1.0kg/m². It is applied in a circular motion obtaining an even film. All voids, concaves, holes should be filled. Denso Seashield Primer can be applied above and below the water's surface.

Primer is required in;

- *Areas with deep cracks or crevices:* Defined as areas of at least 2.0mm wide or deep where there is a danger of the tape wrapping 'bridging' the and leaving a void. These areas must be treated with a liberal coating of Seashield Primer to fill up any voids. If a very deep void occurs, such as holes, then after priming cut a patch of Seashield Mastic and press firmly into the area.
- *Irregular pile surfaces:* Apply a liberal amount of primer to the surface. Use Mastic or tape to create fillets which provide a profile to the substrate that can accommodate the smooth application of tape. Sufficient should be used to avoid any bridging when the tape is applied.
- *Remaining Pile:* Apply a thin coat of primer to the remaining exposed pile surface to be protected.

Second Inspection:
The primed area must be thoroughly inspected to ensure that all the surface area has been properly coated with the primer, including voids, concaves and holes. A smooth profile must be evident to ease tape application and prevent bridging.

c) Tape Wrapping:

It is important to apply the tape with the correct side facing the pile. The outside of the tape is to make intimate contact with the piling substrate. The pile is wrapped from the bottom up

▲ ***Figure 3***. *Tape being applied under water.*

Application of Seal T or Marine Piling Tape:

In the pile protection zone apply the tape by starting with two full circumferential wraps then proceed spirally along the pile progressing with a 55% overlap, giving effectively a double layer of tape. This will ensure a minimum double thickness of tape all the way. Carry on until the roll runs out.

Commence each new roll by overlapping the last roll by the same length as the tape width, for example if the tape is 150mm wide then the overlap will be about 150mm.

As wrapping proceeds smooth by gloved hand to exclude water, air bubbles and wrinkles from under the tape and to aid sealing of overlaps. Any overlapped edges are to be moulded and blended together by hand. This process is repeated all the way along the protection zone finishing again with two complete horizontal turns of the tape.

Third Inspection:
It is imperative to thoroughly inspect the wrapped pile surface area ensuring it has been wrapped with the specified 55% overlap, that all water, air bubbles and wrinkles are excluded from under the tape and that all overlaps are sealed, moulded and blended together.

5. APPLICATION of TAPE SYSTEM (continued):

c) Tape Wrapping (cont):

◀ ***Figure 4.*** *Model of the Series 60 system. Visible is the strapping and Pilemesh with sections removed to show the outer tape.*

Application of Ultraflex 1500 or Densopol 80 Tape Outer Tape:

In the pile protection zone apply the Ultraflex 1500 or Densopol 80 Tape in a similar fashion to the Seal T or Marine Piling Tape by starting with two full circumferential wraps then proceed spirally along the pile progressing with a 55% overlap, giving effectively a double layer of tape. This will ensure a minimum double thickness of tape all the way. Carry on until the roll runs out.

Commence each new roll by overlapping the last roll by the same length as the tape width, for example if the tape is 150mm wide then the overlap will be about 150mm.

As wrapping proceeds smooth by hand to exclude water, air bubbles and wrinkles from under the tape and to aid sealing of overlaps. Any overlapped edges are to be moulded and smoothed down by hand. This process is repeated all the way along the protection zone finishing again with two complete horizontal turns of the tape.

Fourth Inspection:

It is imperative to thoroughly inspect the Ultraflex 1500 or Densopol 80 Tape surface area ensuring it has been wrapped with the specified 55% overlap, that all water and air bubbles are excluded from under the tape and that all overlaps are sealed, moulded and blended together.

6. APPLICATION of PILEMESH:

A sheet of Denso Pilemesh is cut to suit the circumference of the pile and tape with allowance for a 100 to 150mm overlap.

Denso Smartband strapping is then used to secure the Pilemesh at the top and bottom 50mm from its edge and in between at gaps of no more than 500mm apart.

Insert the Smartband strap teeth uppermost into one end of the buckle. Wrap the strap around the outside of the Pilemesh and insert into the opposite end of the buckle. Pull the buckle through hand tight before reverting to the Smartband fitting tool to complete tightening. Use the cutter blade on the fitting tool to remove excess strapping.

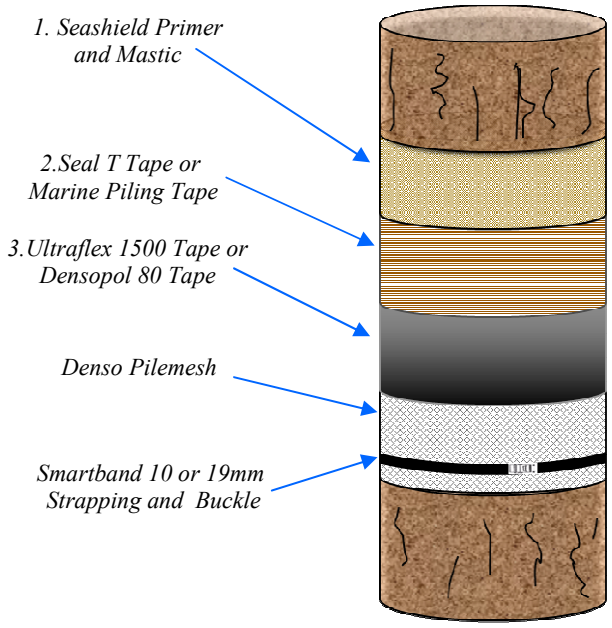
Ensure that all buckles are in the same vertical position on the pile near or on the overlap.

If possible the position of the overlap and buckles should be located on any sheltered side of the piles..

Final Inspection:

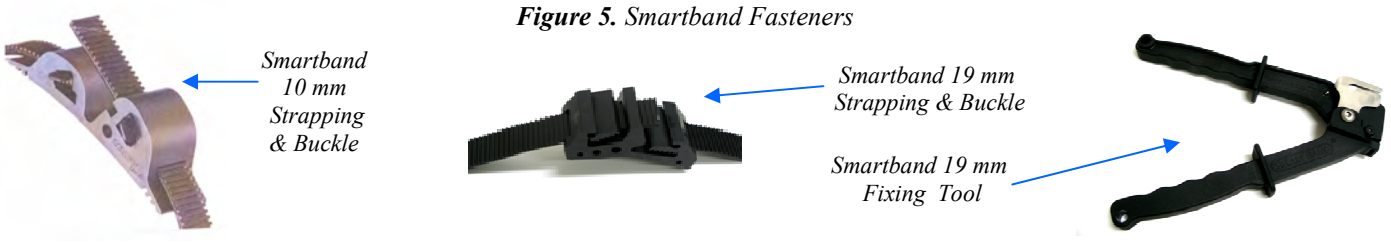
Check that all Pilemesh surfaces are smooth and flat around the pile, all strapping is not loose, that the Pilemesh is securely fixed to the pile and is not able to be moved in any direction.

Diagram 1. *Illustrated example of the Series 60 System*



▲ *Timber Pile*

Figure 5. *Smartband Fasteners*



7. SAFETY DATA:

Storage:	Denso Primer, Mastic and tapes shall be stored in a cool dry place out of direct sunlight between 5° and 25°C. Denso Pilemesh shall be stored the way they arrive and kept out of direct sunlight until they are required.
Transport:	Avoid prolonged exposure to high temperatures during transit, preferably in an enclosed vehicle.
Handling:	Denso Pilemesh shall be kept rolled and taped to prevent damage ready for transportation to the installation site. Care shall be taken to avoid sudden impact that may tear or damage the material.
Action in case of fire:	Extinguish with water fog, dry powder, carbon dioxide or chemical foam. Self-contained breathing apparatus may be required.
Skin Contact:	Wash with warm water and mild soap. Use pumiced heavy duty hand cleaner for stubborn stains.
Swallowing:	If feeling unwell, seek medical advice.
Inhalation:	In a fire situation avoid inhaling fumes.
Spillage:	No materials classified as hazardous. Pick up and collect material by hand or with absorbent rags or pads.
Disposal:	Incineration or landfill in accordance with local regulations.
Other:	For more information please refer to Denso safety data and technical data sheets. Available for all system components.

Approved Quality Management System
AS/NZS ISO 9001:2008
Lloyds Register – Certificate Nº Mel 0927759

Denso (Australia) Pty Ltd

411 - 413 Victoria Street,
Brunswick, Vic 3056
Australia

MELBOURNE ♦ SYDNEY ♦ ADELAIDE ♦ BRISBANE ♦ PERTH

Tel: + 61 3 93567600 or 1300 658 590 (toll free) ♦ Email: denso@densoaustralia.com.au ♦ Web: www.densoaustralia.com.au

Denso (New Zealand) Limited

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A MEMBER OF WINN & COALES INTERNATIONAL

Appendix C: Company capability brochures

Marine and Mining

Our Expertise

Bonacci Infrastructure is an engineering consultancy who provides structural and civil design services across a broad range of infrastructure types, including: marine; mining and resources; transport; water treatment; defence and industrial. Below is a snap shot of our Marine and Mining experience only. The designers at Bonacci are passionate about design solutions being easy and safe to construct, and the final solution being “fit for purpose”. To achieve this, our design teams are led by a group of very experienced Directors and Associates, all of whom are hands on designers. We are therefore in a unique position to offer our clients’ the benefit of over 120 years of collective design experience from our senior staff, all of whom are dedicated to “Perfecting the art of engineering”.

The concept development stage of any design is of critical importance to Bonacci Infrastructure. We firmly believe this is the stage where major benefits can be delivered to a project through the development of clever ideas that bring together construction methodology, creativity, and technical skill. Unlike most other structural design consultancies, Bonacci Infrastructure also specialises in construction engineering and soil-structure interaction modelling. This means that we always approach, and develop our permanent works designs from the point of view of a preferred construction methodology and enjoy reducing complex problems to simple solutions. That is, we seek to couple our construction “know how” with technical skill to deliver simple and hopefully clever solutions, linked to our client’s preferred construction methodology.

We operate with a variety of high end software such as:

- Strand 7 Finite element analysis (FEA) software, complete with all non-linear functions and moving load modules for bridge design
- D-Sheet Piling, state of the art software developed by Delft University for cantilevered or anchored retaining wall analysis and design.
- Phase 2, 2D elastic continuum FEA analysis for slope analysis, tunnel design and rock mechanics
- Slide, 2D classic static equilibrium method analysis software for all types of slope stability assessments.
- An extensive library of in-house software and design tools used to benchmark more complex analyses and for the fast feasibility assessment of concept ideas.
- Autocad (2D and 3D), Revit Structures (3D) and 12D Civil terrain drafting and modelling software.

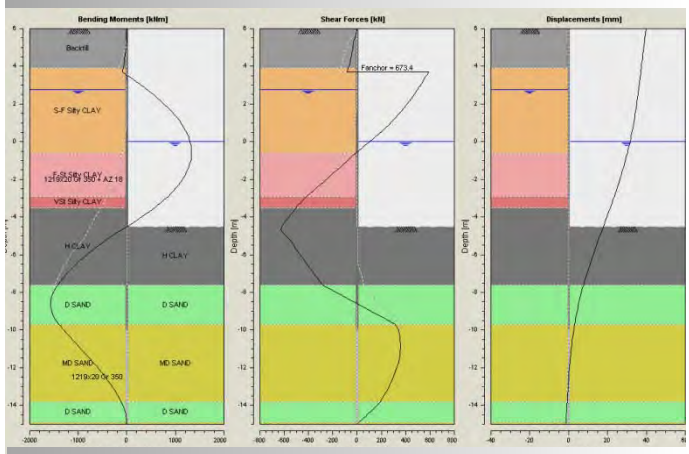
QCLNG – Ferry Dock and Floating RoRo Facility

BONACCI INFRASTRUCTURE

Marine

Including RoRo, Linkspan, LoLo, MOF, Product loading and Container Wharves

GLNG – RG Tanna - RoRo Facility during construction
Superlift Manitowwoc crane installing the linkspan bridge (110t) as a single crane lift

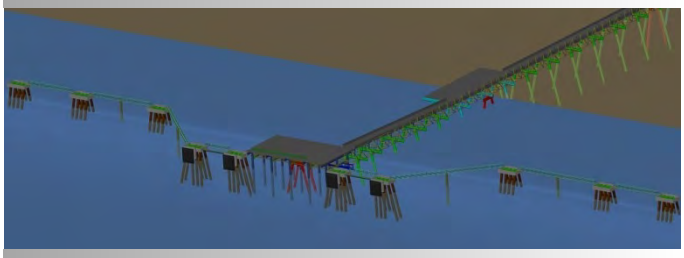


GLNG – RG Tanna - RoRo king pile wall design output

GLNG – RG Tanna - LoLo Facility during construction

GLNG – Port Central - Linkspan Bridge in operation

GLNG – Port Central - RoRo Facility c/w hydraulically controlled linkspan bridge.



QCLNG , GLNG and APLNG Vessel Loading Facility tender designs

Alcan Gove - Material Offloading Facility (MOF)

GLNG – Fisherman's Landing - Temporary RoRo Facility

Self Elevating Platforms (SEP)

Certification and Risk Analysis

SEP Santa Fe - under tow

SEP Ensung - used for Tugun Desalination Plant

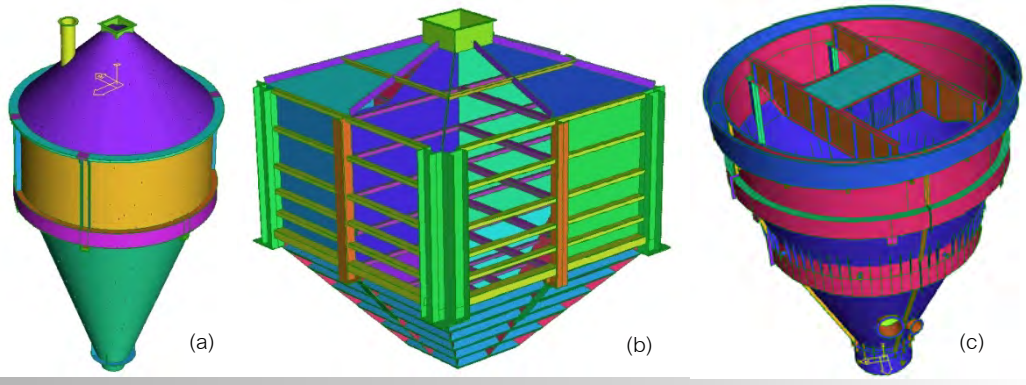
Ensung - in storm tie down mode

SEP Santa Fe - under tow fitted with Favco Crane

SEP Seafox - fitted with new Helipad

BONACCI INFRASTRUCTURE

Silos, Stockpiles and Conveyors



(a) 2000t Mineral Sand Silos
(b) 800t square Silo
(c) FEA Model of Mineral Sand vortex separation silo designed and constructed for Illuka Project

WMC - Phosphate Hill Plant

Lake Lindsay – Oak Park Small ROM

WMC – Fertilizer Stockpile Building

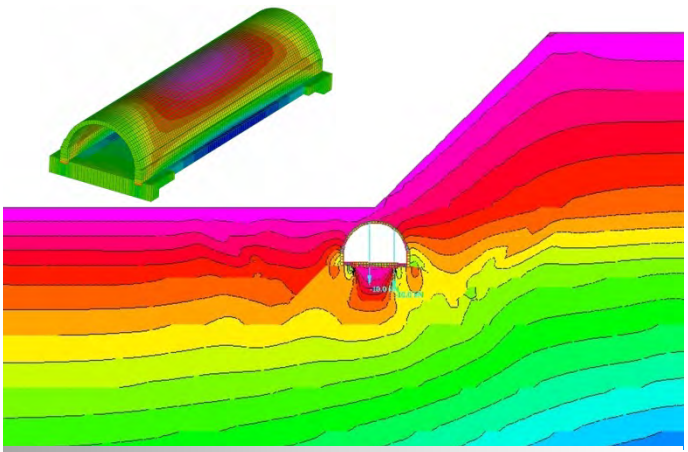
Lake Lindsay – Overland Conveyor

Ban Houayxai - Gold and Silver Plant

Burnett Dam – RCC Delivery Conveyor

Newpac – Coal Stockpile Basin

WICET – Coal Reclaim Tunnel



WICET – Reclaim Tunnel - FEA Model of tunnel

PERFECTING
THE ART OF
ENGINEERING

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BRW – Best Small Engineering Firm 2006

Institution of Engineers Australia – Engineering Excellence Award – Phosphate Hill Project

Australian Steel Institute – High Commendation Award – Queensland Fertiliser Project

Queensland Steel Detailers Association – Award for Excellence in Design Documentation - Oaky Air Base

CCF Earth Awards – Excellence in Civil Construction – Category 5 – Houghton Highway Bridge Duplication

Contact Information

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Email bonq@bon-infra.com

Our People

As with all consultants, it is neither the name nor reputation of the company that defines the quality of the design, but rather the talents and experience of the individual staff involved.

Terry Memory BEng, MEng, RPEQ, NPER

Director

With over 20 years of experience across the maritime sector, the water industry structures and construction engineering, Terry draws upon his strong technical background and breadth of experience to develop simple and effective design solutions for large and small engineering problems alike.

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With a focus on ensuring technical excellence in all his designs, George applies his detailed expertise in the design and detailing of structural steel to ensure that the transition from design to fabrication and erection is as seamless as possible.

Houghton Highway Bridge Duplication

Construction Engineering

Our Design Philosophy

Ingenious temporary works designs offer many savings to a Contractor because they facilitate the timely and safe execution of work. When designing temporary works, Bonacci Infrastructure focuses on three key issues; safety, functionality and versatility.

Versatility/adaptability is considered because purpose made construction plant represents both a short and long term investment for the purchaser. From a design point of view we therefore detail in a manner that is economical for the project at hand, but not restrictive or onerous for future modifications.

The design of temporary works offers both the Client and Designer opportunities to “think outside of the square”. Typically, the functional requirements are reasonably well understood and definable by the Principal or Contractor. The challenge lies in developing an efficient structural system that fulfils the functional requirements, is relatively easy to fabricate, has a degree of robustness that is appropriate for the circumstances, is easy to commission and safe to use.

At Bonacci Infrastructure we embrace this challenge because it represents pure engineering and draws on the innovative skills and construction experience of individuals within the Company.

Below is a collage of the temporary works designs which Bonacci Infrastructure have executed. The commissions are typically associated with either:

- Complete construction systems, methodologies and associated purpose design plant for the construction of major infrastructure
- Temporary ground and/or ocean/river retention systems such as sheetpile walls, cofferdams. These designs typically including seepage assessments.
- Purpose design crane platforms, mobile bridges.
- Slope stability, often for cranes on an embankment.
- Specialist form systems, personnel access and lifting studies for major infrastructure
- Specialist design work for pontoons, barges, self-elevating platforms (SEP) and cranes on barges
- Specialist design work for piling leaders and pile gates.

Wiggins Island Jetty Traveller

Wiggins Island Wharf Traveller and piling frames

Project Experience

- Wiggins Island Coal Export Terminal (WICET)
  - Marine construction
  - Stockpile gantry erection
- GLNG, Gladstone – Marine Construction
- QCLNG, Gladstone – Marine Construction
- APLNG, Gladstone -Marine Construction
- Ocean intake pipe line, Gladstone
- Exxon Mobile PNG LNG
- Houghton Highway Bridge Duplication
- Port Connect - cofferdams
- Calliope Bridge restoration
- Captain Cook Bridge – Enclosed access platform underneath the entire bridge
- Abbott Point Coal Terminal, incl MOF
- Dalrymple Bay Coal Terminal
- Dalrymple Bay Rail Receival Pit (RRP3)
- FMG ore loadout wharf, WA
- Darwin LNG Wharf – SEP Margret
- RG Tanna Wharf
- Douglas Arterial Upgrade, Townsville
- Tugun Desalination Plant – SEP Ensung
- St Lawrence Rail Bridge Duplication
- Abbot Point and Dalrymple Bay Coal Termination Expansion
- Sydney Desalination Project (Blue Water Alliance) – SEP Seafox
- Adelaide Desalination Plant – SEP Santa Fe
- Wivenhoe Dam Upgrade
- Port of Brisbane Seawall Alliance
- SEP Fuji Piling Gate
- Nerang Rail Bridge Duplication
- Doyles Rock Road Bridge Duplication
- Burnett Dam
- Forgan Bridge Duplication – Mackay
- Presentation of numerous training workshops for the Engineers of Contracting Companies

Wiggins Island Coal Export Terminal (WICET)

Contractor: Monadelphous Muhibbah Joint Venture

Bonacci Infrastructure continues to provide extensive construction planning and design services for the jetty and wharf structures on this project, including:

- Self-launching jetty cantitraveller *(pictured below)* fitted with a 300t overhead crane and 2 internal gantry cranes. The structure cantilevers 24m to drive the jetty piles, with piling gates fitted to accommodate both typical and anchor bent piles
- Wharf traveller fitted with a 300t overhead crane
- Wharf dolphin piling frames and wharf strong point piling towers
- Miscellaneous access platforms and paint cages
- Onshore temporary works for jetty cantitraveller including earthworks, concrete foundations and piles
- Cyclone contingency and launch planning
- Miscellaneous lift studies

Houghton Highway Bridge Duplication

Contractor: John Hull and Albem JV

Bonacci Infrastructure provided extensive construction planning and the detailed design services of this project.

This included the temporary access bridge complete with its own piling gate, the multileveled piling gate arrangement for the permanent piles, purpose made headstock form system and the

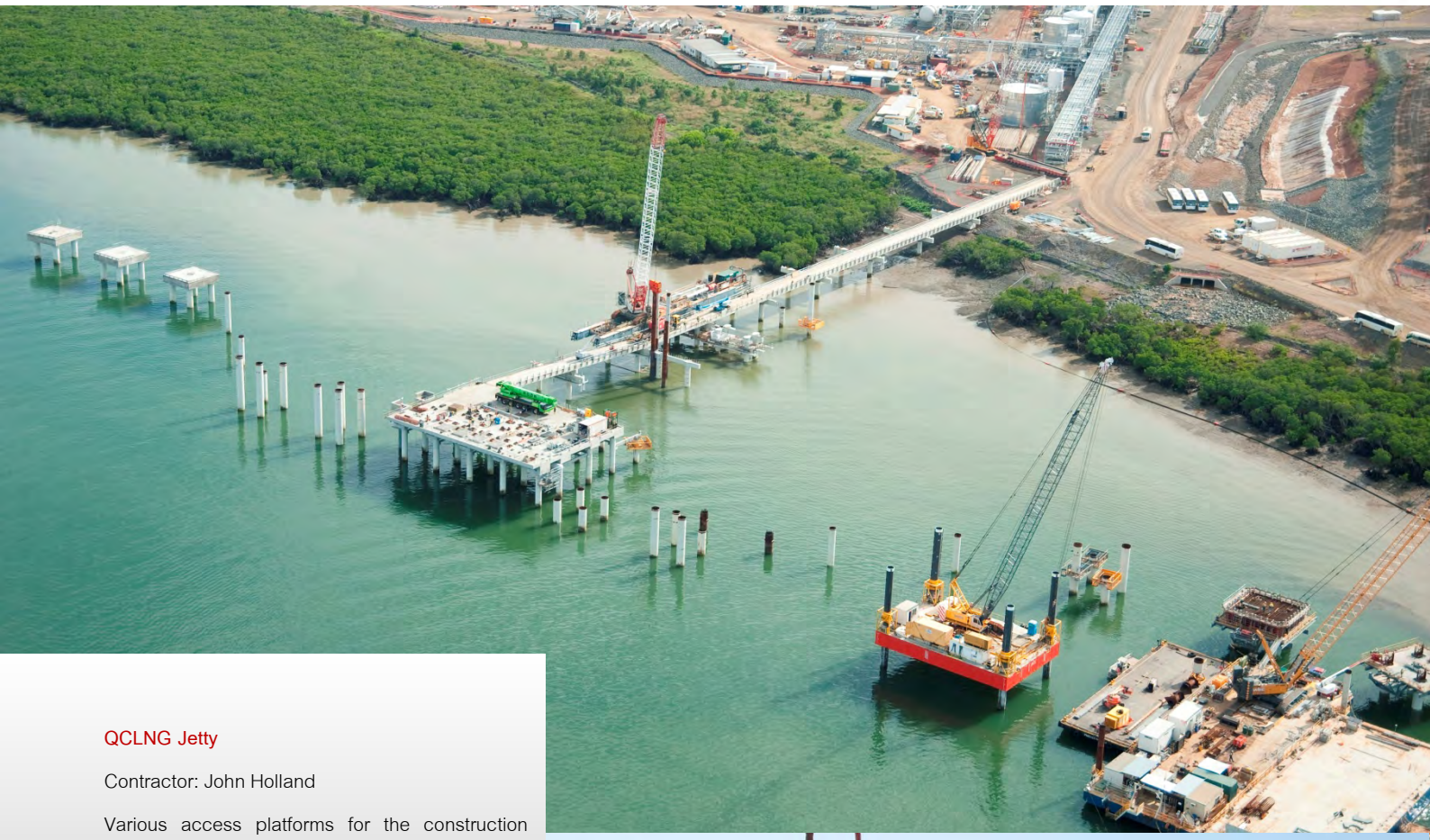
GLNG and QCLNG LNG Gladstone

Contractor: Golding Contractors

Bonacci Infrastructure has an extensive involvement in the Gladstone LNG projects and this includes the following:

- GLNG Mainland: RoRo and LoLo facilities at both Auckland Point, RG Tanna berth and Fisherman's Landing
- QCLNG Mainland: RoRo facility at Auckland Point
- QCLNG RG Tanna: MOF facility travelling piling frame and barge "A" frame piling gate

Pictured:
Cantilevered piling gate mounted off a travelling crane platform. The arrangement was used to drive a tubular pile wall.



QCLNG Jetty

Contractor: John Holland

Various access platforms for the construction of the Jetty headstocks and loading platform.

Project included a suspended soffit form system for the casting of the mooring and berthing dolphin pile caps.

Both berthing and mooring dolphin caps were cast in one pour with a maximum supported mass of 600 tonnes.

BONACCI INFRASTRUCTURE

SEP Fuji Universal Piling Gate System

Contractor: Walz Construction

Bonacci Infrastructure designed the universal piling gate system fitted to the SEP Fuji (shown adjacent working on the Dalrymple Bay Coal Terminal project).

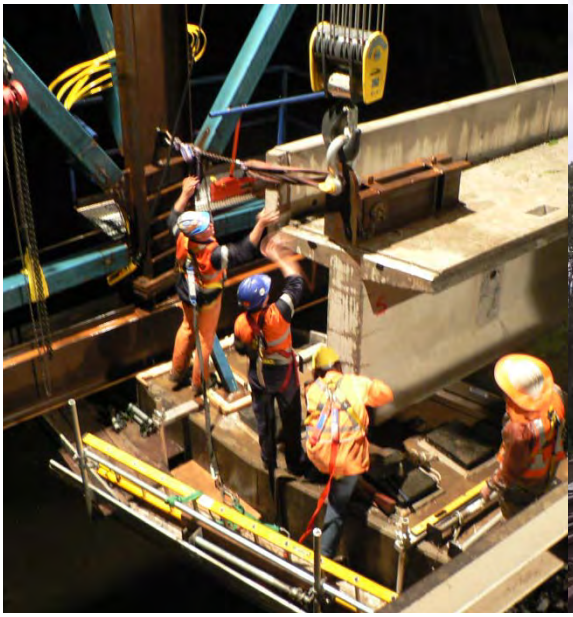
Nerang Rail Bridge Duplication

Contractor: Golding Contractors

This project was particularly successful in that the 7No. x 25m spans of the bridge were installed within 72 hours. Such an achievement required careful planning and comprehensive design and staging documentation.

The girder installation involved a twin travelling gantry with one edge supported on a rail beam that was launched (pulled) across the river.

The fact the bridge was curved served only to complicate matters, however, in the end the engineering prevailed.



Darwin LNG Wharf

Exxon Mobile – Mubi River Cable Ferry System

Exxon Mobile – Piling Leader

St Lawrence Bridge Duplication

Darwin LNG Wharf

Contractor: Thiess

Detailed design piling frame fit-out for Thiess's jack-up platform - the "Margret". Both dual upper and lower gates are hydraulically operated and capable of rotating from 0-90 deg about the vertical tube. The entire head can rotated about the horizontal tube to enable various pile rakes. The complete frame is mounted on a sliding table to enable lateral translations both forward-aft and left and right.

Exxon Mobile PNG LNG

Contractor: Clough Curtain

Bonacci Infrastructure provide all the major temporary works for this project with included the design of two new piling leaders that were fitted to 16000 Manitowoc Cranes. In addition to this we also design a cable guided ferry system across the Mubi River, barge mounted piling frame, an extensive and detailed peer review of a 116m long bridge launch procedure, and numerous other smaller tasks associated with crane-slope stability and pile driving.

St Lawrence Rail Bridge Duplication

Contractor: Seymour Whyte and Piling Contractors

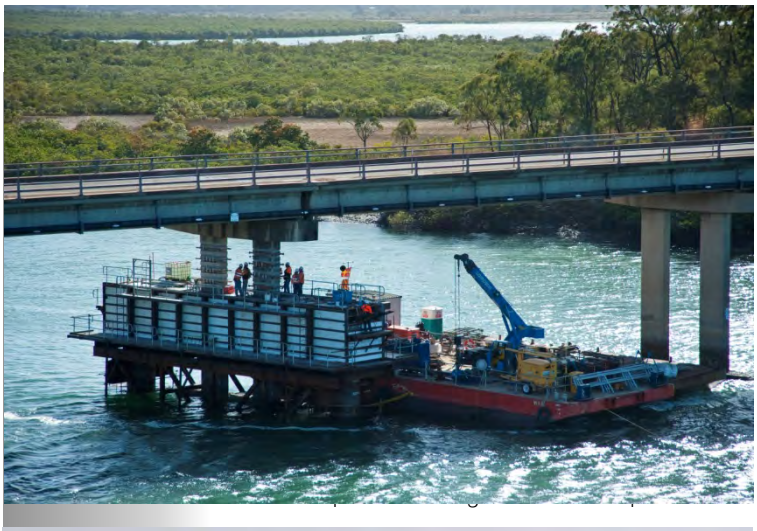
Bonacci Infrastructure provided unified temporary works solution for both head and sub-contractor on this project. The temporary access bridge design was provided for Piling Contractors, whilst the bridge girder gantry system and headstock form system were commissioned by Seymour Whyte. The use of 3D drawings was also used as a visual aid to explain staging and critical issues to construction personnel.

Calliope River Bridge Headstock Replacement

Contractor: Golding

Bonacci Infrastructure provided formwork design for the construction of a 2.7m deep x 15m long concrete headstock completed in a single pour.

The form spanned between 2 permanent 1500mm diameter bored piles which formed part of the replacement abutment.



Oxley WWTP Digester Lid Retrofit

Contractor: John Holland Group

Bonacci Infrastructure performed a comprehensive lift study of 4 digester roof structures to permit their extraction.

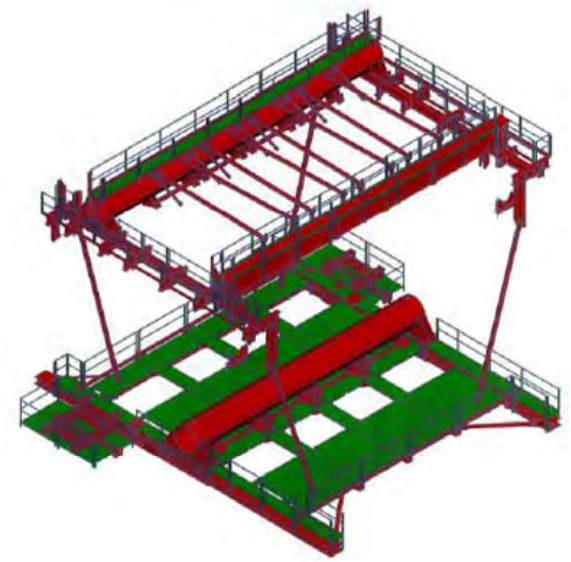
Services for this project included a condition assessment and strengthening review in compliance with current Australian standards.

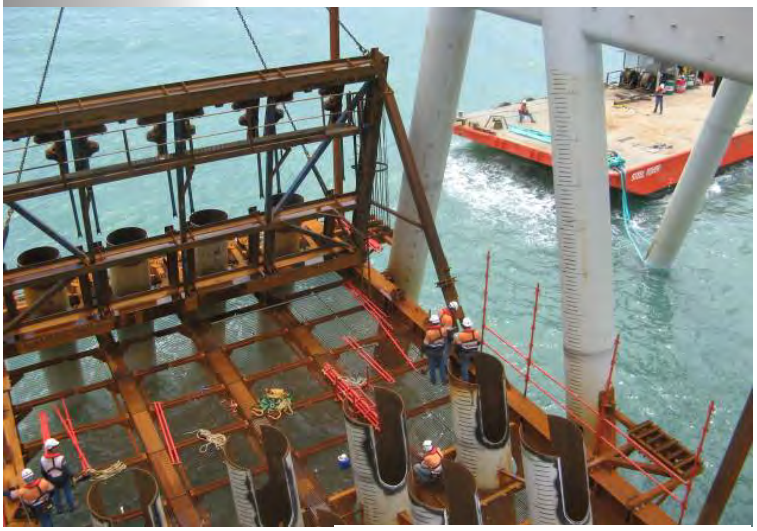
Oxley WWTP Digester Lid Retrofit

Abbot Point and Dalrymple Bay Coal Terminal Expansion

Contractor: John Holland Group

Sophisticated temporary works designs and for both of these wharf expansion projects. Our primary effort was focused on the methodology for the construction of the berthing/mooring dolphins which are a skeletal assembly containing 14No. x 1200 dia piles. The system developed was essentially suspended from the upper wharf structure and purpose designed for monolithic installation and segmental extraction from under the completed dolphin.





Abbot Point and Dalrymple Bay

Forgan Bridge Duplication

Forgan Bridge Duplication

Contractor: Golding Contractors

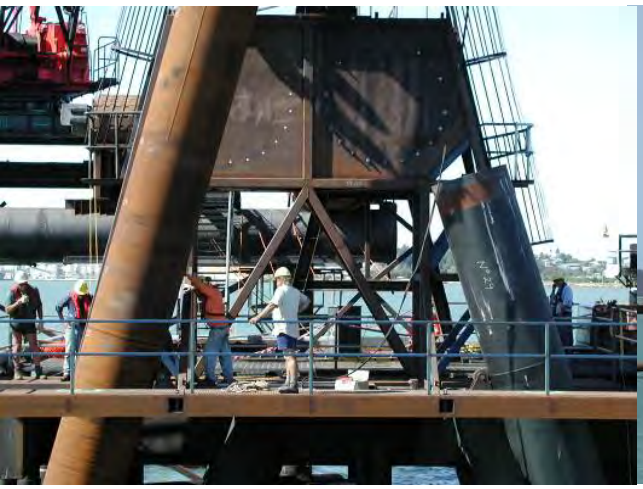
Bonacci Infrastructure provided the temporary works design for the crane access bridge used to construct the new bridge. The access bridge was built over the top of the new bridge, as oppose to beside it, which was largely due to drill reach limitations. The temporary headstock system developed by Bonacci Infrastructure involved driving temporary piles through a suspended sleeve and then hanging the headstock from the installed pile. This system meant that temporary pile cut-off levels were not critical and the headstock was also the gate arrangement for driving the temporary piles.

RG Tanna Wharf

Contractor: Golding Walz

Bonacci Infrastructure provided continuous design and technical support for the duration of the project. Design activities included the main piling frame which cantilevers 14m from a previous bent, and the dolphin concrete form system (130m^3 in a single pour) which accommodated two different dolphin configurations.

The upper and lower piling gates are hydraulically operated with the lower gate concealed within the floor frame. The upper gate is fully detachable for use in different configurations, whilst the entire head frame is detachable for reverse usage.



RG Tanna Wharf

Tugun Desalination Plant

Contractor: Golding

Bonacci Infrastructure undertook extensive engineering reviews and strengthening of this jack-up barge to enable this vessel to construct the 3.1m diameter x 46m long ocean intake and outfall risers for the project. The vessel deck loading included a 600t crawler, 125t drill rig, 140t liner, 120t hydraulic hammer and a 35t mobile crane. In addition to these works.

Bonacci Infrastructure also undertook a comprehensive study on the risk of jacking failure and a storm survivability study that quantify structural capacity as a function of operating height and wave size. During operation the vessel was exposed to peaks waves in the range of 7-8m.

Sydney Desalination Project (Blue Water Alliance)

Contractor: John Holland Group

Bonacci Infrastructure provided the planning and detailed design of the helipad that was retro-fitted to the Seafox 6 S.E.P.

The helipad was installed with the vessel operational and in the position shown. The pad extends 26m off the hull.

Wivenhoe Dam Upgrade

Contractor: Leighton

Bonacci Infrastructure provided concrete form designs for the ogee weir
and 14m high tapered fuse walls as shown in the adjacent photo.

Burnett River Dam (Paradise Dam)

Contractor: McMahon

Bonacci Infrastructure provided continuous construction advice to this project
with the key features being the certification of the main RCC feed conveyor, shown adjacent, and the spillway ogee weir form system which was flush with the face of the dam wall and elevated some 40m above ground level.

Doyles Rock Road Bridge Duplication

Contractor: John Holland Group

Bonacci Infrastructure provide engineering designs for the fit-out of a new piling leader onto an existing barge owned by JHG and also a purpose made girder placement gantry, see photo below. The gantries were in two portions to enable it to be partially assembled over the new works in preparation for the 4hours lane closure when an entire bridge span would be placed.

The pre-assembled configuration meant more time in the 4hr window was available for girder installation, as opposed to gantry setup. The middle image below shows the preassembled gantry. The column next to the existing bridge was on skates and it was literally pushed out of the way once the other gantry end was connected.

Soil Retention System

Bonacci Infrastructure has extensive experience in the design of both permanent and temporary ground retention systems, a collage of images is provided below.

In particular, Bonacci Infrastructure has extensions experience in the design of:

- Deep (up to 26m to date) anchored walls
- Secant pile, contiguous piles and diaphragm walls
- Sheet pile walls, cofferdams (rectangular, circular and elliptical) and cellular cofferdams

BONACCI INFRASTRUCTURE

PERFECTING THE ART OF ENGINEERING

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Appendix D: Terry Memory CV

Terry Memory

Director

DATE OF BIRTH 5 October 1968

QUALIFICATIONS

Master of Civil Engineering (by thesis) Queensland University of Technology, Brisbane
Bachelor of Civil Engineering with first class honours, Queensland University of Technology, Brisbane
Member, Institution of Engineers, Australia
Past Chairman, Queensland Division Structural Branch, Institution of Engineers, Australia

CAREER

2005 to date	Director, Bonacci Infrastructure
2000 to 2005	Associate Director, Bonacci Infrastructure
1998 to 2000	Senior Design Engineer, Bonacci Winward (Qld)
1993 to 1998	Design Engineer, Madsen Giersing
1992 to 1993, 1997 to 1998	Queensland University of Technology Full time and part-time Civil Engineering Lecturer

MARINE AND MINING EXPERIENCE

WICET
Detailed design of 2km of reclaim tunnel

APLNG Marine Terminal
Tender design

Santos GLNG Marine Terminal and MOF
Tender design

Santos GLNG Mainland Facility
RG Tanna, Port Central and Fishermans Landing

British Gas QCLNG Marine Terminal and MOF
Tender design

British Gas QCLNG Mainland Facility
Detailed design floating RoRo facility and ferry terminal

Abbot Point MOF
Material load-out facility

LNG Wharf Darwin
Design Review

East Arm Common User Wharf
Stage 1 and 2 and multi-user wharf tender design. Stage 2 design review.

Hamilton Mineral Separation Plant
Surge Bin, 1000t Silo, 800t Silo.

Glebe Island Sea Wall
Detailed design of seawall revetment and culvert outfall

Portside Wharf Development
Tender alternative

Otomona Bridge
100m clear span, West Papua

P.T. Freeport Gold and Copper
Coal storage cover foundation design, Indonesia.

Western Mining Company, Townsville
Fertiliser receival, storage and reclaim facility.

Quezon Power Station
Marine Facility, Philippines.

MARINE AND MINING EXPERIENCE (CONT.)

Marine Facility for Ross Island Development
Department of defence, Townsville.

Shute Harbour Redevelopment
Tender Design

Ely Bauxite Project
3200m long Jetty

Lihir Project
Barge loading Wharves 1 and 2. Barge maintenance Wharf. Sea dump facility, Lihir Barge Loading Wharf. PNG.

Lihir Gold Project
PNG General Cargo Wharf Tender Design

Manila Grains Terminal
Tender design

PNG Napa Napa Oil Refinery Marine Facility
Tender design

Dredeco Wharf Facility
Detail design of Dredeco's wharf at Whyte Island, Brisbane

Southern Cross Cement Jetty
Tender design, Philippines

Burnie No.7
Berth rear deck, Tasmania

West Port – Port Klang
Tender design, Malaysia

Mount Isa Mines
Blast furnace modification

CIVIL INFRASTRUCTURE EXPERIENCE

Rubyanna STP Upgrade
($40M) Project Director

Wiggins Island Coal Export Terminal
Coal reclaim tunnel, 4x950m long in-situ design

Murrumba Alliance
(approx. $192m) - Project Director and Design lead for all structural works.

CIVIL INFRASTRUCTURE EXPERIENCE (CONT.)

Wagga Wagga Sewer 2010 Project
($130M) - Project Director and design lead for all structural works.

Mackay Water Recycling Project
($150m) - Project Director and design lead for all structural works.

Coffs Harbour Infrastructure Alliance
($154m) - Project Director and design lead for all structural works.

Pimpama Water Future Alliance
($87m) - Project Director and design lead for all structural works.

Wetalla Water Reclamation project
($36m) - Project Director and design lead for all structural works.

Merrimac Water Future Alliance
($70m) - Project Director and design lead for all structural works.

Brisbane Water Enviro Alliance
($208m) – Project Director and design lead for all structural works.

RAAF Base
Central emergency power supply bunker, Townsville

Sandgate WWTP
Stage 1 Inlet works

Bulimba Creek Trunk Sewer
Deep maintenance hole design for 1500 DN sewer

Nightcap WTP
Lime dosing tanks (Steel)

South East Transit Project (SET4)
Numerous soil retaining structures

Douglas Water Treatment Plant Upgrade
Detailed design of 7m high WTP process facility

Luggage Point Water Reclamation Project
Effluent takeoff channels and wells

Maryborough Cogeneration Power Station
Tender design including 56m high stack

South East Queensland Busway Network
5no. Transit Stations

Carol Park
60m high boiler stack Tender Design

Bond University Telecommunication Tower
Detailed design of tower using MStower software

Kangaroo Point Boardwalk
Stage 2, Brisbane

CONSTRUCTION ENGINEERING EXPERIENCE

GLNG, Gladstone
Development and design of construction method to place 400m long ocean intake and outfall pipeline.

Exxon Mobil PNG LNG
Detail design of piling leader fitted to 200t Manitowoc cranes and detailed review of 100m bridge launch.

St Lawrence Rail Bridge Duplication
Detailed design of temporary bridge, piling gates, falseworks and travelling access platforms

CONSTRUCTION ENGINEERING EXPERIENCE (CONT.)

Abbot Point Coal Terminal
Detailed design of various piling systems and the design of the MOF.

Forgan Bridge, Mackay
Detail design of all construction plant including 400m of temporary and reusable steel bridgework

Dalrymple Bay No. 7 Extension
Detailed design of construction plant including dolphin piling system

Nerang Rail Bridge Duplication
Detailed design of gantry system that enabled 7No x 28m bridge spans to be installed in 2No. 48hr shutdowns.

Gold Coast Desalination Plant
Structural certification SEP Ensung and extreme weather survivability assessment of the SEP Ensung

Brisbane Seawall Alliance
Rock impact assessment on rolling stock floor design

Burnett Dam Alliance
Detailed design of various temp works including the main ogee dam weir

Wivenhoe Dam Alliance
Alternate design for fuse gate and detailed design of final fuse gate temporary works.

LNG Wharf, Darwin
Piling gate and leader system for the SEP Margret

C.A.R. Wharf
Detailed design of all construction/piling plant

RG Tanna Wharf
Detailed design of all construction/piling plant

Port Motorway Alliance
Various temporary works including crane stability assessments

EXPERT WITNESS & FORENSIC ENGINEERING EXPERIENCE

Tanjung Bin Power Station – Malaysia.
Expert Witness for the foundation works

Port Botany Container Ship Wharf
Expert witness for structural distress

FMG Port Headland Facility – Piling works
Forensic Reporting / Expert opinion

Victorian Desalination Plant
Expert witness

Eastern Treatment Plant
Expert witness

Darwin East Arm Wharf
Expert witness

Luggage Point WWTP
Gas storage bell derailment

South East Transit Project
Report into concrete cracking of the tunnel roof

Wastewater Treatment Plants
Numerous reports into the concrete cracking and leakage

Wharf, Indonesia
Report on collapsed structure

Project Image Gallery

GLNG – RoRo Linkspan

South East Transit Project – Soil Retaining Structures

BWEA – Structural design of WWTP

Murrumba Downs Alliance – Structural Design of WWTP

WICET – Reclaim tunnels

Quezon Power – Marine Facility

Ross Island – Army Base

QCLNG – RoRo / Ferry Terminal

Project Image Gallery Cont.

Forgan Bridge – Construction Engineering

GLNG – RoRo Facility

St Lawrence – Rail Bridge Duplication

GCDP – Ensung SEP Certification

RG Tanna Wharf –Construction Engineering

Roche Minerals – 2000t Silo

Exxon PNG LNG – Bridge Launch

BMT JFA Consultants

"Where will our knowledge take you?"

ESPERANCE JETTIES CONDITION ASSESSMENTS

Condition Inspection and Maintenance Strategy Report

Reference: R-J15028-1
Date: December 2015
Confidential

SHIRE OF ESPERANCE

ESPERANCE JETTIES CONDITION ASSESSMENTS

CONDITION INSPECTION AND MAINTENANCE STRATEGY REPORT

Prepared for

By

BMT JFA Consultants

Rev	Issue	Prepared by	Submitted to	Date	Copies
A	Draft – First Review	J Fifield	B Saunders	30/11/15	1 Elec
B	Preliminary Draft for Client Review	J Fifield	G Harris (SoE)	1/12/15	1 Elec
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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Project Background

BMT JFA Consultants Pty Ltd (BMT JFA) were engaged by the Shire of Esperance to undertake condition inspection of the Esperance Tanker Jetty, Town Boat Ramp Jetty and James Street Swimming Jetty.

Inspections of all three Jetties were undertaken on the 11th November (underwater ROV) by Justin Fifield and Adam Kayser (Ocean Eyre) and 17th/19th November (Above Water) by Brad Saunders and Justin Fifield. The condition inspection and assessments have been undertaken in accordance with the Ports Australia Wharf Structures Condition Assessment Manual (WSCAM) 2014.

1.2 Site Description

1.2.1 Tanker Jetty

The Esperance Tanker Jetty is situated approximately 2km north of Esperance Port. It extends approximately 700m from the beach in an easterly/south-easterly direction. It was constructed in 1934 and then refurbished in 1991 replacing the piles. Only the outer (North and South) piles were replaced during the refurbishment. The shoreward section (Pile frames 1-30) has been demolished to allow construction of a headland. The Jetty has been joined to the headland with an aluminium pedestrian walkway span.

The remaining section of the Tanker Jetty is approximately 600m long. The jetty was originally constructed of pile frames at 4.5m spacing made up of 3 piles. During the 1991 refurbishment, replacement piles, for a 2 pile frame, have been constructed outside, to the north and south, of the original piles.

The pile frame substructure (pier) consists of the piles and half caps which support the deck superstructure. The piles, of each pile frame, are connected by 2 half caps, which are seated into and bolted to both sides of the pile tops. The pile frames support the deck superstructure on the half caps.

The superstructure is comprised of the main longitudinal stringers, deck planks and the concrete deck. The main longitudinal stringers are supported on bearing corbels over the half caps at each pile frame. The 5 longitudinal stringers support deck planks, arranged transversely, which are topped with concrete pavement.

The substructure pile frames are a critical load path for the dead and pedestrian live loading. The piles are also subject to wave loading and have continued to deteriorate with failures, including ‘necking’, at the seafloor and at sea level. In addition the connections of the half caps at the top of some of the piles have also suffered at least one failure, including crushing.

1.3 Condition Assessment Framework

The jetty was subject to a high level condition inspection in accordance with the Ports Australia Wharf Structure Condition Assessment Manual’s (WSCAM) procedures. The

WSCAM rates the various elements condition from 1 New to 7 Failed. The condition rating scale is clarified in Figure 1-1.

Table A9.1: Timber Condition Rating Scale

CONDITION STATE	DESCRIPTION	EXPECTED REM. LIFE (% of original design life)	RECOMMENDED ACTIONS
1	New with no visible defects/damage.	100	No repairs required. Re-inspection at next scheduled inspection may be considered.
2	As new. Minor splits and checks, no measurable section loss.	55-100	No repairs required. Re-inspection at next scheduled inspection may be considered
3	Minor marine organism attack and pipe rot, decay or necking resulting in up to 5% of section area loss. There may be minor splits or checks evident.	40-55	Planned and preventative maintenance works may be considered.
4	Moderate pipe rot, decay, marine organism attack or necking resulting in up to 5-20% of cross section loss. There may be moderate splits or checks evident.	25-40	Further testing; reactive maintenance and some minor upgrades may be considered.
5	Heavy marine organism attack, evidence of termite activity, pipe rot, decay or necking resulting in up to 20-35% section loss. Major splits or checks evident.	15-25	Structural assessment is recommended. Further investigation may be required to inform the structural assessment. Maintenance; upgrade or rehabilitation works may be considered.
6	Severe marine organism or termite attack, pipe/ surface rot, decay or necking resulting in up to 35-50% section loss. Major splits or checks evident in critical zones mid and end spans.	0-15	Structural assessment is recommended. Further investigation may be required to inform the structural assessment. Rehabilitation or renewal works may be considered.
7	Severe marine organism or termite attack, pipe/surface rot, decay or necking resulting in greater than 50% section loss. Component has failed.	0	Rehabilitation required immediately or replace component/asset.. Structural assessment is recommended where rehabilitation works are to be undertaken. Further investigation may be required to inform the structural assessment.

Notes:

1. The expected remaining life provided in the table is indicative only. Predictive modelling based on physical assessment would be required to obtain an accurate indication of the expected remaining life.

Figure 1-1: Timber Condition Rating Scale (WSCAM 2014)

A high level visual inspection was undertaken, therefore, not all elements were inspected but a sample selected on the basis of previous inspection findings.

1.4 Inspection Preparation and Target Creation

The 2010 P09171 and 2013 R-224.07-1 reports were reviewed identifying areas where defects were identified and where repairs were specified. These areas were mapped prior to undertaking the inspection.

2 SCOPE OF WORK

The scope of services, as outlined in the Project Brief, is for the condition inspection, reporting, and subsequent development of fully costed asset maintenance plans, in two stages, for the following jetty structures:

- The Esperance Tanker Jetty
- Town Boat Ramp (Finger) Jetty (Separate Report)
- James Street Swimming Jetty (Separate Report).

2.1 Stage 1 – Condition Assessment

For each of the above mentioned structures, the Stage 1 scope includes the following activities:

- Review previous information, drawings, reports and specifications as provided by the Shire of Esperance
- Analyse the existing structures for structural integrity
- Based on the previous information determine the best procedure to determine the condition of the existing jetties and each of its components both above and below the waterline
- Assessment of the condition of main structural components and assignment of a score representative to its current condition
- Prepare a summary report of the condition inspections outlining the findings and recommendations for stage 2 of the works to be completed
- Present the results of the condition inspections and assessments to Councillors and Officers of the Shire of Esperance.

2.2 Stage 2 – Fully Costed Asset Maintenance Plan

For each of the above mentioned structures, the stage 2 scope includes the following activities:

- Utilising the condition information obtained from stage 1, produce detailed documentation that outlines a prioritised list of maintenance costs for the existing facilities based on work required to prevent failure and ensure the structures' conditions are suitable for their designated purposes
- Develop Preliminary Asset Management Strategies based on weighted scores and failure criteria to allow for Shire of Esperance feedback
- Submit final Asset Management Strategy documents for each structure, including costings to the Shire of Esperance for implementation.

2.3 Stage 1 – As detailed in Proposal Q-P15.30-2

2.3.1 Desktop Review

A review of the available drawings, reports and other information for the Tanker Jetty has been undertaken providing insight into the inspection planning.

Assessment of the structures to appreciate load paths has been undertaken to determine critical areas and elements of the structure as well as areas of redundancy.

2.3.2 Condition Inspection

In accordance with discussions between BMT JFA and the Shire of Esperance, the inspections will likely be targeted at the critical areas. A high-level inspection of the whole structure will be undertaken to identify any new critical areas, before assessing the specific areas identified to be at most risk.

(BMT JFA offered, as additional scope, a detailed inspection of the whole tanker jetty if required, as assessment of critical areas does carry some risk of defects going unnoticed. The most recent detailed inspection of the Tanker Jetty was undertaken nearly 5 years ago in 2010. This was not undertaken as part of the works.)

The condition inspections themselves have rated the critical structural elements, in the Heat Map (Appendix A) in accordance with the Ports Australia Wharf Structures Condition Assessment Manual criteria for wharves and other marine structures. BMT JFA provided guidance during the development of these guidelines which are similar to the New York Waterfront Inspection Guidelines - 1999 (NYWIG) used to provide the criteria for the inspection and assessment of the Tanker Jetty in 2013 (R-224.07-1).

2.3.3 Condition Summary Report

A simple colour coded Condition Summary Report can be found in Appendix B to identify critical areas which require repairs and outlining what those repairs would be and their priority.

This report includes:

- Summary high level assessment of the global structure and critical defects
- A catalogue of the photographs taken during the inspection (Provided separately to report)
- Tabulated report of areas where repairs are required and when these repairs should be undertaken.

This report is intended as a summary of inspections in accordance with our proposal and updates information in less detail than the 2013 report, R224.07-1. The findings focus on critical issues in the short term ahead of an expected closure or replacement.

2.3.4 Presentation

BMT JFA have presented initial findings to the Councillors and Officers of the Shire of Esperance on the condition and any necessary structural repairs to the three Jetties and outline the potential strategy options and advantages and disadvantages for the proposed remedial approaches.

2.4 Stage 2 - As detailed in Proposal Q-P15.30-2

2.4.1 Maintenance Costing

The maintenance cost list will expand the summary report schedule to include the individual maintenance tasks. Costs will be apportioned for the identified tasks as well as future estimated maintenance costs over the remaining life of the structure.

BMT JFA will use their extensive catalogue of repair and replacement costs for marine infrastructure to provide the basis for accurate costing. This will include net present value (NPV) calculations. Discount rates for the NPV calculations are to be supplied by the Shire of Esperance.

2.4.2 Asset Management Strategies

Once the basic repair costs have been identified the strategies for replacement can be compared. BMT JFA developed costs for the replacement of the Tanker Jetty as part of a previous project. The repair vs replacement strategies can be compared to optimise the most appropriate time to undertake closure or replacement of a structure before it becomes uneconomical to maintain.

3 TANKER JETTY DEFECTS

The Tanker Jetty has the following defects:

- Cracking and displacement of the **deck concrete topping panels**
- Rot and deterioration of **deck planks**
- Rot and deterioration of **stringers**
- Rot and crushing of **corbels**
- Rot and crushing of end distance on **half caps**
- Splitting of **pile tops**
- Surface and underwater teredo worm and rot damage to **piles**
- Corrosion and section loss of **bolts** and other **steelwork.**

3.1 Critical Elements Identified

As noted in section 1.2.1 the superstructure, when supported according to the original design, has overall sufficient load path redundancy and flexibility to accommodate the loads it is subjected to. Whereas the substructure pile frames are a critical load path for the dead and pedestrian live loading. The piles are also subject to wave loading which has a critical load path up into the superstructure to share the loads amongst the surrounding piles.

Both the dead and pedestrian live loading and wave loading load paths are critical and both pass through the same critical elements and connections. These are:

- Piles
- Half Caps (particularly the Pile to Half Caps connection).

The piles have continued to deteriorate with failures, including ‘necking’, at the seafloor and at sea level. In addition the connections of the half caps at the top of some of the piles have also suffered at least one failure, including crushing.

The Tanker Jetty inspections have found numerous significant defects subsequent to those reported in BMT JFA’s 2013 report R-224.07-1.

The most significant defects were; completely failed piles 54 North, 93 North and crushing of both half caps at their northern bearing support adjacent to the bridged section at missing pile 39 North (including 35-38 North, and 40 North).

The condition of the critical elements has been summarised in the heat map in Appendix A, where the elements have been scored based on their condition in accordance with WSCAM.

3.2 Piles

The piles identified as in a critical condition in order of WSCAM scoring 7 to 1.

3.2.1 7 - Failed / Greater than 50% loss of section

- 54 North – Appears to have failed between surface and sea bed

Figure 3-1: 54 North 11/11/15 – Severe necking at base (prior to failure identified 17/11/15)

- 93 North - Failed at water surface

Figure 3-2: 93 North 11/11/15 – Failure at surface

3.2.2 6 - 35% to 50% loss of section

- 53 South

Figure 3-3: 53 South 11/11/15 – Severe section loss at surface

- 58 South

Figure 3-4: 58 South 11/11/15 – Severe section loss at base

- 66 North

Figure 3-5: 66 North 11/11/15 – Severe section loss at base

- 70 South

Figure 3-6: 70 South 17/11/15 – Severe section loss at surface (surface inspected only)

- 71 South

Figure 3-7: 71 South 17/11/15 – Severe section loss at surface (surface inspected only)

- 74 North

Figure 3-8: 74 North 11/11/15 – Section loss and splitting at many locations through water column

- 91 North

Figure 3-9: 91 North (Top-3/8/13, Bottom-11/11/15) – Severe section loss at base

- 101 North

Figure 3-10: 101 North 11/11/15 – Severe section loss at base

- 112 North

Figure 3-11: 112 North 11/11/15 – Severe section loss at base

- 129 South

Figure 3-12: 129 South 11/11/15 – Severe section loss at surface (top), section loss at base (bottom)

3.3 Half Caps

As there are two half caps there is some redundancy in the pile frame substructure unless both have significant defects. Therefore the critical locations noted in this position paper are where both half caps have suffered significant defects.

3.3.1 7 - Failed / Greater than 50% loss of section

- 95 South

Figure 3-13: 95 Southeast (Top-17/11/15, Bottom 30/11/15) – Crushing failure of half caps

3.3.2 6 - 35% to 50% loss of section

- 35 North

Figure 3-14: 35 North West 17/11/15 – Crushing of both half caps

- 36 North

Figure 3-15: 36 North 17/11/15 – Crushing of both half caps

- 37 North

Figure 3-16: 37 North 17/11/15 – Crushing of both half caps

- 38 North

Figure 3-17: 38 North 17/11/15 – Crushing of both half caps

- 40 North

Figure 3-18: 40 North 17/11/15 – Crushing of both half caps

- 43 North

Figure 3-19: 43 North 17/11/15 – Crushing of both half caps

- 44 North

Figure 3-20: 43 North 17/11/15 – Crushing of both half caps

- 93 South

Figure 3-21: 93 South 17/11/15 – Crushing of both half caps

- 94 South

Figure 3-22: 94 South 17/11/15 – Crushing of both half caps

- 133 North

Figure 3-23: 133 North 17/11/15 – Crushing of both half caps

4 DISCUSSION

This section comments on the general condition, performance and remaining life of identified jetty components.

4.1 Concrete Deck Topping

This element is the running surface and merely transfers the pedestrian live load onto the timber deck planks. Cracking is visible in some locations but this crack does not appear to have increased or propagated further since the 2013 survey. The cracking that is present is understood to be due to the local movement and settlement of some sections of the jetty. The cracking tends to be prevalent around broken piles however it is also found in other areas. BMT JFA have confidence that the deck topping will continue to perform for a further 5 years, but may experience further localised differential settlement, translation and cracking.

4.1.1 Hand Railing

The hand railing sections inspected appear to have sufficient capacity for the expected remaining life of the jetty.

4.2 Timber Deck Planks

This element was the original deck surface. The top side is not visible (except in the far east end, 141-143) as it is covered in the concrete deck topping. Only localised defects were identified. These defects are not likely to affect the structural performance of the jetty. BMT JFA are confident that this element overall will continue to perform as it currently does for a further 5 years.

4.3 Timber Stringers

There are 5 timber stringers along the length of the jetty. The outer (north and south) stringers are in the worst condition and in some areas, particularly at the eastern end and on the north side, have deteriorated substantially to the point where they have effectively failed. The inner 3 (the centre and inner south were originally locomotive rail supporting stringers) stringers, are protected from the elements, and these alone are capable of supporting the deck dead and live loading from above if all substructure pile frames are present.

In areas where the piles or half caps of the substructure pile frames are failing and have settled, the stringers are spanning between the functioning pile frames. For this reason the stringers are using more of their capacity. This equates to a reduced level of redundancy in the superstructure.

If multiple pile frames settled or failed the timber stringers will go into a catenary. In this instance the vertical loads are supported under tension by the stringers anchored by the many pile frames on each side (there would be limited anchoring at the far east and west ends of the jetty).

Such catenary tensions would need to be transferred over sufficient length which would be greater than the length of an individual stringer beam. This would require the stringer longitudinal connections to transfer these tensions and rely on the bolts. The bolts are assumed to be the original or at least have not been replaced by maintenance teams for over

40 years. Bolts which have been recovered from the structure have shown significant corrosion losses with just a small fraction of the bolt shank remaining in the majority of instances. Because of this, it is vital that all substructure pile frames remain in good condition to avoid the possibility of progressive collapse.

4.4 Timber Corbels

To support the timber stringers there are 5 timber corbels supported by a pair of half caps on every substructure pile frame. The outer (north and south) corbels are generally in the worst condition and in some areas, particularly at the eastern end and on the north side, have deteriorated substantially to the point where they have split, failed or are missing. The inner 3 are protected from the elements, and these are generally in a good condition and capable of supporting the stringers above.

4.5 Timber Half Caps

This element acts as a cross beam between two piles to form a substructure pile frame. The weathered ends, north and south, are often in a poor condition and some have started failing or have failed. As there are two half caps at each pile frame there is some redundancy in the pile frame substructure unless both have significant defects. There is an inherent weakness in the pile to half cap connection as a result of the 1991 refurbishment replacing the outer piles. Using this method to insert piles outward of the original piles whilst still using the original half caps meant that there was a short bearing length. The short length available provided only sufficient room for a pair, but often only a single, 20mm diameter bolt to be fitted with insufficient (to be in accordance with AS 1720 Timber Structures) end distance. The insufficient end distance in combination with deterioration of the timber due to weathering has caused the shear failures when storm conditions have caused lateral pile movement.

Where the deterioration at the ends, which are open to weathering, has become critical the combination of the short bearing distance and reduced strength timber has resulted in crushing of the half caps. This has occurred in many instances on single half caps but which then relies on the other half cap to “take up the slack” and in some cases this increased load crushes the other. Partial crushing of both half caps, of a substructure pile frame, provides some support to the stringers (this includes all stringers at that, not just the nearest) above for a time. However once the crushing continues the stringers will be forced to span this substructure pile frame (at which point it becomes essentially redundant), this comes with additional problems – see section 4.3. If stringers are required to span further they provide additional load to the adjacent half caps/substructure pile frames increasing the likelihood of these crushing.

A repair is required before significant crushing has occurred to prevent stringers being required to span substructure pile frames.

4.6 Piles

The piles are the main supports for the structure. They are the most critical element of the substructure and structure providing support from the bed. They are found to be in a generally poor condition particularly at the surface and bed. Only a sample of piles were inspected by ROV however many of those chosen to be inspected were in a significantly worse condition than found during previous inspections.

Two failed piles were identified and a further 9 have lost significant section from a combination of rot and marine borer (Teredo) damage. Further investigation of the remaining piles would be prudent to identify the precise repairs required.

An observation is that the piles have reached a point where the protective pressure applied preservative treatment has largely become ineffective. The piles are generally now rapidly deteriorating from marine organism attack. As a result all piles that have been rated 6 require rehabilitation or renewal in the short term. Therefore, should life extension be necessary, this work would be required.

Where piles have failed the stringers are required to span between the adjacent substructure pile frames (9m as opposed to 4.5m standard spans) this provides additional load onto pile frame half caps and piles increasing the likelihood of their failure if defects are present.

4.7 Global Stability

The global stability of the structure as a whole was highlighted as an issued in the 2013 report R-224.07-1. It was advised that existing cross bracing which in some sections isn't even present was ineffective. There appears to be increased flexibility and movement in the structure since the 2013 condition update, the evidence for this is:

- Apparent variance, off the linear, of the jetty deck in both line and level
- Apparent opening/greater translation of cracks in jetty deck
- Springiness of the deck around broken piles 54N and 93N
- Pile 54N breaking between the above water (11/11/15) and below water (17/11/15) inspections
- Increased number and severity of crushed half caps and split piles over the whole structure.

As the flexibility of the structure increases with more failures there are knock on effects to the rest of the functioning elements. The majority of significant defects are occurring on the substructure pile frames which are required to absorb the loads from failed substructure pile frames.

4.8 Overall Condition Summary

As detailed in the heat map introduced in section 3.1 (and presented in Appendix A) a number of areas of high rating defects are evident.

As a result of the worsening condition of critical components and aggregation of defects identified, the overall condition of the jetty at some location can be assumed to have a WSCAM Criticality rating – **High**, and a Safety rating – **High** and therefore has zero remaining service life.

Global stability issues and further deterioration/failures may lead to progressive collapse which cannot be predicted but may occur at any time due to additional environmental or pedestrian live loadings requiring urgent action.

4.9 Stage 2 Jetty Repair Schedule

Due to the inspection findings and the critical nature of the findings, a Tanker Jetty Maintenance Schedule Sch-J15028-1 was produced as part of Stage 1 reporting, (Appendix B), that identified the following prioritised actions:

Immediate

- 12 Pile repairs
- 11 Half Cap repairs
- 11 Corbel repairs.

6 Month

- 18 Pile repairs
- Inspect all Piles (Dive inspection including cleaning)
- 29 Half Cap repairs
- 24 Corbel repairs.

12 Month

- Wrap all Piles to extend remaining life (199 No.)
- 10 Half Cap repairs
- 4 Corbel repairs
- 5 Stringer repairs.

Based on historical repair information, initial cost estimates indicate critical/immediate repairs would be in the order of $300K to $500K. Further less critical repairs costing at least the same order are required in a staged manner to address these areas within 6 months. A further expenditure of perhaps an even larger quantum is required to address the pile repair backlog and other less critical component repairs such as corbels, pile splits etc.

5 RISK ASSESSMENT

As a response to the worsening condition of the jetty components a risk assessment was undertaken based on the Shire of Esperance Council's Risk Management Policy criteria. The following notes document this process.

5.1 Likelihood Ranking – 4 - Likely

A score of **4** - **Likely** has been identified based on ongoing crushing failure and/or swell event that would destabilise half cap connections leading to a progressive failure that could endanger life. This event could occur this year.

5.2 Consequence Ranking – 5 - Catastrophic (Safety)

Scores have been identified for the Shire of Esperance Councils consequence categories:

- **Safety – 5** catastrophic if someone goes in the water with risk of drowning
- **Financial – 4** or **5** high due to compensation for near miss or death
- **Compliance – 3** Moderate – reputational risk with regulators (DoT et al)
- **Reputational – 4** to **5** depending on event
- **Environmental – 1** insignificant – no major environmental risk is identified.

Based on the maximum reasonable consequence rating the score is **5 – Catastrophic**.

5.3 Risk Matrix Outcomes

Risk Matrix outcomes are therefore on the above basis **Extreme** requiring urgent action at the highest level and constant attention. Mitigation measures that would have to be applied to manage would be urgent repairs and ongoing monitoring.

Existing controls that are currently in place including periodic structural monitoring would be considered inadequate at this time given the elevation of the current risk status based on the deterioration identified. Actions should include a review as to whether:

- the facility is immediately closed to public access to control, and
- the implementation of recommended repairs can be effective and justified at this time as a control measure to reduce the risk rating to an acceptable level as opposed to other options including mothballing and/or demolition as control measures. (Any repairs would at this point be extensive over a minimum of we estimate 3 to 4 areas along the jetty and require ongoing monitoring to maintain the current level of service as other components continue to deteriorate).

6 STAGE 2 – JETTY MAINTENANCE STRATEGY

Given the findings of Stage 1 and the critical condition of the structure, the following options were formulated for discussion in consultation with the SoE:

1. Repair the whole Tanker Jetty to a safe level of structural integrity
2. Repair half of the Tanker Jetty (demolish from Pier 88 to 143)
3. Replace pile frames (Steel piles)
4. Demolish whole Tanker Jetty
5. Demolish whole Tanker Jetty and replace

6.1.1 Option 1 - Repair Whole Tanker Jetty

To repair the entire existing tanker jetty to a safe level of structural integrity the following actions are required;

Firstly the critical areas require repair. As discussed in section 4.7 the flexibility of the jetty may have increased over the last two years. Such an increase in flexibility could be both the cause and symptom of the greater number of defects identified since the report of 2013. To address this problem and alleviate future similar issues; firstly, the defects (symptoms) require immediate attention to prevent any further increase in flexibility. That is all the component failures and critical defects identified within this report as requiring immediate remedy.

Secondly, the potential for future defects occurring in the same manner should be stemmed. This is required by a significant increase in the level of maintenance, addressing any defects which may become critical in the near future threatening an increase in flexibility. Based on the findings of inspection of a selection of piles and the widespread teredo damage with which the majority of the piles were found, to be effective, this action would include the wrapping of all piles within a year. A steady process of strengthening/haunching the currently defective half cap to pile connections should also be undertaken. A similar approach should also be taken with the defects to corbels and stringers, i.e. alleviate flexibility to avoid unnecessary stresses on the surrounding components before they effect the structures integrity.

Thirdly, the whole structure should be stiffened to assist in the prevention of further defects occurring, specifically, at weak points such as pile to half cap connection. This stiffening can be achieved with the substructure pile frames by adding effective bracing. An example of this is shown on the sketch included in Appendix C. It is likely with the various pile frame failures (pile breakages and halfcap crushing) that the deck has been put under increasing stress developing greater flexibility, this is of particular concern with respect to the condition of the bolts and bolt holes where rot has been found to be prevalent and corrosion of fixings chronic. Where possible it is also advised that a process of changing out bolts be undertaken and if rot is identified during extraction, removal and application an epoxy grout be applied to set replacement bolts firmly into the timber.

Fourthly, should areas be repaired for ongoing pedestrian access, monitoring and inspection should be undertaken to ensure that the structures flexibility has been stabilised, particularly

after wave events. Monitoring systems could be fitted or inspections could be undertaken regularly to include record keeping of quantitative measurement of deflections at specified locations checking if magnitude varies.

The costs have been approximated for the continued maintenance of the existing structure for a 10 year life extension (Appendix D). It is anticipated that there may be additional risks and complications with this approach beyond those specifically identified in the Cost Maintenance Schedule Appendix B. These include:

- It may not be possible to stabilise all of the bolts (predominantly these may be the original superstructure bolts) requiring replacement are not possible to access (due mainly to the concrete deck obstructing access)
- If the maintenance requirements stipulated are not fully undertaken further failures could endanger jetty user safety and result in floating debris being a navigation hazard
- As the original timbers deteriorate with rot and general wetting and drying they become more susceptible to catching alight and subsequent fire damage. This would mainly be a risk at the outer ends of the pile bent frames and is largely protected by the concrete deck
- Design of special repairs will be required where defects have >50% loss of element capacity and support of the existing structure during the works problematic due to its condition which will impact on the subsequent on cost of repairs
- Even after detailed investigations including specification of intrusive investigations to determine if there are hidden defects within the structure there may be some latent issues or components such as pile mean that costs are excessive and better value obtained by reconstruction
- Extensive repairs could face significant weather related delays and difficulties particularly in winter.

In summary, the repair to target a 10 year life extension would be extensive, difficult and a liability in terms risk remains requiring ongoing monitoring and inspection. It can be expected that the works to carry out the required repairs would take the better part of 2016 and in addition face significant weather risk in the conduct of the repairs. The condition of the remaining piles and latent damage within the deck superstructure may mean that it is not possible to stabilise the structure for the targeted 10 period of ongoing use. With works carried out over the majority of 2016 expected, and the mobilisation of significant marine plant required, an order of cost estimate for the repairs is $4m with further works over the subsequent 2 years in the order of $6m to deal with the lower priority backlog repairs to stabilise the deck superstructure and further extensive pile repairs. Ongoing inspection and repairs are still anticipated over the 10 year timeframe to manage the latent risk of damage within the structure.

6.1.2 Option 2 - Repair Shoreward Half of Tanker Jetty (Demolish outer half)

This option would retain a significant portion of the historic Tanker Jetty. The maintenance requirements for the shoreward end of the Jetty (Pier 31 to Pier 87) would be as described in section 6.1.1. There would a substantial reduction in forward maintenance costs, compared with the whole jetty, by not undertaking the works on the outer half of the jetty.

There would, however, be the requirement to undertake demolition of the outer half of the structure. This is a requirement firstly to separate the retained structure from the neglected half to ensure that additional stresses are not applied to the outer end of the retained length of jetty as piles and other components periodically fail. Similarly, to allow for the periodic failure of components and the risk of floating debris causing damage to the retained length of jetty and be a risk to navigation, demolition should be undertaken to eliminate these risks.

In the cost schedule the costs are included for demolition in the short term (6 months) and subsequently at the end of the structures' life to allow for the completion of demolition to ensure no risk of debris causing a navigation hazard at the end of the life of the structure. This separation of the demolition in to two separate phases does mean the mobilisation of demolition plant and licences is required twice, which does increase the total cost of demolition in comparison with option 1 (particularly after net present value has been applied). An order of cost estimate for these works including partial demolition is in excess of $5m initially with further works in the subsequent 2 years in the order of $3m to stabilise the deck superstructure and further extensive pile repairs. Ongoing inspection and repairs are still anticipated over the 10 year timeframe to manage the latent risk of damage within the structure.

6.1.3 Option 3 – Re-Pile Whole Structure (Retain Half Caps and Deck Superstructure)

This option would see the replacement of the majority of the pile frame substructure components. Steel piles would be driven adjacent to the existing timber piles with steel brackets fitted to connect with good timber of the existing half caps. Such works would require similar levels of design and geotechnical investigation costs as a complete replacement.

An ideal solution would be to completely replace the substructure pile frames however there is potential difficulty in replacing the half cap cross beams for two reasons. Firstly a replacement half cap cross beams would need to be fed underneath the jetty which could require additional plant costs and mobilisation. Secondly the bearing area on the timber would be smaller unless additional fabrication cost for wider bearing locations for corbels were introduced.

There are two options regarding the existing piles. They can either be retained, which adds additional wave loading to the structure with the additional risk of sections breaking off and causing a navigation hazard (much as the original 1934 piles do at present), or they can be removed which has an additional upfront cost and if carried out poorly could damage the existing half caps and deck superstructure.

The costs of this option would include significant geotechnical investigation, design, contract management and supervision costs of a similar order to those for replacement of the entire structure. An order of cost estimate for the pile replacement and repairs is $10m with further works over the subsequent 2 years in the order of $4m to deal with stabilising the secondary priority elements. Ongoing inspection and repairs are still anticipated over the 10 year timeframe to manage the latent risk of damage within the structure.

6.1.4 Option 4 –Demolition of Existing Structure

In assessing the options herein, it is important to note that there is a liability going forward in the order of over $3m to demolish the existing jetty. As noted in a briefing to Council, risks in

leaving the jetty to slowly disintegrate include: a more expensive and less safe demolition; risks to navigation from floating debris and management costs to contain this debris; and compliance issues and approved management of a decommissioned structure.

As a result it would be recommended that any decommissioned parts of the structure be removed as soon as practicable after options were assessed. It is important to note that the Wharf Island section was demolished recently for similar reasons. Demolition is estimated to cost in the order of $4.8m.

6.1.5 Option 5 – Replacement Steel and Concrete Jetty (includes Demolition of Existing Structure)

In 2014 BMT JFA provided the Shire of Esperance with 4 concept options and estimated costing for a replacement to the Tanker Jetty. Following a request from A. Hughes the replacement option to compare with the 3 repair options is a 250m long concrete and steel jetty. Adjustments have been made from the original costing estimates to suit this request. An order of cost for the jetty replacement is estimated to be around $11m inclusive of full demolition.

6.1.6 Basis of Cost Estimation

The cost estimates have been collated from a combination of information provided from a number of reliable sources as well as BMT JFA's catalogue of construction costs. The pile repairs were obtained for a Denso Seashield 400 system currently being installed on the Fremantle Traffic Bridge by Marine and Civil contractors. The haunch repairs have been advised from costs to undertake previous repairs obtained from the Shire of Esperance. Demolition and construction cost estimates were provided by Marine and Civil. For the demolition additional information was obtained for a smaller demolition of the tanker jetty island provided by Esperance Port Sea and Land, additional costs were factored in for the removal of the concrete deck and services.

7 CONCLUSIONS & RECOMMENDATIONS

7.1 Condition Assessment Conclusions

- The jetty inspection and condition assessments carried out found that as a result of aggregation of poor and failed component condition that the structure had insufficient structural capacity to ensure public safety
- Urgent repairs of components highlighted in Section 4.9 as **Immediate** priority are required to Piles and Half Caps
- Full detailed inspection of all piles is required to fully establish the rate of deterioration of these components.

7.2 Condition Assessment Recommendations

- The Tanker Jetty is closed until at least the immediate priority repairs have been undertaken
- Consideration be given to reducing the length of the jetty to reduce the backlog repair liability and cost
- Stage 2 services focus on further definition of repair methodologies and cost estimates of the remaining half of the structure landward of Pier 87.

7.3 Stage 2 Repair & Maintenance Strategy Option Assessment Findings

As a result of the critical condition of the jetty, a range of options were formulated for discussion to inform Council decision making going forward. Options included order of cost reviews of strategies to extend the life of the existing structure for a further 10 years by repairs only and major repiling. Immediate and secondary priority repairs to the jetty would cost in excess of $1m in the near term to reopen the jetty or perhaps 70% of that for a truncated structure with no guarantee that further closures could be held off unless further works to stabilise the structure were carried out. It was found that with re-piling to treat the high risk of ongoing pile failure even with major repairs that costs were well in excess of replacement costs including demolition with latent risk issues for that expenditure with no guaranteed life would be wholly achieved.

It would be therefore recommended that the structure not be repaired and be considered as having reached the end of its life. It is further recommended that the structure be removed to manage ongoing risks ahead of consideration of a suitable replacement structure at the site. Given the iconic nature of the structure and the ongoing maintenance liability in the marine environment, it would also be recommended that such a structure be considered on whole of life costs and specification for durability be the highest priority taking lessons from the deterioration of the current structure. Costs in the order of 2% of the capital cost may be required per annum to maintain such a structure and these should not be overlooked in the decision making process to “get more jetty for the money”.

It is anticipated that specification for such an outcome would be in excess of that for a commercial structure which can be written off in commercial terms. Allowance should be made for ongoing protection and maintenance strategy including consideration of a scheme for concrete durability with special reinforcing or long term corrosion management, steel pile

protection with cathodic protection and wrapping of exposed above water sections to prevent loss of section over time.

APPENDIX A:
CRITICAL ELEMENT (PILE AND HALF CAP) CONDITION RATING (WSCAM) HEAT MAP

Critical Element (Pile and Half Cap) Condition Rating (WSCAM) Heat Map

	Date	South			North			Revision		Status		South			North			
	9/12/2015	East	West			East	West	C		Draft		East	West			East	West	
Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.		Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.
388	Pier 31	2	2	3	4	2	2	823/824		489/490	Pier 88	2	2	4	4	2	2	712/713
391	Pier 32	3	3	4	4	3	3	822/823		491/492	Pier 89	3	3	5	4	3	3	710/711
390/393	Pier 33	2	2	4	4	5	5	820/821		493/494	Pier 90	3	3	4	4	3	3	708/709
	Pier 34	2	2	4	4	5	5	818/819		495/456	Pier 91	2	3	4	6	4	4	706/707
392	Pier 35	2	2	4	4	5	6	816/817		497/498	Pier 92	2	2	4	4	5	3	704/705
396	Pier 36	2	2	5	4	6	5	397/815		499/500	Pier 93	6	5	4	7	2	2	702/703
399	Pier 37	2	2	4	4	6	6	812/813		501/502	Pier 94	6	6	4	4	2	2	700/701
406	Pier 38	2	2	4	4	6	5	810/811		503/504	Pier 95	7	6	4	4	4	4	698/699
	Pier 39	2	2	3	7	3	3	809		505/506	Pier 96	2	2	5	5	2	2	696/697
	Pier 40	2	2	4	4	6	6	404/405		507/508	Pier 97	2	2	4	4	2	2	694/695
	Pier 41	3	3	4	4	4	3	805/806		509/510	Pier 98	3	4	4	4	3	3	692/693
	Pier 42	2	2	4	4	5	3	411/412		511/512	Pier 99	2	3	4	4	2	3	690/691
	Pier 43	2	2	5	4	5	6	801/802		513/514	Pier 100	2	3	4	4	2	2	688/689
	Pier 44	2	2	4	4	5	6	799/800		515/516	Pier 101	3	5	4	6	2	2	686/687
	Pier 45	2	2	4	4	4	4	797/798		517/518	Pier 102	3	3	4	4	3	5	684/685
	Pier 46	2	2	4	4	4	4	795/796		519/520	Pier 103	2	2	5	4	2	3	682/683
	Pier 47	2	2	4	4	3	4	793/794		521/522	Pier 104	3	3	4	4	3	3	680/681
416	Pier 48	3	5	4	4	3	4	791/792		524/525	Pier 105	2	2	5	4	2	3	678/679
	Pier 49	2	2	5	5	4	3	789/790		526/527	Pier 106	3	2	3	4	2	2	676/677
	Pier 50	2	2	4	4	3	4	787/788		528/529	Pier 107	3	2	4	4	2	2	674/675
	Pier 51	2	2	4	4	3	3	786		530/531	Pier 108	4	3	4	4	2	2	672/673
	Pier 52	2	2	4	4	2	2	784/785		532/533	Pier 109	3	3	4	4	3	3	670/671
	Pier 53	2	2	6	4	2	2	782/783		534/535	Pier 110	3	3	5	4	3	3	668/669
423	Pier 54	2	2	4	7	2	2	780/781		536/537	Pier 111	2	2	4	4	2	2	666/667
425	Pier 55	2	2	4	4	2	2	778/789		538/539	Pier 112	3	3	5	6	2	2	664/665
424	Pier 56	3	3	4	5	3	3	776/777		540/541	Pier 113	3	3	4	4	3	3	662/663
429	Pier 57	3	3	4	4	3	3	774/775		542/543	Pier 114	3	5	4	4	2	2	660/661
430	Pier 58	2	2	6	4	3	3	772/773		544/545	Pier 115	2	2	3	4	2	3	658/659
	Pier 59	2	2	4	4	2	2	770/771		546/547	Pier 116	4	4	4	4	3	3	656/657
432	Pier 60	3	3	4	4	4	5	768/769		548/549	Pier 117	3	3	4	4	3	3	654/655
	Pier 61	3	3	3	4	3	3	766/767		550/551	Pier 118	3	3	4	5	3	3	652/653
	Pier 62	2	2	3	4	3	3	764/765		552/553	Pier 119	4	3	4	4	2	2	650/651
440	Pier 63	5	5	4	4	3	5	762/763		554/555	Pier 120	3	3	5	4	3	3	648/649
	Pier 64	2	2	4	4	2	2	760/761		556/557	Pier 121	2	2	5	4	3	3	646/647
	Pier 65	3	2	4	4	3	3	758/759		558/559	Pier 122	2	2	4	4	2	2	644/645
444/445	Pier 66	3	2	4	6	2	2	756/757		560/561	Pier 123	3	3	4	4	3	3	642/643
446/447	Pier 67	3	2	4	4	4	4	754/755		562/563	Pier 124	2	2	4	4	2	2	640/641
448/449	Pier 68	2	3	4	4	3	3	752/753		564/565	Pier 125	3	3	4	4	4	4	638/639
450/451	Pier 69	3	2	4	5	3	2	750/751		566/567	Pier 126	2	2	4	4	2	3	636/637
452/453	Pier 70	2	2	6	4	2	2	748/749		568/569	Pier 127	3	3	4	4	3	3	634/635
454/455	Pier 71	2	2	6	4	5	4	746/747		570/571	Pier 128	2	2	4	4	2	2	632/633
457/458	Pier 72	2	2	4	4	2	2	744/745		572/573	Pier 129	2	2	6	4	2	2	630/631
459/460	Pier 73	4	3	4	4	3	4	742/743		574/575	Pier 130	3	3	4	4	2	2	628/629
461/462	Pier 74	2	2	4	6	2	3	740/741		576/577	Pier 131	2	2	5	4	3	2	626/627
463/464	Pier 75	2	2	4	5	5	5	738/739		578/579	Pier 132	2	2	4	4	4	4	624/625
465/466	Pier 76	3	3	4	4	3	3	736/737		580/581	Pier 133	5	3	4	4	6	6	622/623
467/468	Pier 77	2	2	4	4	2	2	734/735		582/583	Pier 134	3	3	4	4	3	3	620/621
469/470	Pier 78	2	2	4	4	3	3	732/733		584/585	Pier 135	4	4	4	4	3	3	618/619
471/472	Pier 79	2	2	4	4	2	2	730/731		586/587	Pier 136	4	4	4	4	3	3	616/617
473/474	Pier 80	2	2	4	4	2	2	728/729		588/589	Pier 137	3	3	4	5	4	4	614/615
475/476	Pier 81	2	2	4	4	2	2	726/727		590/591	Pier 138	3	3	4	4	3	3	612/613
477/478	Pier 82	3	3	4	4	3	5	724/725		592/593	Pier 139	3	2	4	4	2	2	610/611
479/480	Pier 83	2	2	5	4	3	3	722/723		594/595	Pier 140	3	3	4	4	4	4	608/609
481/482	Pier 84	2	2	4	4	2	2	720/721		596/597	Pier 141	4	4	4	4	2	2	606/607
483/484	Pier 85	2	2	4	4	2	2	718/719		598/599	Pier 142	2	2	4	4	5	3	604/605
485/486	Pier 86	2	3	4	4	3	2	716/717		600/601	Pier 143	2	2	4	4	2	2	602/603
487/488	Pier 87	3	2	4	4	2	2	714/715										

Notes:

1 Condition rating scoring, from 1 (new) to 7 (failed) are in accordance with Ports Australia Wharf Structures Condition Assessment Manual

2 If a cell has a border [ ] this demarcates that the element has been inspected as part of this, if a cell has no border it's condition is approximated based on previous findings inspections or on general condition findings

3 Piles which have not been inspected have been given a condition rating of 4

4 Recently (2013) repaired piles have been given a condition rating of 3

5 Photo numbers relate to the photo files provided as supplemenatry information with this report

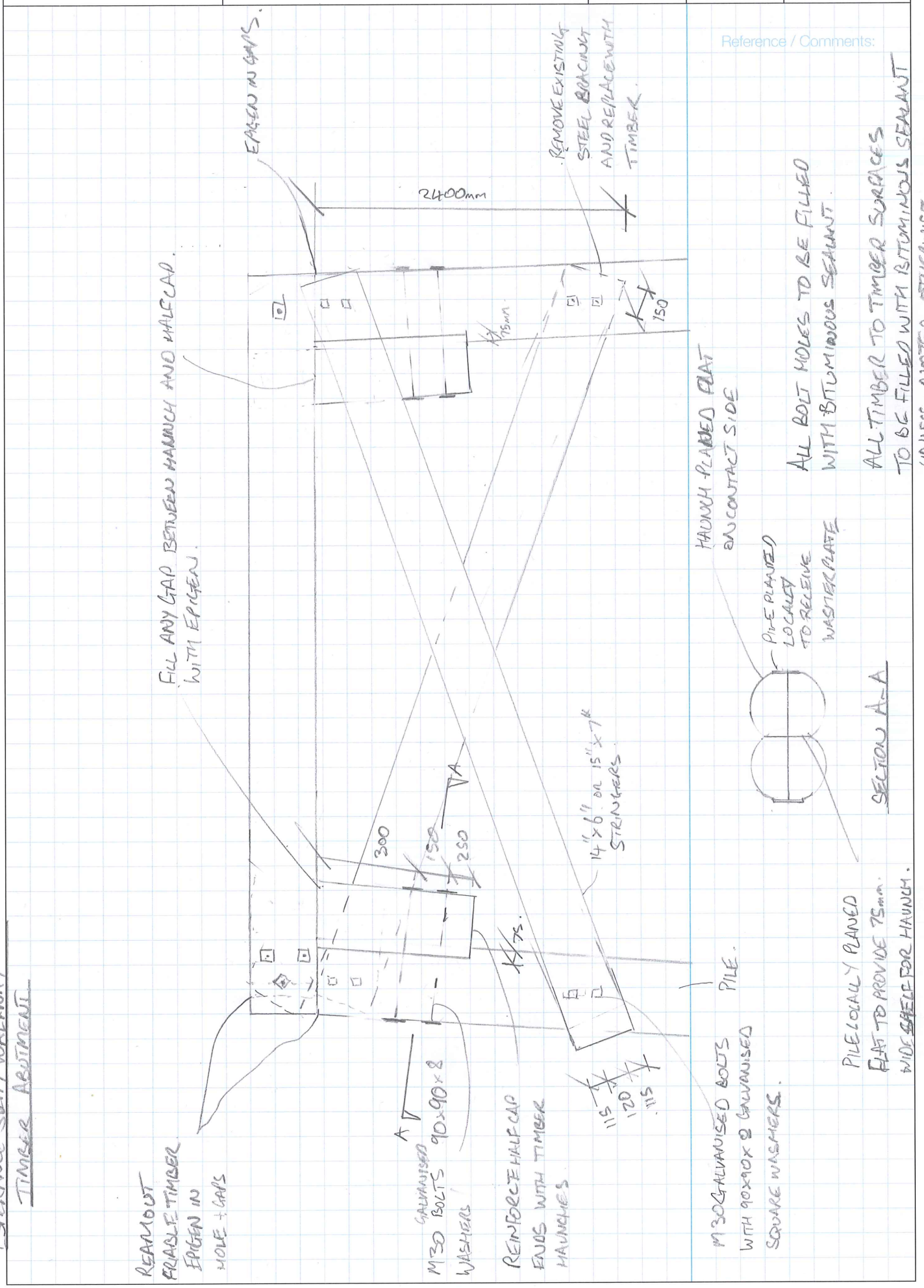
APPENDIX B:
TANKER JETTY MAINTENANCE SCHEDULE –SCH-J15028-1

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME									
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance									
			Tanker Jetty Maintenance Schedule	Date	8/12/2015											
	Revision	A		By	JF		Jetty Maintenance Programme									
							2015	2016				2017				
							Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Category	Item	Condition	Activity	Report Ref	Priority											
				R-J15028-1												
Piles (Below Water)																
	54N, 93N	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate										
	53S, 58S, 66N, 70S, 71S, 74N, 91N, 101N, 112N, 129S	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate										
	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S, 89S, 96N, 96S, 105S, 110S, 118N, 120S, 121S, 131S, 137N	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months										
	All piles		Dive inspection including cleaning		4	6 Months										
	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months										
Piles (Above Water)																
	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months										
Half Caps		Combined														
	95S Both	13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate										
	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both, 93S Both, 94S Both, 133N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate										
	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both, 91N Both, 92N Both, 95N Both, 101S Both, 102N Both, 114N Both, 116N Both, 125N Both, 133S Both, 132N Both, 135S Both, 136S Both, 137N Both, 140N Both, 141S Both, 142N Both	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months										
	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both, 98S Both, 108S Both, 119S Both	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months										
Corbels																
	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate										
	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate										
	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months										
	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months										
Stringers																
	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months										

APPENDIX C:
SKETCH

BMT JFA Consultants "Where will our knowledge take you?"	Project Name:	Job Code:		Page: Of:
	Activity:	By:		Date:
	Title/Purpose:	REV:	CKD:	App'd:

Reference / Comments:



APPENDIX D: COSTS

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Full Jetty	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											Total
No. Units	Item	Condition	Activity	Report Ref	Priority																	
				R-J15028-1																		
Piles (Below Water)																						
2	54N, 93N	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$52,000															
10	53S, 58S, 66N, 70S, 71S, 74N, 91N, 101N, 112N, 129S	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$210,000															
18	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S, 89S, 96N, 96S, 105S, 110S, 118N, 120S, 121S, 131S, 137N	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months		$360,000														
199	All piles		Dive inspection including cleaning		4	6 Months		$39,800							$39,800							
163	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months				$2,608,000												
			Demolition of half of jetty (including electricals)																		$4,471,976	
Piles (Above Water)																						
12	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months				$48,000		$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000			
Half Caps		Combined																				
1	95S Both	13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$14,000					$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000			
10	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both, 93S Both, 94S Both, 133N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$90,000															
29	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both, 91N Both, 92N Both, 95N Both, 101S Both, 102N Both, 114N Both, 116N Both, 125N Both, 133S Both, 132N Both, 135S Both, 136S Both, 137N Both, 140N Both, 141S Both, 142N Both	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months		$174,000														
10	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both, 98S Both, 108S Both, 119S Both	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months				$90,000		$90,000										
50			Bracing to limit pile bent movement			24 - 48 Months						$500,000	$500,000									
Corbels																						
3	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$12,000					$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000			
8	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate	$32,000															
24	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months		$60,000														
4	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$8,000		$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
Stringers																						
5	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$125,000				$125,000			$125,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$2,000,000	$2,000,000									
			Design of Repairs				$80,000	$80,000				$50,000										
			General Quantative and Inspections				$80,000	$80,000	$80,000	$80,000	$80,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000		
							$ 570,000	$ 793,800	$ 80,000	$ 2,959,000	$ 80,000	$ 2,978,000	$ 2,838,000	$ 463,000	$ 377,800	$ 338,000	$ 463,000	$ 338,000	$ 338,000	$ 4,671,976	$ 17,288,576	

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Half Jetty	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											
No. Units	Item	Condition	Activity	Report Ref	Priority																	Total
				R-J15028-1																		
Piles (Below Water)																						
1	54N,	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$26,000															
6	53S, 58S, 66N, 70S, 71S, 74N,	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$126,000															
8	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S,	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months		$144,000														
111	All piles		Dive inspection including cleaning		4	6 Months		$22,200							$22,200							
96	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months				$1,440,000												
			Demolition of half of jetty (including electricals)							$2,966,221											$2,966,221	
Piles (Above Water)																						
12	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months				$48,000		$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000	$48,000			
Half Caps		Combined																				
0		13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$0					$0										
6	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$54,000															
13	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both,	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months		$78,000														
7	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both,	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months				$63,000		$63,000	$63,000	$63,000	$63,000	$63,000	$63,000	$63,000	$63,000			
25			Bracing to limit pile bent movement			24 - 48 Months						$250,000	$250,000									
Corbels																						
2	35N, 41N	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$8,000					$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
3	51N, 52N, 84S	7	Replace corbel.		5	Immediate	$12,000															
10	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N,	6	Bolt corbel together at split / split end(s).		4	6 Months		$25,000														
2	53N, 85S,	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$4,000		$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000			
Stringers																						
2	63N-64N, 72N - 74N,	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$50,000				$50,000			$50,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$1,000,000	$1,000,000									
			Design of Repairs				$80,000	$80,000				$50,000										
			General Quantative and Inspections				$50,000	$50,000	$50,000	$50,000	$50,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000		
							$ 356,000	$ 399,200	$ 50,000	$4,621,221	$ 50,000	$1,543,000	$1,493,000	$ 293,000	$ 265,200	$ 243,000	$ 293,000	$ 243,000	$ 243,000	$3,086,221		$ 13,178,842

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME															
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance															
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																	
	Revision	A	Repile	By	JF		Jetty Maintenance Programme															
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025		
							Q4	Q1	Q2	Q3	Q4											
No. Units	Item	Condition	Activity	Report Ref	Priority																	Total
				R-J15028-1																		
Piles (Below Water)																						
1		7,6,5 &4	Steel piles Plant Mob/Demob	Section 3.2	5	Immediate		$1,613,900														
224	All Piles	7,6,5 &4	Piling					$3,321,900														
			Geotechnical Investigation					$250,000														
			Design of Pile and Connections					$304,251														
			Contract Management					$330,000														
			Construction Supervision					$121,701		$0												
			Demolition (including electricals)																		$4,471,976	
Half Caps		Combined																				
224	All Half Caps	13	Bracket Connection Good Timber to new steel piles					$2,763,125				$0										
								$0														
										$0		$0	$0	$0	$0	$0	$0	$0	$0			
												$0	$0									
Corbels																						
3	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$12,000					$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000			
8	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate	$32,000															
24	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months		$60,000														
4	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$8,000		$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000			
Stringers																						
5	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$125,000				$125,000			$125,000					
Whole Structure																						
	All Bolts		Replace all accessible bolts and epoxy repair any rot with grout if necessary									$2,000,000	$2,000,000									
			Design of Repairs				$40,000	$40,000				$40,000										
			General Quantative and Inspections				$40,000	$40,000	$40,000	$40,000	$40,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000		
							$ 124,000	$ 8,844,877	$ 40,000	$ 173,000	$ 40,000	$ 2,160,000	$ 2,120,000	$ 245,000	$ 120,000	$ 120,000	$ 245,000	$ 120,000	$ 120,000	$ 4,571,976	$ 19,043,853	

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME																
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance																
			Tanker Jetty Maintenance Schedule	Date	11/12/2015																		
	Revision	A	Replace	By	JF		Jetty Maintenance Programme																
							2015	2016				2017	2018	2019	2020	2021	2022	2023	2024	2025			
							Q4	Q1	Q2	Q3	Q4												
No. Units	Item	Condition	Activity	Report Ref	Priority																		Total
				R-J15028-1																			
Demolition																							
1		7,6,5 &4	Plant Mob/Demob (includes equipment for demolition & construction)					$1,614,000															
224	All Piles + Substructure + Deck Concrete + Services	7,6,5 &4	Demolition (including electricals)	3.2	5	Immediate		$2,900,000															
1			Demolition Supervision and Contract Management					$278,000															
Preliminary Pre Construction Works																							
			Community Consultation?																				
1			Geotechnical Investigation					$250,000															
1			Detailed Design					$320,000															
1			Contract Management and Project Tendering					$103,000															
Construction																							
120			Piles 120No,						$1,780,000														
60			Crossheads 60 No.						$1,184,000														
180			Concrete slabs with FRP mesh infill						$1,347,000														
1			Handrail, Kerbing, ladders and services (water + electricals provisional)							$590,000													
1			Low level platform							$300,000													
			Shade area							$90,000													
			Construction Supervision						$300,000	$53,000													
							$ -	$ 5,465,000	$ 4,611,000	$ 1,123,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,199,000

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME																			
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance																			
			Tanker Jetty Maintenance Schedule	Date	8/12/2015																					
	Revision	A	Full Jetty	By	JF		Jetty Maintenance Programme																			
							2015	2016				2017				2018				2019						
							Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Total		
No. Units	Item	Condition	Activity	Report Ref	Priority																					
				R-J15028-1																						
Piles (Below Water)																										
2	54N, 93N	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$28,000																			
10	53S, 58S, 66N, 70S, 71S, 74N, 91N, 101N, 112N, 129S	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate	$100,000																			
18	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S, 89S, 96N, 96S, 105S, 110S, 118N, 120S, 121S, 131S, 137N	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months		$180,000																		
199	All piles		Dive inspection including cleaning		4	6 Months		$19,900																		
163	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months				$1,467,000																
Piles (Above Water)																										
12	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months				$30,000				$30,000												
Half Caps		Combined																								
1	95S Both	13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$14,000							$70,000												
10	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both, 93S Both, 94S Both, 133N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate	$90,000																			
29	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both, 91N Both, 92N Both, 95N Both, 101S Both, 102N Both, 114N Both, 116N Both, 125N Both, 133S Both, 132N Both, 135S Both, 136S Both, 137N Both, 140N Both, 141S Both, 142N Both,	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months		$174,000																		
10	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both, 98S Both, 108S Both, 119S Both	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months				$90,000				$90,000												
50			Bracing to limit pile bent movement			24 - 48 Months								$500,000				$500,000								
Corbels																										
3	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate	$12,000							$12,000												
8	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate	$32,000																			
24	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months		$60,000																		
4	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months				$8,000				$8,000												
Stringers																										
5	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months				$75,000																
							$276,000	$433,900	$0	$1,670,000	$0	$0	$0	$710,000	$0	$0	$0	$500,000	$0	$0	$0	$0	$0	$3,589,900		

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	H O'Keeffe	H Saadai		H O'Keeffe		4/11/16

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