Executive Summary

Quest Reliability Limited was requested by Rustproof Services NZ Limited of the Gold Seal Group to document and report on the condition of the marine wharf at Raglan, New Zealand which was treated by Gold Seal Anti Corrosive coating.

The site was visited and the condition of the coating examined in January 2009.Background information describing the coating history was provided and in combination with the visual inspection, it was possible to conclude that:

Raglan wharf is located in Raglan Harbour on the west coast of the North Island, NewZealand. The wharf was showing premature reinforcing bar corrosion and concrete spalling of support pillars in the splash zone, which was coated by Gold Seal in 1984. An inspection, after 25 years revealed that the coating had effectively halted the concrete degradation and the corrosion of the reinforcing bars. However, exposed areas showed loss of coating from the surface. Despite this loss, the original coating that had penetrated cracks in the concrete was still providing long term corrosion protection to the reinforcement and no additional concrete spalling was seen. Areas that were not coated in 1984 under the reinforced concrete deck of the wharf had corrosion initiation seen as concrete cracking, spalling and exposure of reinforcement.

The Gold Seal coating over concrete or steal when applied in a severe marine environment worked best on previously uncoated components. Gold Seal provided a barrier to the severe marine environment with the coating showing slow degradation over time in sheltered areas and some level of weathering in exposed regions through direct exposure to the sun, wind and rain water movement under severe marine environments.

The Gold Seal coating applied to the Raglan wharf is nearing the end of its life, and should therefore be reapplied. The following should be considered:

- Removing the remnants of the old coating only in the areas where red/brown staining was evident; a 3000psi water blast should be sufficient.
- The underside of the wharf deck, which showed the onset of concrete spalling and rebar corrosion, should also be water blasted and treated with the Gold Seal.
- The existing Gold Seal coated areas can be washed and re-coated with no other preparation required.

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1. Introduction

Quest Reliability Limited (QR) was asked by Rustproof Services NZ Limited of Gold SealGroup to conduct condition assessment of the marine structure at Raglan Wharf, New Zealand,, which was previouslytreated by Gold Seal Anti Corrosive coating (Gold Seal).

The structure was as follows:

- Raglan wharf, located on the west coast of the North Island of New Zealand,

The scope of the work was to:

- Review provided documentation.
- Conduct visual inspection of the structure.
- Document and report on the condition of the structure.

2. Background

2.1 Raglan wharf

Raglan wharf is located in Raglan Harbour – between Cox and Aroaro bays – on the westcoast of the North Island, New Zealand, in a severe marine environment. The wharf is in a tidal zone but away from direct exposure to the Tasman Sea. The wharf was constructed from reinforced concrete pillars and deck with the underwater portions covered in barnacles.Its construction consisted of four independent stages, with the beginning of construction dating back to 1916 [1]. The section that was treated by Gold Seal was the oldest.

In 1983, the Raglan County Council initiated a project of revitalization of the oldest part of the wharf due to its deteriorating condition [2]. A detailed examination in 1983 showed no evidence of structural failure; although, severe degradation was recorded for a number of individual members of the wharf, and the degradation mechanism associated with the severemarine environment. The concrete was spalling locally and reinforcing bar locally corroding.Subsequently, the Raglan County Council considered a number of proposals on wharf remedial work, and gave preferences to a "rustproofing coating", offered by Gold Seal.

After approximately three years from the date of completion of the work, the senior engineer of the Raglan County Council pointed out that [2], "since sealing of the beams with rustproofing product, salt water and air are both restricted thus halting corrosion, however, some action continues in salt impregnated concrete where the product is not in direct contact with the steel. This action over 3 years since coating has caused some further spalling created gaps in the coating which needed to be touched up …" Ultimately, it was

concluded that the coating showed no signs of deterioration after three years of exposure, and provided a cost effective solution to prevent further significant deterioration of the Raglan Wharf.

A more recent inspection [1] of the wharf, conducted in February 2001 by Tonkin & Taylor environmental and engineering consultants, concluded that the condition of the wharf was similar to what it had been in 1987, when the last Gold Seal touch up work was done. In addition, Tonkin & Taylor predicted another 20 or more years for the wharf for the case where pedestrian only access to the wharf was implemented.

3. Visual Inspection and Discussion

3.1 Raglan wharf

A visual inspection of the Raglan wharf, Figures 1 to 4, was completed by QR in January2009. All observations were made from the pedestrian ramp and accessible areas underneath the structure. The assessment was of the early vintage portion of the structure that was GoldSeal coated in 1983/1984. The exposed areas of the structure were on the right side and front of the wharf. The wharf extension on the left shielded that portion from direct exposure to the elements.

In the rain washed zone and near the edges of the wharf, Figure 1, the original damage on the supports and beams was primarily in the form of longitudinal and cross-sectional cracks,with a limited number of spalled areas and minor loss in cross-sectional area of the concrete cover. A limited amount of the Gold Seal coating was seen retained, primarily in cracks onthe vertical and diagonal beams but these surfaces appeared not to have been significantly corroded since time of coating. The Gold Seal in the cracks was thought to have provided protection to the underlying reinforcing bar and significantly limited corrosion even though it was abraided from the outer exposed surfaces.

The Gold Seal coating on horizontal, vertical and diagonal beams, located in the sheltered regions under the wharf deck, and areas protected from rain, was still pliable and in good condition, Figure 2. Only a few small locations exhibited signs of deterioration seen as localised brown staining and drying of the Gold Seal coating, over originally exposed reinforcement, Figure 3. This brown staining was taken as being indicative of onset of slow corrosion of the underlying reinforcement. The brown stain was from build-up of iron corrosion products in the Gold Seal coating. Again the observed spalling of concrete was related to the degradation experienced by the structure before the application of Goldseal coating.

The concrete corrosion had been arrested and even exposed reinforcement was not significantly corroding.

The underside of the wharf deck had not been coated, Figure 3. In a limited number of areas the onset of concrete spalling and exposure of corroding reinforcement was observed. The underside of the wharf was a present candidate for Gold Seal Coating. The opposite side of the wharf was originally exposed to the elements and some degradationof the coating was seen, Figure 4. However the wharf extension effectively shielded these areas and the degradation of the coating was slowed to a low level. The coating on the originally exposed reinforcing and spalled concrete was in better condition in this sheltered area and was less in need of recoating that the more exposed areas on the opposite side.

Overall, there was no obvious additional loss in original cross-sectional area of the beams since the Gold Seal coating was applied. There was loss of outer coating in exposed areas and onset of corrosion staining of coated steal exposed prior to the coating in 1984. The rate of damage accumulation on these originally degraded areas appeared to have been halted entirely by the application of the Gold Seal coating. The rate of Gold Seal coating degradation appears to be directly related to the degree of exposure to the external environment.

Summary on Performance of Gold Seal Coating on Raglan Wharf
Raglan wharf is located in Raglan Harbour on the west coast of the North Island, NewZealand coated by Gold Seal in 1984. An inspection, afterapproximately 25 years revealed that the coating had effectively halted the concrete degradation and the corrosion of the reinforcing bars.
However, exposed areas showed loss of coating from the surface. Despite this loss, the original coating that had penetrated cracks in the concrete was still providing long term corrosion protection to the reinforcement and no additional concrete spalling was seen. Areas that were not coated in 1984 under the reinforced concrete deck of the wharf had corrosion initiation seen as concrete cracking, spalling and exposure of reinforcing bar. The wharf is recommended for Gold Seal re-coating, with the treatment being extended to the underside of the deck.Simple water blast of uncoated surfaces is required but the previously coated zones would only require a light wash before coating.

4. Conclusions and Recommendations

From the above it is possible to conclude and recommend the following:
The Gold Seal coating applied to the Raglan wharf is nearing the end of its life, and should therefore be reapplied. The following should be considered:

- Removing the remnants of the old coating only in the areas where red/brown stainingwas evident; a mild water blast should be sufficient.
- The underside of the wharf deck, which showed the onset of concrete spalling and rebar corrosion, should also be water blasted and treated by the Gold Seal coating.
- The existing Gold Seal coated areas can be washed and re-coated with no other preparation required.