Building Climate Resilient Unsealed Roads (Unsealed Road Treatment Trial)

Conducted by Bland Shire Council – Hollands Lane, New South Wales, 2671





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Executive Summary

Bland Shire is a major transport hub along the Mid –Western and Newell Highways and is one of the most productive agriculture and gold mining areas in the State. The Region has seen a slow decline in population in recent times with rural families moving toward larger population centres. Residents are moving to larger centres to be close to essential services.

Climate change has a major impact on our agricultural systems and regional infrastructure particularly in times of drought. During drought periods water is one of the major constraints to road maintenance. Without optimum moisture content for compaction, the lifecycle of the pavement structure would be reduced due to excessive loss of fines and the poor binding of material which causes pavement degradation.

Critical to prosperity and adaptability to the changing environment is the need for resilient, safe, efficient and cost effective road networks. The Hollands Lane treatment trial is designed to investigate a number of treatment and material options that may be applied to rural unsealed roads throughout Bland Shire to ensure Council is using cost effective road construction methods that require less maintenance and extend the useful life of the unsealed road network. The objective of the trial is to achieve less maintenance on Council's unsealed roads, which will ensure that resources such as water, gravel, operators and plant equipment are better utilised and only required through the initial road construction period. In turn reducing critical resources throughout the maintenance lifecycle of the pavement.

Council held a forum in June 2011 where climate change risk assessments were undertaken (that align with AS/NZS 4360 and ISO 31000). The forum's aim was to establish risk factors, consequences and the likelihood of occurrence to a broad range of Council assets, due to changes in climate within the local government area. Maintaining over 2500km of unsealed road network had been determined to be a high risk area that could have catastrophic results.

Bland Shire Council is actively looking for emerging technologies and techniques to improve our product and ensure that construction and maintenance costs both financially and environmentally are kept as low as reasonably practical. These emerging technologies and techniques will ensure that Council can provide a safe, reliable unsealed road network for residents and visitors to the Bland Region. In 2019 Bland Shire Council applied for a Grant under the 'Increasing resilience to Climate Change' through Adapt NSW (Local Government NSW) to conduct an unsealed road treatment trial in Hollands Lane.

Several trial sections were constructed using different treatments along Hollands Lane. Council staff monitored the construction and post construction performance and resources of each pavement section. Results were compiled and treatments were assessed for their performance and usability to ascertain if treatments would be suitable for use throughout the Shire in scenarios where ground conditions were similar to the test site.

Outcomes may see an increase in resilience to climate change impacts on unsealed roads by reducing degradation from extreme climate hazards, reducing maintenance time and costs to Council, improving safety and access to networks for road users. Improved work methods and treatments will assist in the improvement of construction and maintenance of existing road infrastructure. This would help to support regional businesses using the road network to stay connected and to assist in their financial viability in our rural areas.

It should be noted that several factors have hampered the construction and monitoring phases during the trial, most notably being the restrictions put in place after the outbreak of COVID-19. Another major impact on the project was several significant rain events which caused major inundation of flood waters in the pavement trial areas for prolonged periods of time (which is ironic, considering the trials purpose is conserving water and evaluating road performance under extreme dry conditions).

Introduction

The project plan was to construct 10 trial sections of homogenous unsealed road, each with a pavement section length of 500m (except Double-Double as it required greater outlay of funds). Pavement preparation works included wet grading and gravel patching along a 5.370km section of Hollands Lane. Several products were identified as potential solutions to maintaining and constructing Council's unsealed road network. Due to Council's road works relying heavily on Federal and State government funding the products had to be cost effective, as the ratepayer base is disproportionate to the size of the unsealed road network. Products had to be easily and readily available for our staff to use as logistically the remote location of the roads make it unfeasible to have contractor's complete works on an ongoing basis. The selected products had to be environmentally friendly to ensure the sensitive ecosystem is protected and to assist in the reduction of Council's carbon footprint. This aligns with Councils strategy to achieve our international climate commitments creating lower emissions working towards net zero.

The pavements have been constructed with various products to establish best practice and which products will have beneficial impacts on the construction of unsealed roads during prolonged dry weather periods, whilst utilising minimal water during the construction and maintenance phases. The pavement sections were constructed using Gravel from nearby Piper's Hill Stockpile and incorporated treatments of Polycom[™], Double -Double seal, Primer seal[™], Otta Seal[™], RT-20 Dynamic, Haulpac, Terra-3000, PolyChlor and PolyTahr and untreated Gravel. Each section was constructed according to specifications provided by the suppliers, the construction sequence and techniques were overseen by the subject matter experts for their product respectively, while Council officers recorded critical aspects of the construction process. The asset team began monitoring the performance of the road pavement sections by using Hawkeye[™] and Rough-o-Meter[™] Technology and gathering AADT data. Visual inspections were completed at monthly intervals. Cost comparisons were also established at a per meter squared rate for each 500 (m) treatment respectively. Cost considerations included emissions, human resources, plant equipment and product enhancement cost.

The inspections regime will form part of a comprehensive diagnosis of the condition and performance of each pavement section throughout the 12 month trial. The monitoring was completed by the 30th August 2021. However, Council will continue to monitor throughout the anticipated pavement lifecycle for its longevity and performance. Council redirected all traffic to transverse through Hollands Lane to ensure the pavement had enough traffic related stresses to achieve a good outcome during the monitoring period. Traffic from the nearby quarry was also redirected to transverse through the test site during the period of monitoring. It is expected that Council's adaptive capacity to maintain our unsealed road network will significantly increase due to improved maintenance, materials and construction techniques. This will increase resilience to climate change, reduce routine maintenance intervals, increase safety and contribute to improved travel conditions for the agricultural sector and other critical industries in the Region.

The trial and implementation of strategies and procedures would produce co-benefits that may include the reduction in fuel consumption/lower emission levels during construction/maintenance, as well as reduced emissions from user vehicles due to improved

road conditions. This will assist Council towards its objectives of net zero emissions targets in accordance with Net Zero Plan Stage 1 2020 - 2030.

Improvements will include less wear and tear on the pavement surface, which in turn will reduce Council's insurance risks, improved travel time due to better road conditions such as minimised dust and less erosion. Environmental impacts and reliance on raw materials will be reduced, improving efficiencies in Council's road network will assist in attracting future business to the Region.

Background

The construction and maintenance of roads within the Shire had become increasingly difficult as the Council relied heavily on obtaining water from nearby landholders to use on the construction of the roads. Farmers had become hesitant to let Council use their water resources as farmers relied on these supplies for their own households, stock and farming activities. The unsealed road treatment trial was to establish methods and products that would ensure that the unsealed road networks within the Shire could be maintained during long periods of dry weather. During the drought of 2017 – 2020 affecting Bland Shire Council and large sections of NSW the water supply in rural areas became scarce.



Average Rainfall in Australia

Image: Average rainfall 2019 (Courtesy of Australian Bureau of Meteorology)



Rainfall and Temperature for West Wyalong

Image: West Wyalong Average rainfall 2019 (Courtesy of Australian Bureau of Meteorology)

Maintaining Council's road network during periods of dry weather presents a problem, a major constraint is sourcing water for the construction and maintenance of the unsealed road network. The area links mixed farming enterprises and nearby quarry operations to Goldfields way, a major regional road that runs between West Wyalong and Temora.



Climate Change Adaption Risk

Image: Courtesy of worldvision.com.au 14/4/2021

Recently roadworks in some areas of the Shire were undertaken using potable water from standpipes. This takes away the need to use the residential water supply which is already strained, as well as minimising the pressure on the infrastructure used for domestic water use. This domestic water is paid for at consumer rates – this makes maintenance and construction of unsealed roads less cost effective. In some cases, due to the distance from the nearest standpipe, some unsealed roads were unable to be maintained and works abandoned, leading to rapid deterioration of the asset, this leads to reduced travel speeds and longer trip times for road users.

Building resilience to climate change in relation to water usage on unsealed road networks was identified as a potential avenue for addressing this issue. Council are looking at developing strategies, improved work practices that build Councils resilience to water resources in prolonged periods of dry weather (Drought). Council can improve work practices by developing strategies and improved work operations that build Council's resilience during prolonged periods of dry weather which enables the unsealed road network to be maintained to a safe standard in accordance with Council's assessment strategies.

Bland Shire Council are investigating methods and products that Council could utilise to improve the use of water, reduce our carbon footprint and deliver a high quality level of service from products that requires less maintenance, ensuring cost effective solutions for ratepayers.

Council submitted a funding application to Adapt NSW Increasing Resilience to Climate Change for the trial of several products along an unsealed road section in Hollands Lane. The trial would assess water usage during construction, maintenance, cost of construction and weather conditions, carbon footprint, plant and resources required. The Grant application was supported by project partners, Institute of Public Works Engineers Australasia (IPWEA), NSW Farmer's Association and the National Heavy Vehicle Regulator (NHVR). Refer to Appendix A, B, C for letters of support from the project partners. Bland Shire Council has committed to keeping its project partners up to date with the progress of the trial, including results and findings.

(See Appendix A for letter of support NSW Farmers Association, Appendix B for letter of support from NHVR and Appendix C for letter of support IPWEA)

Several supporting documents were used to determine the need for Council to increase its resilience to Climate Change by conducting an unsealed road treatment trial within the Bland Shire Region. Documents included the Bland Shire Council Climate Change Risk Assessment Adaption Report, The Western Enabling Regional Adaption in the Riverina Murray Regional Report, The Integrated Regional Vulnerability Assessment (volume2), Bland Shire Council Road Strategy Procedures and a risk assessment completed by Bland Shire Council's Risk Officer.

Climate Change is anticipated to continue to be a challenge for transport infrastructure, in particular unsealed roads. In order to embrace these challenges, authorities and planners need to have access to all necessary information on measures that may reduce impacts of climate change on road infrastructure. Climate change impacting a large proportion of assets and a rate paying base that is reducing, Council has less financial ability to maintain assets using current standards and practices. It is therefore imperative that Council continually investigate more effective products, methods of construction and maintenance practices to ensure that all infrastructure remains viable and safe for ratepayers, (Riverina Murray Enabling Regional Adaptation Report, 2017).

The Integrated Regional Vulnerability Assessment: Riverina Murray discusses sustainable Regional infrastructure that the community needs to understand that there is no capacity to build 'bullet proof' infrastructure. Even the best designed infrastructure will fail at the end of its intended lifecycle or beforehand, and communities need to become more self-reliant, particularly in rural areas.

Infrastructure will not last indefinitely without routine maintenance, particularly if climate conditions change. For example, under climate change the standards of engineering required to build structures to withstand certain levels of risk (such as a bridge built to withstand forces up to a 1 in 100 year flood standard) will likely be changing. Investment is needed to get the Regional rail system to a sustainable level. (The Integrated Regional Vulnerability Assessment, 2014.).

Bland Shire Council Climate Change Risk Assessment Adaption Report was conducted in June 2011. The report was adopted as an updated report in 19 March 2019 (Section 4 9.8) at Bland Shire Council meeting. The report on page 37, identified environmental risks due to climate change for the Shire and rated their impacts on the local community and environment and identified the likelihood, consequence and risk of the impact a reduction in

rainfall would have on maintaining the unsealed road network of the Bland Shire (Risk ID RAI 7 – Climate Change Risk Assessment Adaption Report). The unsealed road network in the Bland Shire is more than 2500km with an asset value of in excess of \$30,000,000.

Climate Change Risk Assessment Excerpt

RAI	7	There is a risk that with an average annual reduction in rainfall of 7% as well as a shift in seasonal dominance and annual rainfall patterns there will be less opportunity to maintain unsealed roads.	Almost Certain	Moderate	High
RCI	8	There is a risk that with an average annual reduction in rainfall of 7% as well as a shift in seasonal dominance and annual rainfall patterns there will be less opportunity to maintain unsealed roads.	Almost Certain	Moderate	High

Image: Excerpt (Bland Shire Council Climate Change Risk Assessment Adaption Report, 2019)

The Western Enabling Regional Adaption in the Riverina Murray Regional Report recognises that infrastructure augmentation to rural landholders requires 'chunky' investment. – Strong investment into well-connected infrastructure to support regional businesses (page 9). The investment into such a large unsealed road network for a Council with a low rateable income will not be viable and practically impossible in periods of decreased rainfall. (The Western Enabling Regional Adaption in the Riverina Murray Regional Report, 2017).

The Integrated Regional Vulnerability Assessment (IRVA) Volume 2 - Sustainable Regional Infrastructure (page 42), discusses the need for Council and the community to understand the limits of its capabilities of sustaining infrastructure if climate conditions change. (The Integrated Regional Vulnerability Assessment (IRVA) Volume 2, 2014). With all this information taken into account, a trial of treatments on our unsealed road network, using cost effective products/procedures that would reduce the overall reliance on water during construction or maintenance and delivering quality outcomes for residents and business' of the Bland Shire was deemed to be of great benefit.

This project is aligned with the objectives of Councils Road Strategy Procedures; the project outcomes will be incorporated into the 'Rolling Capital Works Program' for each Council road, this will enable the adoption of appropriate standards of construction for roads throughout the Shire. The Strategy will also address Councils Comprehensive State of the Environment Report (2009), issues regarding transport infrastructure and ecologically sustainable development 'ecologically sustainable development requires the effective integration of economic and environmental considerations in the decision-making processes.' The project is also aligned with objectives found in Bland Shire Council's Community Strategic Plan 2017 - 2027 to 'Work in partnership with key stakeholders to provide equitable access to Council's road infrastructure, services and facilities'.

(See Appendix D Integrated Regional Vulnerability Assessment: Riverina Murray Volume 2, Appendix E Riverina Murray Enabling Regional Adaption Report, Appendix F Hollands Lane – Climate Change Risk Assessment, Appendix G Road Strategy Procedures – Bland Shire Council, Appendix H Risk Assessment – Unsealed Roads Within Bland Shire Council – David Wardell Risk and Insurance Officer)

Expectations

Council's expectations from the trial is that the bitumen type treatments will perform better showing little to no deterioration compared to the additive treatments that show greater deterioration. The cost of treatments should compare with their durability (i.e. additives being more feasible than bitumen seals). The double/double (D/D) seal is expected to be the most effective wearing course providing the underlining pavement structure with the most protection from the environmental and traffic factors. Council also expected this type of treatment is superior and more expensive than other treatments applied, but it was also expected to be more expensive than all the other treatments.

Council have extensive experience using Polycom followed by a primer seal application so the cost and performance capabilities were relatively known. Councils experience with the other trial products were unknown other than the support and information provided from the sales engineers, product brochures and information from other projects carried out by private or government organisations sourced from the internet. Council anticipate the cost associated with the bitumen seal treatments will be higher. This is expected as the surface texture, ride quality and water proofing characteristic standards are higher in comparison to other treatments trailed and are controlled with engineering standards. Given the additional plant, human and time taken to prepare the surface for the sealed treatment emissions will be significantly increased.

Council considered various potential sites across the shire, these sites were brainstormed with key stakeholders in the organisation. Hollands Lane was identified due to it having problematic ongoing maintenance issues where Councils resources were deployed to the locations up to a minimum of twice a year to carry out significant maintenance. The subject road in question has all the key factors that Council were looking for, a heavy vehicle route, high traffic flow and a major road that transverses to a highway. Other key contributing factors considered were the existing in-situ pavement condition, it was highlighted that the road had been recently re-sheeted so the pavement had some body, significant clay, fines and gravel content to form good pavement shaped whist providing the structural capabilities to withstand traffic induced stresses. The road geometry was also suitable with minimal bends, deviations and intersections that would otherwise slow down the construction process.

Determination of treatment options was undertaken and quotes were obtained from several suppliers/companies after initial research into treatment options, including cost, usability and environmental factors. Nine products/treatments were chosen to participate in the trial. Experienced Council engineers and works supervisors assisted in determining what products would be most suitable and also what products would be unviable or not suitable to our area and operations.



Fig1: Aerial Map Hollands Lane (Start Ch: 0 - End Ch: 6273)

Image: Hollands Lane Trial Sections aerial view Spectrum Spatial

Seal Treatments

Double-Double Seal (Two Coat Seal) – (Start Ch: 5832 - End Ch: 6204 - 370m x 6m)

What - A Double-Double seal is applied to a prepared base course pavement layer by spraying a layer of binder, spreading the large-sized aggregate (14 mm) and, after suitable rolling and sweeping, spraying another lower application of binder followed by the spreading of a layer of smaller aggregate (7 mm).

How - Construction of the base course was completed using a John Deere 670G Motor Grader, Amman AP240 multi tyre roller and an Isuzu FYJ300 Water Truck. Once construction of the base course has been completed, the first bitumen spray seal of C240 using a Volvo FMX truck is applied with 14mm aggregate (Hino FM1 tipper). Following rolling and sweeping, a second bitumen spray seal using C240 is applied with the 7mm aggregate. This smaller aggregate fits into the voids between the larger aggregate and interlocks it into place, (*Refer to Figure 1*).

Why - The Double-Double seal design was selected for the trial because it had been used extensively throughout the shire to extend the life and reduce maintenance on busy unsealed pavement sections. The seal protects the underlining pavement structure from water intrusion. The pavement needs to be in structurally sound condition prior to a seal as a Double-Double seal will not provide any structural contribution to the pavement. Due to extended lifecycle of seals when compared to other treatments in trial sites, a superior seal performance verses cost, ensures an acceptable benefit to cost ratio can be attained.

Performance - The Double-Double seal performed well during the flood event of March 2021 and subsequent inundation on three separate occasions saw very little deterioration although, it was not subjected to the same volume of water that other sections encountered. The wearing course continues to outperform the other pavement trial sections and is consistent with Councils initial assumptions with little to no deterioration.

Evaluation - The Double-Double seal has been the most effective treatment when it comes to durability, ride quality, skid resistance and protecting the underling pavement. The wearing course has performed as expected with no signs of surface or structural defects and has shown little to no wear during the trial period. Improved driveability and dust suppression and waterproofing are other benefits of the Double-Double seal. However, the feasibility of this treatment is cost prohibitive due to the need for specialised equipment to construct the pavement sections for the Double-Double sealed treatment.

(See Appendix I Downer Emulsion Safety Data Sheet, Appendix J Downer Spray Sheet)



Image: Courtesy of Austroads

Double-Double Seal- (Start Ch: 5832 - End Ch: 6204)



Image: Double/double seal (Trevor Turner Hollands Lane 2021)

Double-Double Seal Particle Distribution



Image: Double/double seal (Trevor Turner Hollands Lane 2021)

Primer Seal - (Start Ch: 4830 - End Ch: 5334 - 500m x 6m)

What - Primer seal is a single coat emulsion seal that can be undertaken with Council's Jetpatcher. Prior to seal the road was constructed and the pavement surface prepared using John Deere 670G Motor Grader, Amman AP 240 self-propelled multi wheel roller, Isuzu FYJ300 Water Truck. The process involves laying emulsion with 10 (mm) aggregate using Council's Jetpatcher truck on top of the newly constructed unsealed pavement surface, preparation consistent with a Double-Double seal.

How - Requires the pavement base course surface to be prepared to a pre-seal standard. An emulsion and aggregate mix are then spayed onto the surface. The pavement surface is prepared consistent with all other sealed trialled areas (<u>Refer to Figure 2</u>).

Why - The Primer seal application was selected to take part in the trial due to its ease of application and the fact that Council already have the machinery and experience to complete this type of work. Council's feasibility analysis demonstrates that the primer seal is also more cost effective to apply than a double/double seal treatment.

Performance - Benefits include improved comfort and driveability as well as low to little dust emission. It holds the surface of the roadway together and is a more cost effective treatment than the other aggregated seals. Primer seal is an efficient cost effective seal using one application of emulsion and aggregate layer. This is an additional cost to a finished unsealed pavement and requires the use of additional machinery, labour and material. During the Flood

event of March 2021, the seal performed quite well although sections of the seal along the pavement edges had defects including edge breaks and erosion exposing the underling base course causing minor ruts. This was due to the significant rainfall intensity causing excessive velocities to undermine the seal along the edge of the pavement

Evaluation - Although this treatment is significantly less cost prohibitive than the other seal methods, it still requires the pavement to be prepared to a finished standard and therefore requires more time, fuel and resources to complete. Additional plant would be required to consistently apply this treatment throughout the entire shire.



Image: Primer Seal (Trevor Turner Hollands Lane 2021)

Primer Seal Roadway View



Image: Primer Seal (Trevor Turner Hollands Lane 2021)

Otta Seal - (Start Ch: 5334 - End Ch: 5832 - 500m x 6m)

What - An Otta Seal is a bituminous seal consisting of graded aggregate of various sizes and soft penetration grade bitumen. Otta seal was developed for use as a temporary surfacing on new pavements, due to its dust suppression capabilities and was developed as an alternative treatment.

How - The pavement was constructed using a John Deere 670G Motor Grader to shape and mix the base course in preparation for the application of Otta Seal. An Amman AP240 multi tyre roller and Isuzu FJY300 Water Truck were also used in preparing the pavement surface below the Otta seal application, a second self-propelled multi tyred roller as well as a Truck towed road brush to remove the excess loose material. UD 11-Litre Quon CD Tippers x 3 and an UD Quon CG 11L emulsion truck were then used to apply the treatment. The Otta seal treatment requires the finished pavement surface to be prepared to a high standard which is consistent with primer, single and double/double seal treatments. The Otta seal is then applied to the pavement using a binder and an aggregate mix of fine and large particles ranging from 5 (mm) to 15 (mm), (<u>Refer to Figure 3</u>).

Why - Otta Seal has been used to treat roads in neighbouring shires with positive results. Bland Shire Council decided it would be good to see how it performed when compared to other treatments in the Hollands Lane trial.

Performance - Initially there is dust while the treatment settles and has time to embed into the pavement surface however, after a month of vehicular use and rain, there is little dust present and the driveability is improved similar to the Double-Double seal, but a little coarser. The reduction in dust and the ride quality was comparable, noting the inconsistencies of the aggregate sizes making the roughness factor higher. The quality control of material to be used would have to be controlled to ensure that there is no clay material in the aggregate mix as this compromises the finish.

Evaluation - Similar to the other seals previously mentioned the pavement must be prepared to a similar standard as other sealed pavements prior to the application of the Otta Seal. The seal application is additional to the costs and resources required to complete compared to unsealed road pavements. Some small areas have seen the binder delaminate from the pavement however, on the outer pavement area and not in the main wheel path. Currently, Council have the plant required to undertake Otta Seal applications.

(See Appendix K Otta Seal Spray Sheet)

Figure 3: Single Coat Otta Seal



Image: Courtesy of Innovation in Sustainable Roads Services in Rural Setting (IPWEA) -Krishna Shrestha, Narrandera Shire Council

Otta Seal Cross section



Image: Otta Seal Cross section and particle distribution. (Photos Courtesy of Otta Seal vs Conventional Seal – Discussion Paper M Nirupan, Manager Engineering Services Bland Shire Council

Otta Seal Particle Distribution



Image: Otta seal Cross section and particle distribution. (Photos Courtesy of Otta Seal vs Conventional Seal Discussion Paper M Nirupan Manager Engineering Services Bland Shire Council)

Otta Seal Roadway View



Image: Otta seal (Trevor Turner Hollands Lane 2021)

In-Situ Binders

Haulpac - (Start Ch: 2925 - End Ch: 3425 - 500m x 6m)

What - Haulpac is a specifically formulated bitumen emulsion developed to bind mine haul road granular material. Haulpac improves the structural capabilities whilst reducing dust admissions.

How - Haulpac was constructed using John Deere 670G Motor Grader for mixing the product and shaping the surface in preparation for a seal coat, a Dynapac CA3500 Drum Roller and an Amman AP240 multi tyre roller was used to assist with compaction. An Isuzu FYJ300 Water Truck for the application of the product to obtain optimum moisture content.

Haulpac is a bitumen emulsion that is mixed to a depth of 75mm with the existing in-situ gravel. Once optimum moisture is obtained the material is graded and compacted. Another spray application of Haulpac (capping layer) is conducted over the surface and rolled again. This creates a protective seal over the treated pavement material. A follow up maintenance spray is carried out on the capping layer to protect the underling pavement materials.

Why - The benefits of Haulpac include the ability of current machinery and staff to undertake the construction and maintenance. Haulpac has been used on mine haul roads with good results. Due to the nature of machinery that is used around the Bland Shire staff were interested to see how Haulpac performed on unsealed sections of road with consistent traffic generation.

Performance - Once constructed there is little to not dust emitted. During construction Council found that some areas within the section seemed to mix with Haulpac better than others and this resulted in a few areas that initially had surface defects both structural & nonstructural. The defect areas have been isolated into sections that Council believe had inadequate compaction & poor mix consistency. The other pavement areas identified have performed well using Haulpac and the potential to use the product throughout the shire on similar material properties to Hollands Lane is promising.

Evaluation - A follow up maintenance spray of Haulpac was conducted 3 months after installation, as per manufacturer's recommendations. Further general maintenance treatment was carried out on potholes that had been identified in follow up surveillance inspections. Treatments on areas that have potholes were completed using hand mixed Haulpac and material from the road shoulder. Although isolated patches have not performed as well as expected, the fact that Haulpac is mixed into the base course and then capped off using just a water truck, it means the construction is not really different to constructing other unsealed roads.

The remainder of the trial site held up remarkably well, comparative to the seals at a cost that is comparative to the polymer based treatments. Once it is completed it has zero dust emissions. Further trials will be undertaken to understand how it performs in other areas of the Shire. Benefits include that long term maintenance may only require the use of a water truck and not require a grader or roller, thus reducing costs, resources and emissions. When inundated with water the Haulpac performed well deflecting water from penetrating the underling pavement layers by providing a waterproof seal.

(See Appendix L HaulPac Safety Data Sheet, Appendix M Final Report Hollands Lane)

Haulpac Roadway View



Image: Haulpac (Trevor Turner Hollands Lane 2021)

Haulpac Surface View



Image: Haulpac (Trevor Turner Hollands Lane 2021)

Polycom - (Start Ch: 3925 - End Ch: 4418 - 500m x 6m)

What - PolyCom is a Stabilising Aid classed as a Polyacrylamide/soil stabiliser. It is designed and manufactured in Australia and it has the same chemical Compounds as PolyChlor (listed below).

How - Polycom was constructed using John Deere 670G Motor Grader for mixing the product into the gravel and shaping the road surface, an Amman AP 240 self-propelled multi tyred wheel roller for compaction and an Isuzu FYJ300 Water Truck to aid in getting moisture into the treated areas. Applications include sub-grade strengthening (clays, silt, loam, sand). Pavement stabilisation (pit gravel, crushed rock and existing in-situ material).

Why - Polycom has been used by Bland Shire Council staff previously on unsealed roads, particularly where the wearing course and the base course had trouble binding and resulted in failed sections of the road. When constructed with the correct amount of water to obtain optimum moisture content in the gravel, the product has reduced dust capabilities and also improves the lifecycle of the pavement structure.

Performance - Polycom has performed as expected during the trial. Staff are particularly familiar with the installation of this treatment. Under conditions where it was inundated with water it has held together well, when dry the dust emitted from the roadway is significantly

less than an untreated surface. After observation, Council could see no signs of deformation, loss of fines or granular material within the Polycom pavement trail section.

Evaluation - Polycom is cost effective and easy to apply. Polycom can be re-graded at a later date.

(See Appendix N Polycom Safety Data Sheet)



PolyCom Roadway View

Image: Polycom (Trevor Turner Hollands Lane 2021)

PolyCom Surface View



Image: Polycom (Trevor Turner Hollands Lane 2021)

RST 20 Dynamic - (Start Ch: 3425 - End Ch: 3925 - 500m x 6m)

What - RT20 DYNAMIC is a liquid soluble, environmentally safe additive that enables soil and gravels to attain a much higher strength than could be attained in natural materials for road construction.

How - RT 20 was constructed using a John Deere 670G Motor Grader to mix the product and shape the road to pre-existing standards, an Amman AP 240 self-propelled multi wheel roller to assist with compaction and an Isuzu FYJ300 Water Truck to aid moisture content requirements. The required quantity of RT20 DYNAMIC is mixed into the water truck that is used for compacting the material. For existing pavement rehabilitation, the road is ripped to the recommended depth, all large clumps of material is pulverised, the diluted product is applied during the process, blended and compacted to achieve the required density.

Why - RT20 DYNAMIC enables the treated material to be compacted using less water, improving CBR strengths and increasing densities by reducing the voids between the soil particles in turn reducing waters ability to permeate through the compacted material.

Performance - RT20 Dynamic was easily applied to the road subsurface and has been compared to the Polycom upon initial installation. It has however, lost fines after significant rain to expose aggregate and increase the roughness factor.

Evaluation - RT20 Dynamic is cost effective however, RT20 was subject to water inundation for prolonged periods which lead to water infiltration due to the product not providing adequate seal protection. This has caused the material to start unravelling leading to rutting and structural loss in the wheel path. Gravel and loss of fines can be attributed to the pavement being submerged.

(See Appendix O RT20 Dynamic Safety Data Sheet)



RT 20 Dynamic Roadway View



Image: RT20 showing signs of rutting in wheel path (Trevor Turner Hollands Lane 2021)

RT 20 Dynamic Surface View



Image: RT20 showing signs of gravel loss/exposed aggregate and loss of fines (Trevor Turner Hollands Lane 2021)

TERRA-3000 - (Start Ch: 2320 End Ch: 2925 - 500m x 6m)

What – Terra-3000 works as a catalyst that reduces surface tension of the water around particles of soil, so that the film of water surrounding the particles is dispersed. When applied to the soil, it changes the physical and chemical properties so the soil strength and density is improved and the pavement surface will see a decrease in deterioration. Once the pavement has been compacted, water accumulation is reduced in the treated material, this reduces the swelling capacity and the moisture content in the pavement surface and helps to assist with a strong pavement surface after compaction.

How - Terra-3000 was installed using a John Deere 670G Motor Grader for mixing the product into the granular material and to shape and dress the pavement surface. An Amman AP 240 self-propelled multi wheel roller was used for the compaction of the road and an Isuzu FYJ300 Water Truck was used to obtain the optimum moisture content into the gravel. It was mixed into the base course and the construction technique was similar to the polymer based treatments. The process is permanent and irreversible. The ideal composition includes fine soil particles of <0.002m of between 15% and 30% by volume. Terra-3000 is

not an aggregate or binding agent it only needs to be consistently mixed into soil to provide adequate structural performance.

Why - Terra-3000 has been selected to be part of the trial as it was similar in application to the other products, the product itself works differently and has seen good results on other trial sites.

Performance - Terra-3000 has performed well during the trial period. During the trial period some of the treated pavement areas were inundated with flood waters four times in the 12 months that the trial was over. These flood waters affected the treated pavement areas for up to a week at a time and also longer. With this taken into consideration, Terra-3000 showed only a slight loss of fines and no significant deformation once the flood waters had cleared.

Evaluation – Terra-3000 performed well considering the drastic weather events that occurred which lead to water and drainage issues in this location. With the inundation of the flood waters the wearing course had only minor loss of fines and no real defects considering the environmental events that occurred. Considering the cost comparison to the sealed treatments, it would be unfeasible to use extensively throughout the Shire. However, it is more likely to be used as a treatment used for heavy patching opposed to full pavement remediation or reconstruction. Due to the effective treatment in road corridors subject to flooding in this trial, Terra-3000 may be useful for these types of areas in particular floodway's.

Terra-3000 Roadway View Start Ch: 2320 - End Ch: 2925



Image: Terra-3000 (Trevor Turner Hollands Lane 2021)

Terra-3000 Surface View



Image: Terra-3000 (Trevor Turner Hollands Lane 2021)

PolyChlor Omega - (Start Ch: 1823 - End Ch: 2320 - 500m x 6m)

What - PolyChlor Omega is a polymer adhesive stabilizer composed of water based polymer which bonds to soil particles.

How - PolyChlor was constructed using John Deere 670G Motor Grader to shape the surface and mix the product through the gravel, an Amman AP 240 self-propelled multi wheel roller for compaction and an Isuzu FYJ300 Water Truck for adding water. It was blended using the same techniques as the other polymer based additives, mixing in with the base course.

Why - PolyChlor was selected for the trial due to the ease of its application and slight differences to other polymer based products.

Performance - PolyChlor has performed well during the trial showing a slight loss of fines. Structurally the pavement showed no signs of deformation.

PolyChlor had similar performance to the other polymer based treatments and was easily constructed using Council plant.

Evaluation - PolyChlor has performed well during the trial with slight loss of fines which in time might cause exposure of the aggregate or more of an abrasive surface. The price point

is comparable to other treatments. PolyChlor may be used with other materials to further ascertain whether it is suitable to use throughout the shire.

(See Appendix P PolyChlor Safety Data Sheet)



PolyChlor Roadway View

Image: PolyChlor Treatment Section. Also showing drainage issues that occurred during significant rain events during the trial period (Trevor Turner Hollands Lane 2021)
PolyChlor Surface View



Image: PolyChlor (Trevor Turner Hollands Lane 2021)

PolyTahr - (Start Ch: 1320 - End Ch: 1820 - 500m x 6m)

What - PolyTahr is a polymer adhesive based stabilization compound that provides a tight bond within the pavement particles minimising water penetration to the underlining pavement materials. It has identical chemical properties to Polycom.

How - PolyTahr was constructed using John Deere 670G Motor Grader to shape and mix the product with 75mm surface gravel, an Amman AP 240 self-propelled multi wheel roller for compaction and an Isuzu FYJ300 Water Truck to distribute water. PolyTahr requires less water in application when compared to Polycom.

Why - PolyTahr was selected to be used in the trial to compare results with Polycom. Although, the treatments should show almost identical results, the construction technique of each treatment respectively was a little different.

Performance - PolyTahr has performed well during the trial showing a slight loss of fines and remains in good shape. Dust emitted from the PolyTahr is more than Polycom (this suggest greater loss of fines). However, there was no real noticeable difference in the road surface apart from some minor rutting.

Evaluation - PolyTahr may have uses across the shire as staff found the product easy to apply. The fact that the packaging of the product is larger than many of the other polymers means that stock on hand may be slightly more significant.

(See Appendix Q PolyTahr Safety Data Sheet)



PolyTahr Roadway View Start Ch: 1320 - End Ch: 1820

Image: PolyTahr (Trevor Turner Hollands Lane 2021)

PolyTahr Particle Distribution



Image: PolyTahr (Trevor Turner Hollands Lane 2021)

Wet Grade Only - Start Ch: 0 - End Ch: 1320

What - Wet grading is carried out to improve the shape of the road, moisture is added to the pavement and compaction is carried out to remove deformation (shape correction), this allows water to shed off the crown of the road to the table drains. The pavement will take shape, once material has reached optimum moisture content and the desired compaction density has been achieved

How - Wet grade was conducted using John Deere 670G Motor Grader to shape and mix the gravel surface, an Amman AP 240 self-propelled multi wheel Roller for compaction and an Isuzu FYJ300 Water Truck to obtain optimum moisture.

Why - The remainder of Hollands Lane was wet graded to ensure that there was a benchmark for Council to ascertain the effectiveness of the 10 Trial sections. Council could then compare cost versus performance for the various treated areas in the Hollands Lane experiment.

Performance - The wet graded area performed consistent with the lifecycle of a wet grade treatment and has shown signs of deterioration greater than all the other trial sections. The pavement had various defects including rutting, corrugations and loss of fines. Considering

the pavement was submerged 3-4 times for prolonged periods up to 5 days, which could have exacerbated the defects further.

Evaluation - Wet Grade was only used as baseline data, it is a commonly used maintenance treatment throughout Bland Shire however, maintenance of these areas is becoming more frequent. This could be a result of a combination in changes due to climatic conditions such as drought, prolonged hot weather and rain events that contributed to poor performance.



Wet Grade Only Roadway View

Image: Wet Grade Only (Trevor Turner Hollands Lane 2021)

Wet Grade Only Particle Distribution



Image: Wet Grade Only (Trevor Turner Hollands Lane 2021)

Wet Grade Only Deterioration



Image: Wet Grade Only Showing Rutting (Trevor Turner Hollands Lane 2021)

Wet Grade Only Deterioration



Image: Wet Grade Only Loss of Fines (Trevor Turner Hollands Lane 2021)

Assessment of treatments

Geotechnical testing during the trial was conducted by collecting soil samples for laboratory testing. Testing included further CBR (California Bearing Ratio) testing, particle size distribution and ravel testing.

Testing after construction was completed and included treated soil samples from each trial section being sent for analysis and a monthly review of performance by the use of 'Hawkeye 2000 (ARRB) and rough-o-meter' to obtain IRI (International Roughness Index) results, as well as traffic counters to monitor AADT (Average Annual Daily Traffic) and class of vehicles.

Performance measures also included visual inspections to determine the loss of aggregate and fines along with other visual defects such as rutting, potholes shape loss.

A spreadsheet was designed to capture and compare aspects for Construction and Maintenance:

• Weather was monitored throughout the trial and recorded by way of high and low temperatures, average rainfall for the month and significant rainfall events (>25mm)

- Materials
- CO₂ Emissions
- Cost
- Labour
- Plant

The spreadsheet was used to compare all aspects of the construction and maintenance to ensure all data relevant to the trial was captured. There may be a use for each treatment in different scenarios throughout the shire that will have benefit in building resilience to climate change while also being cost effective and environmentally friendly.



Comparable Cost of Treatments

Total Treatment Cost

The exact costing figures for the trial are not displayed due to the current partnerships Council have with some suppliers, and other factors. Get Trevor to check this part.



Water Use During Construction and Maintenance



CO₂ Emissions During Construction and Maintenance

Flood Events March 2021

During the flood event in March 2021, the Otta Seal performed well considering the inundation and velocity of the floodwaters, which was greater in this section compared to other trial areas. The areas showing the greatest signs of erosion were on the pavement edge and the shoulders however, this was limited. Overall the areas remained intact with only minimal surface damage in general.

The flood event in March 2021 impacted all 10 sections of the trial with water covering most of Hollands Lane and in some places in excess of 300mm (Haulpac and RST Dynamic.) Haulpac, Primer Seal, Double-Double and Otta Seal all performed relatively well under flood conditions. Very little erosion from the seal type treated areas was visible. If the velocity of water had been flowing quickly in areas that were treated without a seal type treatment, the pavement sections may have seen significant erosion compared to untreated areas. Other unsealed treatments withstood the inundation well with only loss of fines from the surface recorded.

Flood Damage 2021



Image: Damage to sealed pavement in Hollands Lane March 2021 (Trevor Turner Hollands Lane 2021)

Outcomes

The Resilient Unsealed Road Project is designed to gain a clearer picture of more effective treatments for climate affected unsealed roads within our local government area. Adoption of design and construction elements into the Council's Road Strategy Procedures will reduce the impact on natural resources such as water, gravel, fossil fuels and lessen the impacts of dust on the surrounding environment. For road users an improvement in travel times, ride quality, and less risk to personal health and wellbeing, due to an improved, resilient road surface. Further outcomes include improved efficiency of Council plant and workforce on maintenance, replacement and reduction of waste. Council also would like to reduce the reliance on rate payer funds to maintain our network by improved efficiencies. An adaptive road network will lead to improved prosperity for business and agricultural networks.

Products that have been not as successful such as RST Dynamic during the trial period, may still be considered when looking for solutions to other unsealed roads.

Findings from the trial have led to a revised Roads Strategy Procedure for future projects to ensure best practice is being followed and imbedded this as 'business as usual'. The successful treatments from the trial are able to be replicated throughout Council and this information circulated to key and primary stakeholders who require this information.

Outcomes of the trial will be provided as a case study to the Institute of Public Works Engineers Association for their information and will assist with the National Heavy Vehicle Regulator in planning for a better rural road network.

What worked and what didn't – International Roughness Index readings were not conclusive given the short period of time that evaluations were undertaken. All the treatments improved the road pavement characteristic and performed well considering the inundation of flood waters experienced in the pavement trial areas.

Flooding of Hollands Lane in June 2021



Image: Floodwaters in Hollands Lane June 2021 (Trevor Turner Hollands Lane 2021)

Flooding of Hollands Lane in June 2021



Image: Floodwaters in Hollands Lane June 2021 (Trevor Turner Hollands Lane 2021)

Further trials are being undertaken after preliminary results from the Hollands Lane trial. Particularly troublesome roads (Monia Gap Road and Bootoowa Road) in the west of Bland Shire that see significant vehicle movements, particularly road trains and heavy machinery. These require constant maintenance and consideration to extend the use of Haulpac, PolyCom and Terra-3000 to test its suitability in reducing the need for significant regular maintenance.

Information contained herein detailing treatment performance will be incorporated into Bland Shire Council's Road Strategy Procedures and Asset Management Procedures. This will allow for Lessons Learnt and Asset Management practices to continue to evolve.



International Roughness Index Readings Hollands Lane 2021

International Roughness Index Readings Hollands Lane 2021

The following diagram shows the International Roughness Indicator IRI Roughness Scale (replotted from Sayers et al., 1986). This shows the correlation between, roughness, ride ability and speed. Council intervention levels will be based on this scale.



Bland Shire Council Road Strategy Procedures (2012)



International Roughness Index Readings Hollands Lane 2021

International Roughness Index Readings Hollands Lane 2021





International Roughness Index Readings Hollands Lane 2021

Lessons Learnt

During data collection prior to starting the project it was noted that there was a need for adequate drainage well before commencement of the trial setup. During heavy rainfall, Hollands Lane became a watercourse with water running from Wargin Road down towards Goldfields Way, traversing the laneway in several sections. Landholders had also constructed small 'levy banks' to reduce the impact of large volumes of water on cropland adjacent to the laneway. This led to more concentrated amounts of water running in the table drains and restricting the escape of waters through the mitre drains that were constructed. Landholders were asked to remove the small banks to allow water to follow its natural watercourse instead of the roadway. This significantly reduced the volume of water running on the roadway, but improved drainage saw the water dissipate faster and not remain in low-lying areas of the road for prolonged periods.

Significant rainfall during the construction phase of the trial hampered the installation of each section and extra drainage had to be constructed. Upon completion of the trials construction in January there were three major rain events, one in January (>50mm), one in February (>50mm) and one in March (<100mm) which covered the entire trial section of the road. Maintenance was undertaken on the affected sections and may have hampered results from certain treatments. Loose material on the road could not be determined as being specific to the trial sections and some sections were more impacted due to flows of the natural watercourses.

The COVID-19 pandemic hampered the installation of some treatments, as they relied on state borders remaining open. Although Council is capable of installing most of these treatments, the initial build was to be under supervision of experienced operators and contractors to ensure the products were applied correctly and to manufacturer's standards, particularly the perceived optimum moisture content required.

Calculation of the carbon emissions from the plant used to construct the trial sections had variances due to the weather conditions and surface/subsurface moisture. The days where there was increased temperatures required more moisture to prevent evaporation and some sections had subsurface moisture that assisted in attaining the optimum moisture content. Although this provides a guide of total emissions for the project, comparison between the sections is unreliable.

Ravel tests were to be conducted on the sections to establish particle loss midway through the trial. Unfortunately due to excessive rain washing material on and off various sections of the trial, the use of this data was of no real benefit to the trial.

On the 10th May 2021 on a routine inspection, Council staff observed that a vehicle travelled the length of Hollands Lane gouging lines into the surface of the treatments. This was particularly noticeable on the crown of the sealed treatments. This will continue to be monitored to assess whether it has an effect on the road surface in coming months.

In November 2020 Bland Shire Council participated in a Workshop for Northern Beaches Council Climate Resilience Design Guide and Decision Tree Worksheet and IPWEA Practice Note 12.2. Northern Beaches – Melanie Thomas - IPWEA Practice Note 12.2: Climate Resilient Materials for Infrastructure Assets.

'Practice Note 12.2 aims to assist infrastructure managers and developers to select construction materials that will be more durable to the impacts of climate change and builds on the *IPWEA Practice Note 12.1: Climate Change Impacts on the Useful Life of Infrastructure* (Practice Note 12.1) released in 2018. The Practice Notes consider the likely impacts of high rainfall and floods, low rainfall and drought, increased temperatures and heatwaves, sea level rise and more extreme bushfire weather. The vulnerability of the five most commonly used materials for assets is examined (concrete, bitumen, steel, wood and PVC). '

(See Appendix R Climate Resilience Design Guide Works Power Point, Appendix S Climate Resilience Design Guide Works)





Rainfall During Trial - Date December 2020 to September 2021



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Australian Mean Temperture 2000 - 2019

Image: Change in average temperature anomaly over 20 years (2000- 2019) (Courtesy of Australian Bureau of Meteorology)

Appendices

- Appendix A Letter of support from NSW Farmers Association
- Appendix B Letter of support from NHVR
- Appendix C Letter of support from IPWEA
- Appendix D Integrated Regional Vulnerability Assessment: Riverina Murray Volume 2,
- Appendix E Riverina Murray Enabling Regional Adaption Report
- Appendix F Hollands Lane Climate Change Risk Assessment
- Appendix G Road Strategy Procedures Bland Shire Council

Appendix H - Risk Assessment – Unsealed Roads within Bland Shire Council – David Wardell Risk and Insurance Officer

- Appendix I Downer Emulsion Safety Data Sheet
- Appendix J Downer Spray Sheet
- Appendix K Otta Seal Spray Sheet
- Appendix L HaulPac Safety Data Sheet
- Appendix M Final Report Hollands Lane
- Appendix N Polycom Safety Data Sheet
- Appendix O RT20 Dynamic Safety Data Sheet
- Appendix P PolyChlor Safety Data Sheet
- Appendix Q PolyTahr Safety Data Sheet
- Appendix R Climate Resilience Design Guide Works Power Point
- Appendix S Climate Resilience Design Guide Works

References

A Guide to the Use of Otta Seals - Publication No.93, Directorate of Public Roads, Oslo, Norway.

Bland Shire Council Climate Change Adaption Report 2020

bom.gov.au

Development of Design Standards for Low-Volume Roads in Ethiopia (AFCAP/UKaid) – May 2013

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Integrated Regional Vulnerability Assessment: Riverina Murray 2014

Long-term dust suppression using the Otta seal technique - March 2009 - New Zealand Transport Agency Research Report - J. C. Waters Fulton Hogan Limited, Christchurch, New Zealand

Nanotech Civil

Old Woodcocks Road Dust Suppressant Trial - Update by Auckland Transport

Otta Seals - Better than Chipseals Jeff Waters – Fulton Hogan (REAAA)

Risk Assessment – Unsealed Roads within the Bland Shire 2020 – David Wardell, Risk and Insurance Officer

Riverina Murray Enabling Regional Adaption Report 2017

Road Strategy Procedures – Bland Shire Council 2012

The Otta Seal Surfacing - An economical practical alternative to traditional bituminous surface treatment by Charles Overby (Norwegian Public Roads Administration) and Michael I. Pinard (Infra Africa consultation, Botswana)

2021. IPWEA Practice Note 12.2: Climate Resilient Materials for Infrastructure Assets.

Appendix A



28th August 2019

Trevor Turner Facilities Operator - Town, Village, Parks & Gardens Bland Shire Council PO Box 21 West Wyalong NSW 2671

Dear Trevor

NSW Farmers Barmedman Branch would like to offer our support for Bland Shire Council's application for funding from AdaptNSW (OEH) in relation to Climate Change Resilience Funding, for an unsealed roads trial on Hollands Lane at West Wyalong.

The Branch understands that the trial will incorporate a number of treatment methods along the section of road in order to ascertain the best practice for unsealed road construction and maintenance during extended periods of dry weather. This trial will allow Council to make more informed decisions with regards to construction and maintenance of their unsealed roads network, making unsealed roads better quality and safe for all road users in our rural areas.

Given the current drought situation, this trial could not be taking place at a better time. We understand that Council intend to share their findings with interested stakeholders, and we would certainly be keen to have Council present them at a Branch meeting.

We hope that this trial will lead to better productivity for our region, less costs for Council in the long term, and a safe environment for all those living in this rural Council area.

Yours sincerely

adra MAM.

for John Minogue Chair NSW Farmers Barmedman Branch

NSW Farmers' Association – Barmedman Branch c/- Wilga, 1235 Nobbys Road, BARMEDMAN, NSW 2668

Appendix B



29 August 2019 Our Reference:

Mr Will Marsh Director Infrastructure Bland Shire Council P O Box 21 WEST WYALONG NSW 2671

Dear Mr Marsh

I am advised that Bland Shire Council is seeking funding to trial a range of road improvement treatments on a five kilometre section of Hollands Lane in Bland Shire to determine the most effective treatment for unsealed roads.

This trial has the potential to deliver a better return on investment from Council's infrastructure spending, and also open up heavy vehicle access, not only on Hollands Lane, but also other key freight routes in Bland Shire.

I note the following points of your proposed trial and case for funding:

- Council's vision is to find the best approach to extend the lifetime and improve the quality of the
 unsealed roads within Bland Shire, which will allow for a wider cross-section of heavy vehicle
 combinations approved under the NHVR's Performance Based Standards (PBS) Scheme.
- While the largest heavy vehicle combinations currently able to operate on Hollands Lane are bdoubles at general mass limits; improvements made to the Bland Shire Council road network after the completion of the trial may allow larger combinations at higher masses e.g. AB Triples at Higher Mass Limits.
- The potential for larger vehicles to use more local unsealed roads may significantly reduce traveling
 distances and times and the amount of freight that can be transported. The other benefit of the trial
 will be to reduce the delays for all heavy vehicles due to maintenance requirements and road
 conditions/deterioration. Some treatments may be suitable for heavier vehicles, or may not be
 suitable and require more maintenance.
- Bland Shire Council will share the findings with other councils so that they may similarly improve freight efficiency and safety on their road networks.

I also note that the infrastructure improvements that could be made from this trial could reduce the recurrent repair cost to local roads which would increase confidence among residents and transporters to deliver produce to domestic and export markets that assist with economic development of the region.

The National Heavy Vehicle Regulator (NHVR) welcomes any improvements to infrastructure, which facilitates expanded access for heavy vehicles and all year freight movement, especially high productivity heavy vehicles as these vehicles can carry the same amount of freight more safely, in fewer trips and with improved amenity for the community.

If Council's bid for funding is successful, it is our expectation that an undertaking will be given to the NHVR that the route would be gazetted for heavy vehicle access, to the maximum amount possible, once the proposed work is completed. The NHVR would also expect any requests for heavy vehicle access beyond that limit be assessed as quickly as possible to respond to industry's needs.

www.nhvr.gov.au | PO Box 492 Fortitude Valley QLD 4006

ABN 48 557 596 718

Institute of Public Works Engineering Australasia Limited NSW Division Roads & Transport Directorate



20 August 2019

To Whom it May Concern,

Re: Unsealed Roads Trial – Bland Shire Council

The Roads & Transport Directorate is a joint undertaking between IPWEA (NSW) and Local Government NSW (LGNSW) to provide support to its members working in local government across the state. The Roads & Transport Directorate has been set up to meet the demand from members in NSW to act as a focus for research activities and to provide technical advice.

The Directorate has held discussions with Bland Shire Council in respect of an unsealed roads trial on Hollands lane (West Wyalong) that will examine a variety of treatment methods along the section of road. This project will provide data to assist in ascertaining the best practice for road construction and maintenance during extended periods of dry weather. It is understood that Council is applying for funding under the Climate Change Resilience Funding Programme.

The Roads & Transport Directorate fully supports the funding of this this project and will assist Bland Shire Council in making the results of the trial available to other councils across NSW.

Should you require further information or clarification, please do not hesitate to contact the undersigned at <u>mick.savage@ipwea.org</u>.

Yours faithfully,

Mick Savage Manager Roads & Transport Directorate

Level 12, 447 Kent Street Sydney NSW 2000 • ABN 35 093 562 602 Tel 02 8267 3000 • Fax 02 8267 3070 • Mobile 0418 808 085 • Email: <u>mick.savage@ipwea.org</u> • Website: www.ipwea.org Appendix D



Integrated Regional Vulnerability Assessment: Riverina Murray

Volume 2: Priority Sector Workshops – Summary Findings Appendix E



AdaptNSW

Western Enabling Regional Adaptation

Riverina Murray region report



Appendix F

Climate Change Risk Assessment Adaptation Report

Bland Shire Council





Appendix G

Road Strategy Procedures



QA SPECIFICATION R001

ROAD STRATEGY PROCEDURES

Bland Shire Council



2.01
20/5/12

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<u>Appendix H</u>



Risk Assessment

Description of task / activity / event:	Unsealed Roads	Date of Assessment:		
Location:	Shire wide			
Persons completing assessment:	David Wardeil	Signatures:		
Overview (If required):				

	Risk Rating Table			OHS Hierarchy of Controls		Hierarchy of Controls			
		Severe	Major	Moderate - Lost Time Injury		Minor - Med Treatment	Negligible - 1st Aid		1. Eliminate
	Almost Certain	High	High	High		Med	Med		2. Substitute
ŝ	Likely	High	High	Med		Med	Low		3. leolate
	Possible	High	Med	Med		Low	Low	4. E	Engineering Controls
1	Unikely	Med	Med	Lo	w	Low	Low	5. A(dministrative Controls
	Rare	Med	Low	Lo	w	Low	Low		6. PPE
	Risk /	Hazard / Issue Identifi	ed	inheren	nt Risk	Control Measures (To Reduce Likelihood & Consequences)	Residua	ıl Risk	Person(s) Responsible for Control Actions
				Likelihood	Consequence		Likelihood	Consequence	
				Possible	Moderate -		Unlikely	Minor - Med	
					Lost Time	ensure all roads inspected	· · ·	Treatment	
There is a risk that unsealed road unsafe/unstable to work on		ole to work on	M	ed	and work approved by engineers	Lov	N	Shire engineers	
				Likelihood	Consequence		Likelihood	Consequence	
				Unlikely	Minor - Med Treatment	all workers receive induction	Unlikely	Minor - Med Treatment	
There	There is a risk that workers not inducted or trained		Lo	W	and training reinforeced with tool box meetings	Lo	N	Supervisors WHS HR	
				Likelihood	Consequence		Likelihood	Consequence	

Appendix I



ASS Downer Infrastructure Chemwatch Hazard Alert Code: 1 Issue Dete: 15/03/2018 Print Dete: 14/06/2018 L/GHS.AUS.EN Chernweich: 12963 Version No: 8.1.1.1 Safety Data Sheet according to WHS and ADG requirements SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING Product Identifier Product name ASS Synonyms Not Available Other means of identification Not Available Relevant identified uses of the substance or mixture and uses advised against Relevant identified uses Bitumen emulsion for road surfacing applications. Details of the supplier of the safety data sheet Registered company name Downer Infrastructure Address 468 St Kikle Road VIC 3004 Australia 0386450800 Telephone Fax Not Available Webeite www.downergroup.com Email info@downergroup.com Emergency telephone number Association / Organisation Not Available Emergency telephone numbers 000 Other emergency telephone numbers Not Available

SECTION 2 HAZARDS IDENTIFICATION

Classification of the substance or mixture

NON-HAZARDOUS CHEMICAL. NON-DANGEROUS GOODS. According to the WHS Regulations and the ADG Code.

CHEMWATCH HAZARD RATINGS	
Min Tarrmability 1 Society 0 Socy Contact 0 ReadSvNy 1 Chronic 0	Max 0 = Minimum 1 = Low 2 = Miodenate 3 = High 4 = Externe
Poisons Schedule	Not Applicable
Classification	Not Applicable
Label elements	
Hazard pictogram(s)	Not Applicable
SIGNAL WORD	NOT APPLICABLE
Hazard statement(s) Not Applicable	

Supplementary statement(s) Not Applicable

Prevautionary statement(s) Prevention

Continued...

Appendix J

	OUTBACK OF UNCH SEAL AND RES	CAL DA	LY RECORD	10 10 10 10 10 10 10 10 10 10 10 10 10 1		F	or D 26	M 1	i	Y 2020
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xister	g Surface Type & Texture: New works		Number of Lan	cs: 2						
a de de la composición de la compos	r a	REMO	overs: 0			i Sişşan	se from Stocle	pile to Site:	3	
ength	of Job: 370	TRPMS	: 0			Linem	arking: 0			
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	1b. Spray Driver			Paul	Pa	d L				
	2 Wei-ther			Elia	Fir	KOFJ VA				-
	3. Time of Spraying	His		10.30	11:	15				
	4. Alr Temperature Shade	''C	· ·	28	23	в				
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	5. Starling Point of Run	km	· ·	0	0					_
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	17 Nesklual Binder Quentity Cold	1	10x11	2664	17	78				444D
	13. Cutter OI! Percentage Crid	- % 	Nominated	1		,				-
5 -	 Auneatori Agent Percentage Binder + Cutter Oil Application Bale Cold 	L/m ²	i	1.20	0.2	30				-
1967	16. Residual Binder Nett Cold	L	52x1.1	2930,40	- 950	3.B0			+	
ő.,	17 Cutter Dil Cold	1	106(1544)×13	0.00	0.0	36				a
58	18. Adhesion Agent Cold	ι	16d(14/100-14)	28.60	19.	73				49.33
5	18. Tala Load Cald	L	18+17+18	2960.00	1973	3.83 -		<u> </u>	.	
	20. Toto Load Requires (Approx.)	L	19x1 1	3256,00	2170	1.64				<u> </u>
	21 Sprayer Land & Sant Hot 22 Mishura Temperatura In Sprawar	н н. 1975	DISSOCK	180	15	uo ir	-			
	23. Youne Coracion Multiplier	l .	Tep e \$000.2	1 1109	1.1	109				
	24. Mixture Application Rate Ho.	Um ²	15x23	1.33	0.5	QE			1	
5	25 Pump Speed	RPM	RTA 464							
Ĩ,	25 Road Speed	nýmn	RTA 494							
2	27. Spreyer Loed et Finish Hot		Dipstok	3000	98	ID 				
ō x	28. Mitture Sprayed Hot 29. Violume Correction Multiplier for 1510		21-27 TV06 500:1	0.0002	- 21	00 "02				
Ĩ.	30. Macure Stravert Cold	L	28x29	2700.60	169	2.42				i —
ICA.	31. Gutter Oli Spreyed Gold	L	30x(13/100)	0.CD	0.3	20				0.00
ž	32. Adhesion Agent Sprayed Cold	L	30x(14/100)	27 01	18.	90			ļ	46.91
2	33. Residual Sholar Sprayed Cold	L	30-(31+32)	2673.59	167	1.52				4\$45.1
	34. Over or Under Sprayed Cold	±⊥	33-12	9.59	B5.	52				
	35. Iblerance 35. Sprawed Culture interactor Cold		5% of 12 back as	133.2	88	.a 72				
	37. Actual Binder Application Rate Cold	: L Long	33/10	1.20	a. 11	54 54				
	38. Aggregate Size	0.00	-	14 11	140	ייח				
-	39. Ordered Rale	in¥hii ^a	RTA 395C	100	15	50	- 181			
	40 Ordered Quancity	m>	10/39	22.20	14.	80				
3	41. Precoeting Material	Гура	-						;	
	42. Precoating Material Rate	L/m ³				_			<u> </u>	
Į¥.	43. Aggregate Spread	048	28.40	23	1	5		·		329
	45 Actual Bate	±m3 m2/m3	10/43	98.52	12.8	10			+ · ·	
	No. Worden Halle	11-1111-	10.40	30.02	140					

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Appendix K



HaulPac

Downer Infrastructure	Chemwatch Hazard Alert Code: 0
Chernweich: 5292-75	Issue Date: 2507/2018
Version No: 3.1.1.1	Print Date: 2507/2018
Selfety Data Sheet according to WHS and ADG requirements	L GHS.AUS.EN

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

Product Identifier

r rouget heritanet					
Product name	HauPac				
Synonyma	Unsealed road binding/stabilisation				
Other means of identification	Not Available				
Relevant identified uses of the substance or mixture and uses advised against					

Relevant identified uses Biturnen emulsion for the binding/stabilisation of haul and unseeled roads. In normal use, product is to be sprayed at ambient temperature with no heat.

Details of the supplier of the safety data sheet

Registered company name	Downer Infrastructure				
Address	488 St Kilde Road VIC 3004 Australia				
Telephone	0589450800				
Fax	Not Available				
Webeite	www.downergroup.com				
Email	info@downergroup.com				
Emergency telephone numbe	r				
Acceptation / Opportunition	Net Available				

Other emergency telephone numbers Not Available

Emergency telephone m

000

SECTION 2 HAZARDS IDENTIFICATION

Classification of the substance or mixture

NON-HAZARDOUS CHEMICAL. NON-DANGEROUS GOODS. According to the WHS Regulations and the ADG Code.

CHEMWATCH HAZARD RATINGS

	Min Mex	
Flammability	0	
Toxicity	0	0 = Minimum
Body Contact	0	2 = Moderate
Reactivity	0	3 = High
Chronic	0	4 = Extreme

Poisons Schedule	Not Applicable
Classification	Not Applicable
Label elements	
Hazard pictogram(s)	Not Applicable
SIGNAL WORD	NOT APPLICABLE

Hazard statement(s)

Not Applicable

Supplementary statement(s) Not Applicable

Prevautionary statement(s) Prevention

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Continued...

Appendix M



Appendix N

SAFETY DATA SHEET



POLYCOM COMPACTION & STABILISATION AID

Infosafe No.: LPWGU Issued Date: 23/03/2016 Issued by: BIOCENTRAL LABORATORIES LTD

1. IDENTIFICATION

GHS Product Identifier POLYCOM COMPACTION & STABILISATION AID

Company Name

BIOCENTRAL LABORATORIES LTD

Address

22 Phillips Street Thebarton SA 5031 Australia

Telephone/Fax Number Tel: +61 8 8234 8886 Fax: +61 8 8234 8889

Emergency phone number +61 415 824 608 or +61 458 047 431

Recommended use of the chemical and restrictions on use

Soil stabiliser and compaction aid. The use of the product involves significant dilution with water (1000 - 6000:1).

Additional Information

Polycom is approved by the Western Australian Department of Health as a compaction aid and dust suppressant within drinking water catchment areas. This approval is subject to the following conditions: That Polycom is used in accordance with the manufacturers instructions.

2. HAZARD IDENTIFICATION

GHS classification of the substance/mixture

Not classified as Hazardous according to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) including Work, Health and Safety regulations, Australia.

Not classified as Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. (7th edition)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients

Name	CAS	Proportion
Ingredients determined not to be hazardous		100 %

4. FIRST-AID MEASURES

Inhalation

If inhaled, remove affected person from contaminated area. Keep at rest until recovered. If symptoms develop and/or persist seek medical attention.

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Appendix O



Issued By: Reynolds Soil Technologies Pty Ltd

Reviewed Date: 01/03/2019 Version Number: 1.3

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

COMPANY NAME: ADDRESS:

EMERGENCY PHONE:

Reynolds Soil Technologies Pty Ltd (ABN 31 068 825 696) 14, Greg Chappell Drive, Burleigh Heads, Queensland, Australia, 4220 0417 770567 07 5522 0244 07 5522 0799 info@rstsolutions.com.au

PRODUCT NAME: RT20 DYNAMIC SYNONYMS: None

USE:

PHONE:

FAX: EMAIL:

- Soil Stabilisation
- Compaction Aid
- Dust Suppression

2. HAZARD IDENTIFICATION

NON-HAZARDOUS substance. NON-DANGEROUS GOODS. According to GHS Criteria, and ADG Code.

None under normal operating conditions	
Hazard pictogram(s):	None.
Signal word: Hazard statement(s):	None.
Precautionary statement(s):	None.
Additional elements:	None.
	None under normal operating of Hazard pictogram(s): Signal word: Hazard statement(s): Precautionary statement(s): Additional elements:

OTHER HAZARDS Spills produce extremely slippery surfaces.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 – Substances

Not applicable, this product is a mixture.

3.2 – Mixtures This product is a mixture.

Hazardous components Contains no reportable hazardous substances.

Reynolds Soil Technologies Pty Ltd ACN 068 825 696 I www.rstsolutions.com.au I E info@rstsolutions.com.au Burleigh Heads, QLD I P +61 7 5522 0244 I F +61 7 5522 0799 Carliele WA I P +61 8 9361 5400 I F +61 8 9472 3680

Appendix P



SAFETY DATA SHEET POLYCHLOR OMEGA™ ISSUE DATE: January 2017

1. Identification of the material and supplier

POLYCHLOR OMEGA™ is a polymer based dust suppressant for use in municipal, mining, quarrying, agriculture and forestry. Application of Polychlor Omega to surfaces is by spraying a water mixture using a water tanker.

Supplier: Five Elements International Pty Ltd 13/42 Smith St CAPALABA QLD 4157

Tel: 07 3348 5533 Email: sales@five-elements.com.au



2. Hazards identification

- Non Hazardous
- Non Dangerous
- · Skin May cause slight irritation after prolonged ongoing exposure
- Eyes May cause slight irritation
- Ingestion May cause irritation

CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

3. Composition and information on ingredients

Chemical Name: Polymer adhesive

- 4. First aid measures
- Skin contact Wash contaminated area with clean water. Contaminated clothing should be washed before re-use.
- Eye contact Irrigate the eye with plenty of clean water. If there is any irritation obtain medical attention immediately.
- Ingestion Do not induce vomiting. Wash mouth out with water. If symptoms develop seek medical attention. Give plenty of water to drink



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Appendix Q



MATERIAL SAFETY DATA SHEET POLYTAHR[™] ISSUE DATE: March 2020

(MSDS FEI-PT-158)

1. Identification of the material and supplier

POLYTAHR m is a polymer based soil stabilisation aid for use in roadworks. Application of Polytahr to roadbase is either by direct spreading of dry granules or by spraying a Polytahr water mixture using a watercart.

Five Elements International Pty Ltd. 13/42 Smith St CAPALABA QLD 4157

Tel: 07 3348 5533 Email: sales@five-elements.com.au

2. Hazerds identification

- Non Hazardous
- Non Dangerous
- Skin May cause slight irritation after prolonged ongoing exposure.
- Eyes May cause slight irritation
- Ingestion Low toxicity product
- 3. Composition and information on Ingredients

Active ingredient

- Polyacrylamide 2-Propenamide, homopolymer
- CAS 9003-05-8
- Concentration 99.96%

Impurities and by products of manufacture

- Percentage of detectable impurities 0.049%
- Method of extraction Solvent extraction and vacuum drying
- Method of identification Infrared Spectroscopy
- Impurity type Sodium Dodecyl Benzene Sulphonele CAS 25155-30-0 (Non hazardous, non loxic surfactant)
- Percentage of Acrylic Monomer 0.00% (none detected).
- Laboratory report No. 16021

4. First aid measures

 Skin contact - Wash contaminated area with clean water. Contaminated clothing should be washed before re-use.

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A Technical Society of Engineers Australia and the peak association for professionals who deliver public works and engineering services in Australia and NZ:

- Professional development
- Technical publications
- Conferences
- Technical committees
- Advocacy



IPWEA

Appendix S

