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Global Road Technology

A comparative cost analysis of conventional water spray application and the use of GRT7000 for dust suppression on roads

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Contents

Limitations

Global Road Technology Limited (GRT) has engaged Deloitte Touche Tohmatsu (Deloitte) to conduct a comparative cost analysis of their dust suppression product GRT7000 (GRT Approach) compared to the conventional approach of using water for the suppression of dust during road construction and maintenance activities (Conventional Approach). Deloitte acknowledges that GRT may provide this report to potential users of GRT7000 for the purpose of them making their own assessment as to the suitability of GRT7000 for their use.

GRT has funded this report and provided all the parameters for the use of their product. Deloitte has not analysed, audited or independently verified any of the technical specifications or assumptions provided by GRT and gives no representation that they are correct.

SMEC Australia Pty Ltd (SMEC), a civil engineering firm, and Project Support Pty Ltd (Project Support), a specialist quantity survey consultant, have provided technical input and the assumptions for the base case scenario. The discounted cashflow financial model has been developed by Deloitte.

The comparative cost analysis provided is based on the assumptions as set out in the report in Section 5 and reflects advice on the current use and application of the GRT product in the current market environment. The Conventional Approach has been defined using benchmarked market figures under the same conditions (road parameters and location) to derive an appropriate comparison.

Specific limitations of our analysis include:

- Calculations are based upon costs and typical operating conditions in Queensland, Australia. Users of this report should make their own assessment as to whether these conditions are representative. There may be different or other relevant costs in other jurisdictions
- The cost analysis is limited to a set of operating assumptions, including the type of plant and equipment utilised and the nature in which they are utilised, however these assumptions may not be appropriate in all circumstances. They have been included in this analysis to reflect likely costs that would be incurred on the “reference” project
- It is not the purpose of the analysis to optimise the construction methodology. In particular, the economic number of water trucks is not calculated. The calculations are intended to provide an indicative comparison of the relative construction and operating costs under the GRT Approach and the Conventional Approach
- We have assumed the road is unsealed and will remain unsealed for the duration of the project. We have not considered any alternate engineering solutions
- Costs are pre-tax (and GST) do not take into account the tax laws or tax position of any party
- Calculations are in real terms and implicitly assume all costs will escalate at the same rate over the calculation period
- The pricing of GRT7000 used in the analysis is indicative only and is based on bulk pricing of the product.

Deloitte, SMEC and Project Support have relied on the accuracy and completeness of the technical documentation supplied to them by GRT and make no warranty or representation as to the accuracy or completeness of the information provided.

Furthermore, Deloitte accepts no responsibility for the information or statements, opinions, or matters expressed or implied arising out of, contained in, or derived from information contained in this report.

You should note that actual experience may be different from that portrayed in this report. Deloitte, SMEC and Project Support do not warrant or guarantee the cost savings demonstrated in this report. Deloitte, SMEC and Project Support do not endorse this product and you are required to make your own enquiries in relation to the suitability of the product for your purposes.

Glossary

AUD	Australian Dollar ($)
Deloitte	Deloitte Touche Tohmatsu
GRT	Global Road Technology Operations Pty Limited
GST	Goods & Services Tax
hr	Hour
kL	kilolitre
L	litre
m^2	square metres
MC	Moisture Content
NPC	Net Present Cost
WPH&S	Work Place Health & Safety

1. Executive Summary

Overview of the study

Global Road Technology (GRT), a Queensland based company, operating internationally, manufactures products and provides turn-key solutions to the market for dust control, soil and ground stabilisation with a particular focus on roads. They offer a specially formulated 'non-ionising in water solution' liquid polymer (GRT7000) engineered for use in dust suppression during civil construction. GRT7000 concentrate is diluted with water when loaded into a water tank, then applied to a dusty unsealed road using standard spray equipment.

GRT has engaged Deloitte Touche Tohmatsu (Deloitte) to provide a comparative evaluation of the cost in relation to conventional water spray dust suppression methods (Conventional Approach) and dust suppression using GRT7000 (GRT Approach) under comparable conditions. A "reference" project of a road 8m wide and 10km long in a Queensland environment was nominated by GRT for the comparison.

Deloitte has engaged the services of SMEC Australia Pty Ltd (SMEC), a civil engineering firm, and Project Support Pty Ltd (Project Support), a specialist quantity survey consultant, (together Technical Advisors) assist with the identification of the appropriate cost base and operational assumptions for the Conventional Approach to support the financial analysis.

The scope of costs included in the analysis is limited to plant, materials and labour specific to the provision of dust suppression. The cost analysis does not include overheads and corporate margins, site related management costs such as inductions or accommodation and does not include GST or other on-costs.

Neither Deloitte, nor the Technical Advisors have undertaken any product validation or reviewed the performance, or the suitability of the product or the methodology proposed by GRT in the preparation of this report. Deloitte and the Technical Advisors have undertaken the analysis on the basis that we:

- Adopt the input assumptions and variables as provided by GRT with regard to the GRT Approach
- Adopt the methodology as proposed for each product application
- Prepare a costing in line with the current industry best practice for each product application using methodology proposed

Key assumptions in the analysis

The cost estimation and comparative financial analysis have been undertaken on the basis of a number of assumptions regarding the operation and underlying unit costs. Project Support together with SMEC have developed input assumptions and populated a cost estimation model Expert Estimation. GRT have provided the input assumptions for the use of their product including the cost and application cycle and rates.

The core assumptions underpinning the analysis for the reference project are:

- That the dust suppression operation services an 8m wide 10km road in a Queensland environment
- The road is regularly used and there is a need for an active dust suppression regime equivalent to treatment three times per day under a conventional approach in dry conditions, or a treatment every 90 days utilising the GRT product
- Water is sourced 5km from the application site, requiring a return haul distance of 10km (5km empty plus 5km loaded)
- Suitable equipment is utilised to avoid overspray

- There is an initial set up period/construction period and that the dust suppression maintenance activities will subsequently be required over a minimum of two years
- Costs in real terms are uniformly annual during the maintenance period

Financial Analysis

To compare the relative cost between Conventional Approach and the GRT Approach, we have used a discounted cost analysis (comparison of NPC) using a nominated real discount rate of 10%. The adopted discount rate is for illustrative purposes only.

The comparative cost analysis of the Conventional Approach versus the GRT Approach shows that the GRT Approach is less expensive than the Conventional Approach over the assessment period based on the agreed assumptions. While the initial cost of application of the GRT product is more expensive, the ongoing annual cost of dust suppression maintenance utilising the GRT Approach is lower than the Conventional Approach. A summary of the total costs for each approach over a two year period on an undiscounted basis are set out below in Table 1.

Table 1: Total Costs (undiscounted) over two years

	Conventional $	GRT $	Difference $
Scarify & Reshape Road	214,544	219,078	4,534
Application costs	-	263,498	263,498
Maintenance Regime	1,605,810	762,056	(843,754)
Total costs	**1,820,354**	**1,244,631**	**(575,723)**

The net present costs (NPC) of utilising the GRT product compared to the Conventional Approach over two year, three year and 10 year periods at a 10% discount rate are shown in Table 2 below.

At a 10% discount rate, the difference (savings) in the NPC between the GRT approach and the Conventional Approach for the reference project ranges from close to $0.5m over two years to nearly $2.5m over 10 years. This represents savings of 29.8% over two years, 36.1% over three years and 45.5% over ten years.

Table 2: Net Present Cost (assuming a 10% discount rate)

Period (yrs)	Conventional $	GRT $	Difference $	Difference %
2	1,676,029	1,176,141	(499,888)	(29.8%)
3	2,308,707	1,476,386	(832,321)	(36.1%)
10	5,388,846	2,938,101	(2,450,745)	(45.5%)

Sensitivity Analysis

Further sensitivity analysis using discounted cashflows over each timeframe at different discount rates ranging from 7% to 13%, shows that the GRT Approach delivers a relative cost differential in the order of between 29% and 46%, when compared to the Conventional Approach. The results are shown in Tables 3, 4 and 5.

Table 3: Net Present Cost (discounted) over two years

Discount rate	Conventional $	GRT $	Difference $	Difference %
7%	1,716,160	1,195,186	(520,974)	(30.4%)
9%	1,689,132	1,182,359	(506,773)	(30.0%)
10%	1,676,029	1,176,141	(499,888)	(29.8%)
11%	1,663,190	1,170,048	(493,142)	(29.7%)
13%	1,638,269	1,158,222	(480,047)	(29.3%)

Table 4: Net Present Cost (discounted) over three years

Discount rate	Conventional $	GRT $	Difference $	Difference %
7%	2,394,121	1,516,920	(877,201)	(36.6%)
9%	2,336,421	1,489,538	(846,883)	(36.2%)
10%	2,308,707	1,476,386	(832,321)	(36.1%)
11%	2,281,714	1,463,576	(818,138)	(35.9%)
13%	2,229,787	1,438,933	(790,854)	(35.5%)

Table 5: Net Present Cost (discounted) over ten years

Discount rate	Conventional $	GRT $	Difference $	Difference %
7%	6,047,849	3,250,839	(2,797,010)	(46.2%)
9%	5,594,193	3,035,551	(2,558,642)	(45.7%)
10%	5,388,846	2,938,101	(2,450,745)	(45.5%)
11%	5,196,321	2,846,737	(2,349,584)	(45.2%)
13%	4,845,841	2,680,412	(2,165,429)	(44.7%)

We also undertook a high level sensitivity analysis of the impact of a 25% increase and a 25% decrease on the key cost and operating assumptions over a two year maintenance period on the cost of the Conventional Approach and the GRT Approach. This analysis showed that:

- The Conventional Approach is particularly sensitive to variables impacting costs relating to the supply and haulage of water such as the maintenance cycle and frequency of water applications required per day, the cost of plant (water trucks) and the cost of water.
  - Increasing the number of applications of water per day by 25% increased the costs of dust suppression over two years by approximately $0.4 million to $2.22 million.
  - Increasing the cost of water by 25% increased the cost of dust suppression over two years by approximately $0.2 million to $2.22 million.

- The GRT Approach is less sensitive to changes in the cost assumptions relating to water use, water cost and associated plant.
  - Increasing the number of applications by reducing the maintenance cycle period by 25% increased the costs of dust suppression over two years by approximately $0.16 million to $1.4 million.
  - Increasing the cost of water by 25% increased the cost of dust suppression over two years by approximately $0.01 million to $1.26 million.

Potential non-financial benefits

While our analysis did not consider the relative effectiveness of dust suppression using the GRT Approach compared to the Conventional Approach, the apparent reduced need for regular spraying for effective dust control results in lower water consumption and application costs. While there may be other qualitative benefits attributable to the GRT Approach such as improved road safety due to lower maintenance traffic and more stable road surfacing, or improved environmental conditions due to lower dust levels over prolonged periods, these benefits have not been tested in this study, but may be worthy of further consideration.

2. Introduction

Background to the study

GRT, a Queensland based company operating internationally manufactures products and provides turn-key solutions to the market for dust control, soil and ground stabilisation on surfaces with a particular focus on roads.

GRT currently offers a product in the market to assist with dust suppression on roads – GRT7000. GRT7000 is a specially formulated 'non-ionising in water solution' liquid polymer engineered for use in civil construction. GRT7000 concentrate is diluted with water when loaded into the water tank, then applied to any dusty unsealed road using standard spray equipment.

Scope of the study

GRT has engaged Deloitte to provide an evaluation of the comparative cost benefit of the Conventional Approach to dust suppression (using water spray) compared to the GRT Approach (utilising an additive polymer product) under comparable conditions.

Deloitte was engaged to undertake the analysis utilising an indicative "reference" project for an 8m wide and 10km long road in a Queensland environment.

Deloitte has engaged the services of the following technical advisors to assist with the project:

- **SMEC**: civil engineering and transportation planning consultants to assist with the scenario modelling and operational assumptions, and
- **Project Support**: a specialist quantity survey consultant to assist with the identification of the appropriate cost base and operational assumptions to support the financial analysis.

The scope of costs included in the analysis is limited to plant, materials and labour specific to the provision of dust suppression. The cost analysis does not include overheads and corporate margins, site related management costs such as inductions or accommodation and does not include GST or other on-costs.

It was not intended that Deloitte, or its Technical Advisors, undertake any product validation or performance review or provide any comment on the suitability of the product or the methodology proposed by GRT to prepare the report. Deloitte and the technical advisors have undertaken the analysis on the basis that we:

- Adopt the input assumptions and variables as provided by GRT for the GRT Approach
- Adopt the methodology as proposed for each product application
- Prepare a costing in line with the current industry best practice for each product application and methodology proposed

3. Approach to the Analysis

Deloitte and the Technical Advisors have undertaken the following process to identify, document and analyse the associated costs and any comparative financial differential or benefit arising from two nominated approaches to dust suppression.

1. We have identified the underlying conventional techniques and the GRT Approach for each step of the dust suppression process, to identify where use of the GRT technology will depart from current practice. This has included a review of the dust suppression implications associated with the planned method of construction and the approach to the planning and delivery of temporary and permanent works. It also included a review of the services required to complete rehabilitation or construction processes and maintenance associated with the GRT Approach relative to the Conventional Approach.

2. For the GRT product, SMEC and Project Support reviewed the proposed methodology relative to current industry best practice to confirm the applicability and suitability of the plant, materials and labour proposed.

3. SMEC and Project Support compiled production rates and current industry cost data for the Conventional Approach in line with current best practice for the following cost input categories:
    a. plant (equipment requirements)
    b. materials (material choice)
    c. labour (contractors and human resources)

4. GRT provided the following unit input costs for the GRT Approach:
    a. application rates,
    b. productivity rates, and
    c. distance and cost of delivering the GRT product to site

5. Once the assumptions and inputs were agreed, a cost estimation model was developed by Project Support to generate cost line items under both the Conventional Approach and GRT Approach.

6. SMEC and Project Support then undertook a desktop exercise to benchmark the outcome of this costing against a range of contract types and construction methodologies within a typical Queensland environment.

7. The cost data was then provided to Deloitte for development of a discounted cashflow model to assess the relative costs over the nominated period of time.

8. Finally, Deloitte undertook sensitivity analysis to determine the relative impact of key variables on the results.

4. Dust Suppression Options

As indicated, GRT have requested that this analysis consider the relative costs or benefits associated with utilising the GRT7000 product and methodology for dust suppression over a "reference" road relative to the conventional approach of utilising just a water spray.

This section provides a brief overview of the Conventional Approach to dust suppression and the differences noted with regard to the GRT Approach of utilising GRT7000 as an additive to the process.

4.1 Conventional Approach

Under the Conventional Approach the construction and maintenance regime is likely to include the following activities:

- *Scarify and recompact:* An initial visit to shape the road by utilising a grader, compaction roller and water truck to tyne or rip the existing surface and then re-shape and compact to industry practice of central crown with nominated crossfall to shoulders. In some circumstances there may be a need for the addition of gravel, and for traffic control activities.

- *Maintenance regime over a defined period of months:* A defined number of water trucks (of nominated size and hourly rate) would return to the site to undertake regular watering from a nominated available site supply, at a cycle variable which may be as often as three times a day (with a further allowance made for seasonality/ wet weather).

4.2 GRT Approach

Under the GRT Approach, the following activities are likely to be undertaken during the construction and maintenance period:

- *Scarify and recompact:* An initial visit to shape the road by utilising a grader, compaction roller and water truck as per the Conventional Approach, with the additional cost being the provision of a GRT technical supervisor to oversee activities and utilisation of GRT 7000 during this process.

- *Supply and incorporate GRT7000 product at various rates of application:* Provide GRT 7000 to the site contractor. The product would be applied with a water truck using a multi-stage process to enable the re-tyned pavement to have reducing concentrations incorporated, thus ensuring a complete coverage to a nominal 150mm depth. This is to ensure that the top layer has been treated in accordance with GRT requirements to provide a long lasting treatment. Traffic control is established with the road being re-opened in approximately 4 hours.

- *Maintenance regime over a defined period of months:* Costs are based upon a defined number of water trucks (of nominated size and hourly rate) returning to the site to undertake regular application of watering from site supply with addition of GRT7000 product at a regular cycle (depending on the condition and use of the road).

5. Assumptions

This section sets out the main assumptions and exclusions which have been utilised in the cost estimation exercise for each of the approaches. The assumptions have been split into the following three categories:

1. Common assumptions – base project assumptions that have been used as a common element in the cost estimation of both approaches
2. Conventional Approach assumptions
3. GRT Approach assumptions

5.1 Common Assumptions

The following common assumptions have been used in the cost estimation:

- The reference project is assumed to be a road that is 8m wide by 10km long, or an 80,000m^2 surface, with heavy vehicle traffic, for the purposes of managing dust.
- The project is undertaken in a Queensland environment with the associated topography, climate, unit costs and availability of plant and labour.
- Typical operating and climatic conditions have been assumed.
- Project duration of initial treatment over two months, followed by regular maintenance visits for both options over a two year period.
- Maintenance costs are incurred equally across the two year period.
- Water is sourced 5km from the application site, in a site water holding facility, requiring a return haul distance of 10km (5km empty plus 5km loaded). This distance is considered an important variable, as every project has a different water haul distance which then has a direct relationship on selection of the discharge water truck capacity and the number of water discharge trucks required to ensure that other plant on-site do not remain idle.
- A 26,000 litre water truck capacity has been assumed for the purpose of the calculations.
- Water costs of $6.10 per kilolitre. This also is an important variable considering the value of water to a project would be the bulk supply rate plus any cost to transport to the site water holding facility (which is assumed to be relatively close to the project).
- Water haul truck costs of $180 per hour.
- All costs are excluding GST.

5.2 Assumptions specific to Conventional Approach

The following assumptions have specifically been used in the cost estimation for a Conventional Approach:

- An initial first visit to the site will be undertaken to shape and re-compact the road to suppress the dust
- 60,000L of water per application at 0.75 L/m^2
- A water truck will be employed to wet the road surface three times per day to provide efficient dust suppression for a period of two years.
- The treatment frequency is considered acceptable and comparable to the selected GRT Work Statement for Treating a Heavy Traffic Road as outlined below.

5.3 Assumptions specific to GRT Approach

The following assumptions have specifically been used in the cost estimation of the GRT Approach:

- Includes an initial visit to shape the road, followed by regular ongoing maintenance over a two year period. The GRT7000 product would be applied for dust suppression during the initial shaping and continued as part of an ongoing maintenance regime.
- GRT Method Maintenance Cycle Duration of every 90 days

- Inclusion of a GRT supervisor at a cost of $90 per hour. This requirement is for only the initial treatment and re-shaping.
- GRT7000 haul truck costs of $224 per hour (i.e. haulage costs to bring the product to the site)
- Cost of GRT7000 product of $3.95/L
- Product wastage of 5%, with no overlap or overspray
- Product application assumptions and treatment frequencies are based on GRT's heavy traffic work statement, (as supplied). Key input parameters are presented below

    - Initial application 0.250 L/m2 of product, at a dilution rate of 6:1 (i.e. 1.75L/m2 in total)
    - First coat application 0.250 L/m2 of product, at a dilution rate of 6:1 (i.e. 1.75L/m2 in total)
    - Second coat application 0.250 L/m2 of product, at a dilution rate of 4:1 (i.e. 1.25L/m2 in total)
    - Maintenance at 0.250 L/m2 of product, at a dilution rate of 4:1 (i.e. 1.25L/m2 in total)

A consolidated detailed set of assumptions ranging from unit costs to application rates used in the cost estimation is detailed in Appendix 1.

5.4 Summary of the Unit Rates

The following tables set out a summary of the unit rates utilised for each approach based upon a road of 10km length and width of 8.0m (an area of 80,000m^2) over a two year period.

Table 6: Unit Rates – Conventional Approach

Unit Rates		
Scarify and Reshape Road	AUD/m²	2.68
Application of Maintenance Water	AUD$/m² p.a.	10.04
Application of Maintenance Water	AUD$/month	66,909
Water truck hours	hr	5,129
Water truck cost	$/hr	180
Water application rate - Maintenance period	L/m²	0.75

Table 7: Unit Rates – GRT Approach

Unit Rates		
Scarify and Reshape Road	AUD/m²	2.74
Application of Initial Treatment	AUD/m²	0.05
Application of First Coat	AUD/m²	0.04
Application of Second Coat	AUD/m²	0.03
Supply of GRT Product	AUD/m²	3.17
Total Initial Treatment Works	AUD/m²	6.03
Application of Maintenance Coat	AUD$/m² p.a.	0.09
Supply, Delivery and Storage of Active Ingredient	AUD$/m² p.a.	4.68
Total maintenance	AUD$/m² p.a.	4.76
Application of Maintenance Coat	AUD$/month	579
Supply, Delivery and Storage of Active Ingredient	AUD$/month	31,173
GRT product cost	$/L	3.95
Water application rate - Maintenance period	L/m²	0.75

5.5 Exclusions

It should be noted that the cost analysis of both approaches excludes the following:

- Normal overheads and separate corporate profit margins (other than included in rates) and site costs such as inductions, plant transport and establishment of work.
- Camp and accommodation costs would be similar for both options and are dependent on locale.
- GST and any other on-costs or fees such as workplace health and safety (WPH&S) or insurance.
- Design costs relating to any verification or subsequent testing or any site survey costs.

6. Cost Estimation

This section sets out the detail used in the estimation of the comparative costs of each approach and methodology to dust suppression. As indicated in the previous chapter, this comparison is based upon the reference project.

6.1 Cost analysis

The cost analysis has taken into consideration the parameters set out in section 4 and 5. Based on these factors, the Conventional Approach has a total cost over a two year period of $1.8m compared to the GRT Approach, with a total cost of $1.2m.

Table 8: Total costs comparison (nominal)

$	Conventional	GRT
Scarify & Reshape Road		
Subcontract	4,860	4,860
Plant	112,952	113,112
Material	43,920	43,920
Labour	52,812	57,186
Sub total	**214,544**	**219,078**
Application costs		
Application	-	9,759
Supply, delivery and storage of active ingredient	-	253,739
Sub total	**-**	**263,498**
Maintenance Regime		
Subcontract	-	-
Plant	923,220	5,580
Material	682,590	5,490
Labour	-	2,831
Supply, delivery and storage of active ingredient	-	748,154
Sub total	**1,605,810**	**762,056**
Total Costs	**1,820,354**	**1,244,631**

6.2 Cost Breakdown

The breakdown of these costs is detailed in the following sections.

Initial Road Costs

The initial cost to scarify and reshape the road assumes a surface treatment with scarifying to a depth of 150mm. The difference in total cost for the two approaches is due to the onsite supervision labour costs assumed for the GRT Approach. The GRT Approach includes 48.60 additional hours (at $90/hr) for a GRT supervisor, which is not required in the Conventional Approach. This equates to an additional labour cost of $4,374 over the project duration.

Table 9: Scarify and Reshape Road Costs

$	Conventional	GRT
Tyne and Compact Costs - Scarify & Reshape Road		
Cost of Grinder and Roller	52,800	52,800
Cost of Water Truck	57,600	57,600
Extra Plant Hours due to Water Truck Criticality	-	-
Cost of Water Supply	43,920	43,920
Total Tyne and Compact Costs	**154,320**	**154,320**
Traffic Control Costs - Scarify & Reshape Road		
Traffic Control Labour Costs	37,989	37,989
Traffic Control Ute	4,860	4,860
Total Traffic Control Costs	**42,849**	**42,849**
Onsite Supervision Costs- Scarify & Reshape Road		
Onsite Supervision Labour Costs	14,823	19,197
Mine Spec Vehicle for Onsite Supervisor	2,552	2,712
Total Onsite Supervision Costs	**17,375**	**21,909**
Total Scarify & Reshape Road Costs	**214,544**	**219,078**

Cost of GRT7000 application

The cost of application of the additive under the GRT Approach assumes 63,042 litres of GRT active ingredient is required at $3.95/L. Application costs assume there is 5% product wastage and no additional overlap or overspray losses. It also assumes 22.8 haul truck hours at $224/hr to transport the GRT7000 product from the GRT warehouse to site (3 trips consisting of a 570km round trip travelling at 75km/hr). There is no GRT product cost under the Conventional Approach.

Table 10: Cost of application

$	Conventional	GRT
Application costs		
Application of Initial Treatment Costs	-	4,121
First Coat Costs	-	3,131
Second Coat Costs	-	2,507
Sub total	**-**	**9,759**
Cost of Supply - Application		
GRT7000 Product Cost	-	249,016
Offset of Water not Required	-	(385)
Haul Truck Cost	-	5,107
Sub total	**-**	**253,739**
Subtotal of Initial Treatment Works	**-**	**263,498**

Maintenance

Key maintenance costs under the Conventional Approach include:

- Water truck costs, which have been calculated with a total duration of standby/refill time of 3,264 hours with 1,865 hours of application time (total hours of 5,129) at $180/hr for truck costs, resulting in total cost of $923,220 over a two year period.
- Water volume of 111,900,000 litres at $6.10/kL. This is based on 60,000L of water being used per application at 0.75 L/m^2, with 1,865 applications over a two year period (requiring three water truck loads per day over the maintenance period).

Maintenance costs under the GRT Approach include:

- GRT product cost of $3.95/L with 180,000L of active ingredient utilised over the period assessed. Application costs during the maintenance regime assume there is 5% product wastage with no overlap or overspray. This assumes a mix of 0.25L/m^2 of product, at a dilution rate of 4:1 (i.e. 1.25L/m^2).
- Water supply of 900,000L at $6.10/kL (assuming 100,000L required per application with 9 applications over a two year period at a 90 day frequency).
- Container hire costs are incurred in storing the GRT product onsite with no product spoilage/leakage (calculated at 104 weeks container hire at $350 p/w).
- Water truck costs include 22 hours of total water truck refill time ($180/hr).

Table 11: Cost of maintenance

$	Conventional	GRT
Maintenance Regime		
Cost of Water Truck	923,220	-
Cost of Water Supply	682,590	5,490
Cost of Application	-	1,620
Cost of Water Truck Haul/Fill	-	3,960
Onsite Supervision Labour Costs	-	2,411
Mine Spec Vehicle for Onsite Supervisor	-	420
Sub total	**1,605,810**	**13,901**
Cost of Supply - Maintenance		
GRT7000 Product Cost	-	711,000
Offset of Water not Required	-	(1,098)
GRT 7000 Product Haul Truck Cost	-	1,702
Container Hire Cost	-	36,550
Sub total	**-**	**748,154**
Total of Maintenance Regime	**1,605,810**	**762,056**

6.3 Qualitative benefits of the GRT Approach

The primary focus of this report is to describe and quantify the cost comparison between applying the Conventional Approach and using the GRT Approach to dust suppression on roads.

There may however be some additional qualitative benefits in using the GRT7000 product which are not quantified in this report. It is important to note that the authors of this report have not undertaken any assessment of product performance and cannot independently verify or attest to any the existence or scale of any potential qualitative benefits. Additional, independent auditing of the GRT7000 performance in-situ over a period of time is therefore recommended.

Areas where there may be additional qualitative benefits, that require further independent verification include road safety and community and environmental impacts.

Road safety

Improved road safety is a key consideration in the application of dust suppression. The methodology used to utilise the GRT7000 product results in significantly less traffic being used on the road through a reduction in the number of water trucks, graders etc. This reduction in traffic may lead to reduced exposure rates and improved road safety.

As the GRT7000 product is designed as a long term treatment solution with the aim of producing stable road conditions and significantly less rutting (sometimes associated with traditional water based dust suppression techniques), its use may lead to further improvements with road safety.

The long term nature of the GRT7000 treatment may also reduce the resettling of fine particles on the road surface. This may improve skid resistance and result in a positive impact of improved road surface for users.

Community benefits

Airborne dust is a recognised problem on a number of mine sites, which are often located near local communities, or near the housing development of mine workers. As the mine haul routes operate year round, dust particles have the potential to become an increasing problem for local communities.

Water-based dust suppression techniques achieve dust suppression for shorter periods of time compared to the claims attributed to GRT7000, which may only require re-treatment every 90 days. This means that less heavy traffic in the form of water trucks are required to apply water continually along the road under consideration, reducing the associated community impact of ongoing heavy vehicle traffic.

Because the GRT7000 product is designed as a long term dust suppression alternative, it may also reduce the level of dust in-between applications, compared to water, where the dust particles may become airborne again as soon as the water dries. Wind and warm, dry weather may cause the water to evaporate quickly between applications resulting in an increase the dust particles in the air, leading to increase pollution and nuisance to local communities.

Environmental benefits

Airborne dust may pose health risks to local communities, contractors and drivers. Dust is more than a nuisance and its impact on the environment should not be discounted. Airborne particles are recognised as a contributor to air pollution and measures that cause a reduction in the level of particles may subsequently reduce pollution. A reduction in the overall level of airborne particles may therefore contribute to related environmental benefits which have not been quantified.

Reduced water usage

Water is a scarce commodity in Australia, particularly in rural areas where many of the roads that require dust suppression are located. One of the main conclusions from the comparison of the GRT7000 dust suppression methodology and conventional dust suppression is the reduction in water use. GRT have also indicated that where potable water is especially scarce, or expensive to obtain, it is possible to use non-potable water or even salt water under certain circumstances.

A reduction in the use of this potentially scarce commodity is an additional benefit, which although costed in financial terms for this analysis, has the potential to generate significant unquantified wider economic benefits.

7. Comparative Cost Analysis

7.1 Cashflows and methodology

To compare the relative cost between Conventional Approach and the GRT Approach, we have used a discounted cost analysis (comparison of NPC) using a nominated real discount rate of 10%. The adopted discount rate is for illustrative purposes only.

An overview of the methodology for determining the relative costs over a two year cycle is presented in section 6. A complete summary of the cost modelling assumptions is included in Appendix 10.1.

7.2 Cost summary

Total costs over a two year period on an undiscounted basis are set out in the table below. This summary incorporates both the initial costs and ongoing maintenance costs.

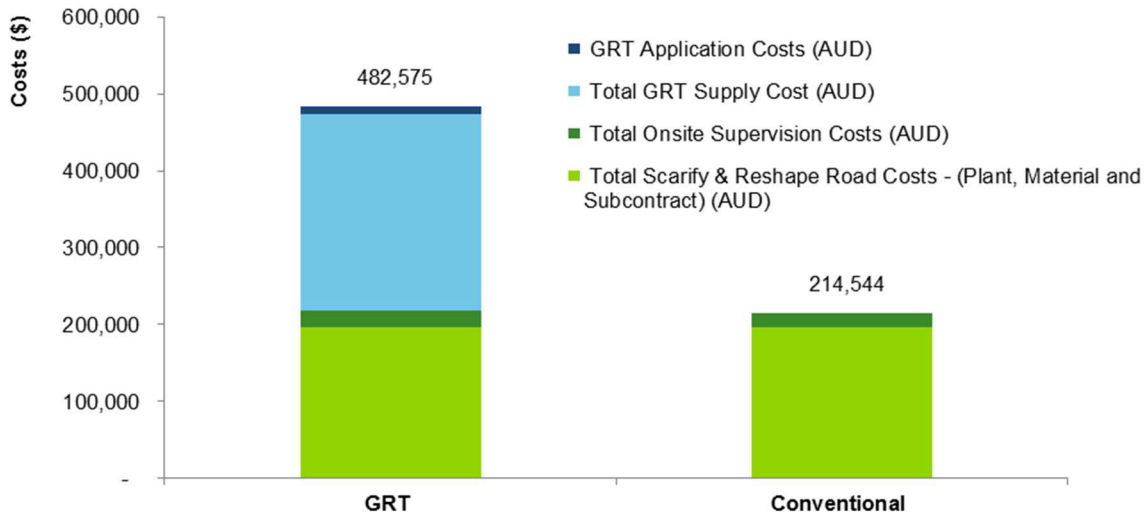
Table 12: Total Costs

	Conventional $	GRT $	Difference GRT vs Conventional
Scarify and reshape road	214,544	219,078	2.1%
Application costs	-	263,498	
Maintenance regime	1,605,810	762,056	(52.5%)
Total costs	**1,820,354**	**1,244,631**	**(31.6%)**

Initial costs

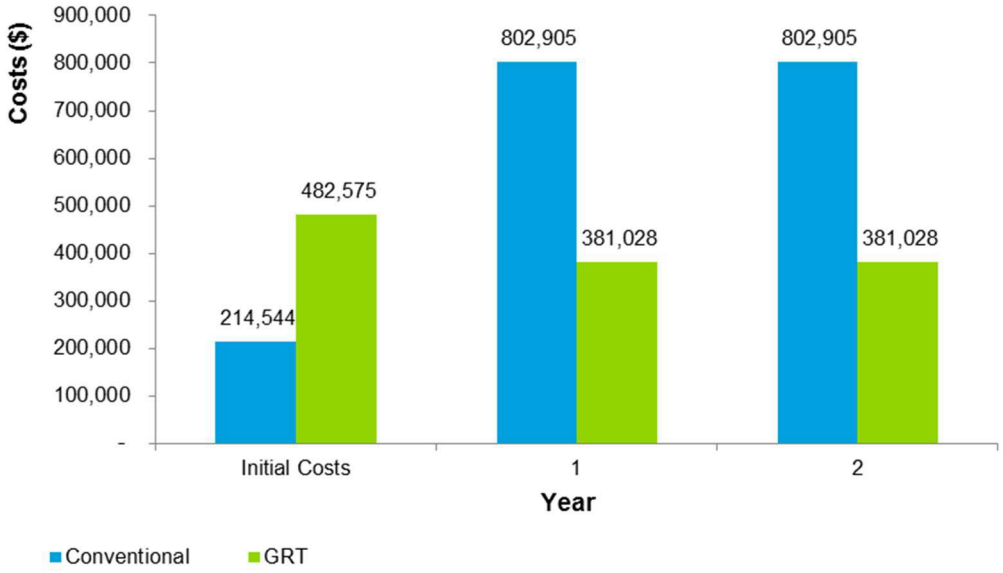
Initial costs compare scarifying and road reshaping costs required to prepare the road for dust suppression for both Conventional and GRT Approaches. GRT also has another additional outlay related to GRT7000 product costs for the initial application across the total road surface (80,000 m^2) which is not included under the Conventional Approach. The initial costs are shown below in Figure 1.

Figure 1: Initial Costs



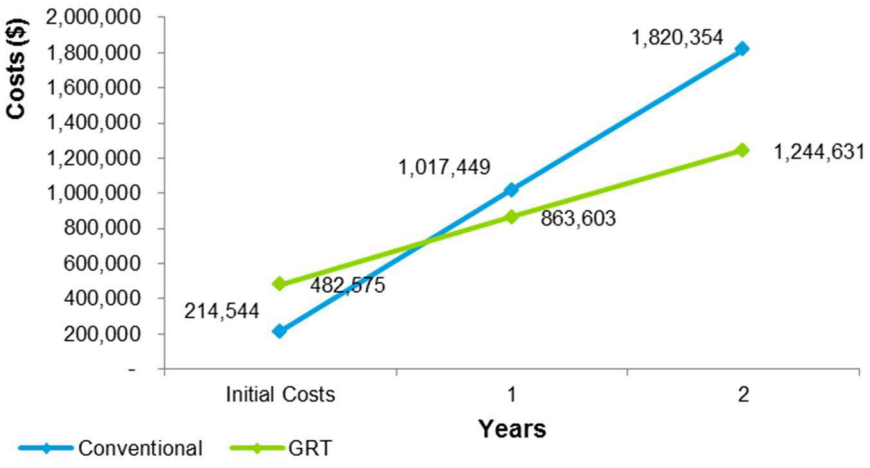
Maintenance costs over a two year cycle are described in section 6. The relative annual and cumulative maintenance costs for the GRT and Conventional Approach, together with the initial costs, are set out in Figures 2 and 3 below:

Figure 2: Annual Costs



The cumulative cost analysis (as shown below in Figure 3) shows the GRT Approach being less expensive than the Conventional Approach, with a breakeven point of approximately six months. While the initial cost of GRT product application is more expensive, the ongoing annual cost of dust suppression maintenance utilising the GRT Approach is lower due to a longer maintenance application cycle (every 90 days) when compared to the Conventional Approach with applications three times a day.

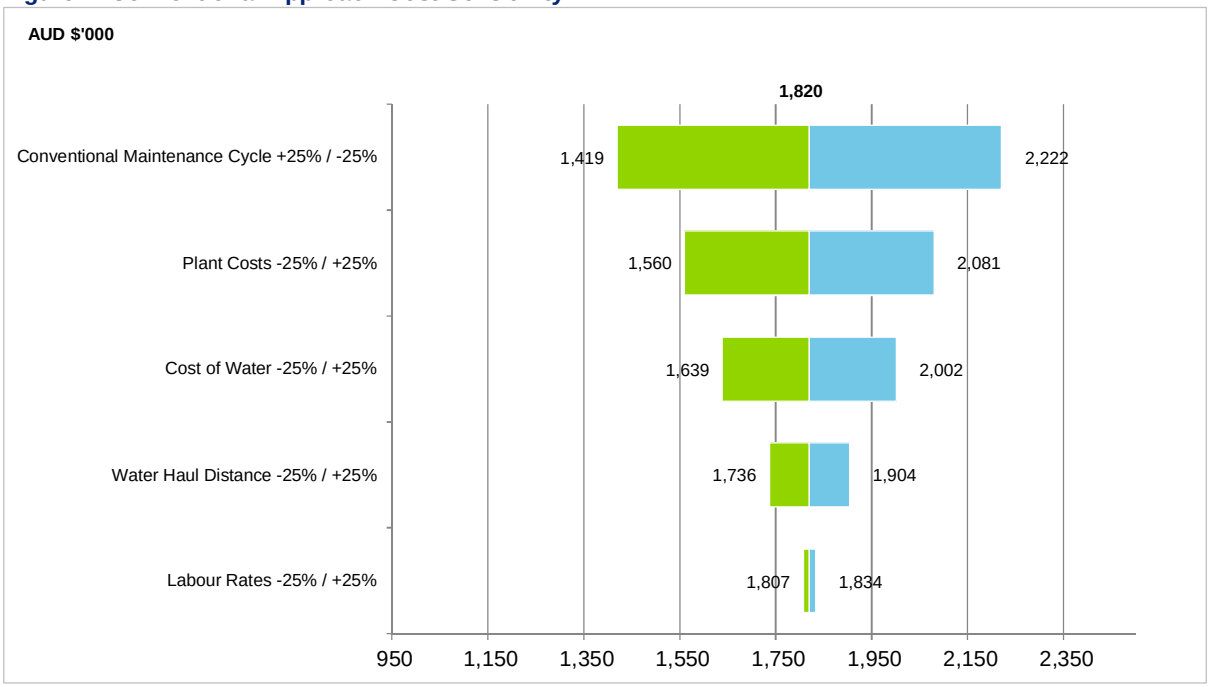
Figure 3: Cumulative Costs



7.3 Sensitivity analysis

Based on the assumptions adopted, the higher initial costs of the GRT Approach are offset by the lower application cost of the GRT product within the first year of maintenance. Figure 4 and Figure 5 below show the impact on the total initial and maintenance costs of a 25% increase and 25% decrease in key cost and operating assumptions, assuming a 2 year maintenance period.

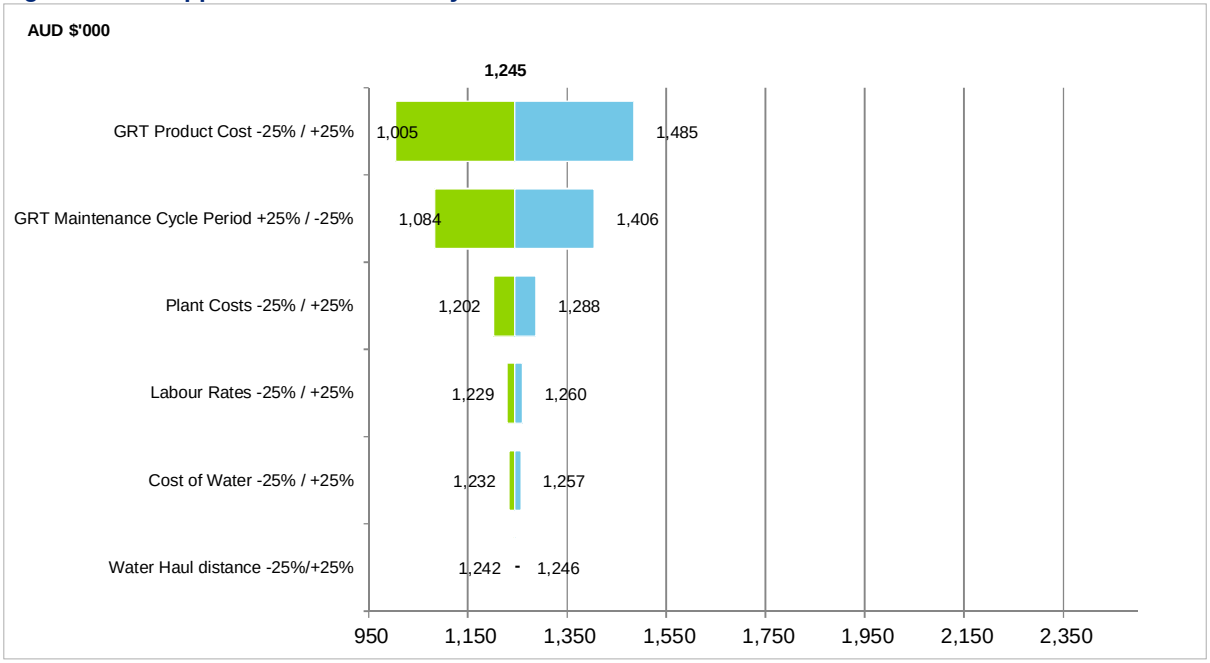
Figure 4: Conventional Approach Cost Sensitivity



Analysis of the impact of changes to these assumptions shows that, under an active dust suppression regime, the Conventional Approach is particularly sensitive to variables impacting costs relating to the supply and haulage of water:

1. increasing the number of applications of water per day (decreasing the maintenance cycle) increases the volume of water required during the maintenance period, resulting in an increase in both the cost of the water and the cost of the plant (water truck) used for dust suppression
2. Increasing the plant cost increases the cost of the plant (water truck) used for dust suppression in the maintenance period, and to a lesser extent, plant used to scarify and reshape the road
3. Increase in the water supply increases the cost of water used for dust suppression during the maintenance period, and to a lesser extent, water used to scarify and reshape the road

Figure 5: GRT Approach Cost Sensitivity



Overall the GRT Approach exhibits a lower degree of sensitivity to changes in cost assumptions. The GRT Approach is most sensitive to the cost of the GRT product (for both the initial application and treatment and subsequent maintenance) and the regularity of application of the GRT product during the maintenance period. The lower degree of sensitivity to changes in water costs, haulage distance and plant costs (particularly water truck hire) reflects the significantly fewer number of applications of GRT product required under the GRT Approach relative to the volume of water applied under the Conventional Approach.

Net Present Cost

The total costs in Table 12 have been discounted to present cost for the purpose of assessing the relative cost of utilising the GRT Approach and Conventional Approach over the following periods:

- 2 years
- 3 years
- 10 years

The NPC analysis is performed using pre-tax cashflows expressed in real terms, using a range of discount rates. All cashflows are expressed exclusive of GST.

Table 13: Net Present Cost – 2 years

Discount rate	Conventional $	GRT $	Difference %
7%	1,716,160	1,195,186	(30.4%)
9%	1,689,132	1,182,359	(30.0%)
10%	1,676,029	1,176,141	(29.8%)
11%	1,663,190	1,170,048	(29.7%)
13%	1,638,269	1,158,222	(29.3%)

Table 14: Net Present Cost – 3 years

Discount rate	Conventional $	GRT $	Difference %
7%	2,394,121	1,516,920	(36.6%)
9%	2,336,421	1,489,538	(36.2%)
10%	2,308,707	1,476,386	(36.1%)
11%	2,281,714	1,463,576	(35.9%)
13%	2,229,787	1,438,933	(35.5%)

Table 15: Net Present Cost – 10 years

Discount rate	Conventional $	GRT $	Difference %
7%	6,047,849	3,250,839	(46.2%)
9%	5,594,193	3,035,551	(45.7%)
10%	5,388,846	2,938,101	(45.5%)
11%	5,196,321	2,846,737	(45.2%)
13%	4,845,841	2,680,412	(44.7%)

The NPC analysis over multiple periods (2, 3 and 10 years) indicates a greater positive cost differential between the two approaches the longer the period. This is attributable to the initial costs of the GRT Approach being more expensive (than the Conventional Approach) with higher ongoing dust suppression maintenance costs under the Conventional Approach.

8. Conclusions

Our analysis has shown that while the initial cost outlay for dust suppression using the GRT Approach is higher than the Conventional Approach, the ongoing maintenance is less expensive, delivering a break even cost for ongoing, dust suppression after approximately 6 months.

Further sensitivity analysis using discounted cashflows over longer timeframes, indicates that the GRT Approach delivers a relative cost differential in the order of $0.5m, $0.8m and $2.5m over 2, 3 and 10 years, when compared to the Conventional Approach.

Table 16: Net Present Cost (assuming a 10% discount rate)

Period (yrs)	Conventional $	GRT $	Difference $	Difference %
2	1,676,029	1,176,141	(499,888)	(29.8%)
3	2,308,707	1,476,386	(832,321)	(36.1%)
10	5,388,846	2,938,101	(2,450,745)	(45.5%)

These results demonstrate that where there is a need for an active dust suppression regime in a hot and dry environment, from a cost perspective, the GRT Approach may be financially attractive especially where there is a requirement for multiple daily treatments.

While there may be other qualitative benefits attributable to the GRT dust suppression approach such as improved road safety due to lower maintenance traffic and more stable road surfacing, or improved environmental conditions due to lower dust levels over prolonged periods, these benefits have not been tested in this study, but are worthy of further consideration.

Appendix 1 - Cost Modelling Assumptions

Table 17: Cost Modelling Assumptions

Item	Costing Unit	Rate
Material Costs		
Cost of water	kL	$6.10
GRT7000 product cost	L	$3.95
Maintenance Assumptions		
GRT Method Maintenance Cycle Duration		90 days
Conventional Approach Maintenance Cycle Duration – Average dry conditions		1/3 day
Conventional Approach Maintenance Cycle – Adjustment for seasonal conditions		15%
Labour Rates		
Traffic Control - Labourers	Hour	$71.50
Traffic Control - Supervisors	Hour	$91.50
Onsite Supervision - Supervisors	Hour	$91.50
Onsite Supervision - GRT Supervisor	Hour	$90.00
Plant Rates		
Water Haul Truck (wet hire)	Hour	$180.00
GRT7000 Haul Truck (wet hire)	Hour	$224.00
Grader (wet hire)	Hour	$180.00
Roller (wet hire)	Hour	$150.00
Traffic Control - Utes	Hour	$30.00
Mine Spec Vehicle for Supervisor	Day	$159.50
Container Hire	Week	$350.00
Timing Assumptions		
Working time per day		10 hrs
Water truck fill time		15 minutes
Haul Equipment		
Water truck capacity		25,000 litres
Number of water trucks		2
GRT Haul truck capacity		26,000 litres
Haul Distances		
Water		10 km
GRT product		570 km

Item	Costing Unit	Rate
Truck Speeds		
Water haul speed		30km/hr
GRT7000 haul Speed		75km/hr
Average Speed of Water Truck - Initial GRT Coat		10km/hr
Average Speed of Water Truck - First GRT Coat		15km/hr
Average Speed of Water Truck - Second GRT Coat		20km/hr
Average Speed of Maintenance Truck		20km/hr
Road Characteristics		
Road Width		8 metres
Road Length		10,000 metres
Tyne and Compact production rate		500 m^2 /hr
Depth of tyning		0.15 metres
Gravel density		2.0 t/m^3
GRT Solution Assumptions		
Proportion of GRT7000 - Initial Application		14.3%
Proportion of GRT7000 - First Coat		14.3%
Proportion of GRT7000 - Second Coat		20.0%
Proportion of GRT7000 - Maintenance		20.0%
Addition of moisture by % to achieve lower bound target MC		4.0%
Wastage factor due to overspray (%) incremental spray		1.05
Spray and Water Requirement Assumptions		
Spray rate diluted GRT7000 - Initial Application		0.70 L/m^2
Spray rate diluted GRT7000 - First Coat		0.70 L/m^2
Spray rate diluted GRT7000 - Second Coat		0.54 L/m^2
Spray rate diluted GRT7000 - Maintenance		0.14 L/m^2
Spray rate water - Maintenance in L/m^2		0.75 L/m^2
Spray Bar Width as a Proportion of Road Width		50%
Water addition to achieve lower bound target MC by weight		30%

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