Increasing runoff from roaded catchments by chemical application

FINAL REPORT to GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

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ABSTRACT

The Great Southern Region relies on irrigation water from roaded catchments made from soil. The efficiency of one such roaded catchment has been doubled by a polymer soil sealant.

The best performing sealants from laboratory work are now being tested in field trials. The polymer and some other sealants are performing well even on loamy soils.

It was shown that catchments in the region vary widely in surface/soil characteristics resulting in very large differences in catchment efficiency.

In two cases, compacting with a roller improved efficiency by about a third.

However the polymer product is giving the best result and is now being adopted with great success on large areas in the region.

A new GWRDC project is now investigating using the polymer to collect water from within vineyard rows.

SUMMARY

The availability of sufficient water for irrigation is a major limitation to grape growers in the Great Southern region of Western Australia. Grape growers in this region rely on on-farm surface water catchments for irrigation water. Roaded catchments are commonly used to harvest rainfall. Increasing the efficiency of runoff from roaded catchments has been identified by growers in the region as a major research priority. This report covers three stages of investigation. During the first stage, laboratory tests were conducted to determine which of the eight products being investigated would be most suitable for testing on small scale plot sites.

Objective 1. Chemical applications to improve runoff from roaded catchments.

Previous research with two soil amendments showed that they can increase runoff when applied to roaded catchments. Funding was sought from GWRDC's RITA program to test a range of other soil amendments that showed potential.

Testing indicated that the chemicals performed better on the loamy sand soils as opposed to the clays.

The polymers and tall oil and organic bitumen emulsion (surface applied) and the tall oil and bitumen emulsion (incorporated) should be considered in the plot trials on the loamy sand soils.

The polymers and tall oils (surface applied) and the tall oil, acid based and lignosulphonate, and enzyme (incorporated) should be considered on the clay soils for the plot trials.

The higher compaction of clay generally gave betters results than the surface applied treatments.

The second stage used recommendations from the laboratory testing. Small plots (3 m x 3 m) were cleared and compacted at Mount Barker Research Station in March 2006. These plots were constructed on both the subsoil (clay) and the topsoil (sandy loam). A range of chemicals at different rates were applied to the plots. A rainfall simulator was used to apply ‘rainfall’ to the plots and the time to runoff and runoff threshold was measured. The results show that for three surface applied chemicals (a polymer, tall oil and organic bitumen emulsion) there was a statistically significant improvement in runoff generation compared to the control plots (95% confidence level). There was no significant difference in the performance of incorporated chemicals when compared to the controls. A polymer product used in the trial performed significantly worse than the control.

As part of the third stage of investigation, a roaded catchment was built at Mount Barker Research Station in March 2006. Sixteen bays (each approx. 500 m^2) have been constructed and each bay equipped with a flume and logger to quantify runoff threshold volumes and obtain performance data from two winter seasons. The three most promising treatments (Surface application of a polymer, a tall oil and an organic bitumen emulsion) based on the results from the small scale plots were applied to the catchment roads and four untreated control.bays were monitored. There are four replicates of each treatment.

Objective 2. Roaded catchment survey.

In April 2005 a survey was conducted to assess the performance of seven roaded catchments on vineyards at Frankland. The study involved:

- collecting information on how the roaded catchment was built;
- surveying the catchment characteristics;
- taking soil measurements from the roaded catchment;
- measuring the runoff threshold with a rainfall simulator

The aim was to give growers feedback on the performance of their roaded catchment and help develop guidelines on what roaded catchment characteristics gave increased runoff. A field day was held at Frankland in June 2005 and the results of this survey were presented to growers who attended.

1. INTRODUCTION AND PROJECT BACKGROUND

Many grape growing regions in Australia rely on on-farm surface water catchments for irrigation water. The availability of sufficient water for irrigation is a major limitation in many of these regions. In the Great Southern, yields in both the 2003 and 2004 grape harvests, were significantly reduced due to lack of irrigation water.

In drier years lower rainfall limits runoff and on-farm dams often fail to fill. In Western Australia, roaded catchments (compacted clay subsoils made into a series of sloping roads and collecting drains) are used extensively to collect water. In the Great Southern approximately one hectare of roaded catchment is needed for every 2 hectares of grapes. In 2003 the Western Australian Department of Agriculture and Food trialed the application of soil sealing chemicals to a roaded catchment at Frankland in an attempt to increase the percentage of runoff. The results were very encouraging and showed a significant increase in the percentage of rainfall that ran off. The trial needs to be repeated on another site with a different soil type to demonstrate that the results can be repeated.

The reduction in harvested water due to lower rainfalls is limiting production in many farming areas that have developed on-farm dam water supplies. Dams often fail in lower rainfall years. For horticulture, the lack of irrigation water causes a considerable reduction in yield. For high value wine grape crops, improved methods to collect runoff are likely to be more cost effective. For dryland farming areas, the reliability of water supplies for livestock, crop spray water and domestic use is a problem in many areas where farmers may be forced to cart water from emergency off-water supplies in low rainfall years. Research is showing that WA agricultural areas are trending towards a drier climate due to climate change.

Increasing surface runoff into a dam can be achieved by various methods. In the south-west of WA, methods include:

- directing water into the dam from paddocks (about 7% of rainfall is collected as runoff by this method);
- using roaded catchment (about 30% of rainfall is collected as runoff), and;
- using a bitumen catchment (about 85% of rainfall is collected as runoff).

Most vineyard operators consider bitumen catchments too expensive. In many dryland areas, costs are a major issue and/or suitable sites may be difficult to locate and efficiently seal for use as water harvesting catchments.

Soil sealing chemicals are relatively cheap and are used extensively in the mining industry to control dust and increase runoff from gravel roads. Applying these chemicals to existing roaded catchments may provide a cost effective method of increasing the collection of water. These chemicals also have the potential to seal previously unsuitable soils and natural catchment areas to provide reliable water supplies.

By applying chemical ameliorants to the roaded catchment surface, runoff can potentially occur after smaller rainfall events. That is, the runoff threshold of the catchment can be reduced. This is critical to increase water collection in regions with lighter (or less intense) rainfall events.

This report describes three stages of research aimed at achieving Objective 1. The first stage describes laboratory testing carried out on a range of chemical products to determine their suitability for field trials. From this testing, seven chemicals were chosen for application to small scale plot trials to determine runoff thresholds using a rainfall simulator and for long term stability monitoring. These results were used to identify three chemicals for testing on scaled roaded catchments to determine runoff volumes. The third stage of this work is ongoing.

The results from a second project looking at the performance of existing roaded catchments are also described to support and contextualize the findings of Objective 1.

1.1 Project objectives

1. To measure the effectiveness of applying chemical applications to a roaded catchment in increasing the runoff (in original application).
2. To examine the performance of existing roaded catchments (additional aim).

2. CHEMICAL APPLICATIONS TO IMPROVE RUNOFF FROM ROADED CATCHMENTS – STAGE 1

The Department of Agriculture and Food is researching the use of infiltration reducing chemicals to increase runoff from roaded catchments. Laboratory tests were conducted at the Main Roads Soil Laboratory. Those chemicals with the most potential were included in field trials established at Mt Barker Research Station.

Eight chemicals that were considered to have potential were examined. These products are used in the road stabilization and dust control industries. A selection criteria was that the product had to cost under $5000 per hectare. A higher price than this would result in most farmers not applying the chemical because of the cost. As a result traditional stabilisation products such as cement and lime were not tested. Table 1 lists the products and the chemical group they belong to.

Table 1. Chemicals tested and their chemical group

Product name	Company	Chemical group
Soil-Loc (Total Ground Control)	Omnichem	Synthetic Polymer Derivatives Combination of polymers. Styrene acrylic.
Road Pave	Rain Storm	Synthetic Polymer Derivatives Combination of polymers. Styrene acrylic (S).
Gluon 240	Rain Storm	Synthetic Polymer Derivatives Combination of polymers. Styrene acrylic.
Dustex	Dustex Australia Pty Ltd	Organic Non Petroleum Product Lignin Derivatives – Lignosulfonate.
Claycrete II	Dynamic Stabilisation	Electrochemical Derivatives -ionic products. Acid based product. Contains Phosphoric and Sulphuric acid.
Soil Bond	Huntsman Chemical Company.	Organic Nonpetroleum. Tall oil derivatives - pine oil fatty resin).
PK4	Eco-Enzymes Australia Pty Ltd.	Electrochemical Derivatives -enzymes. Miscellaneous enzymes produced from food products.
Cooee Ecotrax	Cooee Products	Organic Petroleum Products. Asphalt emulsions. Modified Bitumen emulsion.

The study is important as although these chemicals have been used to seal roads and control dust there has been minimal work carried out on using these chemicals to increase runoff volumes from roaded catchments. The main aim of the laboratory tests was to test a variety of chemicals to determine which would be the most suitable to reduce infiltration and increase runoff volumes from roaded catchments.

2.1 LABORATORY TESTING – STAGE 1

2.1.1 Materials and Methods

One tonne of gravely loamy sand topsoil and one tonne of clay subsoil were excavated from the Mt Barker research station with a front end loader for testing. Roaded catchments are almost always built from clay sub soils. The loamy sand topsoil (taken below the organic matter layer) was included in the testing because it was believed roaded catchments may be able to be built from top soils if they were amended with infiltration reducing chemicals. The soil was taken to the Main Roads laboratory and thoroughly mixed by Main Roads Test Methods WA 105.1 (2003).

2.1.2 Soil properties

The soils were classified as gravely loamy sand and medium clay. A detailed description of the laboratory testing will be published as a DAFWA technical report.

2.1.2.1 In summary

Chemicals were both incorporated and surface applied according to manufacturers recommendations to determine which method and soil type gave the best performance. Most of the chemicals can be surface applied. However some chemicals like Claycrete need to be incorporated into the soil. Three replicates were made for testing purposes.

Laboratory Tests on each sample included a bucket test, drop test and permeability test.

2.1.2.2 Bucket test

The bucket test is similar to the Australian Standard AS 1141.51 (1996). The test was used to give an indication of strength and longevity of the chemical treatments. The treated specimens were completely submerged in a tub of water over a period of 3 days. Observations of the amount of slaking and dispersion of the sample were taken.

2.1.2.3 Drop test

The drop test involved placing 1 ml of water on the top surface of the mould and recording if the water infiltrated into the mould or not after 5 minutes. This was considered to give an indication of water repellence.

2.1.2.4 Permeability test

A permeability test was carried out on the chemically treated specimens that performed well in the bucket and drop test. The permeability test was carried out using the technique described in Main Roads Test Method WA 117.3 (1995). The test involved placing moulds in plastic sealed containers and measuring rate of water infiltration through the specimens.

2.2 Results

2.2.1 Bucket test

2.2.1.1 Loamy sand (surface applied treatments)

The polymers (Gluon, Roadpave and Total Ground Control) showed the best results on the loamy sand surface applied treatments (Table 4). This was followed by the bitumen emulsion (Ecotrax). The remaining treatments did not perform better than the control.

Table 4. Percentage slaking of loamy sand samples after 1, 24, 48 and 72 hours of soaking (treatment surface applied)

Product	Slaking after 1 hour (%)	Slaking after 24 hours (%)	Slaking after 48 hours (%)	Slaking after 72 hours (%)
Untreated (92 % MDD*) Control	50	60	60	60
Untreated (100% MDD)	0	60	60	60
Total Ground Control	0	0	0	10
Gluon	0	0	0	0
Road Pave	0	0	0	0
Claycrete II	100	100	100	100
PK4	60	100	100	100
Dustex	75	100	100	100
Soil Bond	60	90	100	100
Ecotrax	50	50	50	50

**MDD-*

2.2.1.2 Loamy sand (incorporated treatments)

All the loamy sand incorporated treatments performed poorly in the bucket test, except for the bitumen emulsion (Ecotrax), which held together for 72 hours (Table 5).

Table 5. Percentage slaking of loamy sand samples after 1, 24, 48 and 72 hours of soaking (treatment incorporated)

Product	Slaking after 1 hour (%)	Slaking after 24 hours (%)	Slaking after 48 hours (%)	Slaking after 72 hours (%)
Untreated (92% MDD) Control	50	60	60	60
Untreated (100% MDD)	0	60	60	60
Total Ground Control	5	50	60	70
Gluon	50	80	80	90
Road Pave	5	60	60	70
Claycrete II	20	70	80	80
PK4	100	100	100	100
PK4 (+10% clay)	100	100	100	100
Dustex	40	100	100	100
Soil Bond	0	80	90	95
Ecotrax	0	0	0	0

2.2.1.3 Clay (surface applied treatments)

In general the treatments with the clay samples did not perform well in comparison to the loamy sand samples. The surface application of chemicals showed Road Pave having the best results followed by untreated 100 per cent MDD, Gluon and Total Ground Control (Table 6). The other treatments performed the same as the control (untreated).

Table 6. Percentage slaking of clay after 1, 24, 48 and 72 hours of soaking. (treatment surface applied)

Product	Slaking after 1 hour (%)	Slaking after 24 hours (%)	Slaking after 48 hours (%)	Slaking after 72 hours (%)
Untreated (92% MDD) Control	100	100	100	100
Untreated (100% MDD)	10	20	30	30
Total Ground Control	0	100	100	100
Gluon	20	30	40	40
Road Pave	0	10	15	15
Claycrete II	100	100	100	100
PK4	100	100	100	100
Dustex	100	100	100	100
Soil Bond	100	100	100	100
Ecotrax	100	100	100	100

2.2.1.4 Clay (incorporated treatments)

None of the chemical treatments performed well on the clay samples that had the chemical incorporated, with all chemicals reaching 100 per cent slaking after 24 hours (Table 7). The untreated (100% MDD) performed the best with 30 per cent slaking observed after 72 hours.

Table 7. Percentage slaking of clay samples after 1 and 24 hours soaking in the Bucket Test (treatment incorporated)

Product	Slaking after 1 hour (%)	Slaking after 24 hours (%)	Slaking after 48 hours (%)	Slaking after 72 hours (%)
Untreated (92% MDD) Control	100	100	100	100
Untreated (100% MDD)	10	20	30	30
Total Ground Control	100	100	100	100
Gluon	100	100	100	100
Road Pave	100	100	100	100
Claycrete II	100	100	100	100
PK4	100	100	100	100
Dustex	40	100	100	100
Soil Bond	100	100	100	100
Ecotrax	60	100	100	100

Supporting photographs of the results from the bucket test can be found in Appendix 1.

2.3.2 Drop test

2.3.2.1 Loamy sand (surface applied treatments)

The surface applied treatments performed better than the incorporated treatments in the drop test (Table 8 and 9). The chemicals that performed well on the loamy sand samples included the polymers and the tall oil (Soil Bond) with ponding of water still occurring at 5 minutes (Tables 8 and 9). This was followed by the untreated 100 per cent MDD which performed better than the control.

Table 8. Time taken for 1 ml of water to infiltrate into the compacted loamy sand sample (treatment surface applied)

Product	Time (Infiltration)
Untreated (92% MDD)	Immediate infiltration
Untreated (100% MDD)	Within 1 minute
Total Ground Control	Ponds (at 5 mins)
Gluon	Ponds (at 5 mins)
Road Pave	Ponds (at 5 mins)
Claycrete II	Immediate infiltration
PK4	Immediate infiltration
Dustex	Immediate infiltration
Soil Bond	Ponds (at 5 mins)
Ecotrax	Immediate infiltration

2.3.2.2 Loamy sand (incorporated treatments)

The chemical, which may have some potential with the incorporated treatments, was tall oil (Soil Bond) with infiltrating taking place within one minute (Table 9). One hundred per cent MDD also had infiltration occurring within one minute. The control sample showed immediate infiltration.

Table 9. Time taken for 1 ml of water to infiltrate into the compacted loamy sand sample (treatment incorporated)

Product	Time (Infiltration)
Untreated (92% Of MDD)	Immediate infiltration
Untreated (100% MDD)	Within 1 minute
Total Ground Control	Immediate infiltration
Gluon	Immediate infiltration
Road Pave	Immediate infiltration
Claycrete II	Immediate infiltration
PK4	Immediate infiltration
Dustex	Immediate infiltration
Soil Bond	Within 1 minute
Ecotrax	Immediate infiltration

2.3.2.3 Clay (surface applied treatments)

The surface applied chemicals on the clay samples displayed similar results to the loamy sand samples with the polymers and tall oil (Soil Bond) having water still ponding after 5 minutes (Table 10).

Table 10. Time taken for 1 ml of water to infiltrate into the compacted clay samples (treatment surface applied)

Product	Time
Untreated (92% MDD)	Immediate infiltration
Untreated (100% MDD)	Within 1 minute
Total Ground Control	Ponds
Gluon	Ponds
Road Pave	Ponds
Claycrete II	Immediate infiltration
PK4	Immediate infiltration
Dustex	Immediate infiltration
Soil Bond	Ponds
Ecotrax	Immediate infiltration

2.3.2.4 Clay (incorporated treatments)

The incorporated chemicals performed poorly in comparison to the surface applied treatments with the all the incorporated chemical treatments showing immediate infiltration of water (Table 11). The 100 per cent MDD had infiltration occurring within one minute while the control sample showed immediate infiltration of water (Table 10 and 11).

Table 11. Time taken for 1 ml of water to infiltrate into the compacted clay sample (treatment incorporated)

Product	Time
Untreated (92% Of MDD)	Immediate infiltration
Untreated (100% MDD)	Within 1 minute
Total Ground Control	Immediate infiltration
Gluon	Immediate infiltration
Road Pave	Immediate infiltration
Claycrete II	Immediate infiltration
PK4	Immediate infiltration
Dustex	Immediate infiltration
Soil Bond	Immediate infiltration
Ecotrax	Immediate infiltration

2.3.3 Permeability test

There was too much variance in the results of the permeability test with no trends observed between the two replicates of each treatment so the test was abandoned.

2.3.4 Compaction levels

2.3.4.1 Loamy sand

The higher level of compaction (100% MDD) on the loamy sand soils in the bucket test performed slightly better than the normal compaction (92% MDD). The higher level of compaction on the loamy sand soils in the drop test performed better than the normal compaction. The higher level of compaction gave better results than the Claycrete, PK4, Dustex, and Ecotrax when the treatments were surface applied and gave better results than all the chemicals except the tall oil when the treatments were incorporated.

2.3.4.2 Clay

For the clay soils the higher level of compaction gave better results than the normal compaction in both tests. The greater compaction of clay (100 % MDD) performed better than all the chemicals except for the Road Pave - surface applied treatment in the bucket test. The higher compaction of clay also performed better than the control in the drop test with the surface applied treatments. The higher level of compaction performed better than all the incorporated treatments on the clay soils in the bucket test and drop test. Hence there is a potential for the roaded catchments that are made out of clay, to be compacted at a higher level, which would result in increased runoff. If moisture conditions are right it is possible to achieve 95 per cent of MDD by rolling roaded catchments and this should be further investigated.

2.3 Discussion

2.3.1 Loamy sand (surface applied treatments)

For the bucket test the polymers achieved the best results. The better performance of the polymers is likely to be attributed to their waterproofing properties and the surface application of the polymers having less dilution of product in comparison to the incorporated treatments. Greater application rates of the polymers are known to create a crust so strong and waterproof that they can be used for preventing vegetation growth if desired. The styrene in the polymers makes it water repellent. The bitumen emulsion also performed well. This may be due to its hydrophobic properties. The product is a waterproof and binding additive which is commonly used in path construction.

On the loamy sand soils the surface applied treatments of the polymers and the tall oil showed the best results in the drop test. The performance of the polymers can be related to the reasons mentioned above. The performance of the tall oil (Soil Bond) might be attributed to the tall oil showing some water repelling properties when a small amount of water is applied (as in the drop test) however when large amounts of water are applied (as in the bucket test) the sample becomes more permeable.

2.3.2 Loamy sand (incorporated treatments)

The loamy sand incorporated treatments performed poorly in the bucket test except for the bitumen emulsion. This may be due to the products being more diluted in comparison to the surface applied treatments. The binding additive in the bitumen emulsion probably resulted in the success of this product in the incorporated treatments.

Another chemical which may have some potential with the incorporated treatments is the tall oil (Soil Bond) with infiltrating taking place within one minute in the drop test. This is probably due to same reasons mentioned above in drop test of the loamy sand surface treatment.

2.3.3 Clay (surface applied treatments)

The polymers performed better than the rest in the bucket test with the surface applied treatments. This is likely to be attributed to their waterproofing qualities.

The polymers and the tall oil gave the best results in the drop test. This may also be due to less dilution of the product and the waterproofing qualities of the chemicals.

2.3.4 Clay (incorporated treatments)

None of the chemical treatments performed well on the clay samples when incorporated in the bucket and drop test. This is likely to be a result of more dilution of the product in comparison the surface applied treatments where the chemicals would have created a waterproof seal around the mould.

The failure of the PK4 and Claycrete was unexpected as the technical information provided indicated that these chemicals would perform the best on clay when incorporated. This should be further investigated.

2.3.5 Loamy sand vs clay

The chemicals performed better on loamy sands than the clay. There is potential to make roaded catchments out of topsoil. The better performance of the loamy sand soils could be due to the clay samples swelling and cracking as they 'wet up" and the difficulty in achieving a good mixing of chemicals with the clay samples. This may have compromised the performance of the incorporated treatments.

2.3.6 Limitations

One of the limiting factors in the laboratory experiments was the non-replication of the treatments in the bucket test and drop tests. This may have produced anomalous results in relation to chemical performance with some of the treatment producing unexpected and poor performances. Increasing the number of replicates may have provided a better indication of performance. Consequently the results can only provide a rough indication of the performance of the chemicals. The plot trials to be established at the Mt Barker Research Station (with 3 replicates of each treatment) are likely to provide a better assessment of each chemicals performance.

Laboratory conditions do not accurate simulate field conditions in terms of weathering processes and ut is expected that the plot trials will provide a more practical assessment.

2.4 Chemicals for further testing

Taking all of the test results into consideration the chemicals which are recommended for further investigation are listed below in Table 12. Road Pave is being disregarded as it is not a commercial product. The Claycrete (acid based product) and PK4 (enzyme) should be further investigated due to differences between the laboratory testing results and supplied technical information on the product indicating that it performs well when incorporated into clay. The Dustex (lignosulphonate) should also be investigated. It is known that the surface binding action may be completely destroyed by heavy rain due to the solubility of solids in water with the lignosulphonate (Bolander et al 1999, Foely *et al*. 1996). However it would still be of interest to examine how the chemical performs out in the field in comparison to the other products.

Table 12. Chemicals recommended to be tested at the Mt Barker plot trials

Chemical	Loamy Sand - surface applied	Loamy Sand - incorporated	Medium Clay – surface applied	Medium Clay incorporated	Total No.
Untreated (compacted) Control		3	3		6
Untreated (Re-compacted after time)		3	3		6
Total Ground Control	3		3		6
Gluon	3		3		6
Road Pave					0
Claycrete II				3	3
PK4				3	3
Dustex			3		3
Soil Bond	3	3	3	3	12
Ecotrax	3	3			6
Total for soil types		24		27	
Grand Total					51

2.5 Conclusion

The test results highlight a number of issues that should be further investigated using the plot trails to be established at the Mt Barker Research Station. These include:

- The chemicals performed better on the loamy sand as opposed to the clays so there is a potential to make roaded catchments using loamy sand.

- The polymers and tall oil and bitumen emulsion (surface applied) and the tall oil and bitumen emulsion (incorporated) appear to perform better on the loamy sands.

- The polymers and tall oils when surface applied appear to perform better clay soils. The tall oil, acid based product, lignosulphonate and enzyme when incorporated in larger scale plot trials may provide more reliable results than those achieved in laboratory testing.

- The higher compaction of clay gave betters results than the surface applied treatments except for the Road Pave in the bucket test and performed better than the control in the drop test. The higher compaction also performed better than all the incorporated treatments in both tests. Hence there is a potential for the roaded catchments that are made out of clay, to be compacted at a higher level which would result in increased runoff.

3. SMALL PLOT RUNOFF TRIALS AT MOUNT BARKER RESEARCH STATION – STAGE 2

3.1 Introduction

The objective of this stage of the research was to measure the performance of suitable chemical applications identified from the laboratory testing (Stage 1) on small scale field plots. The results from this work have been used to identify chemicals that best reduce runoff thresholds. These chemicals identified have been used on newly constructed roaded catchments (Stage 3) to determine the effectiveness of chemicals in increasing the long term runoff volumes. The small trial plot treatments will continue to be monitored to determine the long term performance and longevity of all treatments. It is expected that the end of data collection will be in late 2007.

The results will be evaluated to identify improved cost effective methods to harvest rainfall runoff in agricultural areas. Results will be published along with Farmnotes that provide guidelines and feedback on the performance of various chemicals (or chemical groups) in increasing runoff volumes. Farmnotes and information will be delivered to the Mt Barker region grape industry to provide guidelines when treating existing roaded catchments for runoff enhancement (e.g. longevity of treatments, economic costs, performance monitoring, chemical application, construction methods for new catchments, applicable soil types, maintenance).

Work at the Mt Barker Research Station trial site plots was completed and results analysed during March 2006.

3.2 Method

The plot trial site has 49 plots (3 m x 3 m) and testing was carried out on different groups of chemical (polymers, oils, organic bitumen emulsion, enzymes, acid based product) on the same two soil types as identified and discussed in the laboratory testing (Stage 1). Chemical applications were applied to each plot in accordance with manufactures or suppliers recommendations. The trial site has 5 benches, with two control plots (no chemical applied) on each bench (Figure 1). Three replicates were used for each chemical, soil type or application method. Thirteen different combinations were tested as described in Table 12. After reviewing observations form a project at Wilsons Pool, and after discussions with the supplier/manufacturer of Reynolds product – Dustex, it was agreed to incorporate the product to test performance rather than surface apply.

Chemicals were applied at the rates shown in Table 13. Incorporated chemical was applied to the surface and rotary hoed to a depth of 100 mm. The plots were compacted using vibrating steel rollers.

Figure 1. 3 X 3 m Trial plots on Bench 1 at Mt Barker RSU with applied chemical.

Table 13. Plot trial chemical applications

Product	Soil type	Incorporated or surface applied	Total ml/m^2 applied	Dilution rates	No. of coats
Soil-Loc (Total Ground Control)	Clay and loamy sand	Surface applied	40	50:1	1
Gluon	Clay and loamy sand	Surface applied	200	10:1	1
Claycrete II	Clay	Incorporated	30	Diluted to achieve OMC for compaction	1
PK4	Clay and loamy sand	Incorporated	3	Diluted to achieve OMC for compaction	1
Dustex	Clay and loamy sand	Incorporated	630 (440 g)	Diluted to achieve OMC for compaction	1
Soil Bond	Clay and loamy sand	Surface applied	450	10:1	4
Soil Bond	Clay and loamy sand	Incorporated	2000	1:1 + water to OMC	1
Ecotrax	loamy sand	Surface applied	100	10:1	2
Ecotrax	loamy sand	Incorporated	1000	1:2 to 1:5 to OMC	1

On the 27 and 28 March 2006 rainfall simulations on the plots were carried out to complete this stage of the research (Figure 2). A rainfall simulator was used to determine the runoff threshold. The runoff threshold is the number of millimetres of rainfall required for runoff to commence. The simulator is mounted on a trailer and consists of a pump that feeds water to a revolving nozzle. Water was applied over a plot size of 1 X 1 metres at a high uniformity. A full description of the rainfall simulator can be found in Grierson and Oades (1997).

Figure 2. Rainfall Simulator at Mt Barker RSU.

The application rate of 'rainfall' coming from the simulator could be altered. An application rate of 37 mm/hour was used for the testing (third lowest setting). At lower application rates the uniformity of the 'rain' is reduced. The time to runoff was measured. The time to runoff was taken as the time for water to begin to flow from each irrigated plot site. A marker stick was placed approximately 10 cm from the lower edge of the irrigated test area.

Four rain gauges placed uniformly within the wetting pattern. The average depth of water in the gauges was taken as the runoff threshold (number of mm of 'rainfall' before runoff occurs).

3.3 Results

The results show that for three chemicals (a polymer, tall oil and organic bitumen emulsion) there was a statistically significant improvement in runoff generation compared to the control plots (95% confidence level). The surface applied products performed better than the incorporated products. Surface applied Soilbond and Soil-Loc (TGC) performed better than the controls on the clay (Ecotrax not tested). Surface applied Ecotrax, Soilbond and Soil-Loc performed better than the controls on the sandy loam. There was no significant difference in the performance of any incorporated products compared to the controls.

Results were consistent with the laboratory testing results. An exception was a polymer product – Gluon 240 that performed significantly worse than the control on all plot sites. After discussions with the supplier it was agreed that this particular product was not suitable for the projects objectives. They indicated that they have other similar products that may be more suitable.

The small scale plot sites will continue to be monitored over the next 2 years to establish performance and the longevity of the treatments. Rainfall simulations will be repeated after winter this year (2006) and monitoring of the long term stability of each plot will continue until October 2007.

3.4 Discussion

The results from both the laboratory testing and the small scale plots show that three surface applied chemical treatments are likely to result in lower runoff thresholds when applied to roaded catchments on a range of soil types. Although surface applied Ecotrax was not tested on the clays it would be expected to also generate lower runoff thresholds. Incorporated treatments when applied to small scale plots did not show a significant difference in performance when compared to the controls. The longevity of these treatments is still under investigation and continued monitoring of their stability and performance may demonstrate an economic advantage over the longer term. As the performance of surface applied chemicals was also successful on sandy loam soils, it increases the potential to identify previously unsuitable soils for the construction of catchments for water harvesting.

4. QUANTIFYING RAINFALL THRESHOLDS ON CONSTRUCTED ROADED CATCHMENTS - STAGE 3

Using the plot trial results and after considering chemical costs, application methods and the likelihood of adoption, three chemicals have been selected for the third stage of the project to quantify rainfall thresholds on constructed roaded catchments at the departments Mt Barker and Merriden Reseach Stations (RSUs). Mt Barker RSU has a mean annual rainfall of 736 mm and 170 rain days annually while Merriden RSU has 314 mm and 72 rain days. The work at the Mt Barker and Meriden RSUs is being supported by the Department of Agriculture and Food and the WA Rural Water Advisory Committee.

Sixteen roaded catchment bays (each approx. 500 m^2) have been constructed at Mt Barker RSU and each bay equipped with a flume and logger to quantify runoff thresholds and obtain performance data from 2 winter seasons (Figure 3). Another sixteen roaded catchment bays (each approx. 600 m^2) were constructed during April 2006 at Merriden RSU in the WA wheatbelt and flumes and loggers were installed during May 2006. At this site a 4500 m^3 dam was also constructed to evaluate dam and catchment efficiency. Surface applied treatments (a polymer, tall oil and a bitumen emulsion) was applied to both the Mt Barker and Merriden roaded catchment sites. This trial will continue over the next 2 winter seasons with reporting of results at the end of 2007.

Funding is currently being sought to carry out detailed economic analysis of the value of lost grape production in dry years when insufficient water is available and the potential value of increased grape production as a result of less land being required for water collection.

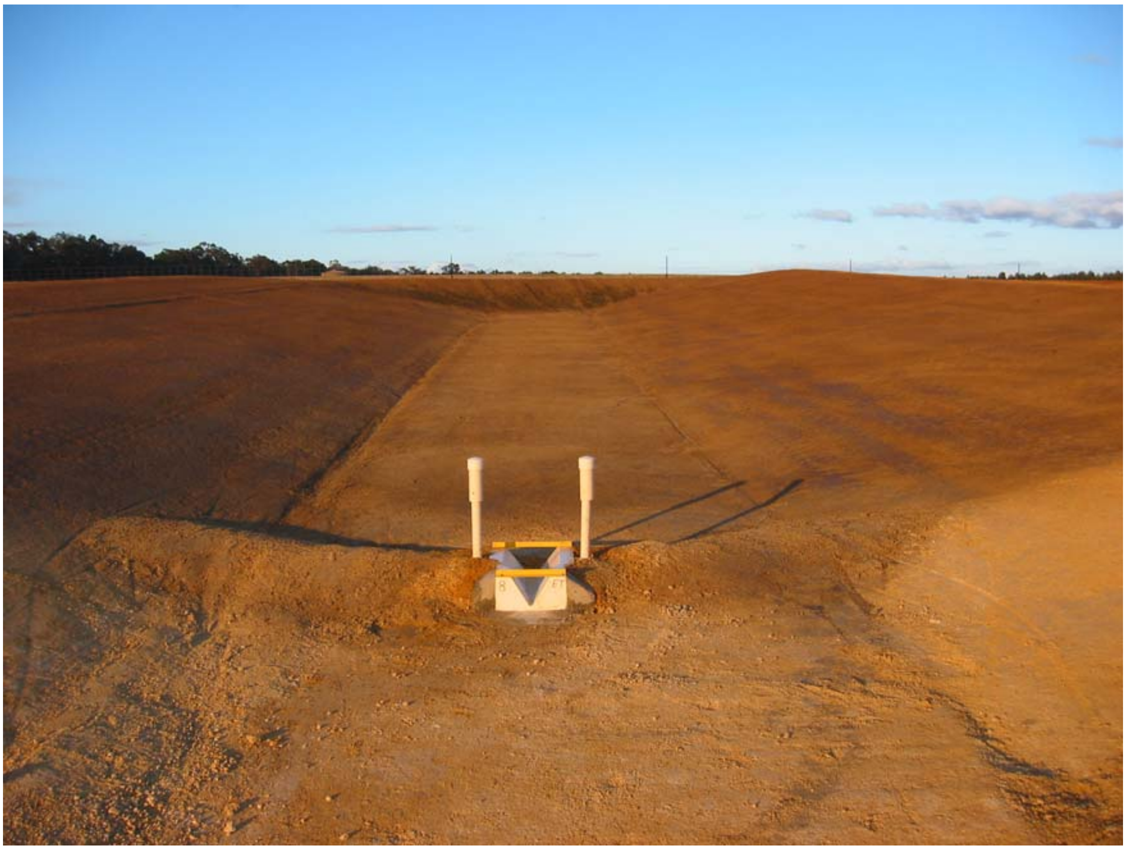


Figure 3. Chemical treated Roaded Catchment at Mt Barker RSU with flume and loggers.

5. CONCLUSIONS

The results show that for three chemicals (a polymer, tall oil and organic bitumen emulsion) there was a statistically significant improvement in runoff generation compared to the controls plots (95% confidence level).

Small scale plot sites will continue to be monitored over the next 2 years to establish performance and the longevity of all treatments. Rainfall simulations will be repeated after winter this year (2006) and monitoring of the long term stability of each plot will continue until October 2007.

The three surface applied chemicals that improved runoff generation have been chosen for ongoing testing at two sites. These chemicals have been applied to newly constructed roaded catchments to quantify runoff volumes and thresholds. The three products tested fit within the evaluation guidelines of cost (< $5000/ha), ability to be applied using commonly available farm equipment (small tanks with fire fighting pumps) and the capacity to be applied to existing roaded catchments. This trial will continue over at least the next 2 winter seasons with reporting of results at the end of 2007.

5.1 Recommendations

- Carry out economic analysis of the value of lost grape production in dry years when insufficient water is available and the potential value of increased grape production as a result of less land being required for water collection.

6. SURVEY OF EXISTING ROADED CATCHMENT

In April 2005 a survey was conducted to assess the performance of seven roaded catchments on vineyards at Frankland. The study involved:

- collecting information on how the roaded catchment was built;
- surveying the catchment characteristics;
- taking soil measurements from the roaded catchment; and
- measuring the runoff threshold with a rainfall simulator.

The aim was to give growers feedback on the performance of their roaded catchment and help develop guidelines on what roaded catchment characteristics gave increased runoff. A field day was held at Frankland in June 2005 and the results of this survey were presented to growers who attended.

The measurements taken at each site are shown on the survey form, which has been included in Appendix 1. Measurements were taken from only a 20 metre by 30 metre section of each roaded catchment. The results relate to this area and may not be representative of the whole roaded catchment. Large variations in roaded catchment characteristics (clay type, gravel content, surface condition and batter slope) can occur across a single roaded catchment.

The slope of the batter and collecting trough of each roaded catchment were surveyed and the widths of the batter and drain were measured. The level of compaction on each of the roaded catchments was measured by taking bulk density and penetrometer measurements. The bulk density was measured using the core method (Cresswell and Hamilton, 2002) with three replicates being taken from each site. Penetrometer measurements were taken with a dynamic cone penetrometer with nine replicates being taken at each site (Australian Standard 1289.6.3.2). A dispersion test was conducted on soil samples which were taken from each site (Pepper, 1983).

A rainfall simulator was used to determine the runoff threshold. The runoff threshold is the number of millimetres of rainfall required for runoff to commence. The simulator was mounted on a trailer and consisted of a pump that fed water to a revolving nozzle. Water was applied over a plot size of 1.5 metres by 1.5 metres at a high uniformity. A full description of the rainfall simulator can be found in Grierson and Oades (1997).

The application rate of 'rainfall' coming from the simulator could be altered. An application rate of 37 mm/hour was used for the testing (third lowest setting). At lower application rates the uniformity of the 'rain' was reduced. Three tests were conducted at each site. The time to runoff was measured. The time to runoff was taken as the time for water to flow 10 cm off the 1.5 m^2 irrigated area on a front of greater width than a 20 cm (a marker stick was placed 1.7 m from the trailer tyres).

Five rain gauges placed uniformly within the wetting pattern. At the end of the test the depth of water collected was measured and the average amount was taken as the runoff threshold (number of mm of 'rainfall' before runoff occurs). The simulator was located between 4 and 7 metres down slope from the crest of the roaded catchment.

Measurements of the percentage of 'rainfall' that ran off were not taken. It was assumed that once a catchment reached its threshold and runoff commenced that most roaded catchments behave similarly (i.e. water runs off at the same rate). This should be tested at a latter date. Calculating the percentage of rainfall that runs off requires installing a collecting mechanism into the roaded catchment surface.

6.1 Construction

All roaded catchments were built within the last 10 years using a grader and compacted with a vibrating roller. About half the roaded catchments were built and compacted when the soil was dry. Whether subsequent compaction of the roaded catchment following rainfall and when the soil is near optimum moisture content is adequate to give optimum compaction and runoff is unknown.

One common fault observed on many of the roaded catchments was excessive grades along the roaded catchment troughs and collecting channels. DAWA Bulletin 4660 outlines maximum grades for various distances from the upstream end of the roaded catchment. Whether these excessive grades were due to poor initial design or the farmer or the contractor not following the plan is unknown. The excessive grades resulted in erosion of the roaded catchment troughs and in the collecting channels which take water from the roaded catchment to the dam. Sediment build up in the channels and dams reduces the efficiency of the collection system.

6.2 Maintenance

Most of the roaded catchments had been rolled since construction and some were rolled annually or biannually. Weed control was adequate on all the roaded catchments tested though on other roaded catchments in the region poor weed control was observed.

6.3 Catchment characteristics

Table 14 shows the batter slope on the seven roaded catchments. Table 15 gives the soil measurements from the roaded catchments tested.

Table 14. Batter slope

Property	Batter slope
Powerbark Ridge	6 %
International Hill	15%
Wilson's Pool	13%
Great Southern	16%
FRV	7.5%
Ferngrove (East)	10%
Ferngrove (West)	11%

Table 15. Roaded catchment soil properties

Property	Texture	Penetrometer (blows to 5 cm depth)	Bulk density (mg/m^3)	Surface condition	Surface gravel (%)	Dispersion rating
Powerbark Ridge	Light clay	5.8	1.54	Firm	30	0
International Hill	Cracking clay	3.5	1.50	Moderate	0	1
Wilson's Pool	Clay	6.5*	1.74	Firm	80	1
Great Southern	Clay	1.8	1.66	Moderate	10	1
FRV	Clay	8.8*	1.71	Loose	40	0
Ferngrove (East)	Clay	2.5	1.76	Firm	25	0
Ferngrove (West)	Clay	4.0	1.56	Firm	10	0

*The penetrometer did not perform well on these roaded catchments because of the high gravel content.

6.4 Runoff characteristics

Three rainfall simulations at an application rate of 37 mm/hour were conducted at each site and the average runoff thresholds are presented in Table 15. At International Hill the runoff threshold was also calculated for a rainfall intensity of 50 mm/hr and at Ferngrove (east) the runoff threshold was calculated for a rainfall intensity of 21 mm/hr.

Table 16. Runoff threshold (mm) for seven roaded catchments at Frankland (19-20 April 2005)

Property	Runoff threshold (at 37 mm/hr)	Runoff threshold (at 50 mm/hr)	Runoff threshold (at 21 mm/hr)
Powerbark Ridge	14		
International Hill	5	5	
Wilson's Pool	11		
Great Southern	7.5		
FRV	13		
Ferngrove (East)	4*		4*
Ferngrove (West)	5*		

*May be unrepresentative sample as tests conducted on best part of the roaded catchment. Retest.

6.4.1 Relationship between soil properties and runoff threshold

A simple soil measurement that could predict how well a roaded catchment would perform would be useful. The soil measurements in Table 15 were correlated with runoff threshold data obtained from the rainfall simulator. The two measurements that best predicted runoff threshold were surface gravel percentage and batter slope. Figures 4 and 5 show the relationship and give the r^2 value. When a multiple linear regression of runoff threshold as a function of surface gravel and batter slope and the interaction of surface gravel by slope was fitted this accounted for 57 per cent of the variation in the threshold. These correlations are limited by the small data set (seven properties).

Figure 4. Effect of surface gravel on runoff threshold (mm)

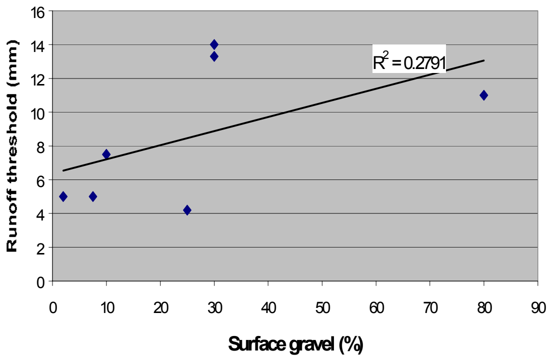
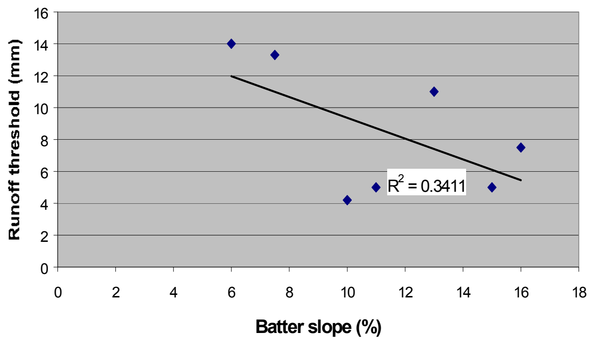


Figure 5. Effect of batter slope on runoff threshold (mm)



6.4.2 Compaction

On 5 May 2005 the roaded catchments at Wilson's Pool and FRV were compacted using steel, non vibratory rollers. The Wilson's Pool roaded catchment had not been compacted for 18 months and the FRV roaded catchment had not been compacted for at least 7 months. The rainfall simulator was then used to determine the runoff threshold on the compacted and adjacent non compacted areas. Three tests were conducted on each area and the average runoff threshold is shown in Table 17. Note that the catchment was moist as rain had fallen in the week before testing.

Table 17. Runoff threshold (mm) for non compacted, compacted and infiltration reducing polymer treated areas (5 May 2005)

Property	Pre compaction	Post compaction	TGC polymer
Wilson's Pool	4.8	2.5	1.6
FRV	8.8	5.3	

6.4.3 Infiltration reducing chemicals

DAFWA is conducting research into the use of infiltration reducing chemicals to increase runoff from roaded catchments. However two of the properties in this survey had areas of roaded catchment to which an acrylic polymer had been applied. While on the properties it was decided to measure the runoff thresholds on these chemically treated areas.

Table 17 shows that on Wilson's Pool the polymer had a lower runoff threshold than the immediately adjacent, recently compacted area. The polymer had been applied to this area in May 2003.

A polymer was applied to roaded catchment at Great Southern in early 2005. On 20 May 2005 the runoff threshold of a polymer treated area on Great Southern was tested. It had a runoff threshold of 3.9 mm, while another untreated, roaded catchment on the property had a runoff threshold of 7.5 mm. The thresholds for the Wilson's Pool data are lower than those for Great Southern because the catchment was wetter due to preceding rainfall.

6.5 Discussion

The performance of the roaded catchments sampled varied widely with the amount of 'rainfall' required before runoff commenced ranging from 4 to 14 mm. The Frankland region experiences many light rainfall events of less than 10 mm. As a result catchments with higher runoff thresholds will produce considerably less runoff. The Department of Agriculture and Food's DAMCAT model can be used to predict the amount of water collected for varying thresholds. Table 18 shows the area of roaded catchment required to supply 50 000 cubic metres of water for different runoff thresholds at Cranbrook, Western Australia (from DAMCAT model). The annual long term average rainfall for Cranbrook is 491 mm.

Table 18. Area of roaded catchment required to supply 50 000 cubic metres of water for different runoff thresholds at Cranbrook, Western Australia from the DAMCAT model (Farmer 2004)

Runoff threshold (mm)	Area of roaded catchment required (hectares)
2	25
4	33
8	72
10	120

The area of roaded catchment required can be greatly reduced if the catchment is well designed and maintained. Regular compaction is critical in lowering the runoff threshold. Preliminary data on the application of infiltration reducing chemicals shows that they can reduce the runoff threshold to below that of a well compacted catchment surface.

6.5.1 Percentage of gravel on the roaded catchment surface

Large amounts of gravel on the roaded catchment surface increase roughness of the roaded catchment and the volume of water stored on the batter slope by acting as 'miniature dams.' This storage has to be filled before runoff can occur. Figure 4 shows a general trend where roaded catchments with higher surface gravel contents had higher runoff thresholds. Rolling the roaded catchment pushes the gravel into clay matrix resulting in a smooth surface.

6.5.2 Firmness of the surface of the roaded catchment

The firmness of the surface to a depth of 5 mm appears critical in determining the runoff threshold and therefore volume of runoff. Rolling the soil, when it is at the appropriate moisture content, results in the compaction of this layer and a decrease in the runoff threshold (Table 4). The longevity of this effect and the frequency of rolling needs to be determined. A method of measuring the firmness of the soil in the top 5 to 10 mm of the roaded catchment is required.

Some of the roaded catchments tested had developed a loose surface layer (5 to 10 mm thick). This loose layer may form due to rain drop impact. The FRV roaded catchment had such a loose surface layer. After rolling when the roaded catchment was close to optimum moisture content the surface layer compacted and the runoff threshold decreased (Table17).

6.5.3 Roaded catchment batter slope

The steeper the slope of the roaded catchment batter the less water storage on the catchment surface and hence the lower the runoff threshold (Figure 5). However if slopes are too steep the batter will erode. DAFWA recommends a batter grade of 1:5 to 1:7 (20% and 14% respectively), though batter grades of 1:10 (10%) are acceptable on roaded catchments with wide batters or on erosive soils. Table 1 shows that a number of the roaded catchments surveyed had slopes lower than this. A diagram showing the erosion process that occurs on a roaded catchment is given in Appendix 2.

6.5.4 Clay type

The roaded catchment at International Hill was constructed in 2004. Part of the catchment was constructed out of pinkish/red clay. Over the summer of 2004/05 large 10 mm wide 300mm deep cracks opened up on the soil surface. This area was chosen as the test site. In early March, 2005 twenty litres of water were poured over a 1 m^2 area and all the water disappeared down the cracks – indicating a very high runoff threshold. At the end of March Frankland received 140 mm of rain. The cracks in the roaded catchment sealed and upon drying the surface was firm. The rainfall simulator tests after the rain showed that the roaded catchment had a low runoff threshold. Observations should be taken at the site after it has dried out to see if the roaded catchment cracks again. If so areas of this pinkish/red cracking clay are likely to yield low amounts of runoff until they wet up with rainfall.

6.5.4.1 Usefulness of soil measurements as a predictor of runoff threshold

The penetrometer and bulk density measurements did not correlate with the runoff threshold as determined by the rainfall simulator. The dynamic cone penetrometer appears to be of limited usefulness as a measure of runoff performance. Its accuracy is affected by the gravel and it measures the level of compaction in the top 5 cm. A smaller, more sensitive penetrometer that can measure the level of compaction in the top 5 to 10 mm may be useful.

6.5.4.2 Thickness of the clay blanket covering the roaded catchment

DAFWA recommend the clay blanket covering the roaded catchment surface should have a minimum thickness of 75 mm. At Powderbark Ridge the depth of the clay blanket covering the roaded catchment was only 20 mm on the upper and mid parts of the batter. If erosion removes this material the underlying gravelly loamy sand will be exposed. This will have a much greater runoff threshold and the catchment will function poorly.

6.5.4.3 Grade of trough of roaded catchment

The grades of many of the roaded catchments troughs were in excess of DAFWA guidelines (Bulletin 4660), with some being as high a 4 per cent. Erosion was common in the troughs of the roaded catchments. This reduces longevity of the roaded catchments and sediment is deposited at low points in the water collection system reducing the efficiency of water collection.

The Great Southern Plantations have moved to the construction of ‘u’ shaped channels rather than ‘v’ shaped channels. The ‘u’ channel is easier to construct and cheaper to maintain as there is less erosion and therefore less sedimentation.

Figure 6. ‘U’ shaped channel on a roaded catchment.

6.5.5 Effect of rainfall intensity on runoff threshold

The intensity of the rainfall did not appear to affect the runoff threshold of the roaded catchments. Table 3 shows that when the rainfall intensity was increased at International Hill from 37 mm/hour to 50 mm/hour the amount of water required for runoff to commence did not change and remained at 5 mm. At Ferngrove (east) rainfall simulation tests were conducted at 37 mm/hour and 21 mm/hour. Again the runoff threshold remained the same. It appears that a certain depth of rain is required before runoff will commence regardless of the intensity of the rainfall. This water may be required to fill up loose surface layer which has a high infiltration rate. Once the water infiltrates to the compacted layer beneath then runoff can occur due to saturation excess.

7. OUTCOMES/CONCLUSIONS

Objective 1. Chemical applications to improve runoff from roaded catchments

Laboratory testing

The chemicals tested generally performed better on the loamy sand as opposed to the clays

The polymers and tall oil and organic bitumen emulsion (surface applied) and the tall oil and bitumen emulsion (incorporated) should be evaluated on the plot trials on the loamy sand.

The polymers and tall oils (surface applied) and the tall oil, acid based and lignosulphonate, and enzyme (incorporated) should be evaluated on the clayey soils for the plot trials.

The higher compaction of clay generally gave betters results than the surface applied treatments.

Small plot trials

The results show that for three chemicals (a polymer, tall oil and organic bitumen emulsion) there was a statistically significant improvement in runoff generation compared to the controls plots (95% confidence level). There was no significant difference in the performance of a further three chemicals when compared to the controls (acid, oil and emzyme). A polymer product used in the trial performed significantly worse than the control plots.

The small scale plots will continue to be monitored over the next 2 years to establish performance and the longevity of the treatments. Rainfall simulations will be repeated after winter this year (2006) and monitoring of the long term stability of each plot will continue until October 2007.

Roaded catchments

Three chemicals have been chosen for ongoing testing at two WA sites. These chemicals have been applied to newly constructed roaded catchments to quantify runoff volumes and thresholds. Surface applied treatments (a polymer, tall oil and a bitumen emulsion) will be applied to both the Mt Barker and Merriden roaded catchment sites. This trial will continue over at least 2 winter seasons with reporting of results at the end of 2007.

Objective 2. Survey of existing roaded catchments

Roaded catchments with a firm, hard surface and with low amounts of surface gravel tended have a lower runoff threshold.

Rolling the catchment when it was moist compacted the loose surface layer and pushed gravel into the clay matrix resulting in smooth, firm surface that had a lower runoff threshold.

Roaded catchments with steeper batter tended to have a lower runoff threshold. However on some catchments erosion had occurred on the lower slope of the batter.

Pinkish/red cracking clays which crack open in summer probably produce less runoff than non cracking clays. They may require considerable rain at the beginning of each winter to seal over the cracks.

Grades in roaded catchment troughs and collecting drains should not be too steep. If they are too steep erosion will occur resulting in sediment collecting in drains and dams thus reducing the efficiency of the collection system.

Chemicals that reduce the infiltration of the roaded catchment resulted in a lower runoff threshold as compared to compaction with a steel roller.

The rainfall simulator is a useful tool to compare performance of roaded catchments on different properties.

More rainfall simulator testing should be conducted on properties in the spring /summer to determine the effect of different levels of compaction (vibrating roller, rubber tyred roller) and how frequently roaded catchments should be compacted.

8. REFERENCES

Australian standard 1289.6.3.2(1997). 'Soil strength and consolidation tests – determination of the penetration resistance of a soil – 9 kg dynamic cone penetrometer test'.

Cresswell, H.P. and Hamilton, G.J. (2002). 'Bulk density and pore relations.' In McKenzie, N., Coughlan, K. and Cresswell, H. (2002). 'Soil physical measurement and interpretation for land evaluation'. pp 35–57. CSIRO Publishing. Melbourne Australia.

DAWA Bulletin 4660 (2005). Roaded Catchments to improve reliability of farm Dams, Department of Agriculture

Farmer, D. (2004). DAMCAT Version 4. Dam and improved catchment water supply software. Department of Agriculture, Western Australia.

Grierson and Oades (1997). A rainfall simulator for field studies of run-off and soil erosion. Journal of Agricultural Engineering Research **22:** 37–44.

Pepper, R. (1983). Testing soils for dam sites. Department of Agriculture Technote 5/83.

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9. COMMUNICATIONS FROM THIS PROJECT

<u>Field Days and Seminars</u>

June 2004 and June 2005

Field Days on site for regional grape growers, consultants and earth moving contractors (Neil Lantzke)

September 2004

Presentation of project findings at 'Viticulture Issues Seminar' in Albany (Neil Lantzke)

May 2006
Presentation of project results at Margaret River Field Day (Colin McDonald)

June 2006
Presentation of project findings to bus tour by resource management researchers (Colin McDonald)

August 2006
Presentation of project findings to bus tour by landcare technicians (Colin McDonald and Rob Hetherington)

August 2006
Presentation of project findings to bus tour by Curtin University viticulture students (Colin McDoanld and Rob Hetherington)

September 2006
Presentation of project findings at Dowerin Machinery Field Days (Rod Short)

Publications

Lantzke, Neil (2005) 'Increasing run-off to on-farm irrigation dams'
Australian Viticulture September/ October 2005, Vol 9, No 5, p 70-71.

Lantzke, Neil (2005) 'Increasing run-off to on-farm irrigation'
Wine Industry News, Department of Agriculture WA, November 2005.

10. RESEARCH RESULTING FROM THIS WORK

In 2004 RITA Project no: RT 02/50-5 held workshops with growers to establish future viticultural issues for the Great Southern Region of Western Australia.

The success of the current research into improving the performance of roaded catchments was of great interest. Improving the efficiency of water catchment and irrigation was voted one of the top priorities established by the growers who participated.

As well as continuing this research the growers were keen to investigate the possibility of increasing water collection from the vineyard itself in addition to the unplanted land.

GWRDC and the Department of Agriculture and Food have consequently established project RD 04/01-1 "Increasing irrigation water and controlling vigour by collecting runoff from the mid row of vineyards" (Colin McDonald and Rob Hetherington).

This project uses soil sealants aimed at:

1. Increasing runoff from within the vineyard that can be collected for use later in the summer/autumn.

2. Reducing the water infiltration that recharges the underground aquifer (a regional problem).
3. Controlling vigour early in the season thus reducing canopy management practices and improving yield and quality.

11. BUDGET RECONCILIATION

Budget	Funding GWRDC	Funding DAFWA
Trial establishment	15000	15900
Items		
Flumes	4344	500
Loggers/water level sensors	4500	920
Earthworks	2000	10130
Automatic rain gauges	200	200
Rain simulator	2800	1850
Installation costs	1156	2300
Total	15000	15900
Add 10% GST	1500	1590
Total expenditure	16500	17490

***Note additional expenditure incurred by DAFWA for travel and salary cost associated with the construction and monitoring of this project.**

12. APPENDICES

SURVEY FORM QUESTIONS

Run off efficiency of roaded catchments

Property:

Roaded catchment location:

Date built:

Contractor:

Design guidelines:

Machinery used:

Moisture conditions at construction:

Annual maintenance:

When last rolled:

Growers assessment of performance:

Other grower comments:

Width of bank:

Width of drain:

Length of road:

Slope of bank:

Grade of drain:

Weed rating:

Erosion rating:

Condition of surface:

Sediment rating:

Texture:

Penetrometer readings:

Bulk density:

Dispersion test:

Rainfall simulator

Time to runoff:

Depth of rainfall in rain gauges:

Digital photos taken:

Other comments

EROSION PROCESS OCCURRING ON ROADED CATCHMENTS