

“Maintaining frictional resistance on mine road surfaces”

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Background Statistics

- From 1st Jan-10 to 11th May 2015 there have been 477 High Potential Incidents reported to the Qld Inspectorate due to equipment and vehicles losing control on mine road surfaces. This has come from 41 open cut coal mines during this period.
- Types of equipment involved in these incidents:-
 1. 374 x Rear Dump Trucks
 2. 48 x Light Vehicles (including some rollovers)
 3. 25 x Water Trucks (including a rollover)
 4. 14 x Service Trucks (including some rollovers)
 5. 4 x Scrapers (inc a rollover)
 6. 12 x Others (Bus, Moxy Truck, Light Truck, Grader, MMU Truck, and Kress Hauler)

Background Statistics

- 58% of the incidents occurred on ramps
- 49% occurred due to inappropriate watering of mine road
- 69% occurred in pits, or on Truck / Shovel circuits
- 25% occurred on permanent mine roads or industrial areas





Safety bulletin

Mines

Mines Inspectorate

Safety bulletin no. 99 (Version 1)
23 August 2010

Uncontrolled movement on mine roads, including skidding, sliding, and light or heavy vehicle roll-over.

Recent trends in uncontrolled movements by various vehicle types on Queensland open cut coal mine roads have raised serious concerns. While some increase in the number of such incidents may be due to improved reporting, high potential incidents of this type have averaged 7-10 per month for some time now. Several have actually resulted in serious consequences, while a significant number of narrow misses had potentially severe outcomes.

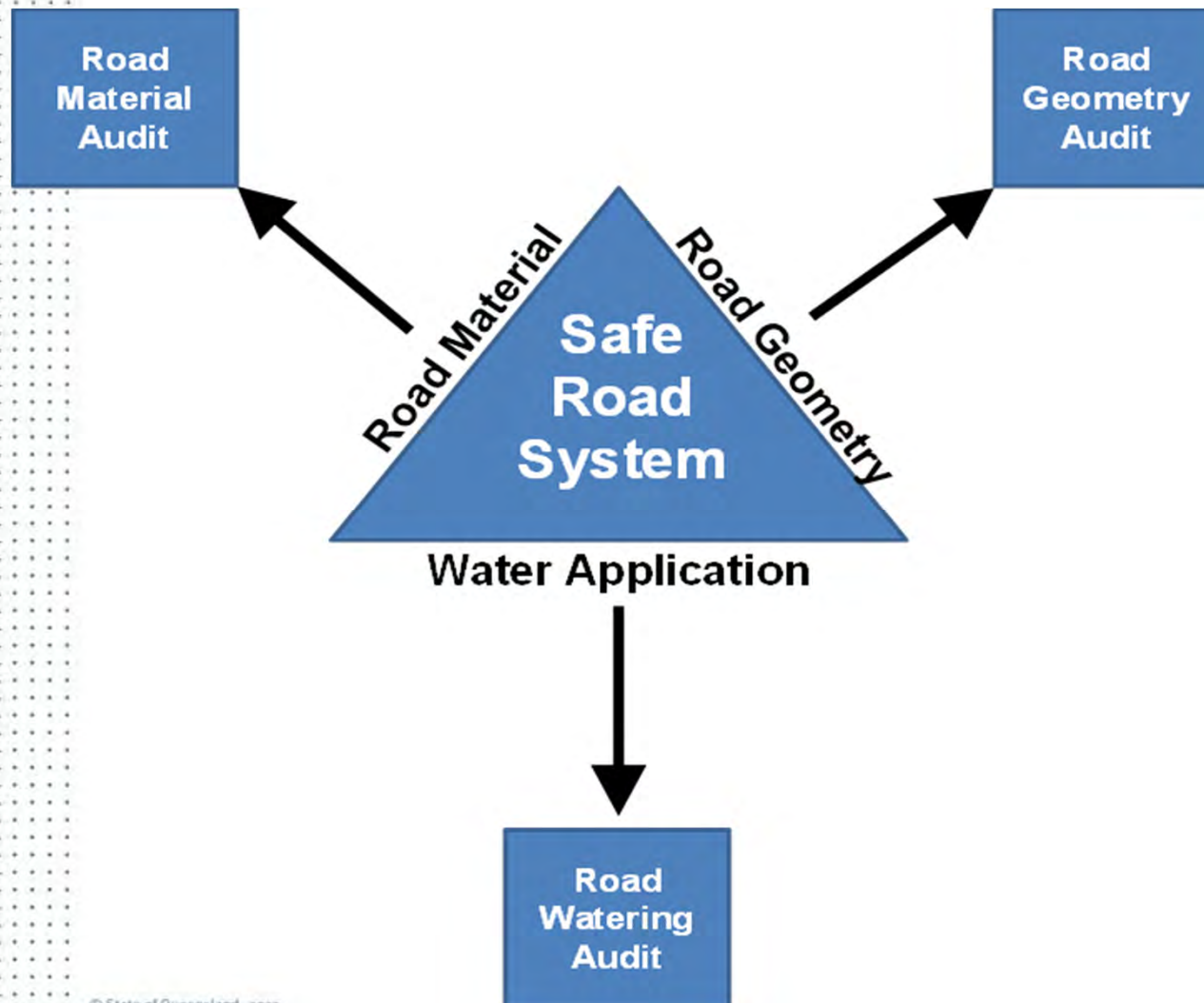


In The Beginning

Mining Inspectorate Sponsored Pilot Study

- Can we measure friction on a mine?

What Factors Contribute to Truck Slides



These components interact
to contribute to truck
Improvement in one area
increases truck slide risk;
Improvement in all three will
potentially reduce the risk

What Factors Contribute to Truck Slides

Road Material – slides rarely occur on competently sheeted, moderate to high friction surfaces. When they do it is usually because of operator error in terms of over braking or oversteering or both in combination.

Road Watering – The most common reason for truck slides is over watering. Over watering is a common term but really only applies to low friction or road wearing course material that is friction sensitive to water.

Road Geometry – Most uncontrolled truck slides occur on ramps in particular steep ramps with curves and/or intersections. For example if a level surface friction value of 0.30 is considered safe, that same surface on a 10% ramp effectively has 1/3 friction reduction by virtue of the road grade geometry ($0.30 - 0.10 = 0.20$).

Testing the frictional co-efficiency of road surfaces



Vericom Friction Measuring Device



Using a Vericom Friction Measuring Device

- **Cost Effective**
- **Safe**
- **Accurate**
- **Portable**
- **User Friendly**

My advice is, initially use an expert to assess your mine roads and provide a detailed report.

From there it can be managed by the mine providing they are using the appropriate resources.

Testing the frictional co-efficiency of road surfaces

- More than 60% of mines in the Bowen Basin have now carried out frictional co-efficiency testing on their mine roads, and this has led to them having:-
 1. Having a better understanding of their mine road surface materials (are sometimes surprised by which materials give the better frictional resistance)
 2. Understanding how watering applications affect the frictional resistance of the different type road surface materials
 3. Investing in crushing plants to produce effective road surface material
 4. Making engineering changes to their watering systems
 5. Improved road maintenance programs

Testing Water Truck Calibration

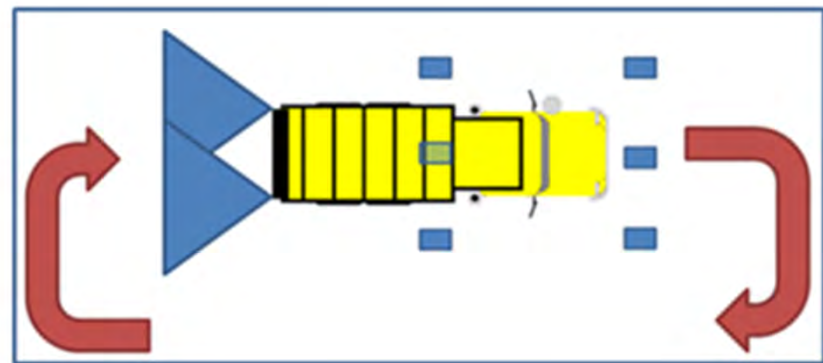
$$A_W = \frac{V}{(A_S \times n)}$$

A_W = Water Application Rate (mm/m²)

V = Volume of Water Captured (litres)

A_S = Surface Area of Containers (m²)

n = Number of Passes in Water Truck



Testing Water Truck Calibration

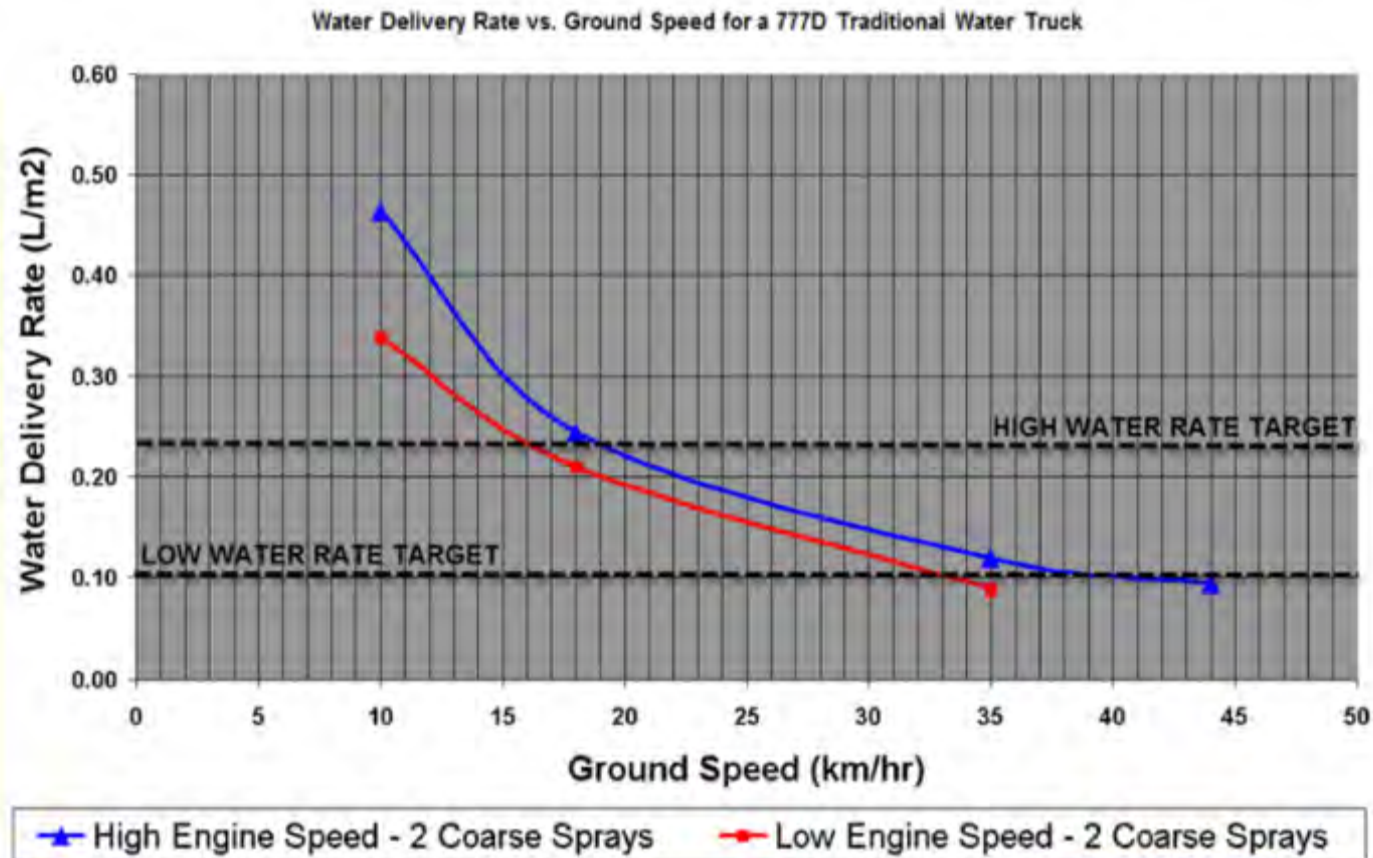


Water Truck Calibration Results

The following are common issues identified from testing the calibration of water trucks:-

- Identical trucks and watering systems delivering very different application rates of water
- Water rates are not being applied consistently across the travel path (overlapping of sprays, direction of sprays etc)
- Overwatering occurring when water trucks are travelling at slower speeds
- Water being wasted due to spray direction and width
- Sprays applying wider than required strips of water meaning a truck can have all wheels in the wet line

Caterpillar Watering System - Past



01/07/2013



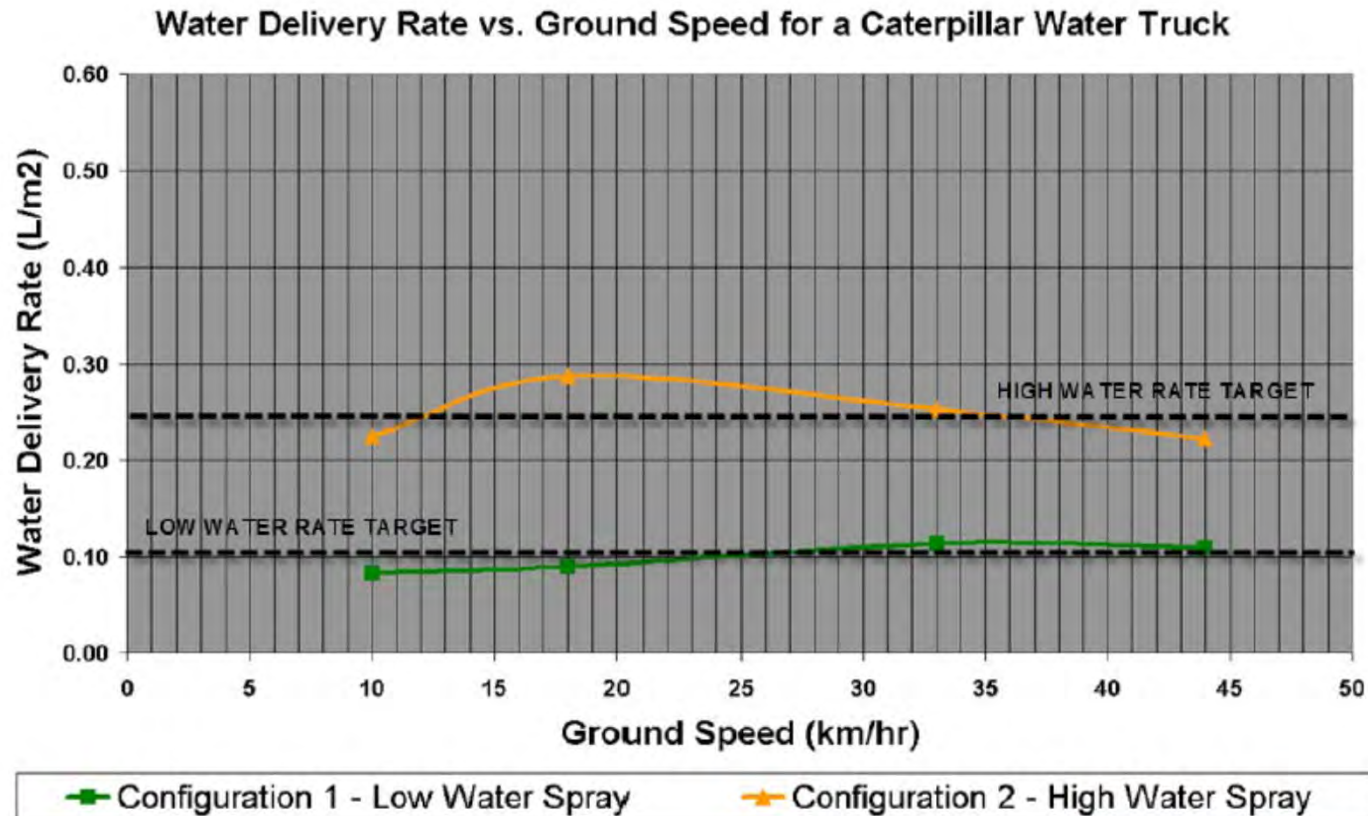
A member of the Sime Darby Group

Hastings Deering



Product People Commitment

Caterpillar Watering System - New



01/07/2013



A member of the Sime Darby Group



Product People Commitment.

Australia Diversified Engineering Pty Ltd

Watering Systems

ADE have now released an upgraded watering system:-

“The system is programmable with a target water application rate (mm/sqm or l/sqm) which is determined from “Mine Friction Testing” of the haul roads . An access password can be programmed into to the system if mine management requires the programmable target water application rate to be set by a “supervisor”. A data logger is also included to capture when the target application rate is changed. The water tanker controls are an On/Off switch and switches to select which bank of spray heads (Left, Middle or Right) that they want to water the haul road with. The “smart” controller automatically determines which spray heads (or combination) of each bank (left, middle or right as switched by the operator) will be used by assessing the target water application rate and the vehicle speed. The current Eco-Spray systems is upgradable to the Premium specification. Operational modes such as firefighting or flood mode can be added.”

Mine Site Crushing Plants

At least 14 open cut mines in the Bowen Basin now utilise crushing plants on site to produce effective road surface material. (Delivers both Safer roads and Production uptime)



Road Surface Maintenance Practices



Some mines have equipment dedicated to sheeting road surfaces with effective material

Strip v Spot Spraying

There are no comprehensive industry guidelines for mine road watering protocols available. This has created a knowledge vacuum and inconsistent past and present practices with regards to road watering dust suppression and maintenance activities.

It may be said the arguments tend to cancel each other out resulting in a 50/50 decision.

Currently, due to the unreliability and lack of sophistication with water truck design and associated equipment means most mines are predominantly utilising strip watering methods.

Arguments For

Strip Spraying

Simplicity of application for water truck operators with reduced fatigue

Lower pump maintenance and wear, longer pump life due to continuous spray and water pressure

Road surface maintenance benefits of continuous water application

Spot Spraying

Haul truck operators don't need to maintain a dry line with reduced fatigue

Lower risk of uncontrolled movements if spot spray application done correctly (automated pulse)

Less risk of long or speed acceleration during uncontrolled slides down ramp

Arguments Against

Strip Spraying

Dry lines are susceptible to operator compromise particularly at night or on demanding road geometry

Creates significant differential friction (1 side high and the other low friction) which can cause rapid vehicle rotation in over braked or over steered situations

Majority of reported uncontrolled movements are down ramp strip spraying application when dry line is compromised

Tendency to overwater strip and place too much confidence in dry line for safety

Spot Spraying

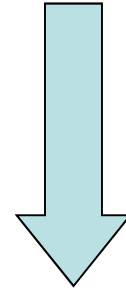
Optimal spot spray length 7-10m for haul trucks still presents instability problems for light vehicles particularly on curves

Manual pulse operations very demanding on water truck operators and results in inconsistent application and elevated risk

Hard on the pumps, high maintenance and lower pump life

Road maintenance not as good due to Irregular coverage

Leica Jigsaw Fleet Management System



Watered Roads Functionality

There are at least 2 mines in the Bowen Basin using this feature.

Watered Roads Functionality

Overview

Leica Jigsaw installed equipment have the ability to see watered roads on the screen map

- These are marked in blue and indicate that a road has been watered in the last **30 minutes**

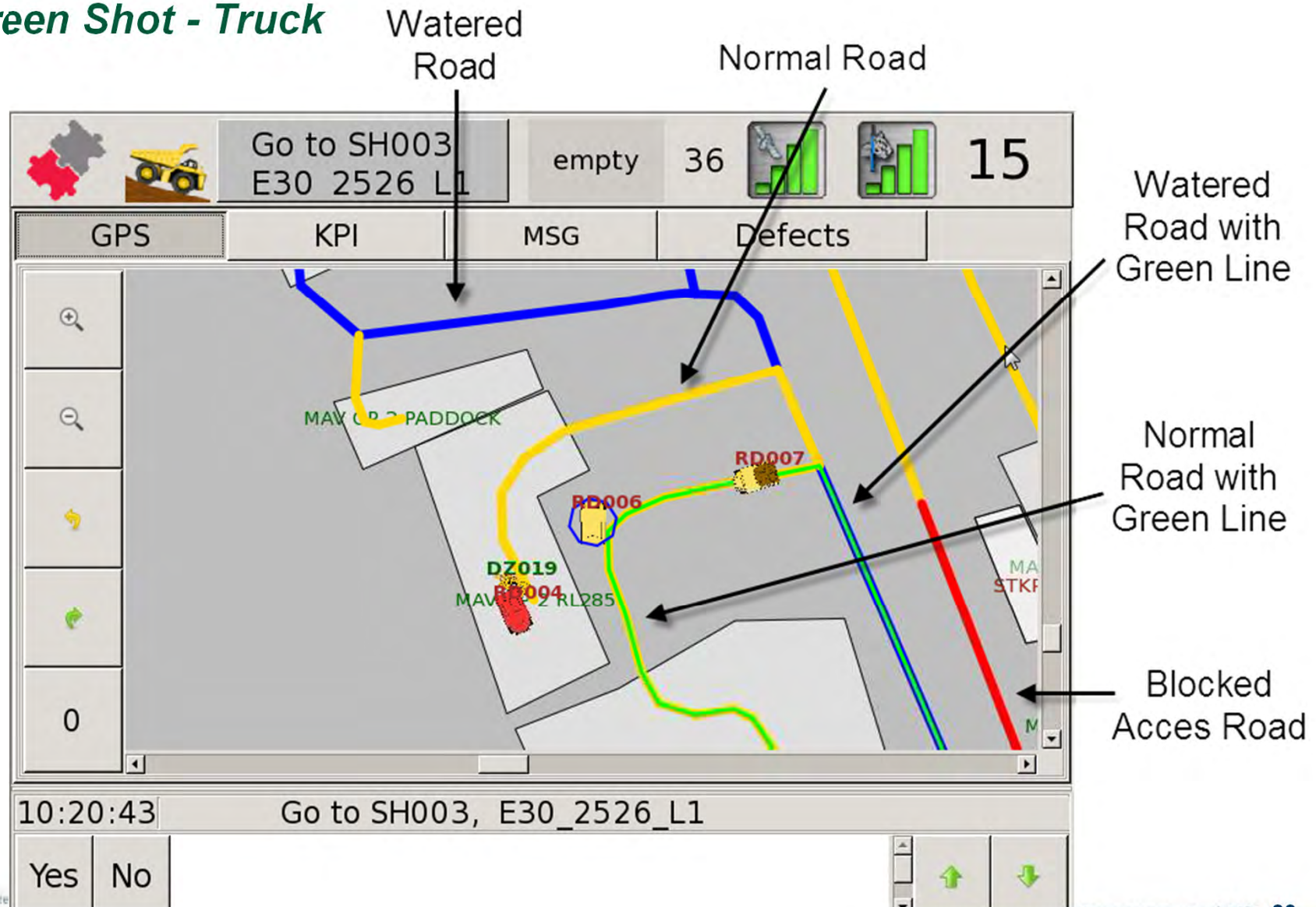
Water carts have the sprays wired to the Leica system onboard, the system detects when sprays are on and marks road segments blue accordingly

The green line showing current path will display through the center of a normal or watered road

Please have the map always displayed when travelling so you can be aware of roads that have been recently watered

Watered Roads Functionality

Screen Shot - Truck



LED Information Sign

(This LED sign situated at the top of ramps is activated by the water truck operator, and shows other operators accessing the ramp if the road has been recently watered, and also what side of the road has been stripped watered. Sign automatically stays lit up for the selected period of time)



Open Cut Examiner / Supervisor regularly monitor and assess mine roads with a Vericom unit

- Mine has fitted a Vericom unit to the OCE / Supervisor's light vehicle.
- Roads are assessed following rain events before restarting operations.
- New ramps and roads assessed
- Deteriorating roads checked.



Good Procedures / Practices

- Use only experienced operators on water karts with the right attitude
- Train water kart operators in all of the elements required for maintaining road surface friction
- Water karts should only water circuits when requested to do so
- Speed / Gear restrictions going down ramps
- Operators speaking up re watering issues
- Conduct audits on watering procedures
- Use of dust suppressants

Mine Owners – Contract Companies

There is evidence showing that some major contractor companies are leading the way with the development and implementation of improved watering systems being fitted to water trucks

However in some cases these contractor companies have little knowledge and understanding of the frictional values of the mine roads they are operating on, and subsequently don't know what is the optimum rate of water that should be applied to these roads.

Role Of The Inspectorate

- Monitor the safety and health performance of mines
- To investigate serious accidents and High Potential Incidents
- To provide advice and information to mines pertaining to the safety and health of coal mine workers
- Provide direction and guidance to mines through Mine Record Entries
- Where necessary issue mines with Directives requesting them to reduce the level of risk by taking certain corrective or preventative actions
- Plans to develop a Recognised Standard for “Mine Roads”

Summary

- There is no single “silver bullet” that will provide the solution
- Conduct road surface frictional co-efficiency testing to help you better understand your mine road surfaces
- Check the calibration of your water trucks
- Take the appropriate action to rectify identified deficiencies

**Don't wait for a serious accident
to force your hand into
addressing your mine roads and
watering practices**

Questions?