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Queensland Transport and Main Roads Department Quarry Registration System

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ABSTRACT: The Queensland Department of Transport and Main Roads (TMR) manages a network of almost 34,500km roads, all of which is constructed of either bound or unbound pavement material. TMR must ensure adequate quality of the materials involved, to reduce risk.

To manage quality, TMR contractor were spending over \$12million annually on quarry material testing. Faced with concerns about excessive testing on some projects, TMR standardised its testing frequencies for the major flood damaged Transport Network Reconstruction Program (TNRP) in 2012.

However, this was not an optimal approach, since source rock quality and consistency, and quarry management, vary markedly between quarries, and so should testing frequencies. The challenge for the Department was how to address these issues, and still maintain material quality.

This paper outlines the collaborative and innovative risk based process adopted in consultation with relevant quarry industry stakeholders to develop guidelines to deliver self-assessed quarry specific testing frequencies.

1 INTRODUCTION

The Queensland Department of Transport and Main Roads (TMR) manages a network almost 34000km of roads and associated infrastructure across the State of Queensland.

In recent years, the Department has managed a major flood damaged Transport Network Reconstruction Program (TNRP) and has been managing approximately \$3 billion of road construction works annually. To construct this road network, TMR's contractors have been procuring and processing approximately \$800 million worth of road construction quarry materials (quarry products) annually. These paving materials are procured from 390 privately operated hard rock quarries and sand and gravel plants that produce crushed fine and coarse aggregates.

As the steward of this massive road network, TMR needs to ensure that these quarry materials are well managed, to avoid premature failure or reduced life of the pavements.

Because the type and quality of paving materials varies markedly and widely throughout Queensland due to their source rock/material variations (Fig. 1), the Department requires a robust risk-based, effective and efficient mechanism to manage risks associated with road construction quarry materials.



Fig. 1 An example of source rock variability—Partially melted limestone xenoliths embedded within andesitic intrusions resulting difficulties in crushing & screening.

It has been estimated that TMR paving material suppliers and contractors spend over \$12 million each year on testing road construction quarry products at different stages during construction. This constitutes approximately 1.5% of total materials cost. Major quarry industry operators have long suggested that these costs are excessive, particularly for well managed quarries. As the costs of testing are included in the cost of paving materials supplied to TMR, the department has a strong incentive to work with quarry industry to review the testing requirements.

2 MANAGEMENT OF QUARRY MATERIALS IN QUEENSLAND

2.1 Background

Unlike other Australian States, TMR actively regulates quarries which can be used for road construction materials of road pavements and concrete infrastructure in Queensland.

A small team of Departmental engineering geologists lead by the TMR Manager (Construction Materials) manages the TMR Quarry Registration System (QRS); applying a well-developed process, to assess the suitability of potential quarries for Departmental use, and to register the particular road construction quarry products in TMR Quarry Database accessible by individual quarries. To attain registration, quarries must conduct a series of laboratory tests following established TMR and Australian Standard test methods, and demonstrate that quarry materials can be produced to satisfy the material properties and engineering parameters established in TMR Technical Specifications. Table 1 summarises the eleven (11) TMR Technical Specifications which are impacted by the QRS.

Table 1. TMR Technical Specifications impacted by TMR Quarry Registration System (QRS).

Technical Specification	Technical Specification Title
MRTS05	Unbound Pavements
MRTS08	Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends
MRTS11	Sprayed Bituminous Surfacing (Excluding Emulsion)
MRTS12	Sprayed Bituminous Emulsion Surfacing
MRTS13	Bituminous Slurry Surfacing
MRTS22	Supply of Cover Aggregate
MRTS30	Dense Graded and Open Graded Asphalt
MRTS31	Heavy Duty Asphalt
MRTS39	Lean Mix Concrete Sub-base for Pavements
MRTS40	Concrete Base in Pavements Jointed Unreinforced, Jointed Reinforced, Continuously Reinforced and Steel Fibre Reinforced Pavements.
MRTS70	Concrete

2.2 Traditional Testing frequencies

Traditionally, managers of individual road construction projects set their own testing frequencies without guidance from the TMR Engineering and Technology Branch. It was quite difficult for them to do this, and reliable information to assist in this determination is either not available (for new quarries) or difficult to access for existing quarries. Consequently there were wide variations in testing

frequencies between different quarries. Some contract administrators elected to invest heavily in testing, and others conducted minimal testing, resulting in some cases, with an order of magnitude difference between testing conducted in similar quarries. Industry raised concerns that TMR was wasting money and time on excessive testing on some projects.

For the very large Queensland flood reconstruction program (TNRP), TMR management realised that excessive testing had the potential to divert funding from projects which could otherwise be funded, and delay construction of a program with very tight delivery timelines. In Australia, National flood damage funding must generally be spent within 2 years of the event.

TMR convened a meeting of flood reconstruction managers throughout Queensland, and negotiated a set of consistent testing frequencies for Flood Reconstruction (TNRP) projects, so that these would apply across Queensland on all projects. These frequencies were later rolled out to all regions for the normal TMR road construction programs. The effect of this was that similar testing frequencies applied for all quarries throughout Queensland.

However it was always appreciated that this approach was not optimal. There are sound reasons why different quarries should have different testing frequencies. However, testing frequencies should be based on valid grounds, and not solely on the risk aversion or otherwise of an individual contract manager.

2.3 Why Testing Frequencies Should Differ between Quarries

TMR technical leaders from Geotechnical, Pavement and Material disciplines met with the Industry Group represents the major quarries in Queensland, the Cement, Concrete and Aggregates Association (CCAA) and Institute of Quarrying Australia (IQA) and worked through the factors which should influence the testing frequencies in individual quarries:

These include:

- Quarries contain different source rocks, with different physical properties
- Some source rock types have strengths well in excess of TMR Technical Specification limits
- Quarries have different levels of management and technical and operational experience and expertise in handling their productions
- Some quarries are able to demonstrate excellent quality control measures whereas some others have very limited or no quality control measures

2.4 The Challenges for TMR in Changing the System

The fundamental challenges for TMR were:

- How can it apply different testing frequencies for different quarries, and still manage its risk?
- How can a new system which allows different frequencies be administered fairly, without leading to claims of favouritism or bias?
- As TMR already had a Quarry Registration System, can a new system be incorporated into this system?
- How can we possibly gain industry acceptance of a new system?

TMR technical leaders together with technical and operational experts from Quarry Industry formed a working group in middle of 2013. They worked collaboratively and consulted extensively with industry to work through these challenges. The agreed approach was to develop robust guidelines, which would allow quarry management to self-assess their own testing frequencies. The new role of the TMR Manager (QRS) would be to verify these assessments, and issue TMR registration certificates which specified the frequencies to be applied.

2.5 How the New System Works

The Quarry Registration System and new section on Quarry Specific Testing Frequencies only applies to source rock testing. Table 2 below summarises relevant source rock property tests that are required by TMR Technical Specifications.

Table 2. Required relevant source rock property tests for TMR Technical Specifications

Source Rock Property	Test Method/s
Petrographic Analysis	ASTM C295
Wet 10% Fines Value	Q258B
Wet/Dry Strength Variation	Q205C
Degradation Factor*	Q208B
Water Absorption	Q214B/AS1141.6.1
Particle Density	Q214B/AS1141.6.1
Polished Stone Friction Value	Q203
Alkali Silica Reactivity	AS1141.60.1&60.2
Alkali Carbonate Reaction**	ASTM C1105
Sand Equivalent***	Q124

*Not required for sedimentary duricrust for natural gravels

**Applicable to dolomitic and argillaceous limestones and other carbonate rocks only

***Applicable to fine aggregate only

There is still a requirement for product testing from the construction site. Eventhough material may be conforming in a quarry; it may become segregated or contaminated during subsequent handling, cartage or construction. However, samples for tests to determine rock strength or durability properties (refer Table 2 above) should always be taken from quarries, to avoid wasting money in delivering inferior materials.

2.6 What the New QRS System Contains

The new QRS system contains seven (7) separate documents:

- QRS1 - Quarry Registration System Outline
- QRS2 - Preparing a Quarry Assessment Report for a Hard Rock Quarry
- QRS3 - Preparing a Quarry Assessment Report for a Natural Sand and/or Natural Gravel Quarry
- QRS4 - Assigning Quarry Specific Testing Frequencies for Source Rock Tests
- TMR Quarry Registration Application Form
- Flowchart showing TMR Quarry Registration System
- Process for assessing Quarry Specific Testing Frequencies (includes *e-form*)

These documents are all available on the TMR website at the following link.

<http://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers/Pavements-materials-and-geotechnical.aspx>

2.7 Process for Preparing an Registration Application under QRS

The applicant must complete the *e-form* (an interactive spreadsheet) and address all attributes to satisfy TMR that they have control of their processes to allow the testing frequencies that they nominate. A separate spreadsheet containing a worked example is also available on the TMR website.

The completed spreadsheet, and accompanying substantiating documentation is submitted electronically to the TMR Manager (QRS) for processing.

2.8 TMR Administration of QRS

Upon receipt of an application, the TMR Manager (QRS) will assess the application based on TMR engineering geologists' knowledge of the quarry. For existing quarries, the Technical Manager will also consult with TMR regional staff, to obtain any

updated information about recent operational and material performance.

The Manger (QRS) will either agree with the submission, or resolve different testing frequencies with the applicant, before issuing a QRS registration certificate and updating details on the TMR website as a registered supplier.

TMR can amend the frequencies should it encounter issues with non-conforming or well performing materials which indicate that amended testing frequencies are required.

QRS registration certificates are valid for two years, but can (upon application) be upgraded six monthly. TMR aims to inspect all quarries during the two year period.

2.9 *Future Enhancements to QRS*

The potential exists to further improve the process to achieve even greater saving as the system is further refined, and more information about the quality performance of individual quarries becomes available. TMR will review the operation of the QRS (in consultation with CCAA, IQA and TMR regional staff) after 12 months, and amend it where required.

Work is well developed on a new Geographical Information System (GIS) system to allow access to quarries, and their approvals through interactive mapping.

2.10 *Current status of new QRS*

TMR is currently rolling out the new system, and has already received applications from 12 quarries for assessment since it was introduced.

3 CONCLUSIONS

The new QRS system has effectively addressed quarry industry concerns that excessive testing was resulting in increased costs which were being passed on to TMR construction projects. While the cost savings from implementing the new system are difficult to quantify, a preliminary estimate is that it will reduce testing costs for quarries, and ultimately to the road construction quarry material industry by \$6 million per year. This is based on a testing frequency reduction of almost 90% in some cases of well managed quarries.

The fact that TMR has already received 12 applications from quarries is evidence that Industry has embraced the new system.

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REFERENCES

- Cement Concrete & Aggregates Australia (2005), Code of Practice – Testing Frequencies for Extractive Industry in Queensland, September 2005. P8
- Queensland Department of Transport and Mains Roads, (2013). TMR Technical Note 102: “Selecting Testing Frequencies for Acceptance Sampling of Pavement Materials (August 2013).
- Queensland Department of Transport and Mains Roads, (2015). QRS1 - Quarry Registration System Outline, P12.
- Queensland Department of Transport and Mains Roads, (2015). QRS2 - Preparing a Quarry Assessment Report for a Hard Rock Quarry, P12.
- Queensland Department of Transport and Mains Roads, (2015). QRS3 - Preparing a Quarry Assessment Report for a Natural Sand and/or Natural Gravel Quarry. P8.
- Queensland Department of Transport and Mains Roads, (2015). QRS4 - Assigning Quarry Specific Testing Frequencies for Source Rock Tests. P18.