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Purposely
Greener
Infrastructure

Product and Material Trials for Recycled Material Use

Reference Guide – June 2021

An initiative of Victoria's Big Build



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Background

The Victorian Government's Recycled First Policy requires bidders on Victoria's major transport projects to optimise their use of recycled and reused content.

The policy aims to maximise the use of recycled and reused materials within major transport projects, build a better understanding of the types, volumes and location of recycled and reused material use and support new markets and innovation.

The policy supports the circular economy and is expected to reduce the amount of virgin material used in major transport infrastructure

projects and the amount of waste going to landfill.

Ecologiq is a Victorian 'whole of government' program that is supporting the implementation of the Recycled First Policy, as it helps Victoria innovate and grow its domestic recycling capabilities, build local markets and find new uses for recycled content.



Introduction

The term 'trial' in this document refers to product or material trials, proof of concept exercises, validation trials or demonstrations.

The purpose of a full-scale trial is to gather technical information and evidence to validate supply quality, construction processes and in-service performance of materials and products.

This guide provides an overview of a typical in-service trial process.

It can be used to assess the use of recycled materials in construction and to assess the use of products manufactured from recycled materials.

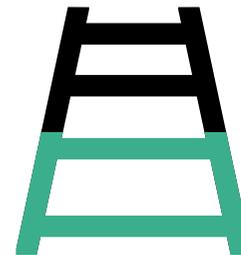
Trials should be designed to verify the claims of specific products or to assess new construction practices and equipment.

Ecologiq supports in-principle product trials and validation of recycled material uses in transport

infrastructure projects. This guide is intended for use by suppliers, contractors, registered Rail Transport Operators (RTOs), asset owners and others wanting to trial, demonstrate or validate products or materials suitable for transport projects.

Its purpose is to provide a step-by-step guide to systematically plan, execute and evaluate the performance of a product in the field.

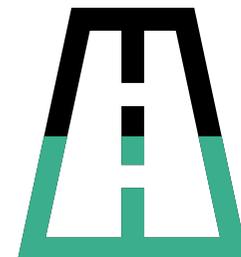
By following a robust and comprehensive approach to measuring the performance of new materials and products, Ecologiq and its partners will be provided with the evidence necessary to assess the performance and use of recycled materials in road and rail infrastructure.



Rail product trials

Validation trials help to confirm or reject the performance of products made of recycled material against the rail track operating criteria set by the relevant Rail Transport Operator (RTO).

For guidance on the RTO type approval process, refer to Ecologiq's reference guide *Recycled Materials in Rail Infrastructure*.



Road product trials

Validation trials help to assess the performance of materials and products made of recycled materials against the specifications and standards set by the road authority

For guidance, refer to Ecologiq's reference guide *Recycled Materials in Road Infrastructure*.



How Ecologiq can help

Ecologiq can assist to disseminate trial updates to keep key stakeholders engaged and facilitate knowledge transfer across the media and industry networks.

Ecologiq collaborates with communications teams across Major Transport Infrastructure Authority (MTIA), government departments, RTOs, VicTrack and Sustainability Victoria.

While material and product approvals lie with the asset owner or responsible operator/maintainer, Ecologiq may be able to provide support to project teams and/or contractors by connecting them to suppliers, the relevant approval agency or supporting a pathway to approval or to other project partners.

If your team would like support from the Ecologiq team, contact ecologiq@roadprojects.vic.gov.au. Note that trial proposals will be assessed on a case-by-case basis to understand what support Ecologiq can practically provide.

Trial process

The following steps outline the key stages which must be plainly communicated, documented, and shared across project partners for the duration of the trial.





1. Assess your trial idea

The following preliminary assessment questions will assist in validating and determining the scope of the trial idea:

- Does the trial support the increased use of recycled materials?
- Does the recycled material being used address a specific waste stockpile?
- Is there a significant demand for the product being trialled?
- Will the use of the product result in a reduction in use of virgin materials?
- Does the product suit a major project application?
- Has the product/material's whole of life sustainability been considered i.e., recyclability at end of life, embodied carbon or design life?
- Does the use of the product provide benefits to consumers i.e., in constructibility, performance or design life?
- Does the product meet current standards/specifications and was it tested by an independent certified testing organisation?
- Have any WHS or negative environmental impacts associated with the product production or trial been identified?
- Who will need to be engaged for successful delivery and execution of trial outcomes? (Refer to 1.1 Engagement and collaboration)

1.1 Engagement and collaboration

Collaboration and engagement must occur across industry and government partners.

Project teams will need to identify appropriate partners such as DoT, Sustainability Victoria and in the case of rail projects the relevant RTO to help determine appropriate trial opportunities and support.

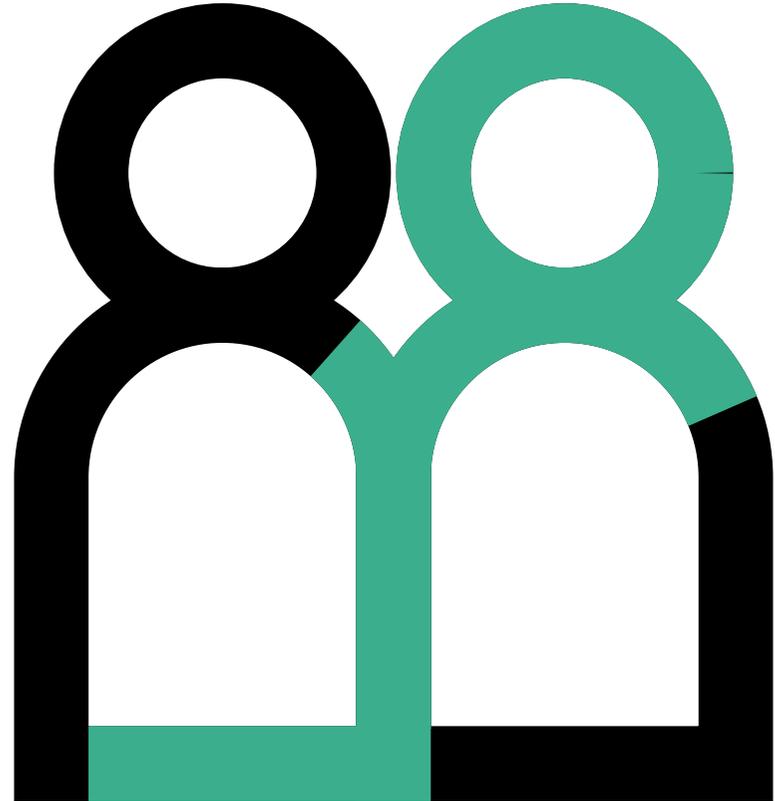
It is also important to identify the right people in each of the partner organisations.

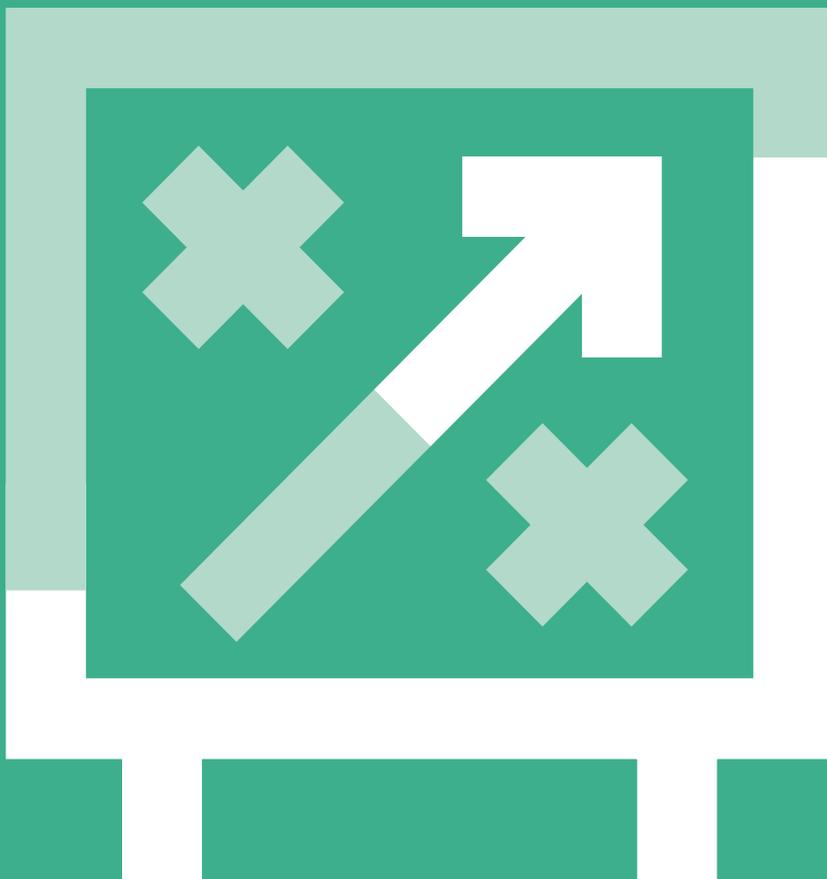
The product developer/supplier, construction industry (contractor) and the appropriate body to manage monitoring of the trial site should all agree as to the objectives and method for collecting performance data. The intervals at which performance data is collected needs to be established.

A Validating Laboratory (independent and qualified person) may be nominated to witness the field trials by the project teams, suppliers and other stakeholders.

Remember that once the trial monitoring is complete and the liability period has elapsed, responsibility for the asset and its maintenance will be transferred to the government's asset owner. It is therefore essential that the ultimate asset owner (for example DoT, VicTrack or Australian Rail Track Corporation) is involved in the trial development process and agrees to the undertaking of the trial.

During collaboration, the ownership, confidentiality and accessibility of data that is to be collected during the trial must be clearly communicated and documented.





2. Plan your trial

Trials must be thoughtfully planned from the generation of the idea through to the product's end of life.

The process of planning a trial will help Ecologiq and individual stakeholders to execute the trial successfully, as well as support the pathway from innovation to business as usual.

Figure 1 provides a basic outline of the key considerations when planning a trial. Further detail is provided for each consideration in Table 1.

It is important to note that these considerations can be thought of concurrently and iterations may occur throughout the planning process.

The considerations should form the basis of the trial proposal and project execution plan as well as be used for project reporting (see trial process Step 7 Reporting).

In the case of MTIA projects, it would be worthwhile reviewing the Client Requirements Document - the key document where project scope and technical details are agreed upon between the delivery authority (e.g. MRPV) and DoT as the asset owner.

Figure 1 – Key trial planning considerations

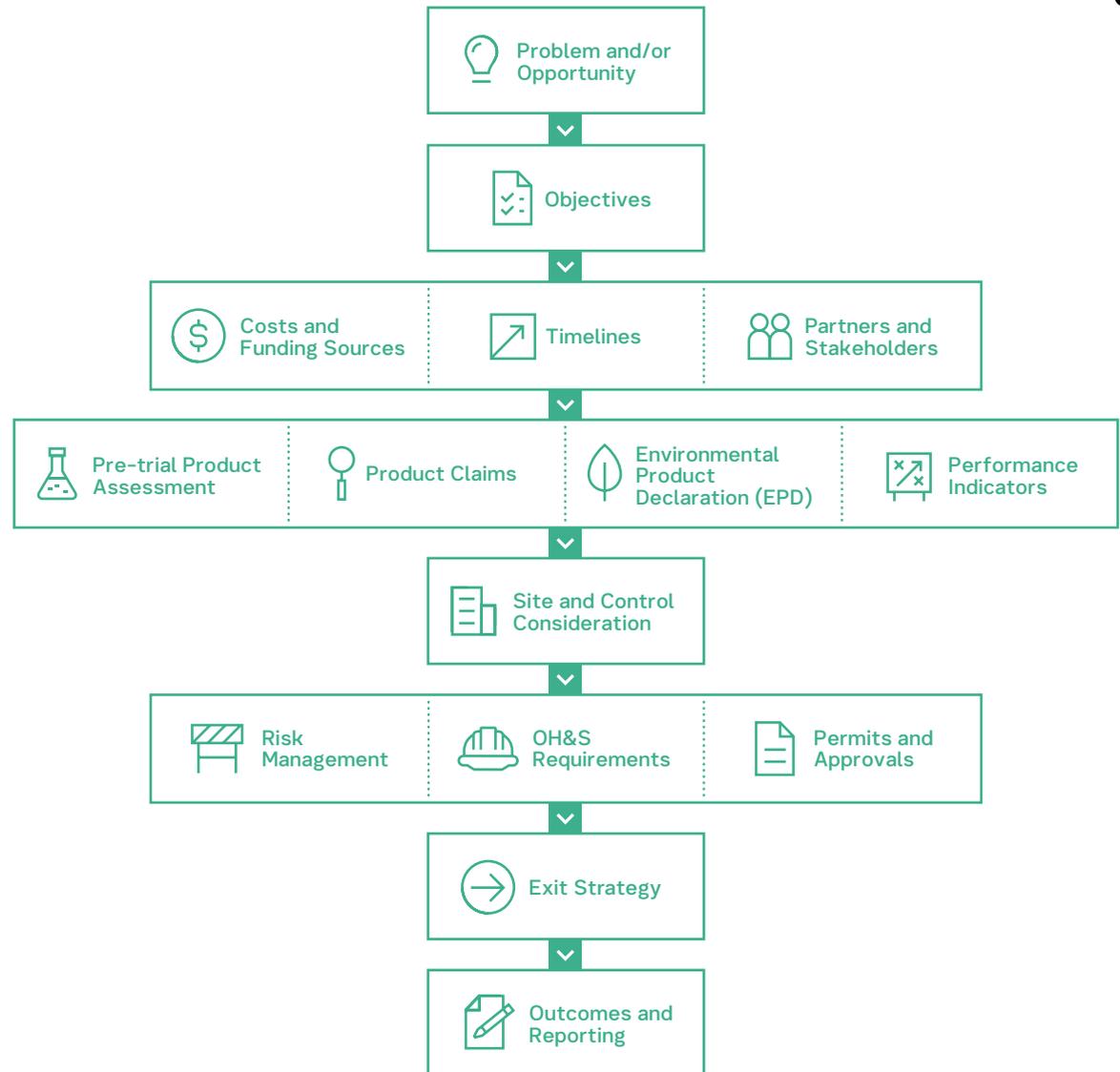


Table 1 – Considerations when planning a trial

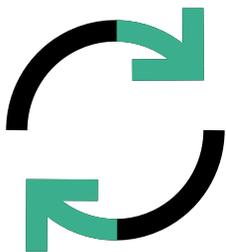
Consideration	Description
 Problem and/or Opportunity	Identify the problems and opportunities the product will address i.e. waste stockpile, structural performance or increased safety.
 Objectives	What is the objective or purpose of the trial? This should relate to the problem or opportunity.
 Costs and Funding Sources	How much will the trial cost, and who will fund the trial? Is funding secured or is the trial dependant on finding a funding source?
 Project Partners or Stakeholders	Identify project partners and any stakeholders that will be involved in the project. What stakeholder engagement activities need to be undertaken? Communication with these people is key to successful project performance.
 Timelines	Expected dates for the trial execution, evaluation, reporting and the issuing of any required approvals. Timelines may be rough until the site is selected.
 Pre-trial Product Assessment	Does the product meet current standards/specifications and has it been tested by an independent certified testing organisation? If the product is going to replace another product, quantitative comparison data will be beneficial. Summary of desktop review and assessment or preliminary assessment of the product which warrants the field trial. Any similar trials and past precedence from comparable applications undertaken by other jurisdictions should also be summarised.
 Product Claims	In the case of a proprietary product, the proponent of the product needs to clearly articulate the claims being made in relation to the performance of the product and these claims need to be documented (such as the expected service life of the product).
 Environmental Product Declaration (EPD)	Does the product have an EPD? An EPD is a transparent, objective report that communicates what a product is made of and how it impacts the environment across its entire life cycle. A verified EPD can earn your products credits for green building rating systems.
 Performance Indicators and the Nature of Evaluation	Product evaluation should be conducted against the required operating parameters and against the standards and specifications used to validate product performance in laboratory testing.

Consideration	Description
 Data Collection Requirements	What performance indicators need to be measured, how often and who will evaluate the data?
 Site Consideration	Initial assessment of potential site characteristics that will be required for the trial. Identify any issues that might arise in the trial site evaluation and selection stage.
 Control Section Consideration	For objective assessment of the product, a control section should be included in the trial. If no control section is to be allocated, then a documented rationale and alternate strategy for the objective assessment of a product's trial performance must be provided and agreed upon by the ultimate asset owner.
 Risk Management	What are the major risks and associated mitigation strategies to be involved in using the product?
 OH&S Requirements	What are the OH&S requirements to be considered at all stages of processing, production, laying, maintenance and future recycling of the trial product?
 Permits and Approvals	<p>Any anticipated or known permissions required to undertake the trial (e.g. provisional type approvals from the RTO) should be outlined. Regulatory requirements, such as Environmental Protection Act or associated legislation.</p> <p>Is any part of the trial confidential (including the collected performance data ownership)? If so, consider confidentiality agreements.</p> <p>Should the trial site be signed as a trial site and is there a need for this?</p>
 Exit Strategy	In the case of product failure or determination that the product is not fit-for-purpose, an agreement on who will accept the risk and cost of product replacement should be in place.
 Outcomes and Reporting	<p>How are the trial outcomes going to be reported and shared?</p> <p>What are the expected reporting frequencies and activities, and who is to receive these reports?</p> <p>Also consider the final report delivery expectations e.g. are any recommendations for updates to standards and specifications to be made based on the outcomes of the trial, or any anticipated approvals to be issued such as the RTO type approvals and any associated conditions.</p>

3. Site evaluation and selection

There are multiple factors that need to be thought about when choosing an appropriate trial site.

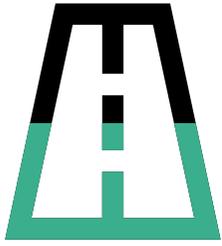
Table 2 lists site selection criteria. A shortlist of sites should be made in the planning phase and evaluated against the criteria. Note that some factors are site and product dependent.



General

Table 2 – Site evaluation and selection criteria

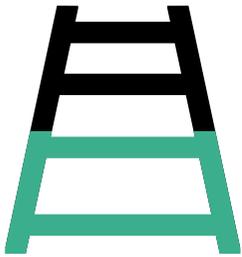
Climate	Consider the temperature, rainfall and solar exposure and how this will affect the trial construction and product function.
Location	Are there any specific construction requirements that will be affected by location?
Community impact	<p>Are there any specific construction requirements that will affect the local community? For example, access to local businesses for the duration of the construction.</p> <p>How would poor product performance impact the surrounding community?</p> <p>Impact can further be reduced by considering the use of sites already scheduled to be occupied for existing maintenance works or planned projects.</p>



Road Pavement

Table 2 – Site evaluation and selection criteria (cont.)

Site geometry	<p>Number and nature of lanes such as through lane or parking lane, lane length and width, curvature, inclines, approaches to bridges, roundabouts or intersections.</p> <p>The impact of stresses caused by site geometry such as braking from heavy vehicles.</p> <p>The control section should follow the same characteristics as the rest of the trial.</p>
Traffic volumes and vehicle types	<p>A local road with low traffic compared to an arterial road with a high volume of heavy vehicles.</p> <p>The impact of stresses caused by traffic.</p> <p>Uniformity of traffic across the site, for example if there are turning lanes and whether a high proportion of traffic enters or exits the road in the trial section.</p> <p>The impact of stresses caused by traffic loading and movement i.e. braking, acceleration or turning.</p>
Existing pavement conditions and planned works	<p>Is the existing pavement in suitable condition for the trial product to be implemented?</p> <p>Testing may assess existing pavement strength, cracking, rutting and roughness so that the trial can be assessed from a known base level as well as reduce variability of performance due to underlying issues, for example, reflective cracking of asphalt.</p>
Service location	<p>Consideration may also be required for the impact on adjacent systems or components, such as mechanical, electrical, drainage or natural systems.</p> <p>Existing planned projects or scheduled maintenance activities should also be considered to exploit the opportunity to occupy the road and minimise costs.</p>



Rail

Table 2 – Site evaluation and selection criteria (cont.)

Suitable track geometry and purpose	Consider whether the rail line is a mainline, spur line or a stabling yard, whether it includes cross-overs and turn-outs, the number of rail lines included in the trial and what operating parameters have been defined by the relevant RTO.
Track loading	Such as line and curve speeds, maximum axle loading, maximum track gradient, minimum curve radius, ballast profile, formation condition and status of track drainage.
Railway track classification	Heavy (e.g. ARTC) or light (e.g. Yarra trams) rail, rail form (continuously welded rail (CWR) or jointed), and rail weight.
Railway corridor or site accessibility	Visual monitoring of the product or material being trialled will require track protection to be established, which can become costly with regular inspections. Instead, consider implementing remote monitoring/recording equipment where possible to minimise the need for physical access to the trial site.
Existing conditions, maintenance requirements and occupation of the railway	Is the trial proposed in an operating rail corridor, can the trial coincide with an existing planned project or scheduled track maintenance so that the opportunity to occupy the track is exploited and costs minimised?

4. Product design evaluation

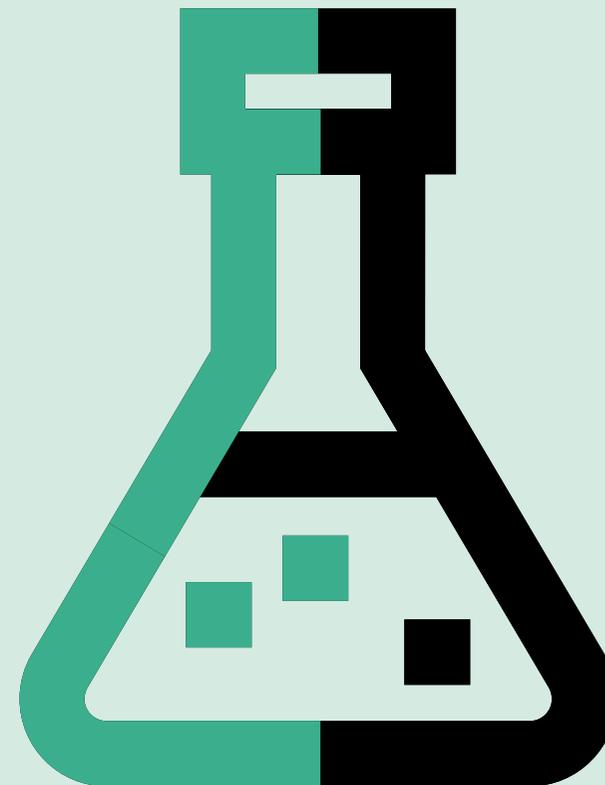
If the design application meets an existing specification it will need to match the specification criteria.

If the proposed application does not meet a current specification, a variety of information may be required, such as (but not limited to) that in *Table 3*.



Table 3 – Product design evaluation requirements

Requirement	Criteria
Rationale	In the case of a proprietary road pavement product, state clearly the performance expected, such as: what it will improve, what it will reduce, and its performance in comparison to an existing material/product.
Product and/or application design details	Standard drawings, preliminary mix design and pavement design information for road pavement trials etc.
Laboratory performance testing	For example, for road pavement rut resistance, durability, fatigue, melting point, smoking point or slip resistance.
Environmental assessments	For example, leaching, which might include the product's EPD.
OH&S requirements	For preparing and handling the material/product.
End of life plan	Considering expected product life and future recyclability.
Duration of the trial	Considering also that there need to be limits of degradation/non-performance acceptable at certain intervals of monitoring, before intervention in the trial takes place e.g. rejection and subsequent removal of a trialed sleeper in a rail trial.



5. Construction

No two construction projects are the same. Recording the specifics of a project and trial site is vital and will dictate how successful the trial is.

During construction, a variety of information must be tracked such as (but not limited to) that in *Table 4*.



Table 4 – Construction information to be recorded

	Requirement	Criteria
General	Product manufacture details	Quality control and assurance records. This may include installation or construction methodology, handling, and storage requirements.
	Sampling of the product	Such as the aggregate, binders or asphalt mix used to be able to verify the constructed product (if required).
	Laboratory testing	To confirm quality of product or material supply.
	Placement and installment arrangements	In both road and rail construction phases, the finished product will need to be visually inspected and a record of the inspection must be held, as well as having photos of the final product taken.
	Equipment details	List of all plant and equipment used for construction, including those to be used for maintenance.
	OH&S documentation and monitoring	Such as PPE, risk assessments – Job Safety and Environmental Analysis, material safety data sheets and auditing documentation.
Roads	On site pavement testing	Paving and compaction details such as temperatures, pavement thickness and density.
Rail	Equipment details	As above. For rail the RTO is to be included in discussions surrounding the equipment selection for handling, insertion, ballast regulation and tamping.
	On site testing	The stressing and welding records must be collected and accurate and the correct ballast profile must be maintained.





6. Performance Monitoring

Performance monitoring is an essential step in any trial, and quantitative measures of product performance should be sought and recorded where possible.

The actual monitoring process will depend on the trial and its objectives.

Assessments are to be made of both minor issues that can be corrected on site (for example a damaged sleeper edge caused by handling/inserting) and of more serious issues that might cause structural concerns and affect the trial.

In the case of minor issues, a potential extension of the trial may be considered.

The trial's duration will influence monitoring frequency, however, it is usually appropriate to monitor immediately after construction and then at specific intervals which should be collaboratively decided.

If monitoring indicates the trial is not proceeding satisfactorily, it may need to be modified or abandoned.

If this is the case, the trial process to date and the data which led to the decision to modify or abandon the trial must be documented.

Note that there can be a limited non-performance level accepted by the project team and stakeholders to continue trialing before the product is completely removed.

It is essential that key trial partners have a collective monitoring plan in place. This will ensure all partners are kept abreast of key challenges and opportunities and are able to know and articulate results or trends that may impact the broader industry.

Common monitoring measures for rail and road pavement projects are in *Table 5*.

Table 5 Common performance monitoring measures

Road pavement trial

- Visual assessment
 - Pavement strength
 - Skid resistance
 - Surface texture
 - Permeability
 - Environmental effects (microplastics, leaching, emissions)
 - Cores to examine depth and density cracking
 - Rutting and roughness.
-

Rail product trial

- Visual assessment
 - Track bed formation changes
 - Geometry changes (vertical alignment, twisting)
 - Environmental effects (microplastics, leaching)
 - Permeability
 - Monitoring of sleepers may include consideration of delamination, exposure of reinforcing fibres, cracking, damage to coatings, discoloration, burn marks, deformed surfaces, loose/damaged fastening, lateral instability of the track.
-



7. Reporting

Reporting and documentation of the trial process should be completed at every stage of the trial process.

Important reports for any project or trial include:

- Concept proposal (for initial assessment)
- Trial plan and proposal
- Project execution plan
- Project/trial update reports
- Final report and summary report
- Lessons learnt report.

The audience of the reports and language used should be carefully considered. Confidential information that is to be reported must be clearly articulated and the report labelled 'Commercial in Confidence'.

Reporting is an essential way of communicating the objectives, progress and outcomes of a trial and can be a useful reference for conducting future trials. Therefore, it is also important to be clear, honest and open about the progress and outcomes of a trial.



References/Further Reading

Austrroads 2008, Management of an Asphalt Road Trial, AP-T109-08, Austrroads, Sydney, NSW

VicRoads 2014, Conducting On-road Trials of New and Innovative Treatments – Guideline, QD:2634163, VicRoads, Kew, VIC

The following reference guides are available by contacting **ecologiq@roadprojects.vic.gov.au**:

Recycled Materials in Rail Infrastructure. Reference Guide September 2020, Ecologiq, Victorian Government, VIC.

Recycled Materials in Road Infrastructure. Reference Guide March 2020, Ecologiq, Victorian Government, VIC.

Recycled Materials in Ancillary Infrastructure. Reference Guide October 2020, Ecologiq, Victorian Government, VIC.

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