The Strategic Local Government Asset Assessment Project

Webinar 3
Bridge Assessment Framework

Webinar Topics

SESSION	TOPIC
1	About the Strategic Local Government Asset Assessment Project
2	Basic Vehicle/ Bridge Interactions
3	Bridge Assessment Framework
4	Tier 1 Assessments
5	Interpreting Engineering Reports for Access Decision Making
6	Vehicles and Route Assessment
7	Applying Conditions for Heavy Vehicle Access
8	NHVR Portal – Digital Asset Management
9	Pre-approvals for key routes

Webinar Presenters

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Contents

11:00 - 11:05	Welcome	Todd Wellard
11:05 - 11:40	Tiers of Assessment	Dr Neal Lake
11:40 - 11:50	Bridge Assessment Framework	Dr Neal Lake
11:50 - 12:00	QNA	All

Session format

- QnA (end and in chat)
- Please mute microphones
- Session recorded and will be emailed with slides
- Please watch in order as designed to build on knowledge

SLGAAP - Stay connected

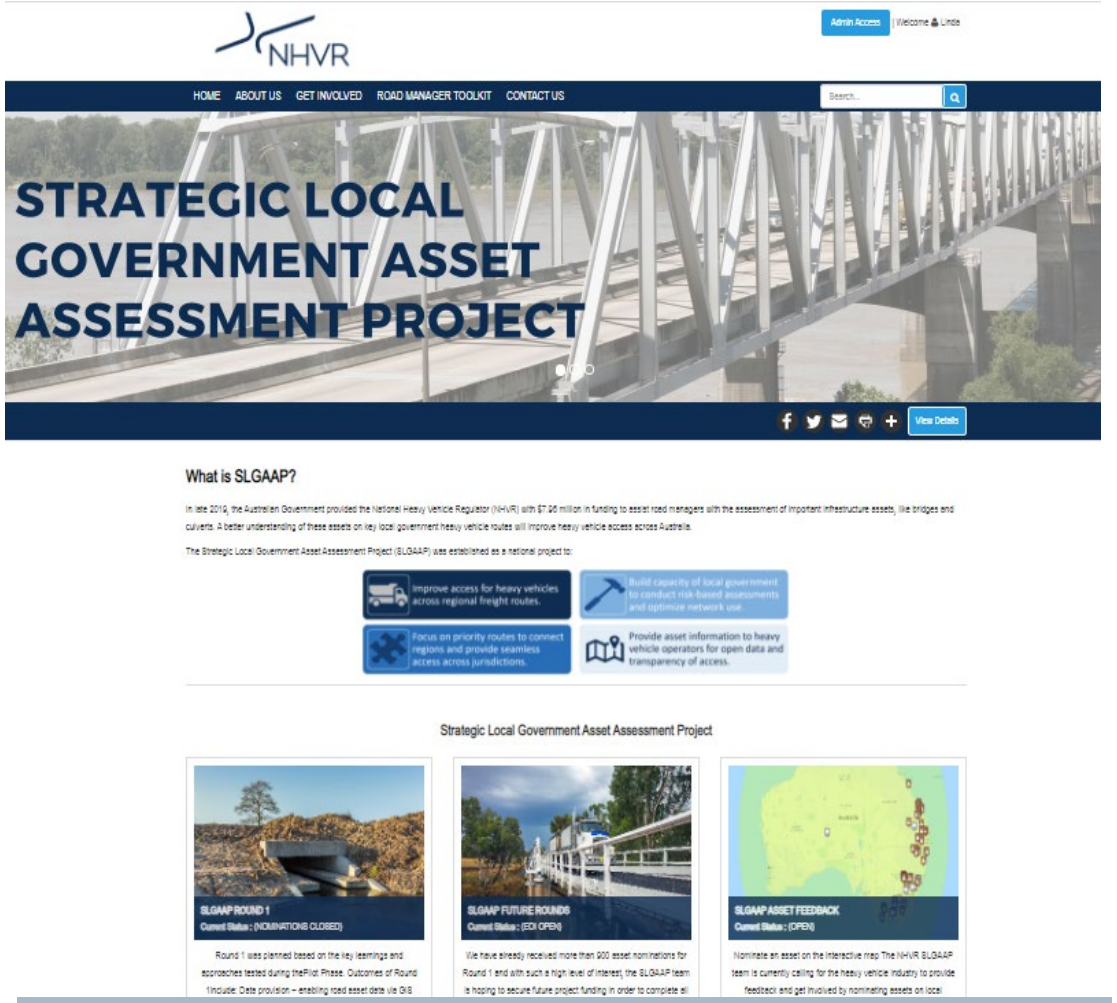
Road Manager Toolkit

01 PLAN

02 COMPARE

03 ASSESS

04 INTERPRET



Visit the SLGAAP Website to keep updated with all of the project news and progress.
https://nhvr.engagementhub.com.au
E: roadassetproject@nhvr.gov.au

Bridge Assessment Framework

Key outcomes from today to understand the:

- Various Tiers of Assessment
- Variations in terminology used throughout Australia
- Difference between bridge assessment and heavy vehicle access assessment
- Framework for Tiers of assessment and how they interrelate

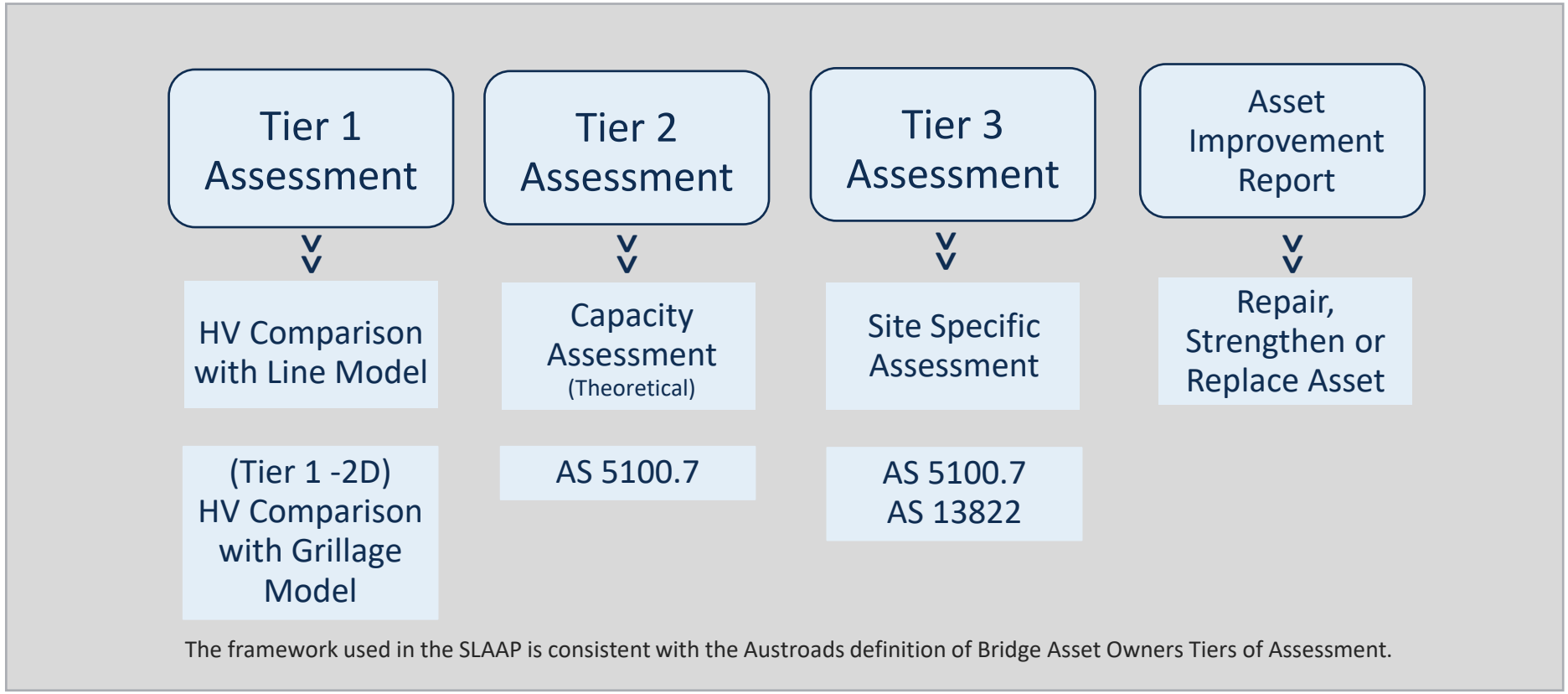
Tiers of Bridge Assessment

Neal Lake

Tiers of Bridge Assessment

- Three tiers of assessment (typically)
- Are progressive in terms of complexity and cost
  - But Tier 1s can be very accurate (depending on quality of reference vehicles)
  - It is a myth that Tier 1 assessments are inherently “conservative” (dependent on quality of the reference vehicles used to define bridge capability)
- Terminology varies widely in Australia both among road managers and the heavy vehicle industry

Tiers of Bridge Assessment



Heavy Vehicle Access Assessment ⇦ | ⇨ Bridge Assessment

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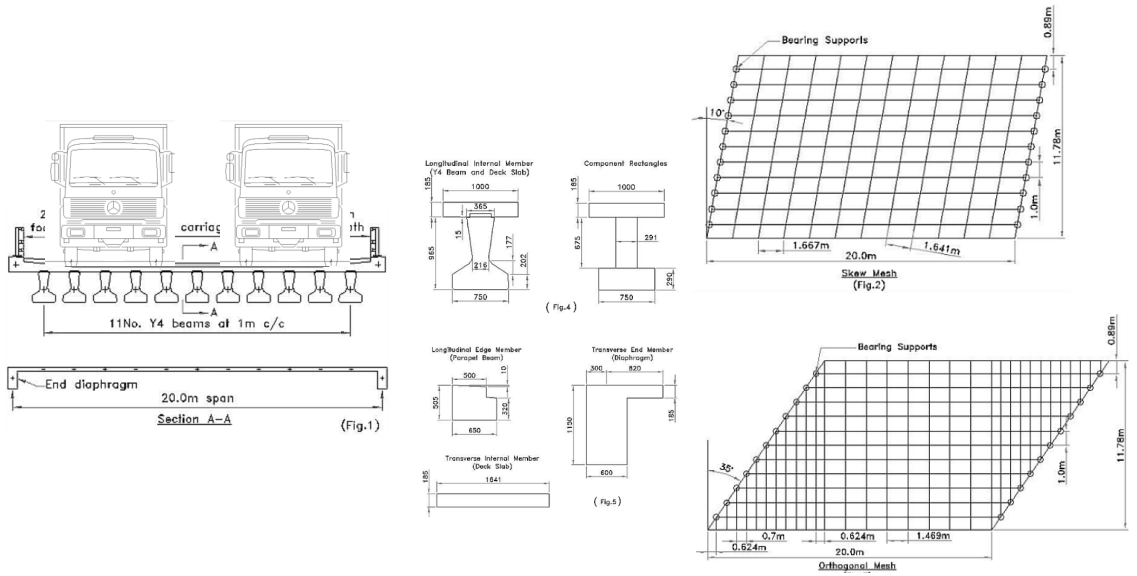
Tier 1 Assessment

- Tier 1 (Heavy Vehicle Access Assessment)
  - Simplest method – compare reference vehicle line model load action effects (bridge capability) to an application vehicles line model load action effects
  - Compares moment, shear and support reaction
  - Accounts for the configuration and articulation of the bridge
  - Can be performed inhouse with limited bridge design/assessment experience
  - Accuracy depends on the appropriateness and accuracy of the reference vehicle assessment (% reference vehicle)

Note this is not a bridge assessment!

Tier 2 Assessment

- Tier 2 (Individual Member Capacity Assessment)
  - Tier 2 assessments are focused on using structural engineering principles to identify the theoretical maximum load action effects in individual members comparing these the member capacities as governed by the material and configuration (capacity assessment).
  - Two-dimensional analysis techniques such as grillage analysis are typically used to determine the theoretical member load action effects from the dead loads and live loads such as heavy vehicle loads.
  - Typically evaluated using AS 5100.7 using generic load factors and capacity reduction factors
  - Typically use marked lanes



Tier 2 Assessment (cont.)

- Tier 2 (Capacity Assessment)
  - Condition must be considered.
  - Requires bridge design/assessment experience, appropriate software and appropriate engineering oversight.

$$RF = \frac{\text{Available bridge capacity for traffic load effects}}{\text{Traffic load effects of nominated rating vehicle}}$$

The rated load (L_R) may be expressed as follows:

$$L_R = (RF)L_{RV}$$

where

L_{RV} = nominated rating vehicle or loading

LR is equivalent to the bridge capability or % of reference vehicle

Tier 2 Assessment (cont.)

- A key output should be the “bridge capability” as defined by a suitable set of % reference vehicle/s for future Tier 1 assessments
- Associated vehicles are to be identical to the main assessment vehicle and associated vehicles need to be scaled in the same proportion as the main assessment vehicle when determining the % of reference vehicle results.
  - Ensures equitable access
  - Ensures validity of Tier 1 assessment

Tier 3 Assessment

- Tier 3 (Capacity assessment +)
  - Covers a wide range of activities that can be undertaken by an asset owner in evaluating the capacity and performance of a structure
  - Used in special cases where we have:
    - a ‘plausibility gap’
    - Insufficient information to conduct a Tier 2
    - Reason to believe better outcomes can be obtained by understanding behavior and/or understanding uncertainty to improve load/capacity factor estimates

It is not a given that Tier 3 will reach an answer!

Tier 3 Assessment (cont.)

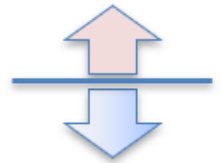
- Tier 3 (Capacity assessment +)
  - May include (but not limited to):
    - Invasive and/or non-invasive inspections of components to confirm design details, deterioration and/or material characteristics.
    - Higher-level advanced analyses including non-linear and plastic methods
    - Assessment methods based on overseas standards
    - Assessment to AS/ISO 13822
    - Field and laboratory testing to understand the in-service performance of bridges and the loads applied.
    - Collection and/or the analysis of reliable weigh-in-motion (WIM) data.

Differences in assessment terminology

PBS tiers of assessment	Bridge asset owner tiers of assessment
Tier 1 PBS Assessment 'Must meet the PBS Bridge Formula'	
Tier 2 PBS Assessment 'Must not cause more effects than existing commercial vehicles acceptable to bridge owner'	**Tier 1 (TMR Tier 0) Bridge Asset Owner Assessment (Access assessment)** Line model (comparison) comparing load effect of applicant vehicle and design vehicle or previously approved commercial vehicle. Must consider condition of structures.
Tier 3 PBS Assessment 'Detailed individual bridge assessment'	**Tier 2 (TMR Tier 1) Bridge Asset Owner Assessment (Structural assessment AS 5100.7)** 2D Grillage model/Line model (with distribution factors) analysis and structural capacity assessment. Must consider condition of structures.
	Tier 3 (TMR Tier 2) Bridge Asset Owner Assessment (Site specific and or higher order assessment) More advanced method, bridge specific analysis and use of international standards that are more sophisticated than AS 5100.7. Non-linear analysis, load testing to support either recalibration of computer models/determination of capacity.

Source: AP-R565-18 Implementation of a Nationally Consistent Framework for the Assessment of Bridges in Australia

Vehicle Access Assessment



Bridge Capacity Assessment

Framework for Tiers of Assessment

Neal Lake

Assessment Type Selection

A reference vehicle must be of similar ground contact width and position on bridge. Typically, different reference vehicles for in-lane vehicles and straddling lane OSOM vehicles are needed. Some consideration needs to be made to the axle configuration and mass concentration when deciding on the appropriateness of a reference vehicle for comparison to an application vehicle. Reference vehicles may have come from:

- *Previous design vehicles*
- *Previous Tier 2 assessment vehicles*
- *Previous Tier 3 assessment vehicles*

Note: Design vehicles need to be verified on design drawings, otherwise engineering judgement is needed. All reference vehicles must have been developed considering associated lane vehicles.

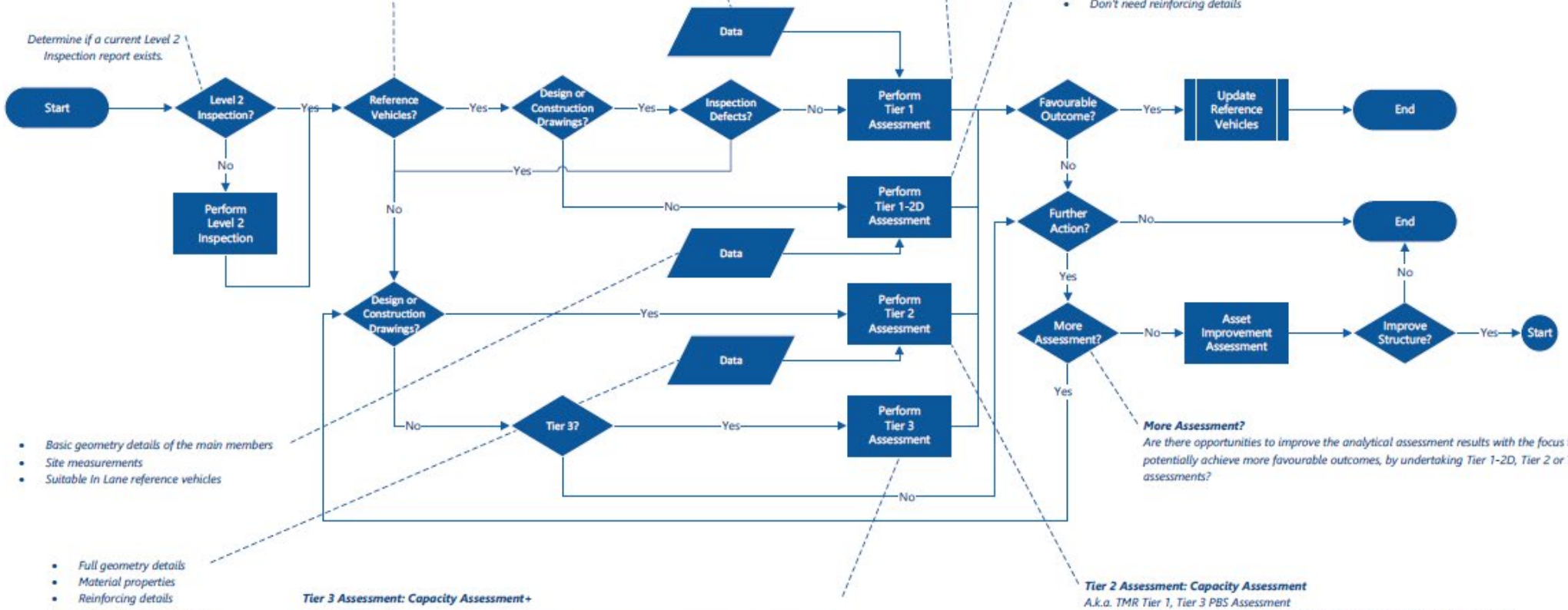
Tier 1 Assessment: Heavy Vehicle Access Assessment
Line Model Comparison (Reference vs Application vehicle)
A.k.a. TMR Tier 0, Tier 2 PBS Assessment
Line model (comparison) comparing load effect of application vehicle and design vehicle or previously approved commercial vehicle. Must consider condition of structures.
Note: A Tier 1 assessment is not a bridge assessment, it is a heavy vehicle assessment.

- *Span lengths*
- *Articulation*
- *Reference Vehicle Loads and Spacings*

Tier 1-2D Assessment
2D Grillage Model Comparison (Reference vs Application vehicle)

- *2D grillage model used for the comparison of reference vehicles (in lane, including associated lane vehicles) to the application vehicles (out of lane)*
- *Need suitable in lane reference vehicles*
- *Need basic geometry of the main members to model the stiffness of individual members, may require some site measurements*
- *Don't need reinforcing details*

Determine if a current Level 2 Inspection report exists.



- *Basic geometry details of the main members*
- *Site measurements*
- *Suitable In Lane reference vehicles*

- *Full geometry details*
- *Material properties*
- *Reinforcing details*
- *Pre-stressing details, etc.*

More Assessment?
Are there opportunities to improve the analytical assessment results with the focus to potentially achieve more favourable outcomes, by undertaking Tier 1-2D, Tier 2 or Tier 3 assessments?

Tier 3 Assessment: Capacity Assessment+
A.k.a. TMR Tier 2
More advanced method which involves bridge specific analysis and the use of international standards that are more sophisticated than AS5100.7. Analysis includes, but is not limited to, non-linear analysis and load testing to support either recalibration of computer models/determination of capacity estimates. It is used in special cases where we have:

- *A 'plausibility' gap*
- *Insufficient information to conduct a Tier 2*
- *Reason to believe better outcomes can be obtained by understanding behaviour and/or understanding uncertainty to improve load/capacity factor estimates.*

Tier 2 Assessment: Capacity Assessment
A.k.a. TMR Tier 1, Tier 3 PBS Assessment
2D grillage model or line model with appropriate distribution factors analysis. Must include assessment of structural capacity. Must consider condition of structure and all critical elements including the substructure. Judgement may be used for some elements but cannot be excluded from consideration for convenience.

Some critical points

- Why not just do higher tiers of assessment for each heavy vehicle application?
  - Very expensive
  - Computation time is long (even if some form of rapid Tier 2 assessment is set up)
  - We don't have information on every bridge
- Tier 2 and 3 assessments "can" be used to assess individual heavy vehicle applications……
  - but the primary focus should be on developing representative % reference vehicles for fast and accurate Tier 1 assessments
- Selection of the appropriate Tier of assessment is dependant on context and may not be successive
- Rapid Tier 1 assessment has the potential to be
  - Cheap, Fast application turn around times, Automated, Reliable
  - Allow many configuration to be considered and compared rapidly
  - But need appropriate reference vehicles (will cover this in next webinar on Tier 1 assessment)
- Tier 1 is Heavy Vehicle access assessment……. Tiers 2 and 3 are bridge assessment

Further Training

- Overview of heavy vehicle access landscape in Australia
- Understanding the tiers of bridge assessment
- The decision making process for bridge access
- Defining bridge capability
- Critical variables that affect assessment
- Resourcing assessments and getting the most from consultants

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Questions?

Next Webinar
Thursday 15 July

Tier 1 Assessments

Register for the rest of the Webinar series here:
https://www.eventbrite.com.au/o/national-heavy-vehicle-regulator-11836541834

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