LG TRRIP

Local Government Transport & Roads Research & Innovation Program

Presentation Webinar

Design and Construction Guideline for the use of Crushed Recycled Concrete on Local Government Roads in WA

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Agenda

- ►Introduction
- ►Important Information
- ►Background
- ►Practitioner’s Guideline Development
- ►Practitioner’s Guideline Walkthrough
  - ►Worked example
- ►Technical Report
- ►Summary

Introduction

Welcome

About LG TRRIP

LG TRRIP

The Local Government Transport and Roads Research and Innovation Program is a joint initiative between WALGA and Main Roads Western Australia.

LG TRRIP seeks to provide collaborative research that positively contributes to the design, construction and maintenance of safe, sustainable transport infrastructure for local government in Western Australia.

Project Overview

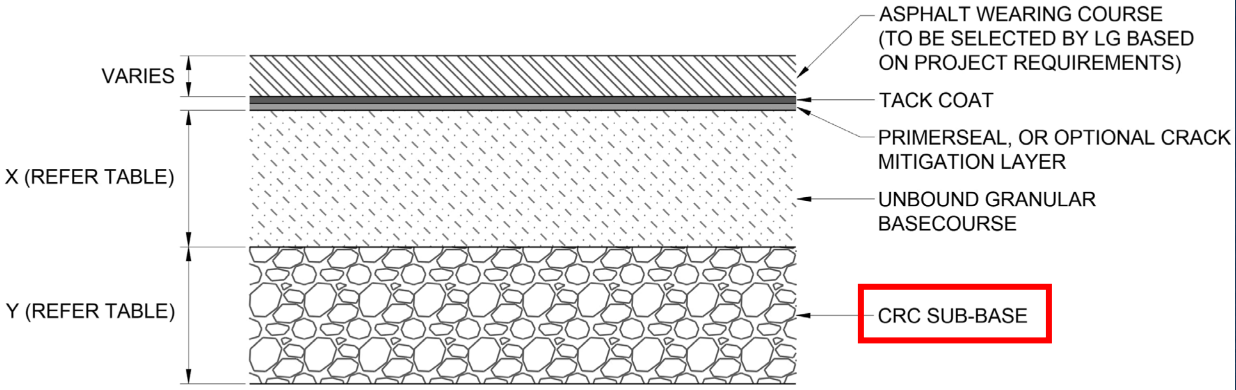
- This project is being delivered by WSP and Civil Sciences and Engineering with their respective expertise, with project support by NTRO.
- This project will deliver a practitioner's guideline and technical report to aid local governments in the use of CRC.
- The guideline and report are in the final stages of review.

Important Information

CRC Sub-base

- ►The most important take-away from this presentation is **CRC can be used as sub-base with very low risk**

1. Direct replacement of current sub-base materials
   - ►No change to design – “like-for-like” replacement
   - ►No redesign required
2. Use the designs presented in the guideline



SUBGRADE DESIGN CBR	TRAFFIC VOLUME (ESAs) / X/Y (mm)						
	1×10^4	3×10^4	1×10^5	3×10^5	1×10^6	3×10^6	1×10^7
5%	100 / 100	100 / 140	100 / 195	115 / 225	135 / 260	150 / 290	170 / 325
8%	100 / 75	100 / 85	100 / 125	115 / 145	135 / 165	150 / 185	170 / 205
12%	75 / 75	75 / 75	100 / 75	115 / 85	135 / 95	150 / 110	170 / 120

Note: ESAs - Equivalent standard axles

CRC AS SUB-BASE

Background

Waste Strategy

RECOVER TARGETS		
⦿ **2025** – Increase material recovery to 70% ⦿ **2025** – All local governments in the Perth and Peel region provide consistent three bin kerbside collection systems that include separation of FOGO from other waste categories ⦿ **2030** – Increase material recovery to 75% ⦿ **From 2020** – Recover energy only from residual waste		
Waste generators		**Waste managers***
Community	**Government and industry**	**Waste industry**
⦿ **2020** – Increase MSW material recovery to 65% in the Perth and Peel regions, 50% in major regional centres ⦿ **2025** – Increase MSW material recovery to 67% in the Perth and Peel regions, 55% in major regional centres ⦿ **2030** – Increase MSW material recovery to 70% in the Perth and Peel regions, 60% in major regional centres	⦿ C&I sector – Increase material recovery to 70% by **2020**, 75% by **2025**, 80% by **2030** ⦿ C&D sector – Increase material recovery to 75% by **2020**, 77% by **2025**, 80% by **2030**	⦿ **2030** – All waste facilities adopt resource recovery better practice

Source: Waste Avoidance and Resource Recovery Strategy 2030 (Waste Authority WA)

Specifications

Roads to Reuse

Product Specification - recycled road base and recycled drainage rock

WASTE AUTHORITY
WA...TOO GOOD TO WASTE

Roads to Reuse – **NOT** an engineering specification.
Addresses contaminants

IPWEA
INSTITUTE OF PUBLIC WORKS ENGINEERING AUSTRALASIA

WALGA

IPWEA/WALGA Specification for the supply of recycled road base

IPWEA/WALGA – Is an engineering specification
Provides physical properties requirements for recycled materials

Guideline Development

- ►IPWEA/WALGA recycled road base specification published in **2016**
- ►Reluctance to specify CRC by some practitioners
- ►WALGA identified a need for a Practitioner's Guideline on pavement design and construction incorporating CRC
- ►Intent is to:
  - ►Increase confidence using CRC in pavements
  - ►Increase use of CRC
  - ►Support WA Waste Avoidance and Resource Recovery Strategy 2030

Webinar update

- ►Guideline has been updated since original webinar
  - ►Comments received from stakeholders
  - ►Have reduced CRC pavement thicknesses
  - ►Have reduced crack mitigation requirements

- ►**Guideline now provides more economical CRC pavement options**

Practitioner’s Guideline Development

Documents

- Two documents will be available:
  - **Practitioners Guideline** – short, common risks and mitigation, typical pavement profiles, construction and maintenance advice
  - **Technical report** – further background information, literature review, general CRC properties, design calculations
- **Most practitioners will only need to refer to the Practitioners Guideline**
- This presentation focusses on the Practitioners Guideline

Methodology

1. **Literature review**
2. **Consultation**
    1. Practitioners – local government
    2. Industry – suppliers, contractors, consultants
3. **Draft report and guideline preparation**
4. **Technical review**
5. **Presentation (this presentation)**
6. **Issue of report and guideline**

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Only included in technical report

Practitioner’s Guideline Walkthrough

Walkthrough

1. Assess suitability of project (Section 2)
2. Select an appropriate CRC pavement design (Section 3)
3. Procure a CRC supplier (Section 4)
4. Construct the CRC pavement (Section 5)

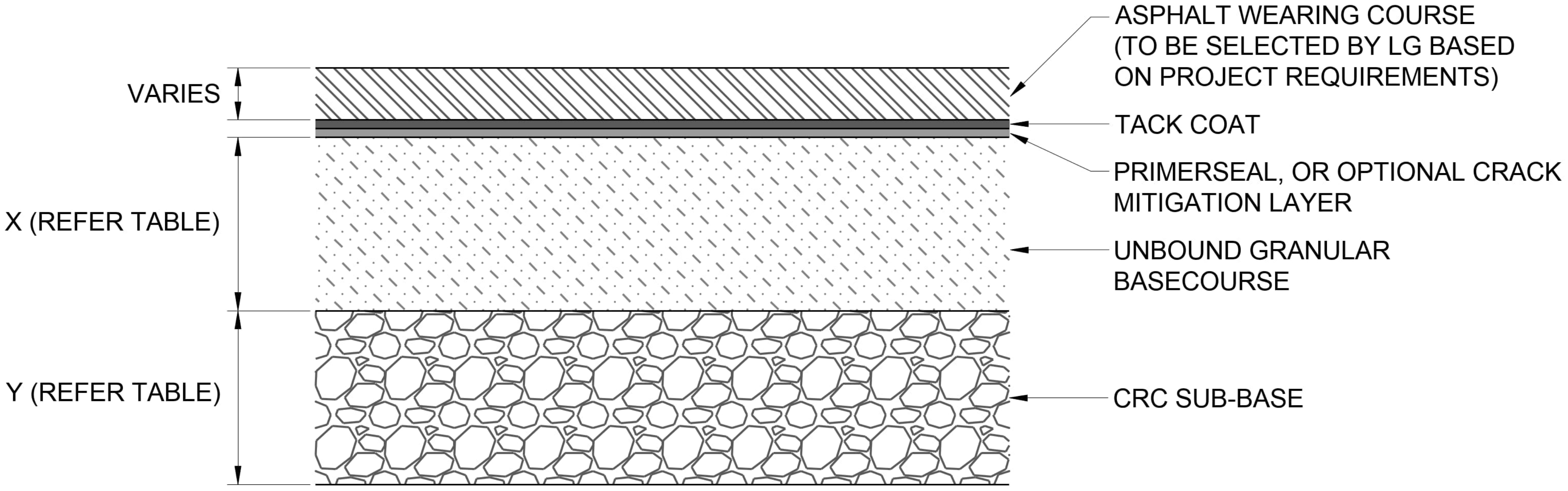
Assess Suitability

- **Project suitability:**
  - RtR Specification – limitations on recycled material use
  - Economics – how does CRC compare to other options?
  - Availability – sufficient quantities & delivery/haulage distance
  - Risk tolerance – particularly block cracking and blisters
    - These are explained later
  - Surfacing type – asphalt or sprayed seal (seal not recommended at this stage)
  - Specification – IPWEA/WALGA, MRWA 501, PTA etc.
- **Pavement profile:**
  - CRC sub-base – very low risk, “like-for-like” replacement
  - CRC basecourse and sub-base – requires more consideration
  - **Not recommended as basecourse only**

Select a CRC Design

- ►**Designs based on:**
  - ►Traffic volume – various traffic volumes selected between 10^4 and 10^7 ESAs
  - ►Subgrade design CBR – 5%, 8%, 12%
- ►**Fatigue of CRC – only assessed if used as basecourse for traffic volumes above 3×10^5 ESAs**
- ►**Traffic volumes and subgrade design CBRs selected to provide a range of "recipe" designs**

CRC as Sub-base



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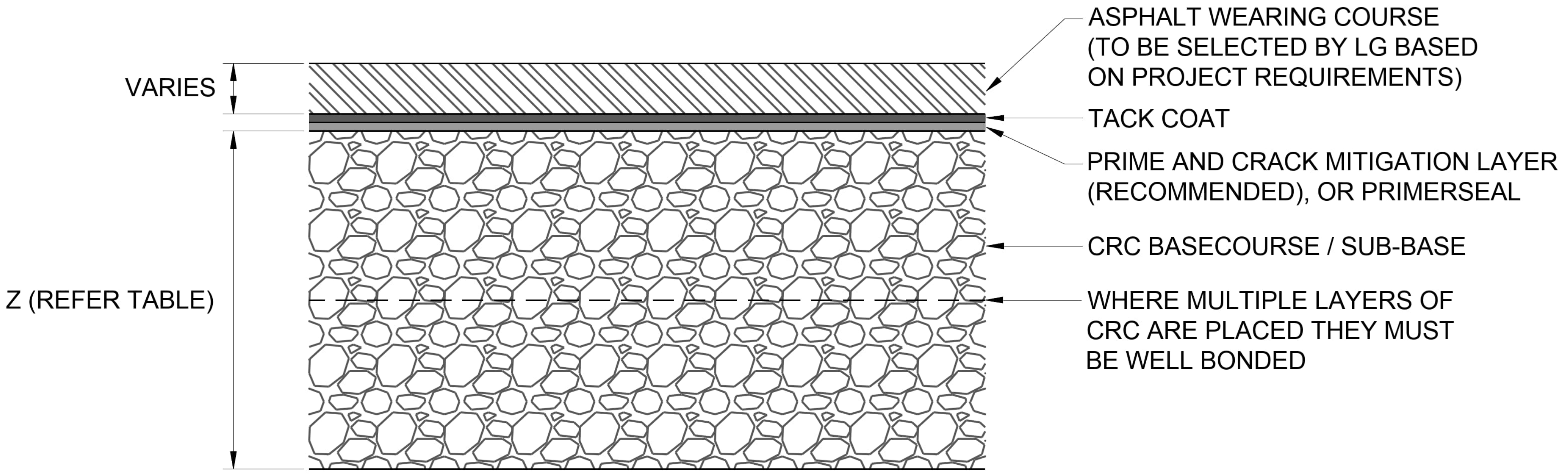
Note: ESAs - Equivalent standard axles

CRC AS SUB-BASE

CRC as Basecourse and Sub-base



SUBGRADE DESIGN CBR	TRAFFIC VOLUME (ESAs) / Z (mm)						
	1×10^4	3×10^4	1×10^5	3×10^5	1×10^6	3×10^6	1×10^7
5%	200	240	295	340	355	375	405
8%	175	185	225	260	320	340	370
12%	150	150	175	200	285	305	330

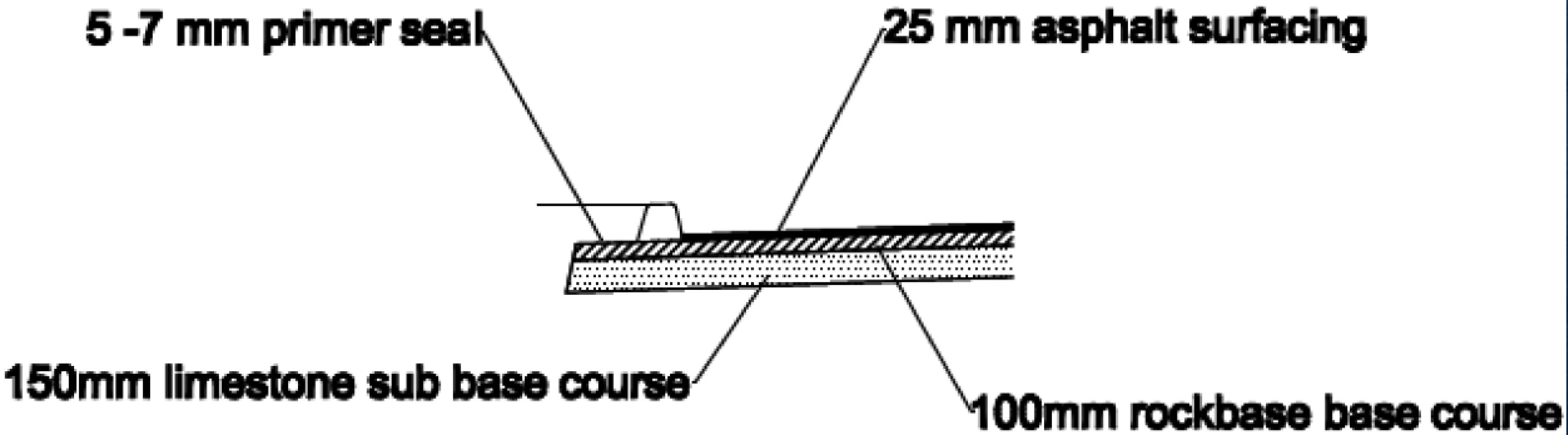
Note: ESAs - Equivalent standard axles

CRC AS BASECOURSE AND SUB-BASE

"IPWEA" Designs

- Where the IPWEA "Residential Subdivision" profiles are adopted, CRC may be used as a like-for-like replacement to replace the sub-base

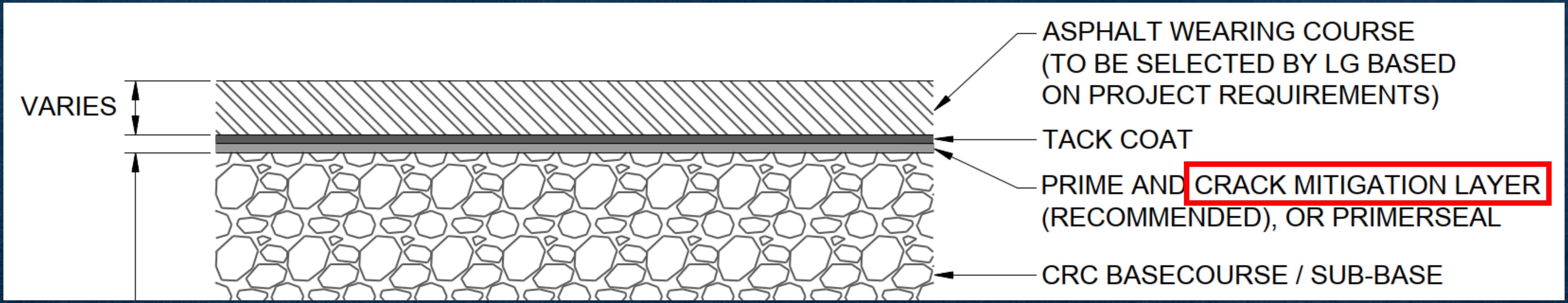
FIGURE 3.4: TRADITIONAL BASE COURSE PROFILE



Source: IPWEA Local Government Guidelines for Subdivisional Development, November 2017

Crack Mitigation Layer

- ►CRC can crack as it rehydrates (similar to concrete)
- ►A crack mitigation layer can delay cracking in the overlying wearing course
- ►Guidance provided to facilitate decision making; however, practitioners should make a risk-based decision for each project



Crack Mitigation Treatments

- **In general, crack mitigation is recommended if:**
  - CRC is used as basecourse
  - CRC is used as sub-base, but there is low tolerance for cracking of the surface
- **Crack mitigation is usually not required for CRC sub-base**
- **Alternative crack mitigation options:**
  - Polymer modified asphalt
  - Stone mastic asphalt, including bottom layer SMA
  - Fine gap graded asphalt with polymer modified binder
  - Inclusion of aramid or polyolefin fibres within the asphalt (has been quite successful and economic on other projects)
- **Flowchart included in Practitioner's Guideline**

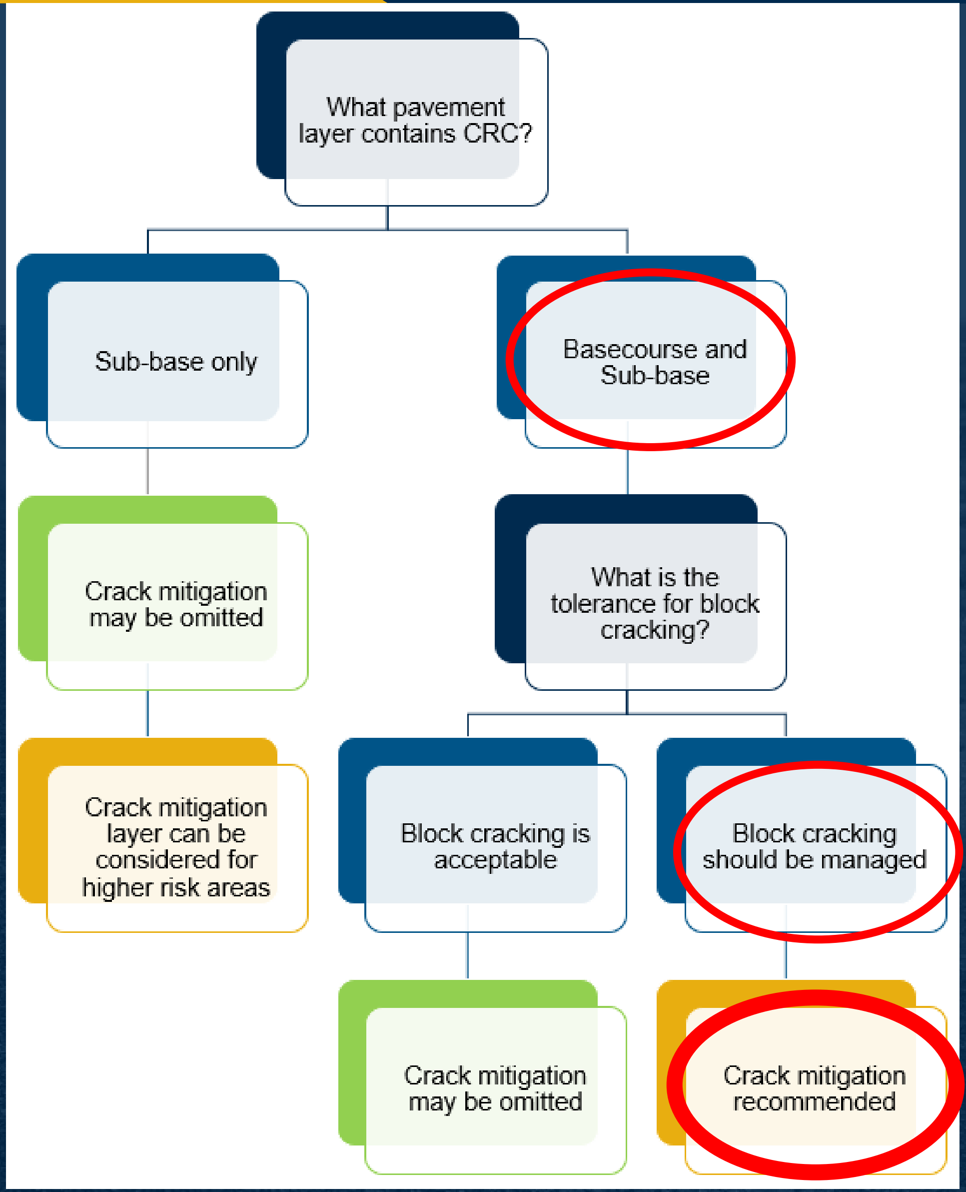
Example CRC Design

- Want to use CRC as basecourse and sub-base to maximise quantity of CRC used and RtR incentive payment
- Medium traffic:
  - 1.0×10^6 ESAs
- Sand subgrade:
  - CBR 12%

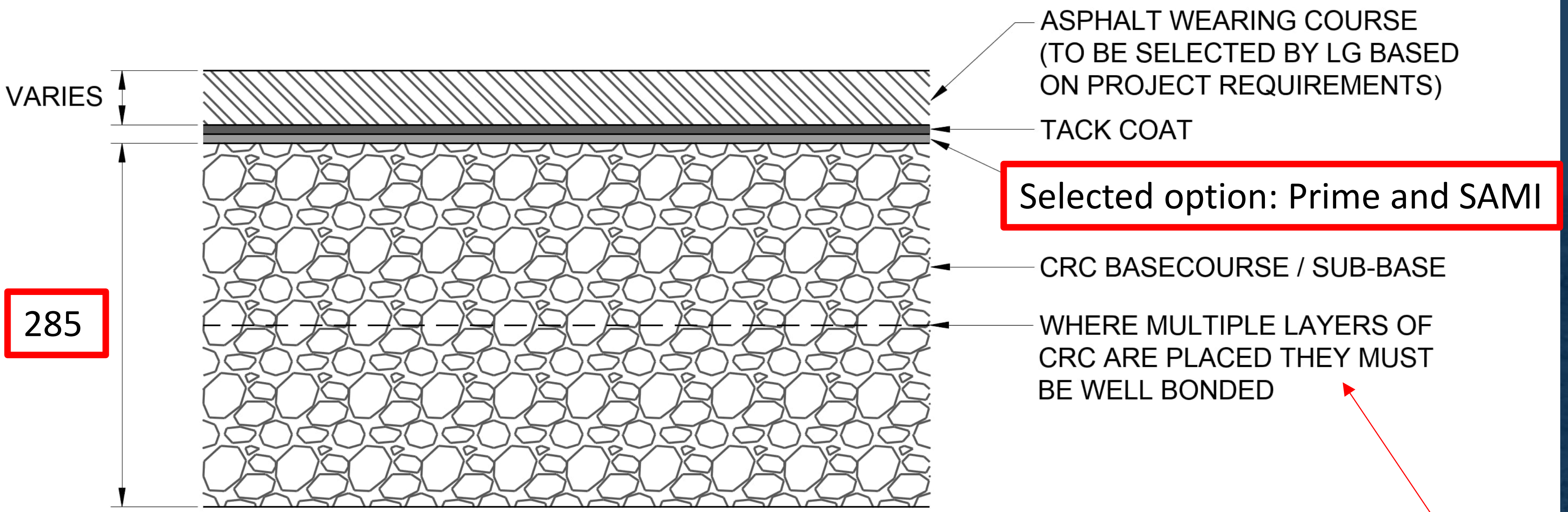
1. Decide which pavement layers will use CRC	Sub-base only, or Basecourse and Sub-base	Section 2.3
2. Select an appropriate design traffic volume	1×10^4 ESAs to 1×10^7 ESAs	Section 3.2
3. Select an appropriate design subgrade CBR	5% 8% 12%	Section 3.3
4. Is crack mitigation required?	Required, or Not required	Section 3.7
5. Select the appropriate pavement profile	CRC as sub-base CRC as basecourse "IPWEA" profiles	Section 3.4 Section 3.5 Section 3.6

Example CRC Design

- Do we need a crack mitigation layer? Refer to Guideline…
- The type of crack mitigation is up to the practitioner
  - **If unsure select a SAMI**
  - Asphalt with fibre reinforcement has had good performance



CRC as Basecourse and Sub-base



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CRC AS BASECOURSE AND SUB-BASE

For this particular pavement, may be able to place basecourse and sub-base as one layer

Procurement

- ►Will an RtR accredited supplier be used?
  - ►Use of an RtR accredited supplier is strongly recommended as it provides assurance that risks associated with human health and the environment have been managed
- ►Quality control – CRC source, sampling & testing, traceability, auditing…
- ►Engineering Specification – IPWEA/WALGA, MRWA 501, PTA…
- ►CRC Supply – quantity, timeframe, haulage distances

Construction

- ►CRC is reported to be a good material to work and compact
- ►Layer bonding (where multiple layers placed)
- ►Compaction, moisture conditioning
- ►Trimming – within ~24 hours of compaction (prior to recementation)

Risks

- **CRC does have some unique risks:**
  - Block cracking
  - Surface blistering/domes
  - Fatigue cracking
- **These can be managed through:**
  - Using CRC on appropriate projects
  - Selecting a suitable pavement profile
  - Inclusion of crack mitigation measures
- **Using CRC for the sub-base layer only practically eliminates all the above risks**

Risks – Block Cracking

- ►Typically only an issue if CRC used as basecourse
- ►Caused by recementation and shrinkage of CRC

Risks – Block Cracking

- **Include a crack mitigation layer:**
  - SAMI
  - Geotextile reinforced seal
  - Asphalt geogrid
- **Include additives such as reinforcement fibres in the asphalt**
- **Change the asphalt type and include a polymer modified binder**

Option	Requirements
Option 1 – SAMI Seal (recommended in most instances)	• Prime. • S20E or S45R bitumen at 1.6 L/m^2 (residual bitumen at 15°C). • 10 mm sealing aggregate at 140-160 m^2/m^3. • Tack coat and asphalt wearing course.
Option 2 – GRS[1]	• Prime (optional). • C170 bitumen bond coat at 0.8 L/m^2 (residual bitumen at 15°C). • Minimum 130 g/m^2 polyester non-woven geotextile fabric • C170 bitumen with or without 5% crumb rubber at 1.1 L/m^2 • 10 mm sealing aggregate at 160-180 m^2/m^3. • C170 bitumen with or without 5% crumb rubber at 0.6 L/m^2 • 5 mm sealing aggregate at 180-220 m^2/m^3. • Tack coat and asphalt wearing course.
Option 3 – Asphalt Geogrid[2]	• Prime. • C170 bitumen bond coat at 0.45-0.65 L/m^2. • Asphalt geogrid. • Asphalt wearing course.

Risks – Surface Blistering

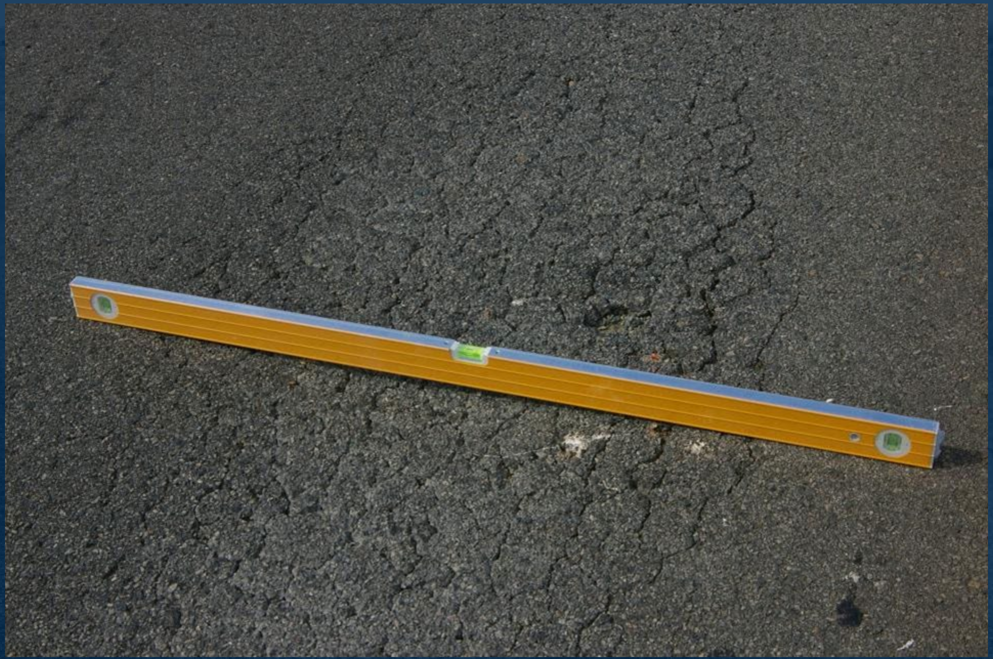
- Only an issue if CRC used as basecourse
- Caused by expansive impurities:
  - Metallic aluminium – window frames, pop rivets etc.
  - Gypsum – plasterboard

Risks – Surface Blistering

- **Remove impurities**
  - Some suppliers can remove metallic aluminium
  - Gypsum needs to be controlled at source
- **Don’t use CRC as basecourse**
- **Don’t use CRC in areas where blisters might be an issue, e.g. paths, sporting courts.**
- **Relatively easy to repair – saw cut and remove affected area**

Risks – Fatigue Cracking

- **Only an issue if CRC used as basecourse**
- Typically only an issue on medium to heavy traffic roads
- Insufficient thickness of CRC basecourse for the traffic
- Poor bond between CRC basecourse and sub-base



Risks – Fatigue Cracking

- ►Select an appropriate CRC pavement design – refer to the Practitioner's Guideline
- ►Ensure good bond between CRC layers
- ►CRC basecourse not recommended for very high traffic volumes
- ►No easy fix – resurface with crack mitigation layer in short term (will fail again), reconstruct pavement in long term

Technical Report

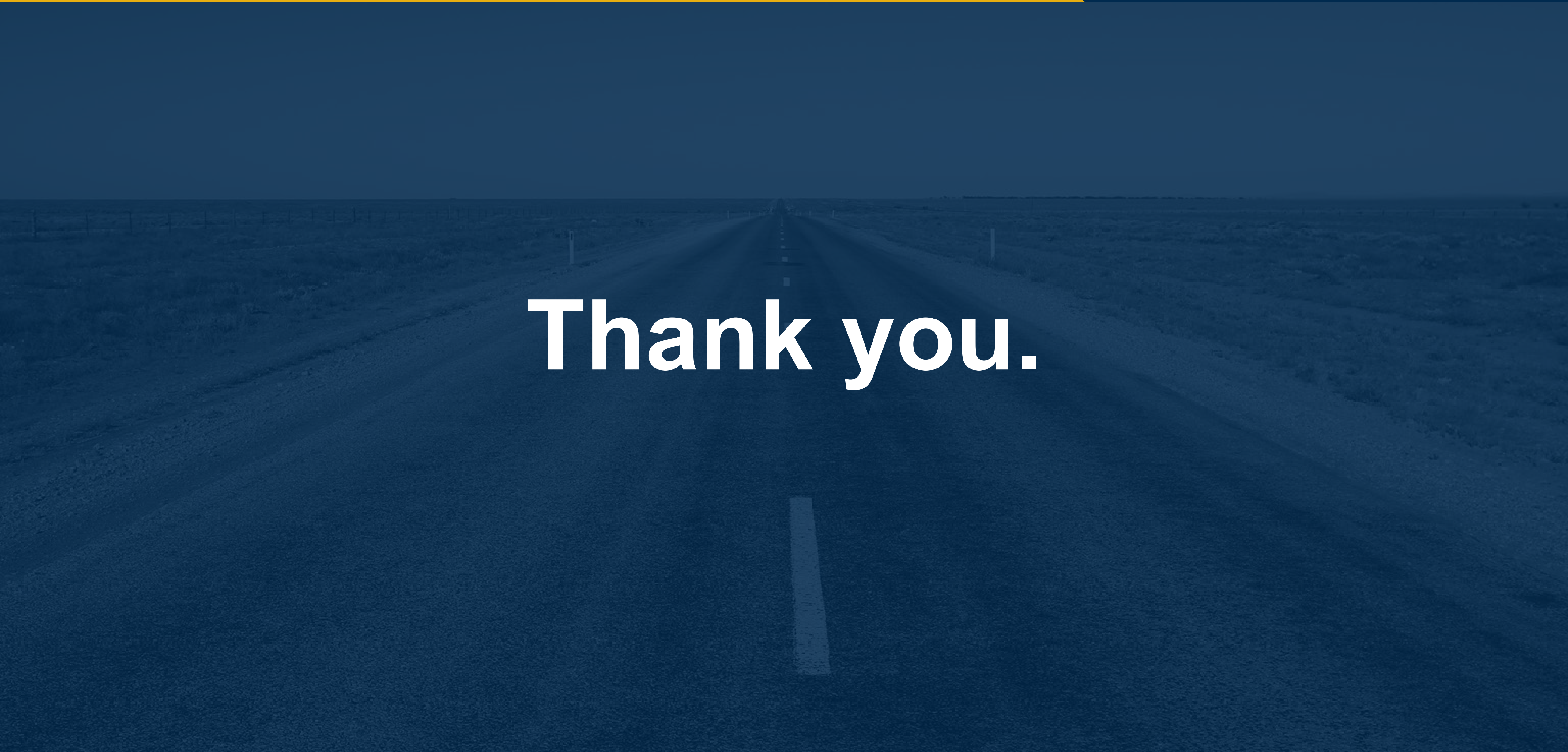
Technical Report

- There is a Technical Report that accompanies the Practitioner's Guideline
- The Technical Report contains additional background information to support the Practitioner's Guideline
- The Practitioner's Guideline contains the relevant information to facilitate use of CRC. The Technical Report does not need to be referred to, but provides additional information for those that seek it

Summary

Summary

- CRC is **available and a suitable material** for pavement construction
- CRC does have **unique risks** but they usually **can be managed**
- In general, **using CRC as sub-base is very low risk** (comparable to other typical materials)
- If in doubt – ask!


Thank you.