Everything roads
Since 1894.

Quality at the Source – RAP Report & Management Guide

ORBA – OAPC
Fall Asphalt Siminars
Dec 1nd 2022

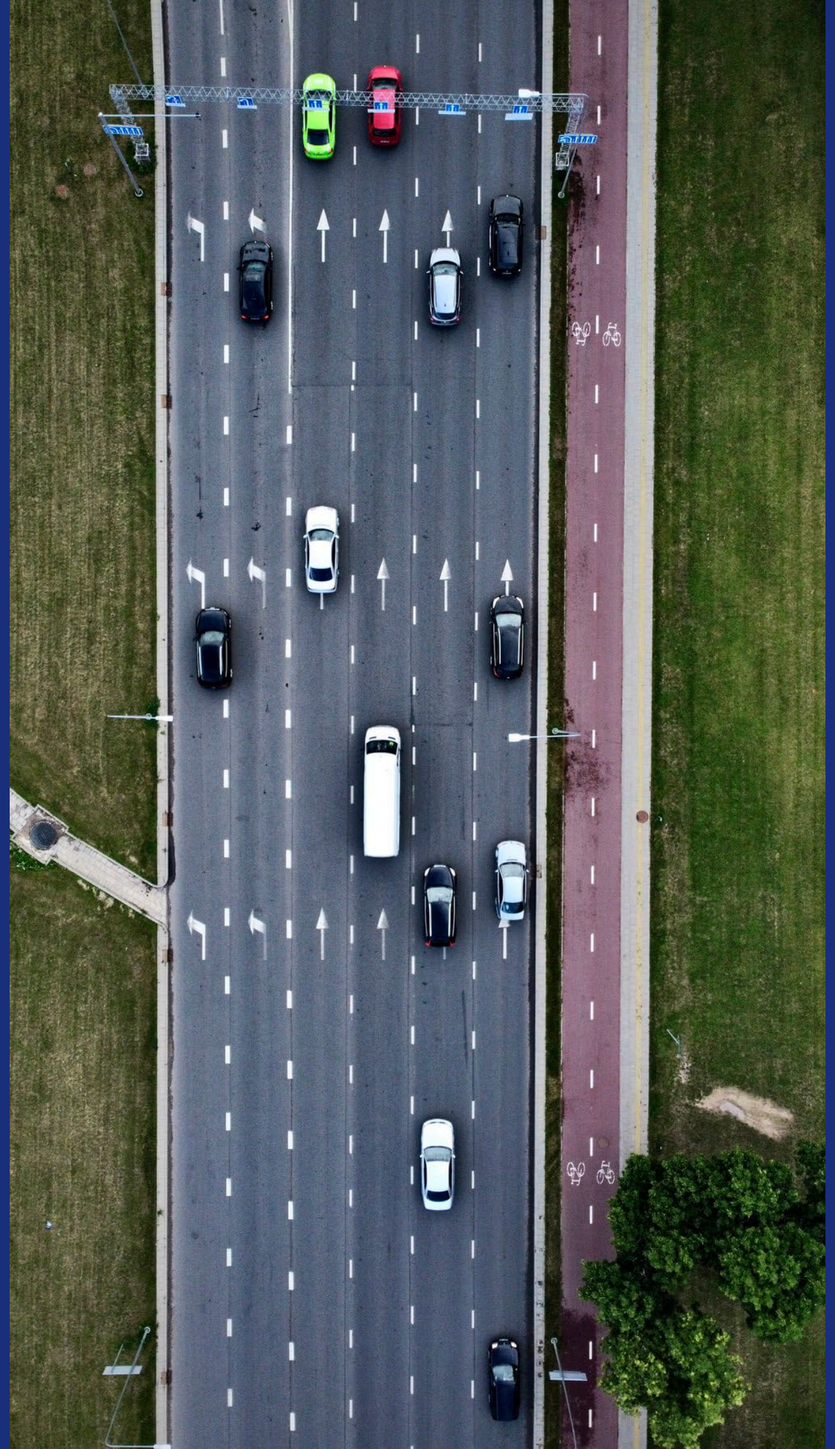
Amin Mneina, MSc., EIT.

Good Roads

Presentation Outline

- Background & History
- Current Baseline on RAP Inventory
- State of Practice
- RAP Management Guide
    - Aiming for Quality at the Source
    - Stockpiling and Processing
    - Success Stories
- Upcoming Steps

Good Roads



Background

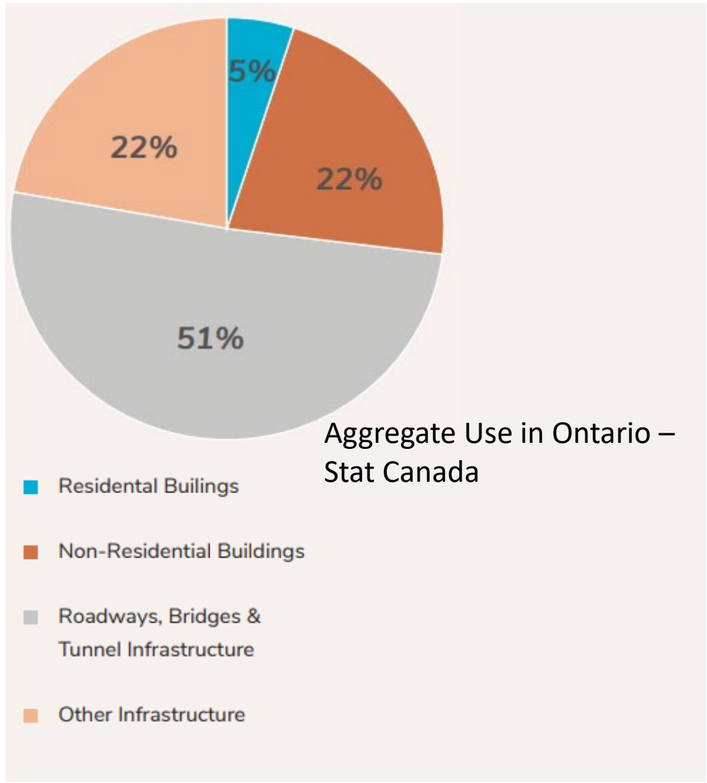
Current Situation

184M Tonnes of Aggregates used Annually in Ontario

Depleting Aggregate Sources (OCC Report – The Long Haul)

50% of Municipali Budget goes to Construction & Infrastructure – Circular Innovation Council

+500 Municipalities in Canada have declared a climate emergency



Aggregate Use in Ontario – Stat Canada

Good Roads

Background

Potential

MTO was one of the first agencies worldwide to utilize RAP in 1960's

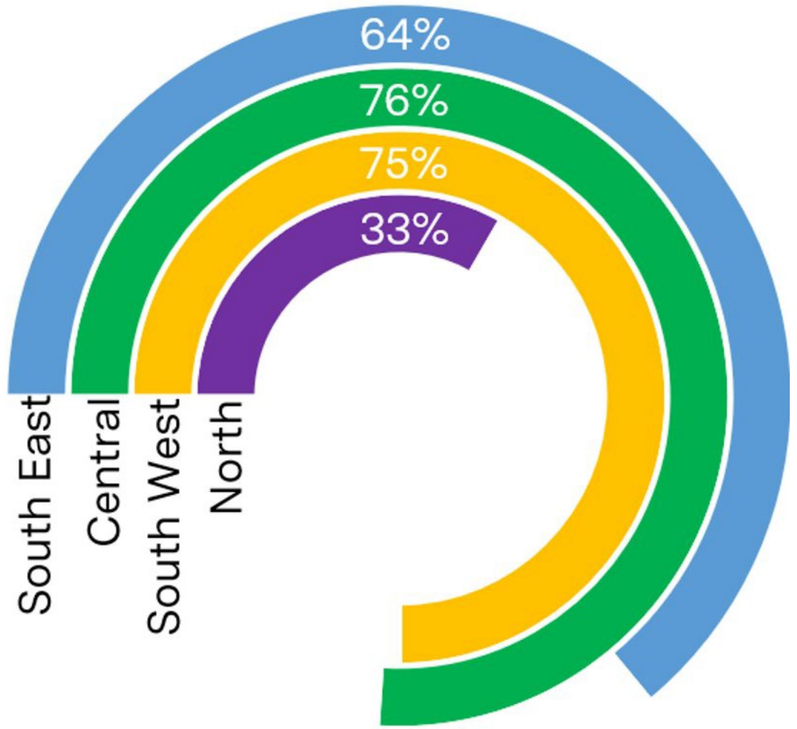
Today only 67% of Ontario Municipalities Allow the Use of RAP

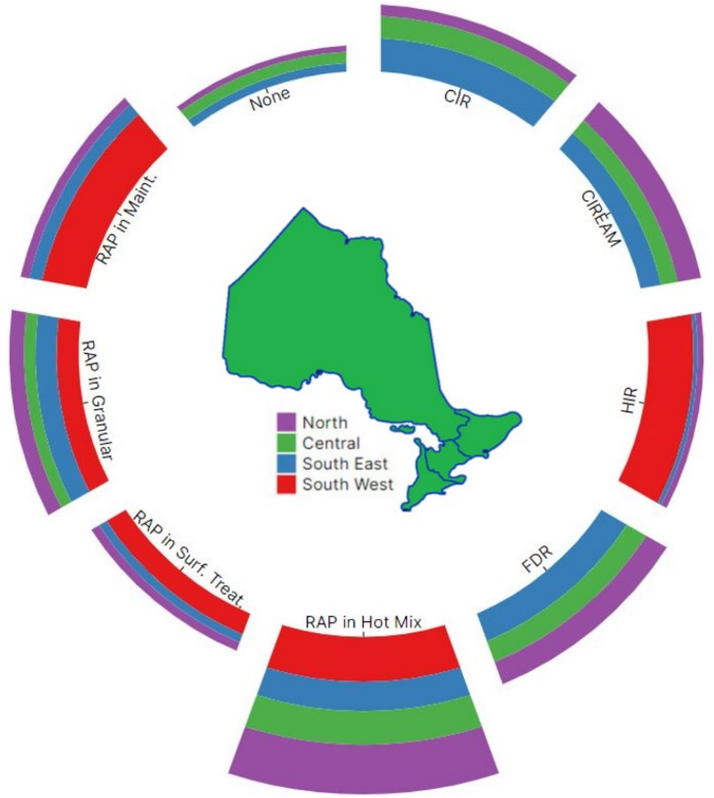
Most Common recycling technique is RAP in HMA

Saving 15M tonnes of conserved fresh water – enough for 56K houses for 1 year

Saving 125K Tonnes of GHG – 27K cars for 1 year

Saving 2M barrels of bitumen



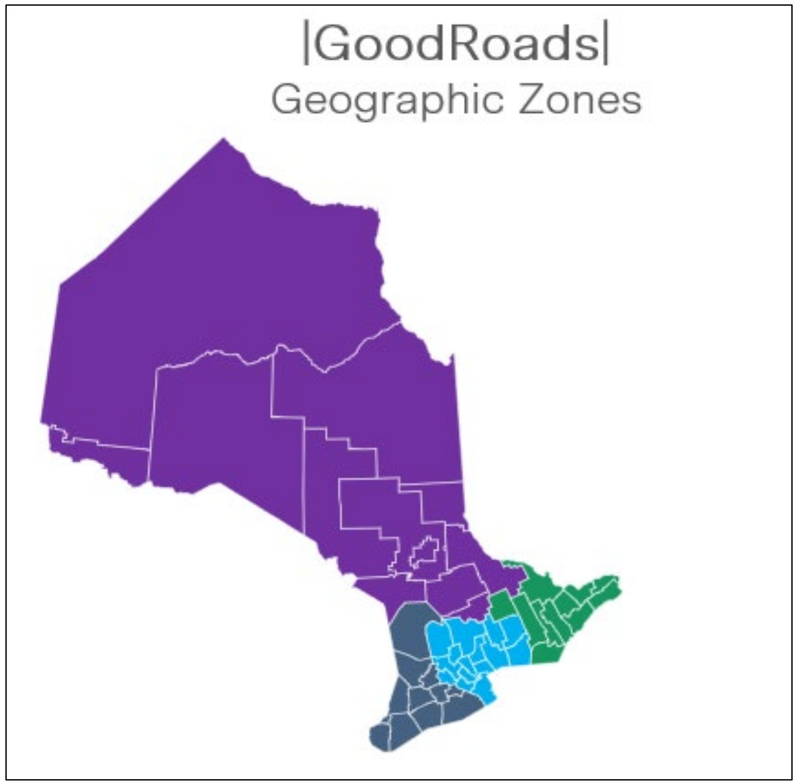


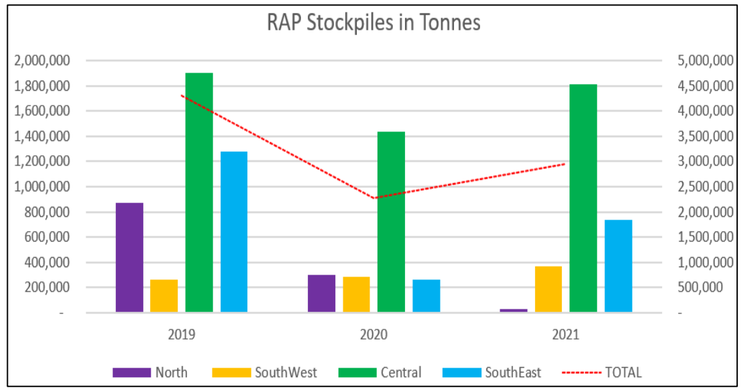
Current Baseline

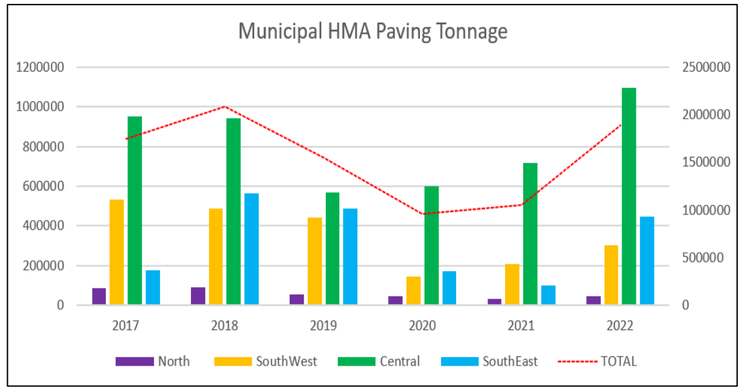
> “You can’t manage what you don’t measure
>
> - Peter Drucker

RAP Inventory

- Started in 2019 as GoodRoads study using Google Earth
- Annual RAP Survey (GR/OAPC)
- Private/Public Partnership
- Better Monitoring = Better Managing







Good Roads

Current Baseline

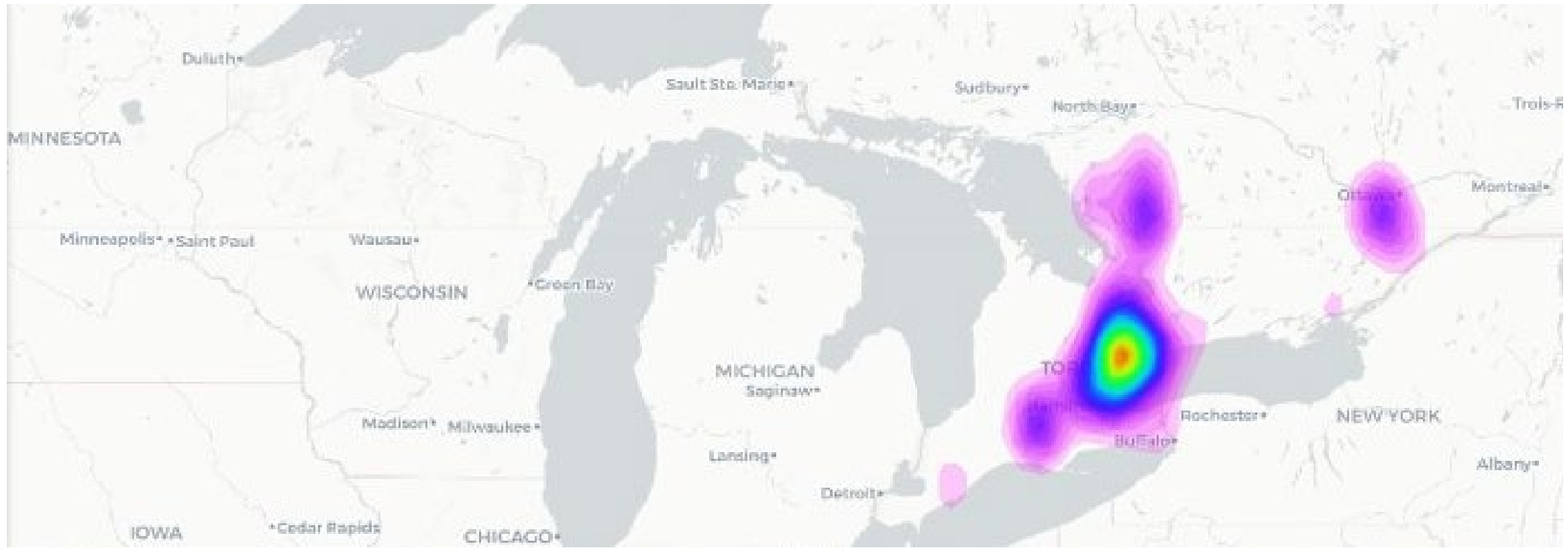
2021 RAP Inventory

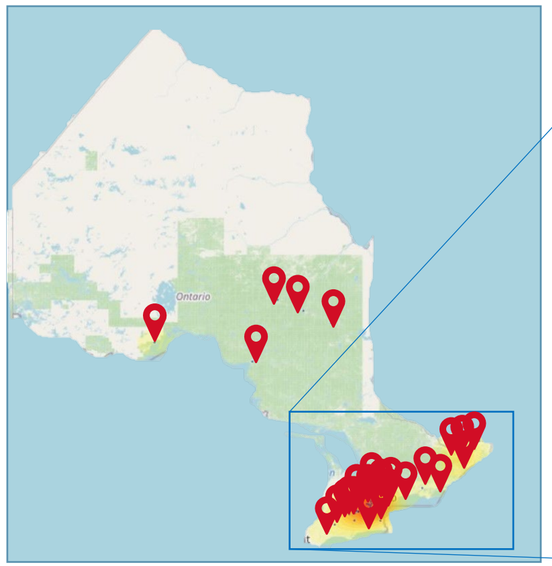
Partnership

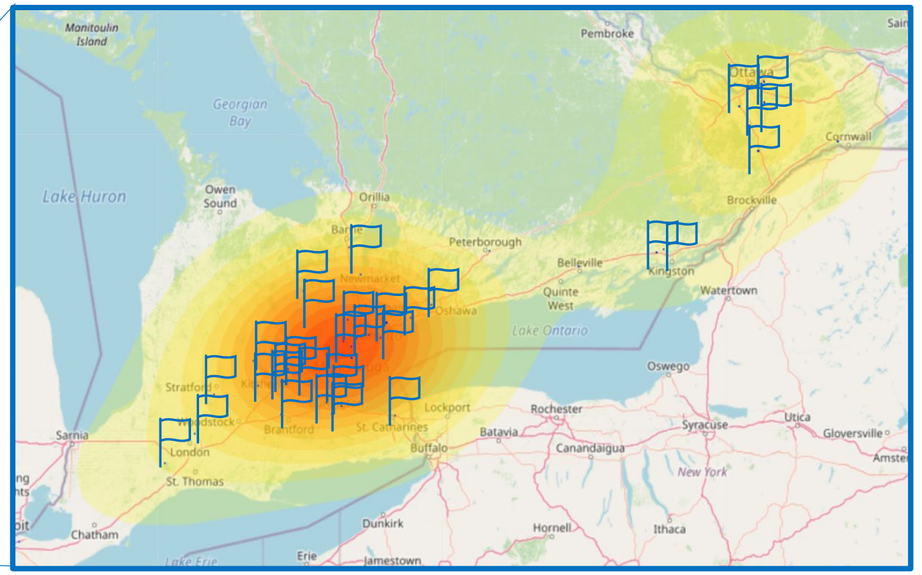
60 Facilities Responded

2.9M Tonnes Reported

Mostly Concentrated in Southern Ontario
>90%







Good Roads

Current Baseline

Practices

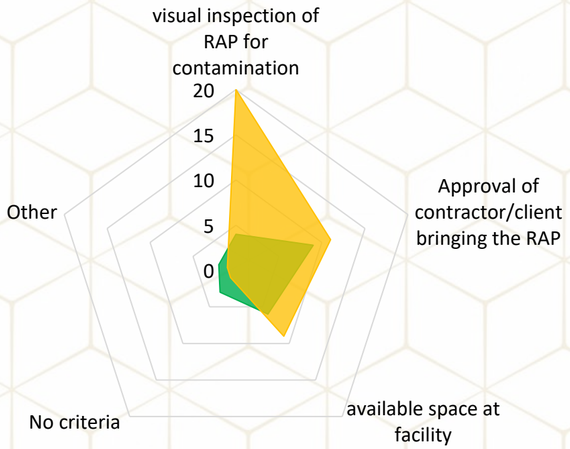
- Stockpile separation
  . Limited space
  . Practiced by majority of contractors
- Incoming RAP is inspected visually
- Stockpiling best practices
  . Drainage
  . Screening
  . Fractionation

Not Everyone Applies These!

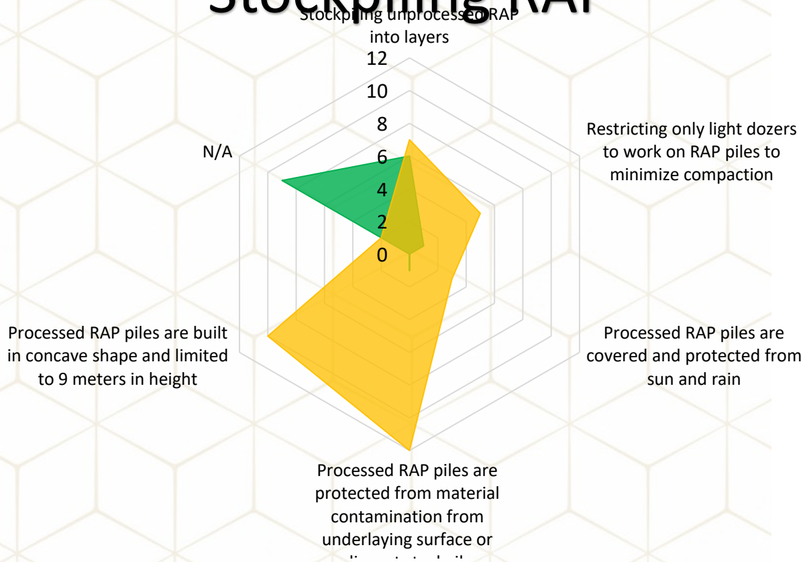
MUNICIPALITIES

HMA PRODUCERS / CONTRACTORS

Incoming RAP



Stockpiling RAP



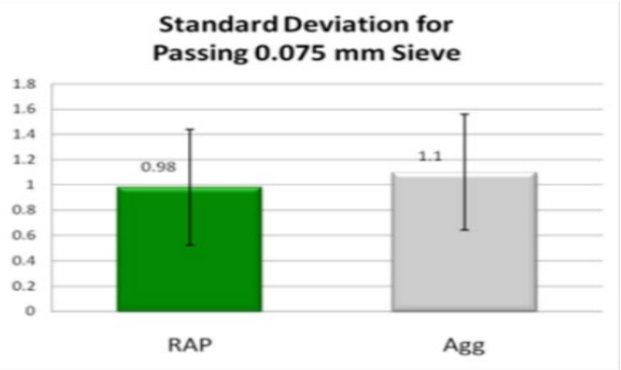
Good Roads

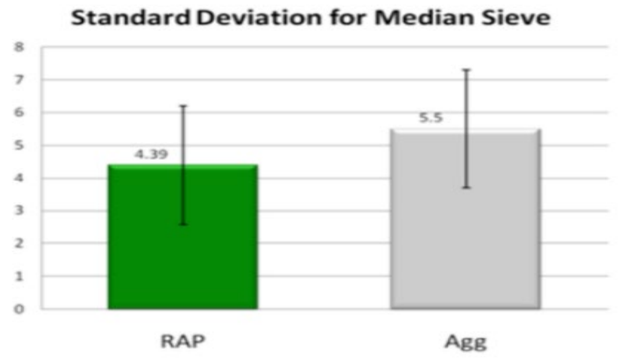
Current Baseline

Why Are we Using Little to No RAP?

Municipal Perspective
- Municipal Specs
- Concerns for Quality and Performance
- Limitations on QA Oversight

Contractor Perspective
- Municipal Specs
- Lack of Experience
- Negative Perception on RAP
- Material Variability





Good Roads

Current Baseline

Ontario Provincial Standards & RAP

More focus on QA for RAP during production

Variability and issues at stockpiling/processing stage will affect quality at production

- OPSS.MUNI.310 Construction | Hot Mix Asphalt
- OPSS.MUNI.1150 Materials | Hot Mix Asphalt
- OPSS.MUNI.1003 Aggregates | Hot Mix Asphalt
- OPSS.MUNI.1001 Aggregates | General

RAP Report
& Management Guide

Quality Starts at the Source

- Public/Private/Academia partnership GR / OAPC / MEA / UW-CPATT
- Annual Reporting of Province-wide RAP Inventory
- Support from Industry Experts
- Synthesize information on best practices for RAP processing, and stockpile management
- Solid base for advancing use of RAP

Good Roads

RAP Report & Management Guide

Good Roads

apc ONTARIO ASPHALT PAVEMENT COUNCIL

CPATT CENTRE FOR PAVEMENT AND TRANSPORTATION TECHNOLOGY

MUNICIPAL ENGINEERS ASSOCIATION

A special thank you to all private sector companies that provided feedback and valuable input in the data collection and creation of this report

VILLENEUVE CONSTRUCTION

Oxford Sand & Gravel Limited

PAVE-AL

AECON

Bruno's Contracting Thunder Bay Limited

STEED AND EVANS Experience that works.

C.Valley PAVING & ASPHALT

Est. 1952 GAZZOLA PAVING LIMITED

APITAL

Crupi Group

GRAHAM BROS. CONSTRUCTION LIMITED BRAMPTON ONT.

GIP Green Infrastructure Partners

RAP Report
& Management Guide

Document Focus

Quantities | RAP and HMA Paving

State of the Practice

RAP Management Best Practices
- Stockpiling
- Crushing & Processing
- Sampling & Testing

Good Roads

REDUCING MAINTENANCE NEEDS

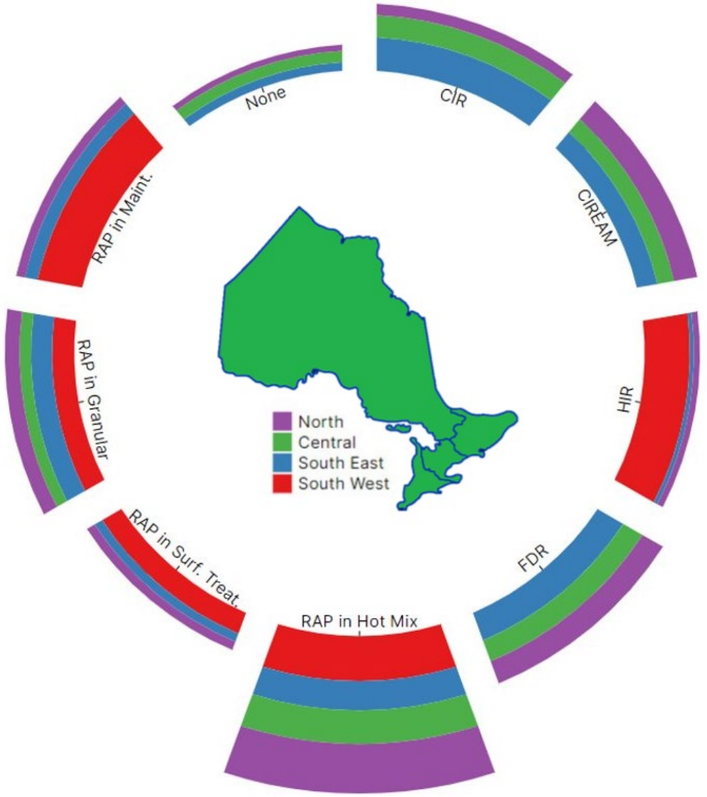
Avoid crushing and screening RAP that is wet or that has absorbed a lot of heat. When the RAP is wet or hot it would become stickier and would tend to build up on screen equipment, conveyor belts and clogs crushers which leads to additional equipment maintenance.

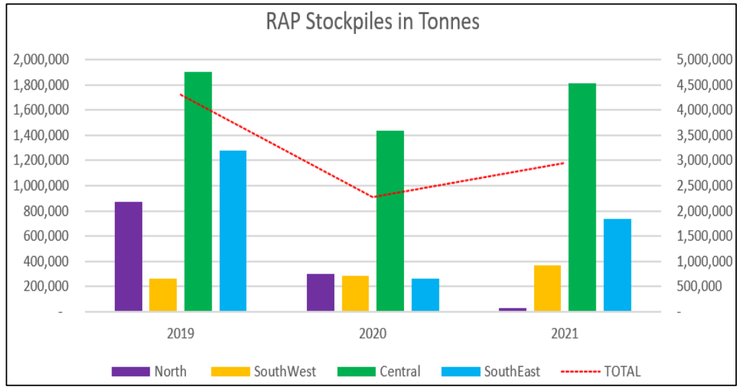
Recommended tests

- Gradation Test of Recovered Aggregates (Sieve Analysis)
- Consensus Properties of Recovered Aggregates
- Bulk Specific Gravity of Recovered Aggregates
- Asphalt Cement Content (AC%)
- Recovered Binder Properties

ISSUES WITH USING INAPPROPRIATE CRUSHER:

Using Cone crushers would repeatedly crush RAP particles to break it apart resulting in stripping the asphalt coating from the RAP creating white rock which will need additional asphalt to coat it when used in hot mix.





RAP Report
& Management Guide

We Process RAP to:

- Achieve material uniformity (reduce variability)
- Reduce NMAS
- Break agglomerations

While Considering:

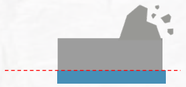
- Minimizing dust generation (P_{200})
- Minimizing trapped moisture
- Minimize segregation
- Maintaining safety of personnel and equipment

Good Roads

- Stockpiling Requirements

- Paved or Compacted Granular Pad

- Bottom 0.3m of the Stockpile Shall not be Used



- Slope – min 3%

- Crush or Screen to NMAS

- Process Control Shall be Specified in Contract Docs

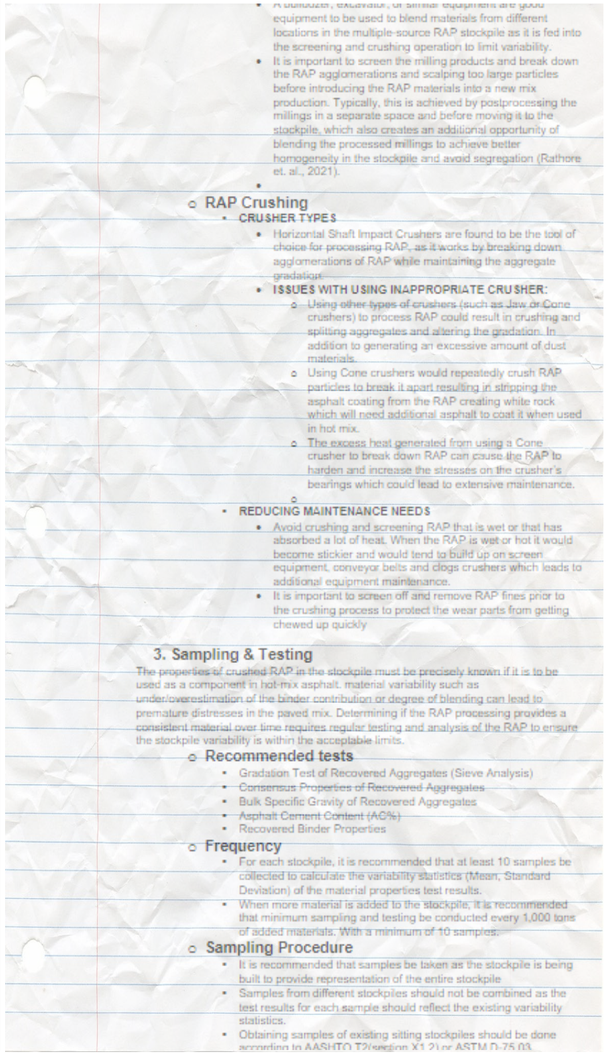
Pre-Screen & Fractionate

RAP Report
& Management Guide

Quality Control

- Knowing the material properties
- Ensuring variability is within limits
- Frequency of testing
- Proper sampling (ASTM D-75.03)

Good Roads



- A bulldozer, excavator, or similar equipment are good equipment to be used to blend materials from different locations in the multiple-source RAP stockpile as it is fed into the screening and crushing operation to limit variability.
- It is important to screen the milling products and break down the RAP agglomerations and scalping too large particles before introducing the RAP materials into a new mix production. Typically, this is achieved by postprocessing the millings in a separate space and before moving it to the stockpile, which also creates an additional opportunity of blending the processed millings to achieve better homogeneity in the stockpile and avoid segregation (Rathore et. al., 2021).

- RAP Crushing
  - CRUSHER TYPES
    - Horizontal Shaft Impact Crushers are found to be the tool of choice for processing RAP, as it works by breaking down agglomerations of RAP while maintaining the aggregate gradation
    - ISSUES WITH USING INAPPROPRIATE CRUSHER:
      - Using other types of crushers (such as Jaw or Cone crushers) to process RAP could result in crushing and splitting aggregates and altering the gradation. In addition to generating an excessive amount of dust materials.
      - Using Cone crushers would repeatedly crush RAP particles to break it apart resulting in stripping the asphalt coating from the RAP creating white rock which will need additional asphalt to coat it when used in hot mix.
      - The excess heat generated from using a Cone crusher to break down RAP can cause the RAP to harden and increase the stresses on the crusher's bearings which could lead to extensive maintenance.
  - REDUCING MAINTENANCE NEEDS
    - Avoid crushing and screening RAP that is wet or that has absorbed a lot of heat. When the RAP is wet or hot it would become stickier and would tend to build up on screen equipment, conveyor belts and clogs crushers which leads to additional equipment maintenance.
    - It is important to screen off and remove RAP fines prior to the crushing process to protect the wear parts from getting chewed up quickly

3. Sampling & Testing

The properties of crushed RAP in the stockpile must be precisely known if it is to be used as a component in hot-mix asphalt. material variability such as under/overestimation of the binder contribution or degree of blending can lead to premature distresses in the paved mix. Determining if the RAP processing provides a consistent material over time requires regular testing and analysis of the RAP to ensure the stockpile variability is within the acceptable limits.

- Recommended tests
  - Gradation Test of Recovered Aggregates (Sieve Analysis)
  - Consensus Properties of Recovered Aggregates
  - Bulk Specific Gravity of Recovered Aggregates
  - Asphalt Cement Content (AC%)
  - Recovered Binder Properties
- Frequency
  - For each stockpile, it is recommended that at least 10 samples be collected to calculate the variability statistics (Mean, Standard Deviation) of the material properties test results.
  - When more material is added to the stockpile, it is recommended that minimum sampling and testing be conducted every 1,000 tons of added materials. With a minimum of 10 samples.
- Sampling Procedure
  - It is recommended that samples be taken as the stockpile is being built to provide representation of the entire stockpile
  - Samples from different stockpiles should not be combined as the test results for each sample should reflect the existing variability statistics.
  - Obtaining samples of existing sitting stockpiles should be done according to AASHTO T2(section X1.2) or ASTM D-75.03

Table 4-2. Proposed RAP sampling and testing guidelines for high RAP content mixes.

Property	Test Method(s)	Frequency	Minimum Number of Tests per Stockpile	Maximum Standard Deviation
Asphalt Content	AASHTO T 164 or AASHTO T 308	1 per 1,000 tons	10	0.5
Recovered Aggregate Gradation*	AASHTO T 30	1 per 1,000 tons	10	5.0 all sieves 1.5 on 75 micron
Recovered Aggregate Bulk Specific Gravity	AASHTO T 84 and T 85	1 per 3,000 tons	3	0.030**
Binder Recovery and PG Grading	AASHTO T 319 or ASTM D5404 and AASHTO R 29	1 per 5,000 tons	1	n.a.

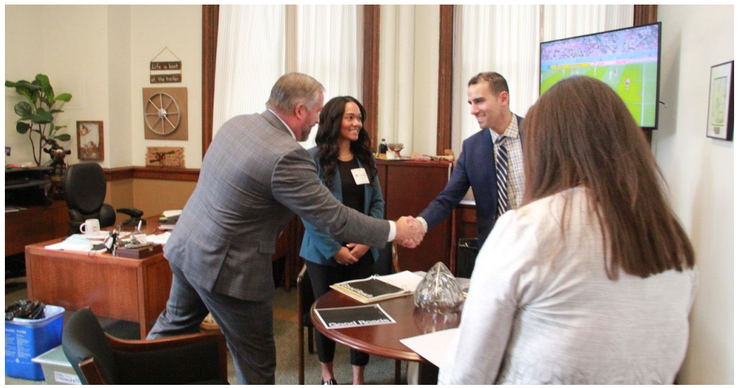
* Samples for Superpave aggregate consensus properties or other aggregate testing needs may be obtained by combining the tested aggregates following sieve analyses.
**This is a preliminary value based on limited data and possible impacts to VMA for high RAP content mixes.

NCHRP 752

Advocacy at Queens Park

Asking for Proper Utilizing of This Resource

- **Incentivize** ★★☆
  Tying additional infrastructure funding responsible RAP consumption
- **Promote** ★★★
  Province-led task force to bridge gaps f proper RAP consumption across the province
- **Mandate** ★☆☆
  Mandating a minimum percentage of RAP in road construction and maintenance



Final Remarks

What's Next?

- We will be publishing RAP inventory and HMA paving quantities annually
- Build a sound evidence base for promoting the economic and environmental benefits of using of RAP in road building across Ontario
- We are looking for input on successful stories on use of RAP to be featured in our guide
- Exploring possibility of including RAP stockpiling and processing in Trillium Plant Certification

Thank you to all industry partners that provided RAP quantities

Good Roads

Amin Mneina, MSc. EIT.

Coordinator, Technical Programs and Research

GoodRoads

Amin@GoodRoads.ca

G

R

Everything roads since 1894