2021 Initial Idea Development

2021-2022 NRRA Research and MnROAD Construction Development
(Updated Form – March 23, 2021)

Initial Proposal is for NRRA Executive Team to Approve for further development (keep to two pages)

Research Title:	Recycled Binder Availability
NRRA Team(s):	Flexible
Type of Effort:	**Research/Synthesis**
Developed By:	Texas A&M Transportation Institute
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Research Funding Estimate:	$200,000
Research Years Expected:	**3 years**
Beneficial Partnerships:	**DOTs who utilize reduced recycled binder availability (DE, GA, SC, LA for RAP; DE, IL, TN, NY, OH, SC, KY for RAS) & contractors interested in high RAM contents who constructed recent NCHRP or DOT research field projects**

Number of Test Sections:	4 test sections (two pairs) with minimum 500 tons of mixture each
Instrumentation Effort:	**Minimal**
MnROAD Monitoring:	**MnROAD staff will cover routine monitoring and dynamic testing as did before**

Research Objectives:

What are the objectives of this research effort?

To promote sustainability and ensure adequate performance, there is a need to consider the amount of asphalt binder available from recycled asphalt materials (RAM), including reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS). The use of recycled materials is growing due to economic and environmental benefits, yet there is no accepted method to quantify or account for the effective binder content available from these materials that represents larger fractions as RAM contents increase. AASHTO guidance on the design of asphalt mixtures with RAP and/or RAS assumes that 100% of the recycled binder is available to blend with virgin binder and any additives such as recycling agents or warm mix asphalt (WMA) products. In reality, the amount of recycled binder available is somewhere between 0% availability and near 100% availability, with lower availability for heavily aged RAP or RAS binder and mixtures produced at lower temperatures. Thus, the assumption of 100% availability leads to less overall effective binder content, yielding a dry mixture with insufficient coating that may be difficult to compact and exhibit inadequate durability and cracking performance in-service. These poor-performing pavements cost agencies due to reduced life and increased maintenance expenditures. This research will demonstrate the benefits of adequately quantifying binder availability from RAM and thus provide guidelines for their efficient use.

Different methods to quantify recycled binder availability will be explored and compared in a likely forthcoming NCHRP research project (based on #1 ranking from AASHTO COMP), but ***demonstration of the effects of adequate quantification of recycled binder availability in the field*** will be needed for implementation. The objective of this research effort is to provide this collaborative demonstration by comparing laboratory and field performance of at least two mixtures each with a pair of MnROAD test sections. Required steps to meet this objective include:

- Design 4 test sections to compare two mixture pairs with an assumed 100% recycled binder availability versus an adequately quantified reduced recycled binder availability and consider the following factors influencing available RAM binder: (1) recycled materials: type and source (aging

state), content (%), binder content, and gradation; (2) virgin binder: performance grade and capacity for use with high RAM; (3) virgin aggregate: gradation; (4) optional additive(s) including recycling agents or WMA products: type and dose; and (5) production: plant type, mixing and storage times and temperatures.

- Characterize binder and mixture performance in terms of balanced rutting and cracking performance and durability in the laboratory and field with laboratory-produced samples of plant mix and raw component materials and cores.
- Monitor field performance.
- Quantify the impact of adequately accounting for reduced RAM binder availability.
- Revise methods to incorporate binder availability into mix design developed in associated NCHRP project.

This collaborative effort will build on related research including:

- RAP binder availability factor (BAF) developed in NCHRP 09-58,
- RILEM Technical Committee 264 Task Group 5 method to characterize 100% RAP with indirect tensile strength after conditioning at different temperatures,
- NCHRP 20-44(24) Implementation Project to demonstrate guidelines in the draft AASHTO Standard Practice developed in NCHRP 09-58 with two field projects,
- TxDOT Project 0-7062 synthesis on recycled binder availability including a national survey,
- TxDOT Project to refine Balanced Mix Design (BMD) for high RAM mixtures, and
- NAPA QIP 131 contractor guidelines for using recycling agents in asphalt mixtures.

Pavement Test Cells Needed:

What test sections (MnROAD or other roadways) do you propose to provide data? (None, if synthesis).
A comparison of at least two mixtures each with a pair of test sections with an assumed 100% recycled binder availability versus an adequately quantified reduced recycled binder availability with respect to balanced rutting and cracking performance and durability would provide an engineering assessment of the impact of this important consideration.

NRRA Sustainability/Resiliency and or Intelligent Construction:

How will this project fit the primary themes of NRRA Phase-II efforts?
Improved assessment of binder availability from recycled materials in asphalt mixtures should yield improved compactability, durability, and cracking performance. The National Asphalt Pavement Association (NAPA) estimated that in the U.S. in 2019 the cost savings of using recycled materials totaled approximately $3.3 billion with 89 million tons of RAP and almost 1 million tons of RAS replacing virgin materials in asphalt mixtures. Since these recycled materials are used on a large scale, it is critical to understand their contribution to improved rutting resistance and compromised durability and cracking performance, which may be exacerbated by an assumption of 100% binder availability. Recycled binder availability is important to engineering each unique asphalt mixture so that sustainability goals and expected significant economic benefits are realized while producing mixtures with balanced engineering performance.

Cross-cutting Opportunities:

Can your idea fit with or utilize concepts proposed by other NRRA teams?
Loose mix aging procedure for BMD cracking resistance can be utilized
Evaluation tools for additives (if used) can be considered

Implementation Plan:

How do you envision implementing the findings from this study?
The results of this research will be used by state DOTs (specifically state DOT materials engineers) and other owner-agencies, asphalt mixture designers, and asphalt paving contractors to produce asphalt mixtures with balanced performance for pavements with recycled contents that are environmentally sustainable and economically viable.