

Reclaimed Asphalt Shingles - Demonstration Project



THE CITY OF
COLUMBUS
MICHAEL B. COLEMAN, MAYOR

DEPARTMENT OF
PUBLIC SERVICE

Presenters:

- Hassan Zahran, P.E.- Division of Design and Construction Administrator/City Engineer (Retired)
- Dan Johnson, P.E.- Construction Section Manager

Overview

- RAS overview
- Green Initiative request
- Ohio Epa Grant
- City of Columbus Citywide Resurfacing 2015 Project 1
- Specifications
- Mix Design
- Project Location
- Inspection
- Post-construction Monitoring

Thank you!

- Ohio Environmental Protection Agency -Grants Administrator- Chet Cheney
 - Community Recycling Grants
 - Litter Clean-up and Tire Amnesty Grants
 - Recycling Market Development Grants
 - Scrap Tire Grants
- Flexible Pavements of Ohio
 - Partner on Grant Application
 - Tremendous Resource on all things asphalt
- City of Columbus- Assistant Director of Sustainability- Randall Bowman, P.E.
 - Sustainability Policy Development
 - Coordination of Green Initiatives
 - Environmental Stewardship
 - Liaison to Mayor's Green Team

Reclaimed Asphalt Shingles (RAS)

- According to the U.S. Environmental Protection Agency, approximately 11 million tons of asphalt roofing shingles are disposed of each year. About one million tons is waste produced by the roofing manufacturers and about 10 million tons is waste produced by residential tear-off shingles. The 11 million tons amounts to about 8 percent of the nation's total building-related waste. Recycling this waste stream makes economical and environmental sense.
- The composition of shingles makes them an especially appropriate material for use in asphalt pavements. Shingles are typically composed of 25 to 30 percent asphalt cement, 40 to 60 percent hard aggregate contained on the 30 and 60 sieves and 3 to 12 percent fiber. All of these ingredients are routinely used in hot mix asphalt (HMA) pavements.

Several potential markets exist for asphalt shingles. These include:

- hot mix asphalt
- cold patch
- dust control on rural roads
- temporary roads or driveways
- aggregate road base
- new shingles
- fuel

Hot-Mix Asphalt (HMA)

- This is the largest current market for RAS. There are several benefits which can be derived from using RAS. These include:
- Reduced demand on virgin asphalt cement
- Reduced demand on aggregate
- Improved properties of HMA pavement

Hot-Mix Asphalt (HMA)

- The added asphalt cement decreases the demand for virgin asphalt cement. This has several benefits. Primarily, an economic advantage to the producers of HMA. Cutbacks from shingle factories can be ground up and immediately be added to the HMA process, or regenerated with rejuvenating chemicals prior to the HMA process. HMA requires certain gradations of aggregate. The ceramics in the shingles provide a source of aggregate, reducing the demand for mined aggregate. Certain properties of asphalt pavement have been shown to improve with the addition of RAS. These include rutting and cracking resistance. It is suspected that the added mineral fillers and organic fibers help reinforce the matrix.

Cold Patch

- The use of RAS as cold patch is a practice that has been employed for years. It has been used in New Jersey, Washington, and California as well as the city of Chicago. Advantages to using cold patch comprised of RAS include the following:
- Patches have a longer life compared to other patch materials. This is likely due to the fibers from the felts or fiberglass in shingles.
- The patch material is very easy to apply. A pothole is simply filled approximately an inch over grade. No equipment is needed as the patch may be compressed by vehicle traffic. The patch is also less dense than other materials, making it easier to haul.
- The RAS cold patch material can be stored longer because it does not "clump" as quickly as other materials

Dust Control

- Recycled asphalt shingles may be ground and mixed into the gravel used to cover rural, unpaved roads. The mixture leads to several improvements in these rural roads, including:
- Dust is minimized. An Iowa DOT ["Let Me Shingle Your Roadway"] study showed little or no dust for two years on a rural road.
- Reduced loss of gravel into side ditches.
- Vehicle noise is reduced.
- The roads have a longer life and require less maintenance. The study conducted by the Iowa DOT noted that the road performed well for at least two years.

Temporary Roads or Driveways/Aggregate Base

- RAS has been used in temporary roads, driveways, or parking lot surfaces. RAS is typically ground to 1/4 inch and passed under a magnetic separator in order to sufficiently remove all nails. The processed shingles are spread and compacted for an easily installed surface. In Altus, OK, RAS was mixed with RAP to create a parking lot surface.
- Little research has been conducted into this market, but shingles have been used as part of the sub-base in road construction. Processed shingles may be blended with recycled asphalt pavement and concrete. It is suspected that the addition of RAS may improve the compaction of the sub-base .

New Roofing Shingles/Fuel

A report prepared for the U.S. Department of Energy showed that the addition of up to 20% of recycled shingles did not affect the production of new shingles. They showed significant energy savings in using RAS

The recovery of the BTU value of waste shingles is an established market in Europe. Only recently has the concept been applied in the United States. It is very limited, however, because of concerns over air pollution.

Green Initiative Request

- June 2014- Asst. Director of Sustainability received a request regarding the usage of RAS in our Resurfacing Program
- August 2014- Met w/ Shelly Company- Vice President of Quality Control Larry Shively to discuss RAS usage
- October 2014 Met with Flexible Pavements of Ohio and Ohio Environmental Protection Agency to discuss RAS Usage
- November 2014 Developed List of Potential RAS Streets for review
- December 2014 Draft Grant Agreement
- February 2015 Grant Agreement Finalized
- April 2015 Notice to Proceed on 2015 Resurfacing Project 1
- June 2015 Began RAS Paving

Ohio EPA Grant

Project Type	Grant Funds Requested	Match Funds Committed	Total
Roadway Resurfacing	\$156,775	\$156,775	\$313,550

Targeted Material(s)	Annually Projected Tons (TPY)
ASPHALT CONCRETE SURFACE COURSE (HEAVY TRAFFIC) PG70-22M, RAS, AS PER PLAN and ASPHALT CONCRETE SURFACE COURSE (HEAVY TRAFFIC) PG64-22, RAS, AS PER PLAN	3,500-Tons

OEPA Grant Required Performance Tracking

- Visual Observations and Measurements conducted by CoC Test Lab
- Rutting and Cracking Monitoring
- Rate of increase in rutting and cracking
- Comparison of Standard Section
- Measured over a 5 year period with a Formal RAS performance report issued at the conclusion

Project Information

- INVITATION FOR BID:
- PROJECT NAME: RESURFACING – RESURFACING 2015 PROJECT 1
- DEPARTMENT NAME: DEPARTMENT OF PUBLIC SERVICE
- DIRECTOR: TRACIE R. DAVIES
- PROJECT NUMBER: 530282-912015
- Date Bids Due: 2/24/2015
- Low Bidder: Strawser Paving Company



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Bid Unit Prices

- Asphalt Concrete, Surface Course, (Heavy Traffic), PG 70-22M (1.5")
 - RAS APP mix 5% price increase vs. standard mix
- Asphalt Concrete, Surface Course, (Medium Traffic), PG 64-22 (1.25")
 - RAS APP mix 15 % price increase vs. standard mix

Specifications

ODOT 2013 CONSTRUCTION & MATERIAL SPECIFICATIONS



- 401.04 - Revised to allow Reclaimed Asphalt Shingles
- Supplemental Specification 800 revised the 2010 CMS in January 2011

Specifications

- ODOT 401.04
 - Maximum 5.0% RAS by dry unit weight of mix
 - Allowed RAS in Medium Traffic and Light Traffic Surface Course, Intermediate and Base Courses
 - Allowed RAS tear-offs in Intermediate and Base Courses
 - SUPPLEMENTAL SPECIFICATION 1116 Requirements for Suppliers of Reclaimed Asphalt Shingles Used in Asphalt Mixtures

Specifications

- SUPPLEMENTAL SPECIFICATION 1116 Requirements for Suppliers of Reclaimed Asphalt Shingles Used in Asphalt Mixtures
 - Reclaimed Asphalt Shingle Material Requirements
 - meets AASHTO MP 15-09, 3.2(manufacturing waste) and 3.3 (tear-offs from residential only).
 - Reclaimed Asphalt Shingle Supplier Approval Process
 - Obtain written approval as a RAS Supplier
 - Quality Control Requirements for RAS Suppliers
 - provide a separate quality control plan
 - Quality Assurance
 - Department or other agencies may visit the processing site

Mix Design



MARSHALL MIX DESIGN

Producer	90		
Project	Columbus Resurface		
Spec	441	Year	2015

ODOT SPEC. BAND			
Sieve	% Pass	Low	High
2" (50.8)	100	100	100
1-1/2" (38.1)	100	100	100
1" (25.4)	100	100	100
3/4" (19)	100	100	100
1/2" (12.7)	100	100	100
3/8" (9.5)	95	90	100
#4 (4.75)	54	50	72
#6 (2.36)	37	30	55
#16 (1.18)	27	17	40
#30 (0.6)	18	12	30
#50 (0.3)	9	5	20
#100 (0.15)	6	2	12
#200 (0.075)	3.1		

Mix Type
Usage: (1" for Surface)
Traffic Designation:
(1" if Heavy, 2" if Light)
Line Item Reference Number(s)
% Binder Content @ Max. Stability
% Binder Content @ Max. Unit Weight
% Binder Content @ Opt. Air Voids
Max. Theoretical @ Optimum
PG Grade by Proposal
% Virgin Binder
Virgin Binder Grade
Binder Supplier
Polymer Type (SBR -or- SBS)
Mixing Temperature
Compaction Temperature
F/A Ratio
50 - 30 Ratio
TSR Ratio
Loaded Wheel Test Results

Type 1 RAS 70-22M
Surface
Heavy
0023
6.2
2.418
PG 70-22M
5.0
PG 70-22M
Shelly-Tolado
SBS
315 F
295 F
0.5 OK
0 OK
NA OK

NOTES:

Lab No 20150067 COC

Coarse aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
56	#8	GR/LS	Shelly Materials-Columbus, Oh (Pugmill)	4502B-01	2.592

Fine aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
16	Sand	Natural	Mar Zene-Zanesville, Oh	04416-01	2.571
15	Sand	Limestone	Shelly Materials-Columbus, Oh	04502-01	2.602

*RAP & Shingles					
%	% AC	Type	Source	Composition	Gse
9	5.60	Standard	X	Composite 15-Fine Rap	Limestone 2.697
4	18.00		X	Pit 90 Shingles	Shingles 2.383
AVG	9.35				

*If RAP taken from State route, enter State route and project.

If other recycled material, or RAP taken from non-State route, enter size, type and source/location of fine and coarse aggregate, and source of information.

Blend Gsb = 2.590

For Official Use Only					
AT OPTIMUM AC CONTENT:					
Original Rc'd:	Resubmit Rc'd:	Air Voids		VMA	UnitWt
					(g) (m)
Maximum Theo.	Stability	Flow	Opt. At Median Air Voids?	2 Points Above and Below Opt.?	
			X	X	
Date Approved	JMF			Calibration #	

GR7004

Mix Design

THE Shelly COMPANY MARSHALL MIX DESIGN

Producer	90
Project	Columbus Resurface
Spec	441 Year 2015

ODOT SPEC. BAND			
Sieve	% Pass	Low	High
2" (50.8)	100	100	100
1-1/2" (38.1)	100	100	100
1" (25.4)	100	100	100
3/4" (19)	100	100	100
1/2" (12.7)	100	100	100
3/8" (9.5)	95	90	100
#4 (4.75)	54	50	72
#8 (2.36)	37	30	55
#16 (1.18)	27	17	40
#30 (0.6)	18	12	30
#60 (0.3)	9	5	20
#100 (0.15)	6	2	12
#200 (0.075)	3.1		

Mix Type	Type 1 RAS 70-22M
Usage: (1" for Surface)	Surface
Traffic Designation:	Medium
(1" if Heavy; 2" if Light)	0025
Line Item Reference Number(s)	
% Binder Content @ Max. Stability	
% Binder Content @ Max. Unit Weight	6.5
% Binder Content @ Opt. Air Voids	2.408
Max. Theoretical @ Optimum	PG 70-22M
PG Grade by Proposal	5.2
% Virgin Binder	PG 70-22M
Virgin Binder Grade	Shelly-Tolado
Binder Supplier	SBS
Polymer Type (SBR -or- SBS)	315 F
Mixing Temperature	295 F
Compaction Temperature	0.5 OK
F/A Ratio	0 OK
50 - 30 Ratio	NA OK
TSR Ratio	
Loaded Wheel Test Results	

NOTES:

Lab No 20150068 COC

Coarse aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
55	#8	GR/LS	Shelly Materials-Columbus, Oh (Pugmill)	4502B-01	2.592

Fine aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
16	Sand	Natural	Mar Zane-Zanesville, Oh	04416-01	2.571
15	Sand	Limestone	Shelly Materials-Columbus, Oh	04502-01	2.602

*RAP & Shingles					
%	% AC	Type	Source	Composition	Gas
10	5.50	Standard	Composite 15-Fine Rap	Limestone	2.697
4	18.00	Extended	Pit 90 Shingles	Shingles	2.383
AVG	9.07				

*If RAP taken from State route, enter State route and project.

If other recycled material, or RAP taken from non-State route, enter size, type and source/location of fine and coarse aggregate, and source of information.

Bland Calc = 2.591

For Official Use Only					
AT OPTIMUM AC CONTENT:					
Original Rc'd:	Resubmit Rc'd:	Air Voids		VMA	UnitWt
					(a) (b)
Maximum Theo.	Stability	Flow	Opt. At Median Air Voids?	2 Points Above and Below Opt.?	
			X	X	
Date Approved	JMF			Calibration #	

GR2094

Mix Design

THE shelly COMPANY
MARSHALL MIX DESIGN

Producer	90		
Project	Columbus Resurface		
Spec	441	Year	2015

ODOT SPEC. RAND			
Sieve	% Pass	Low	High
2" (50.8)	100	100	100
1-1/2" (38.1)	100	100	100
1" (25.4)	100	100	100
3/4" (19)	100	100	100
1/2" (12.7)	100	100	100
3/8" (9.5)	95	90	100
#4 (4.75)	54	50	72
#6 (2.36)	37	30	55
#16 (1.18)	27	17	40
#30 (0.6)	18	12	30
#60 (0.3)	9	5	20
#100 (0.15)	6	2	12
#200 (0.075)	3.1		

Mix Type	Type 1 RAS 64-22
Usage: (1" for Surface)	Surface
Traffic Designation:	Medium
(1" if Base, 1/2" if List 1)	
Live Item Reference Number(s)	0024
% Binder Content @ Max. Stability	
% Binder Content @ Max. Unit Weight	6.4
% Binder Content @ Opt. Air Voids	2.414
Max. Theoretical @ Optimum	Pg 64-22
PG Grade by Proposal	5.1
% Virgin Binder	PG 58-28
Virgin Binder Grade	Shelly-Cleveland
Binder Supplier	
Polymer Type (SBR -or- SBS)	290 F
Mixing Temperature	275 F
Compaction Temperature	
FIA Ratio	0.5 OK
50 - 30 Ratio	0 OK
TSR Ratio	NA OK
Loaded Wheel Test Results	

NOTES:

Lab No 20150066 COC

Coarse aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
55	#8 BLD	GR / LS	Shelly Materials-Columbus, Oh (Pugmill)	4502B-01	2.592

Fine aggregate					
%	Size	Type	Producer/Location	Code	ODOT Gsb
16	Sand	Natural	Mar Zane-Zanesville, Oh	04416-01	2.571
15	Sand	Limestone	Shelly Materials-Columbus, Oh	04502-01	2.602

*RAP & Shingles					
%	% AC	Type	Source	Composition	Gse
10	5.50	Standard X	Composite 15-Fine Rap	Limestone	2.697
4	18.00	X	Pit 90 Shingles	Shingles	2.383
AVG	9.07				

*If RAP taken from State route, enter State route and project.

If other recycled material, or RAP taken from non-State route, enter size, type and source/location of fine and coarse aggregate, and source of information.

Blend Gsb = 2.591

For Official Use Only					
AT OPTIMUM AC CONTENT:					
Original Rc'd:	Resubmit Rc'd:	Air Voids	VMA	UnitWt	
				(g)	(g)
Maximum Theo.	Stability	Flow	Opt. At Median Air Voids?	2 Points Above and Below Opt.?	
			X	X	
Date Approved	JMF			Calibration #	

08/2004

Mix Design

- All mix designs (three) included 4% of the max 5% RAS by dry unit weight
- Mix designs used between 9 and 10 % RAP in each mix
- RAS was pre-blended with the RAP prior to incorporating into the mix

Mix Design



Plans- RECLAIMED ASPHALT SHINGLES (RAS)

- GEORGESVILLE ROAD
- ITEM 448 ASPHALT CONCRETE SURFACE COURSE (HEAVY TRAFFIC) PG70-22M, RAS, AS PER PLAN (1.5") - AT THE LOCATIONS SPECIFIED, USE CITY OF COLUMBUS CMS 448 MIX PRODUCED WITH RECLAIMED ASPHALT SHINGLES (RAS) MANUFACTURING WASTE ONLY AT NOT LESS THAN 4% AND UP TO 5.0% RAS PER DRY WEIGHT OF MIX AND PER ODOT 401.04; TABLE 401.04-1. RAP MAY BE USED WITH THE RAS PER ODOT 401.04 WITH A TOTAL RECLAIMED PRODUCT NOT MORE THAN 20%. ENSURE MANUFACTURING WASTE RAS COMES FROM APPROVED ODOT QCP SOURCES. IT SHALL BE UNDERSTOOD THAT THE RAS AND RAP 448 ASPHALT CONCRETE MATERIALS USED AT THE SPECIFIED LOCATIONS FOLLOW ODOT 401.04 FOR THE RAS AND RAP ADIMIXTURES ONLY.

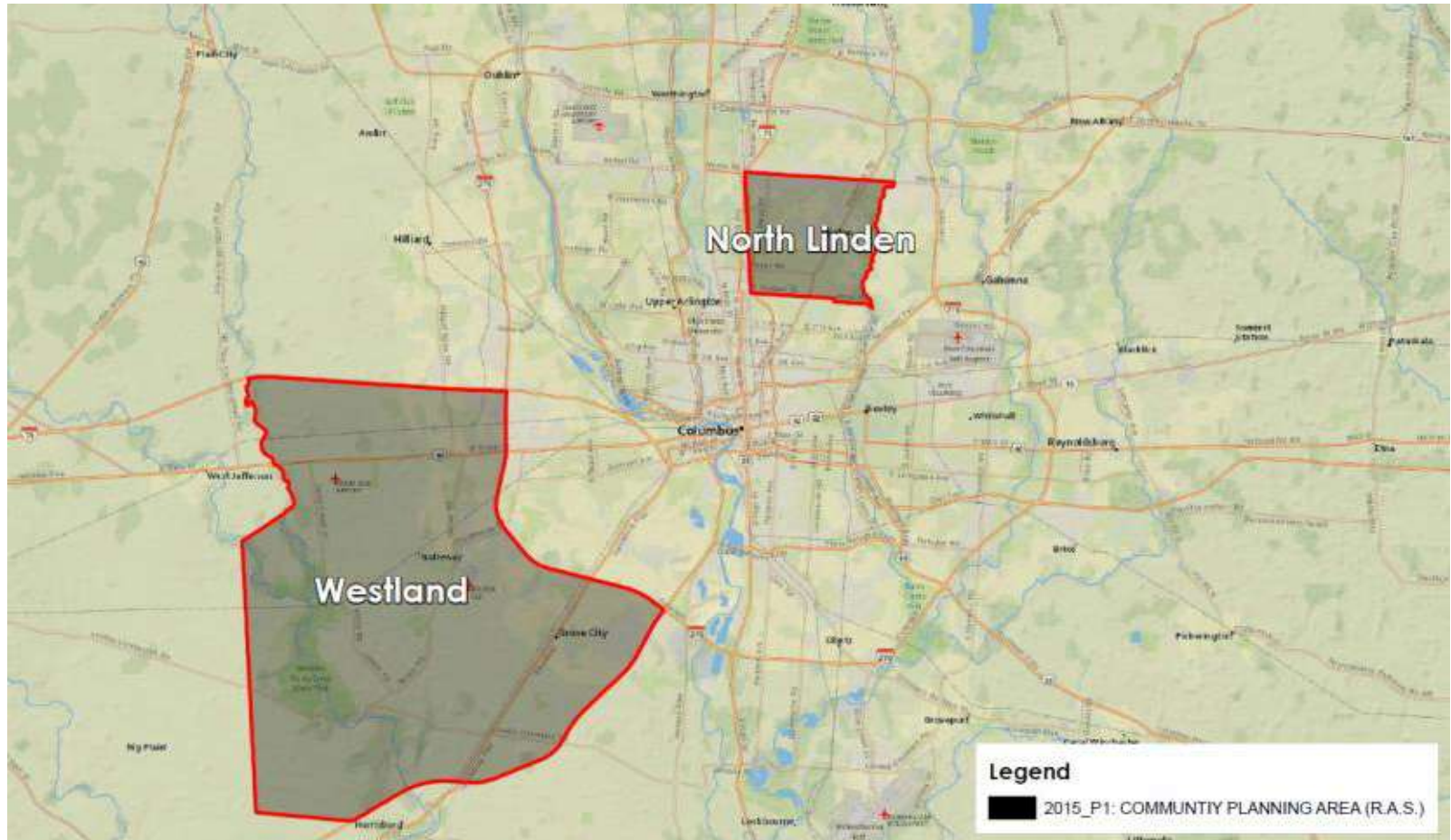
Plans- RECLAIMED ASPHALT SHINGLES (RAS)

- WEBER ROAD
- ITEM 448 ASPHALT CONCRETE SURFACE COURSE (MEDIUM TRAFFIC) PG70-22M, RAS, AS PER PLAN (1.5") - AT THE LOCATIONS SPECIFIED, USE CITY OF COLUMBUS CMS 448 MIX PRODUCED WITH RECLAIMED ASPHALT SHINGLES (RAS) MANUFACTURING WASTE ONLY AT NOT LESS THAN 4% AND UP TO 5.0% RAS PER DRY WEIGHT OF MIX AND PER ODOT 401.04; TABLE 401.04-1. RAP MAY BE USED WITH THE RAS PER ODOT 401.04 WITH A TOTAL RECLAIMED PRODUCT NOT MORE THAN 20%. ENSURE MANUFACTURING WASTE RAS COMES FROM APPROVED ODOT QCP SOURCES. IT SHALL BE UNDERSTOOD THAT THE RAS AND RAP 448 ASPHALT CONCRETE MATERIALS USED AT THE SPECIFIED LOCATIONS FOLLOW ODOT 401.04 FOR THE RAS AND RAP ADIMIXTURES ONLY.

Plans- RECLAIMED ASPHALT SHINGLES (RAS)

- RESIDENTIAL STREETS
- ITEM 448 ASPHALT CONCRETE SURFACE COURSE (MEDIUM TRAFFIC) PG64-22, RAS, AS PER PLAN (1.25") - AT THE LOCATIONS SPECIFIED, USE CITY OF COLUMBUS CMS 448 MIX PRODUCED WITH RECLAIMED ASPHALT SHINGLES (RAS) MANUFACTURING WASTE ONLY AT NOT LESS THAN 4% AND UP TO 5.0% RAS PER DRY WEIGHT OF MIX AND PER ODOT 401.04; TABLE 401.04-1. RAP MAY BE USED WITH THE RAS PER ODOT 401.04 WITH A TOTAL RECLAIMED PRODUCT NOT MORE THAN 20%. ENSURE MANUFACTURING WASTE RAS COMES FROM APPROVED ODOT QCP SOURCES. IT SHALL BE UNDERSTOOD THAT THE RAS AND RAP 448 ASPHALT CONCRETE MATERIALS USED AT THE SPECIFIED LOCATIONS FOLLOW ODOT 401.04 FOR THE RAS AND RAP ADIMIXTURES ONLY.

RAS Asphalt Placement Areas



RAS Asphalt Placement Areas

- Reviewed the streets being resurfaced on Resurfacing 2015 P-1
- Recommended RAS streets to maximize the widest range of traffic types
- Selected areas with previous pavement rutting to observe future pavement performance
 - Arterial Streets (heavy truck and bus use)
 - Collector Streets (routine bus use)
 - Residential Streets (light traffic)







RAS Asphalt Quantities Placed

- Georgesville Rd. RAS quantities PG70-22M Heavy RAS (1.5")
 - 1069.77 C.Y.
- Weber Rd RAS quantities PG70-22M Medium RAS (1.5")
 - 351.68 C.Y.
- Residential street RAS quantities PG64-22M Medium RAS (1.25")
 - 272.59 C.Y.
- Total 1694 C.Y. - approx. 3400 tons



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Expectations

- Reduced rutting and deformation on heavy traffic areas
- Reduced cracking on all streets where RAS asphalt is used throughout the project
- Improved life cycle costs (maintenance and resurfacing frequency)
- Improved sustainability through increased recycling and reduction in natural resource consumption and waste diversion from landfills

Future Considerations

- Continued monitoring proves successful
 - Supplemental Specification 1100
 - Implementation in the 2017 Specification rewrite
- 3400 tons placed at 4% RAS = 140 tons of shingles kept out of landfills
- COC current annual resurfacing program just under \$30 million
 - Places approx. 55,000 C.Y. or 110,000 tons of asphalt
 - @ 4% RAS = 4400 tons of shingles
 - @ 6 % RAS = 6600 tons of shingles
 - @ 8 % RAS = 8800 tons of shingles



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Acknowledgements:

- Ohio EPA
- Flexible Pavements of Ohio
- Shelly Company
- Strawser Paving Company
- Ohio Department of Transportation
- City of Columbus Design Section
- ShingleRecycling.org
- National Asphalt Paving Association



Questions?