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ILLINOIS HIGHWAY MATERIALS SUSTAINABILITY EFFORTS OF 2015

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16. Abstract

This report provides a summary of the sustainability efforts of the Illinois Department of Transportation (IDOT) in recycling reclaimed materials in highway construction during calendar year 2015. This report meets the requirements of Illinois Public Act 097-0314 by documenting IDOT's efforts to reduce the carbon footprint and achieve cost savings through the use of recycled materials in asphalt paving projects. Research efforts undertaken and those that will have a future impact on IDOT's sustainability efforts are also highlighted.

In 2015, 2,009,972 tons of reclaimed or recycled materials, valued at $59,715,613, were used in Illinois highways. It was estimated that the substitution of virgin materials with reclaimed and recycled materials resulted in a net reduction of carbon dioxide emissions of 132,247 tons.

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- We are greatly indebted to the hot-mix asphalt contractors and their staff for providing information on use of reclaimed asphalt shingles.
- We thank Jody Meador and Tom Schutzbach of the Materials Integrated System for Test Information and Communication (MISTIC) Unit for assembling data on recycled material use.
- We thank Jan Yates for coordinating the survey on contractor use of shingles.

EXECUTIVE SUMMARY

Increased awareness of sustainability in transportation has encouraged the Illinois Department of Transportation (IDOT) to use more quantities of reclaimed and recycled materials in highway construction. Recycled materials are used in highway construction to supplement natural aggregates, concrete, hot-mix asphalt (HMA), steel, and sealants, as well as for soil modification and pavement markings. This report provides a summary of IDOT's efforts in the use of recycled materials in 2015, along with specific reporting on use of shingles, efforts to reduce the carbon footprint, and efforts to achieve cost savings through the use of recycled materials, as required by Illinois Public Act 097-0314.

The recycled materials currently tracked are summarized in four major groups related to uses of aggregate, HMA, concrete, and other. Aggregate use consists of recycled concrete material (RCM) and reclaimed asphalt pavement (RAP) used as an aggregate in lieu of natural aggregates. The HMA category includes slags used as friction aggregate, RAP, and reclaimed asphalt shingles (RAS). Concrete-related materials include fly ash, ground granulated blast furnace slag, and microsilica used to replace cement or provide specific properties to the final concrete product. The "other" category is made up of by-product lime used for soil modification, glass beads used for pavement-marking retroreflectivity, ground tire rubber used for rubberized pavement sealant, and steel used for reinforcement.

In 2015, reclaimed and recycled materials totaling 2,009,972 tons were used in Illinois highways. This represented more than a 366,000 ton, or 22%, increase over 2014 quantities. Funding for construction projects from fiscal year (FY) 2014 to FY 2015 increased 31%, which was the prime driver in increased recycling quantities. Funding level and the portfolio of project types were major factors influencing recycle levels. On a tons-per-mile basis, the amount of recycled materials used in 2015 decreased from 2014 levels but maintained a nearly threefold increase over the recycled content of 2009 construction. It should be noted that the 2014 report used incorrect data for the program record, which has been corrected in this report. The recycled materials used in 2015 were valued at more than $59 million, a slight increase from 2014 related primarily to increases in quantities. Some of the recycled materials values reflected general commodity deflation trends related to crude oil in 2015.

The amount of RAS used in 2015 was 55,362 tons, which was a 47% increase from the 2014 use of 37,756 tons. The main driver for this was the 32% increase in pavement miles in the program and increased use of RAS downstate. The number of IDOT districts for which contractors produced HMA containing RAS remained at seven in 2015.

While reporting tons of materials is an easy measure, it does not represent the true environmental benefit of recycling the various materials. This report estimates the equivalent carbon dioxide (CO_2EQ) emissions savings of the recycled materials used by IDOT. The use of fly ash resulted in the greatest environmental benefit, by replacing energy-intensive cement. It is estimated that IDOT's recycling efforts reduced CO_2EQ emissions by 132,247 tons in 2015. The use of fly ash accounted for approximately 50% of the reduction in emissions.

In 2015, work was conducted on eight material sustainability-related research projects at the Illinois Center for Transportation.

Projects that recently produced interim or final reports are as follows:

R27-124: Evaluation of Aggregate Subgrade Materials Used as Pavement Subgrade/Granular Subbase. This study concluded with publication of a final report.

R27-125: Sustainable Aggregates Production: Green Applications for Aggregate By-Products. This study concluded with publication of a final report.

R27-128: Testing Protocols to Ensure Performance of High Asphalt Binder Replacement Mixes Using RAP and RAS. This study produced a final report summarizing the work. Implementation outcomes were development of a testing method and new parameter called the flexibility index (FI). This work has been accepted by the American Association of State Highway and Transportation Officials as a provisional test method. Equipment manufacturers are producing and marketing the specialized equipment to run the test and determine the FI.

R27-161: Construction and Performance Monitoring of Various Asphalt Mixes. This study produced an interim report to document construction of overlays in 2014 and reported on the performance of all sections under study after the 2014/2015 winter.

R27-SP28: Evaluation of the Impacts of Re-Refined Engine Oil Bottoms (ReOB) on Performance Graded Asphalt Binders and Asphalt Mixtures. This study concluded with publication of a final report.

R27-SP29: Thermodynamics Between RAP/RAS and Virgin Aggregates During Asphalt Concrete Production—A Literature Review. The results of the literature review were published in a report.

Projects that were initiated in 2015 are as follows:

R27-162: Chemical and Compositional Characterization of Recycled Binders. A report is expected at the end of 2016.

R27-168: Field Performance Evaluations of Sustainable Aggregate By-Product Applications (Phase II). A report is expected in 2018.

CONTENTS

FIGURES

CHAPTER 1: INTRODUCTION

This report is part of a series of annual reports published since 2010 to document recycling and sustainability efforts of the Illinois Department of Transportation (IDOT). This report also meets the reporting requirements of Illinois Public Act 097-0314 (Illinois General Assembly 2012).

Various past reports by IDOT and the Illinois Center for Transportation (ICT) provide excellent background information on reclaimed and recycled materials used in highway construction (Brownlee 2011, 2012; Brownlee and Burgdorfer 2011; Griffiths and Krstulovich 2002; IDOT 2013; Lippert and Brownlee 2012; Lippert et al. 2014, 2015; Rowden 2013).

In 2012, Illinois Public Act 097-0314 called on IDOT to report annually on efforts to reduce its carbon footprint and to achieve cost savings through the use of recycled materials in asphalt paving projects (IDOT 2013; Lippert and Brownlee 2012; Lippert et al., 2014, 2015; Rowden 2013). The act also required IDOT to allow the use of asphalt shingles in all hot-mix asphalt (HMA) mixes as long as such use does not cause negative impacts to life-cycle cost.

Illinois has many years of experience using various reclaimed and recycled materials in highway construction. These materials tend to be aggregates or materials that extend cement or asphalt. Fly ash and ground granulated blast furnace slag (GGBFS) have been added to concrete in Illinois for over 50 years. These additions reduce the amount of cement (a carbon-intensive material) required, while also lending other desirable properties to concrete. Reclaimed asphalt pavement (RAP) has been in use since the early 1980s, and its use is widely accepted.

Other materials, such as reclaimed asphalt shingles (RAS), have a much shorter history of use. Until 2011, IDOT was conducting experimental projects using asphalt shingles in HMA. With the passage of Public Act 097-0314, specifications were developed and adopted to allow RAS to be used on all IDOT projects if the contractor chose to do so (Lippert and Brownlee 2012).

This report is structured to first cover the use of all reclaimed and recycled materials in Illinois highway construction in 2015. Next, IDOT's efforts in utilizing RAS are presented. Following that, a life-cycle assessment based on available information is presented to better portray the environmental benefits of recycling the various materials. Finally, the report provides an overview of research projects that will provide long-term improvements to the life cycle of pavements using recycled materials.

CHAPTER 2: USE OF RECLAIMED AND RECYCLED MATERIALS IN ILLINOIS HIGHWAY CONSTRUCTION IN 2015

2.1 REPORTING HISTORY

The first report on using recycled materials in Illinois highway construction was published in 2002 to answer various inquiries on recycling (Griffiths and Krstulovich 2002). After this first effort to report on recycled materials, a follow-up report was not produced until 2010 construction information was available (Brownlee and Burgdorfer 2011). Reporting of recycled material use has since been on an annual basis. (Brownlee 2011, 2012; Lippert et al. 2014; 2015; Rowden 2013). The 2012 report on materials recycled provided the most in-depth overview of how each material is derived and used in highway construction (Rowden 2013). The 2013 report provided benchmark performance measures on recycled material use on a per-mile basis rather than total quantity (Lippert et al. 2014).

This 2015 report uses the same basic methodology for determining quantities as used in past reports—that is, data from IDOT's Materials Integrated System for Test Information and Communication (MISTIC). Information from MISTIC is summarized to report quantities of each material recycled. There was no significant change in data collection methodology since the 2013 report on recycled material use (Lippert et al. 2014).

2.2 RECLAIMED AND RECYCLED MATERIALS ADDED OR DELETED IN 2015

During the 2015 reporting year, the same materials as in past years were recycled into Illinois highways, including air-cooled blast furnace (ACBF) slag, by-product (BP) lime, fly ash, glass beads, ground granulated blast furnace slag (GGBFS), ground tire rubber (GTR), microsilica, RAP (for use as an aggregate and in HMA), RAS, recycled concrete material (RCM), reinforced steel, and steel slag. No new materials were added or old materials deleted in 2015.

2.3 MATERIALS RECLAIMED AND RECYCLED IN 2015

2.3.1 Determining Recycle Quantities

The manufacturing stream for each material listed in this report has been reviewed (Rowden 2013). The reported quantities pertain to the materials for which the amount of recycled material can be soundly documented through existing records. Items such as steel reinforcement and glass beads are composed of 100% recycled materials as a result of how those materials are manufactured, and thus are simple to report. Many additional tons of recycled materials are used by IDOT and local agencies, but tracking quantities used is impractical. For example, recycled steel is used in large steel shapes for bridge construction; however, the amount of recycled material varies in each steel heat or batch. Information on the recycled content of such items is not available and therefore not reported.

While MISTIC reports are the source of material quantities for most of the reported materials, there are two exceptions—namely, glass beads and RAS. The reported quantity for glass beads is based on quantities accepted for use in the State of Illinois. This quantity includes use by some local agencies. Also included in the MISTIC data are quantities for state-let local agency projects. The reported

quantity of RAS is based on contractor provided amounts used on each 2015 HMA contract. For one firm no longer in business, MISTIC data of record was used for contract tonnage.

2.3.2 Economic Values of Recycled Materials

Economic values for the various materials were updated to provide a reasonable comparison from year to year. For 2015 pricing, a statewide average was determined from supplier- and contractor-provided information. For items that have price indexes, such as steel, the monthly IDOT index was averaged for the year (IDOT 2016b). For RAP used in HMA, a combination of the annual index average for the asphalt index price and statewide aggregate prices was used to determine the 2015 value. For RAP used as an aggregate, a typical value was determined.

2.3.3 Recycled and Reclaimed Material Quantities and Values for 2015

2.3.3.1 Summary of 2015 Use

In 2015, a total of 2,009,972 tons of material were recycled, which was a 366,024 ton, or 22%, increase in recycled tonnage from 2014. The value of 2015 recycled materials was $59,715,613, which was a $1,680,418, or 3%, increase from 2014. In 2015, the miles of roadway improvement increased, the number of bridges constructed or rehabilitated decreased, and the value of projects awarded increased from 2014, which impacted recycled quantities on an overall basis. Details regarding the 2015 recycled and reclaimed material quantities and values can be found in Appendix A.

2.3.3.2 Data Analysis of 2015 Use

To present a more accurate picture of IDOT's recycling effort, a series of figures are presented that provide information on 2015 results as well as historical trends. As can be seen in Figure 1, three materials make up the bulk of the recycled tonnage: RAP in HMA mix, followed by recycled concrete material (RCM), and finally RAP as an aggregate.

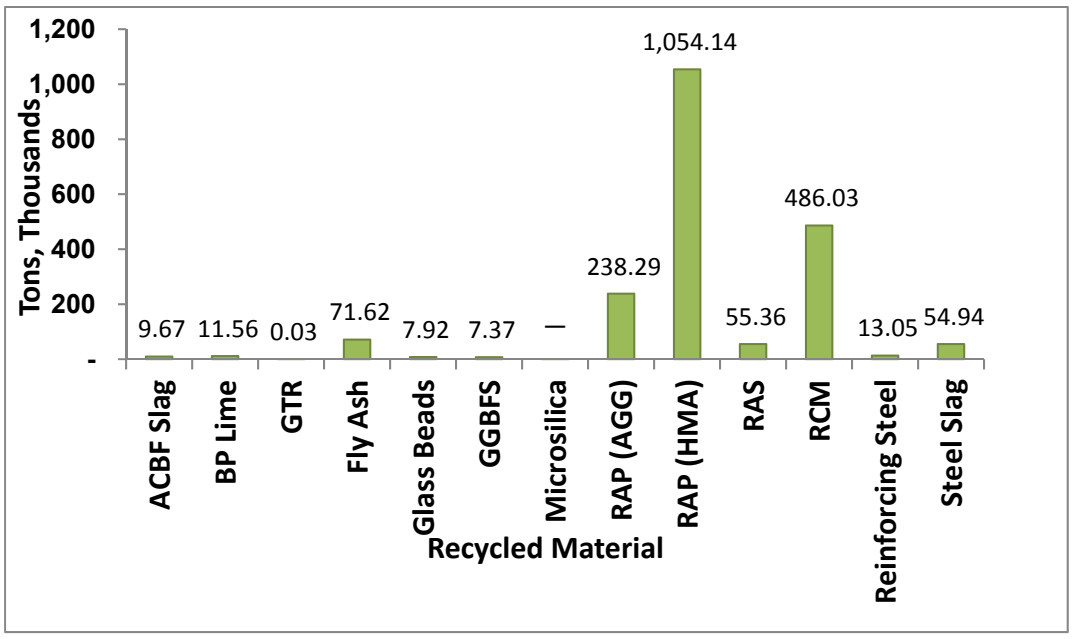

Figure 1. Recycled material use in 2015.

Figure 2 breaks out quantities by related uses for HMA, aggregate, concrete, and other. The HMA category includes slags used as friction aggregate (in HMA), RAP, and RAS. Concrete-related materials include fly ash, GGBFS, and microsilica used to replace cement or provide specific properties to the final concrete product. Aggregate use consists of RCM and RAP used in lieu of natural aggregates. The "other" category consists of by-product lime, glass beads, GTR, and steel. From this breakout, one can see that the majority of recycled tonnage is related to HMA and aggregate uses.

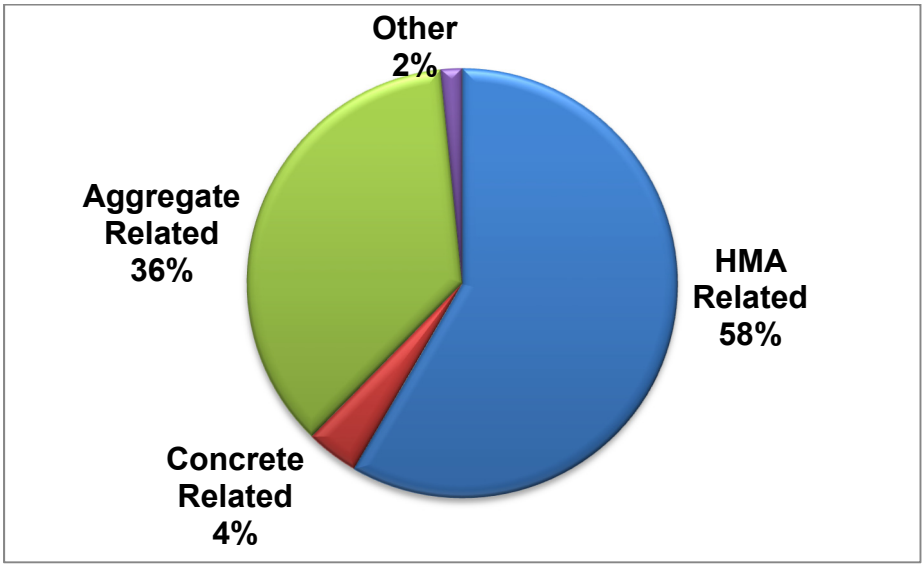

Figure 2. Recycled materials by related tons of use in 2015.

2.4 HISTORICAL RECYCLING TRENDS

2.4.1 Data Analysis from 2009 to 2015

2.4.1.1 Recycling Relationship to Program Budget

Recycling quantities are highly correlated to the overall budget and portfolio of project types within that budget year. In general, resurfacing projects result in RAP being produced and used. Major reconstruction or new alignment (greenfield) projects can use substantial amounts of recycled material. On the other hand, bridge projects tend to use limited amounts of materials because of the short lengths involved with these types of projects.

Figure 3 presents the total tons recycled from calendar years (CY) 2009 through 2015. Also presented in this figure by fiscal year (FY) are the values of projects awarded, centerline miles paved/improved, and number of bridges built/improved (IDOT 2015). Note that FY is not the same time frame as the CY reported for recycled tonnage because IDOT's FY is July 1 through June 30. However, the values tend to roughly align themselves on a CY basis because of the delay between the award of contracts and use of materials in the project. For the purpose of this report, it was considered reasonable to use all data as if they had been from the same time period by CY. It should be pointed out that in the writing of the report on sustainability efforts of 2014 (Lippert et al. 2015), incorrect values were obtained from *"For the Record* (IDOT 2014)," resulting in lower values for reported miles, number of bridges,

and program size. These values have been corrected for the 2014 data in this report, as shown in Figures 3 and 4.

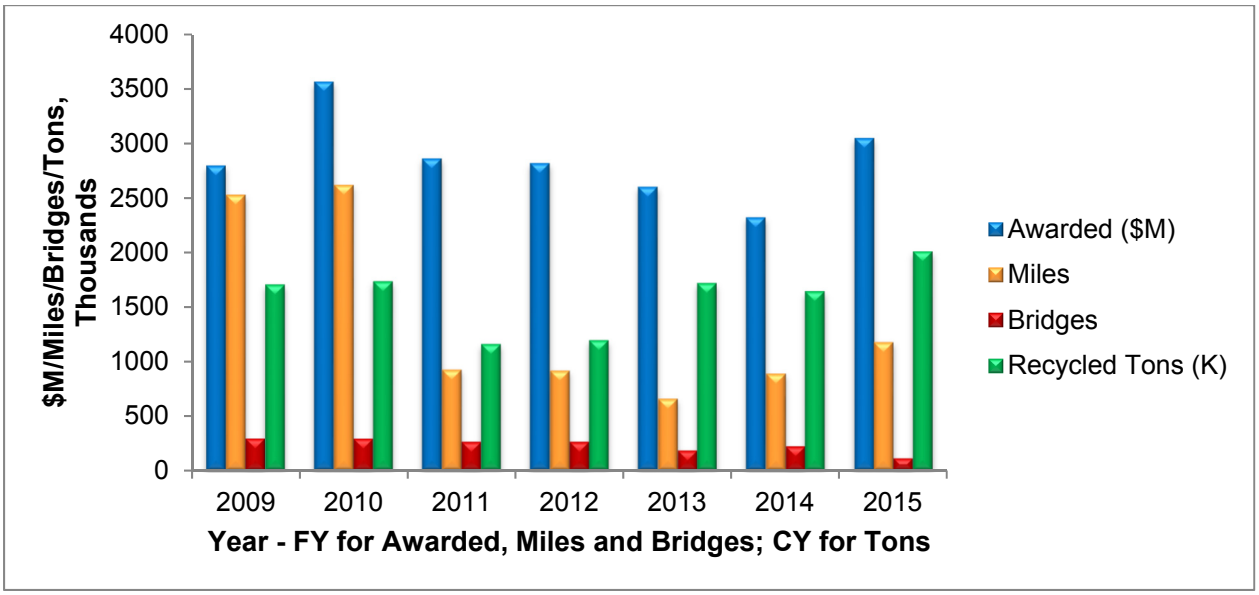

Figure 3. Annual projects awarded (FY), miles improved (FY), bridges built/improved (FY), and recycled tons (CY).

2.4.1.2 Determination of Recycled Content

A method was developed to determine the general recycle content by calendar year, in order to provide a measurement of IDOT's recycling efforts (Lippert et al. 2014). Figure 4 presents the results of determining the average tons of recycled material for each centerline mile of improvement from 2009 to 2015. On a tons-per-mile basis, 2015 represents a slight reduction of approximately 4% in recycle content from 2014—but still nearly a threefold increase in recycled content since 2009.

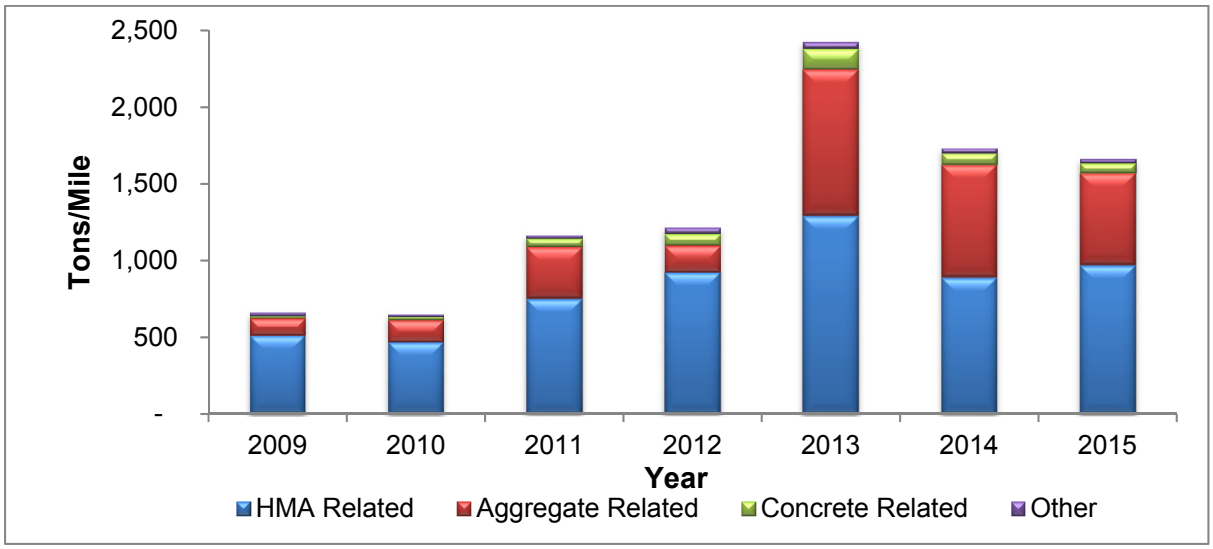

Figure 4. Recycled content from 2009 through 2015.

2.5 REGIONAL/DISTRICT RECYCLING EFFORTS

A few of the districts have developed their own special provisions. The materials recycled under these special provisions are reported as part of normal materials acceptance and contribute to the quantities reported in Appendix A. The previous reports described the special provisions in effect at the time (Lippert et al. 2014, 2015). Unless a change is noted here the previous special provision is still in use. This report provides a summary of changes during 2015, as shown in Appendix B. Comments on special provision modifications are provided below.

2.5.1 Aggregate Subgrade Improvement (D-1)

2.5.1.1 Revised March 3, 2015. This special provision outlines the use of RAP as part of subgrade improvement for use in pavement sections. The changes issued outline requirements on calibration of feeders, non-mechanical blended RAP limit amount and clarifies the use of round gravel.

2.5.2 Friction Aggregate (D-1)

2.5.2.1 Revised July 24, 2015. This special provision describes aggregate use for adequate friction in HMA surfaces. The changes provided restrictions on the use of crushed concrete and crushed gravel in Mix E and Stone Matrix Asphalt (SMA) N80 mixes.

2.5.3 Reclaimed Asphalt Pavement and Reclaimed Asphalt Shingles (D-1)

This Special Provision provides for mixes unique to the district such as 4.75mm sand level binders and SMA mixes. Several changes were made during 2015 as follows:

2.5.3.1 Revised January 2, 2015. The main change incorporated with this revision was the adoption of a revised RAS stone bulk specific gravity (Gsb) of 2.3.

2.5.3.2 Revised April 2, 2015. The main change incorporated with this revision was the reinstatement of higher asphalt binder replacement (ABR) levels (recycled asphalt from RAP and RAS).

2.5.3.3 Revised July 24, 2015. The main change incorporated with this revision was a coarser gradation for RAP when used as a shoulder aggregate.

CHAPTER 3: RECLAIMED ASPHALT SHINGLES

This chapter is a continuation of reporting on the specific status and use of RAS as required by Illinois Public Act 097-0314 (Illinois General Assembly 2012). Four previous reports provided details of RAS adoption (IDOT 2013; Lippert and Brownlee 2012; Lippert et al. 2014, 2015). Because of known under-reporting of RAS quantities in the MISTIC database, the contractor-provided information was deemed more accurate and is reported herein. An update of where quantities of RAS are being used, along with specifications, is presented to document activities for 2015.

3.1 RAS POLICIES AND SPECIFICATIONS IN EFFECT FOR 2015

3.1.1 RAS Policy for Sources

The BMPR Policy Memorandum "Reclaimed Asphalt Shingle (RAS) Sources" (28-10.3) continued to be in effect for all 2015 RAS production and represents no change in policy since 2012 (IDOT 2012). During 2015, IDOT added three new RAS suppliers, increasing the count of listed suppliers to 16. The current listing of RAS sources can be found on IDOT's website (IDOT 2016a).

3.1.2 RAS Specifications

3.1.2.1 Statewide Specifications

The Bureau of Design and Environment (BDE) specification "Reclaimed Asphalt Pavement and Reclaimed Asphalt Shingles (BDE)," effective November 1, 2012, was revised on January 2, 2015 and used throughout 2015. Past revisions to the original 2012 specification can be found in previous reports (IDOT 2013; Lippert, et al. 2014, 2015). Since this was a single revision pertaining to the RAS stone bulk specific gravity (Gsb), only the change in Article 1031.07 is presented in Appendix B.

3.1.2.2 Regional/District Specifications

As noted in Section 2.5, during 2015, Region 1/District 1 used its own special provision for RAP and RAS. The district special provisions are provided in Appendix B.

3.2 QUANTITY OF RAS USED IN CALENDAR YEAR 2015

As previously reported, the ability to perform a query of RAS tons used on state projects is limited by the MISTIC database (Lippert et al. 2014), which could lead to under-reporting RAS quantities. For that reason, contractor input was sought to confirm quantities on a project-by-project basis.

In 2015, IDOT experienced a 47% increase in RAS use—to 55,362 tons from 37,756 tons in 2014 (Lippert et al. 2015). The increase is attributed to a 32% increase in roadway miles paved and the addition of RAS suppliers. The majority of the increased RAS used was in Districts 1 and 9.

In 2015, seven of the districts reported use of RAS. Appendix C presents the percentage of the 2015 statewide total RAS used by each IDOT district. District 1 reported highest use of RAS, followed by District 9 and District 2.

CHAPTER 4: ENVIRONMENTAL EVALUATION OF RECYCLED MATERIALS USED IN 2015

There is a long history of using reclaimed and recycled materials in highways, more from a cost savings approach of using local or low-cost waste materials to achieve the same function as virgin material. Relatively new is the ability to perform an environmental evaluation of substituting these alternative materials from the perspective of carbon emissions.

4.1 LIFE-CYCLE ASSESSMENT

For this report, the environmental evaluation was conducted in a similar fashion, using life-cycle assessment (LCA), as was introduced in the previous report (Lippert et al. 2015). A main assumption is that the performance of the highway infrastructure item is considered equivalent for both virgin and recycled options.

To briefly recap this approach here, the example of aggregate production is used. For virgin aggregate, the material must be mined, crushed, sized, transported to the site, placed, compacted, and used for the duration of the facility, then salvaged or wasted at the end of the facility's life. Fuel and electricity use can be assigned to each step in the process. Recycled aggregates have an advantage in that they do not have the economic or environmental burden of mining, which is a major part of the environmental savings when using recycled aggregate. Recycled aggregate would still have the impacts as virgin aggregate associated with processing (crushing, screening, and stockpiling). The measure used in this evaluation of emissions is carbon dioxide equivalents per ton of material used, or CO_2EQ.

Replacing aggregate with recycled aggregate results in CO_2EQ emission savings; however, the impact is generally low because the aggregate is a relativity low carbon–intensive material in its production. On the other hand, when energy-intensive materials such as lime and cement are replaced with by-products such as fly ash, by-product lime, or GGBFS, very high savings of CO_2EQ can be realized.

From this simple LCA analysis, it is estimated that a total of 132,247 tons of CO_2EQ were saved in 2015, which is a greater environmental benefit compared with the 114,719 tons of CO_2EQ emissions saved in 2014. Accounting details of CO_2EQ emissions saved in 2015 are presented in Appendix A.

The environmental burden saved by material for 2015 is presented in Figure 5. This is a very different picture than Figure 1, which shows tons of material use by recycled material. Likewise, Figure 6 shows the distribution of CO_2EQ savings by related use, which differs greatly from the tonnage distribution presented previously in Figure 2.

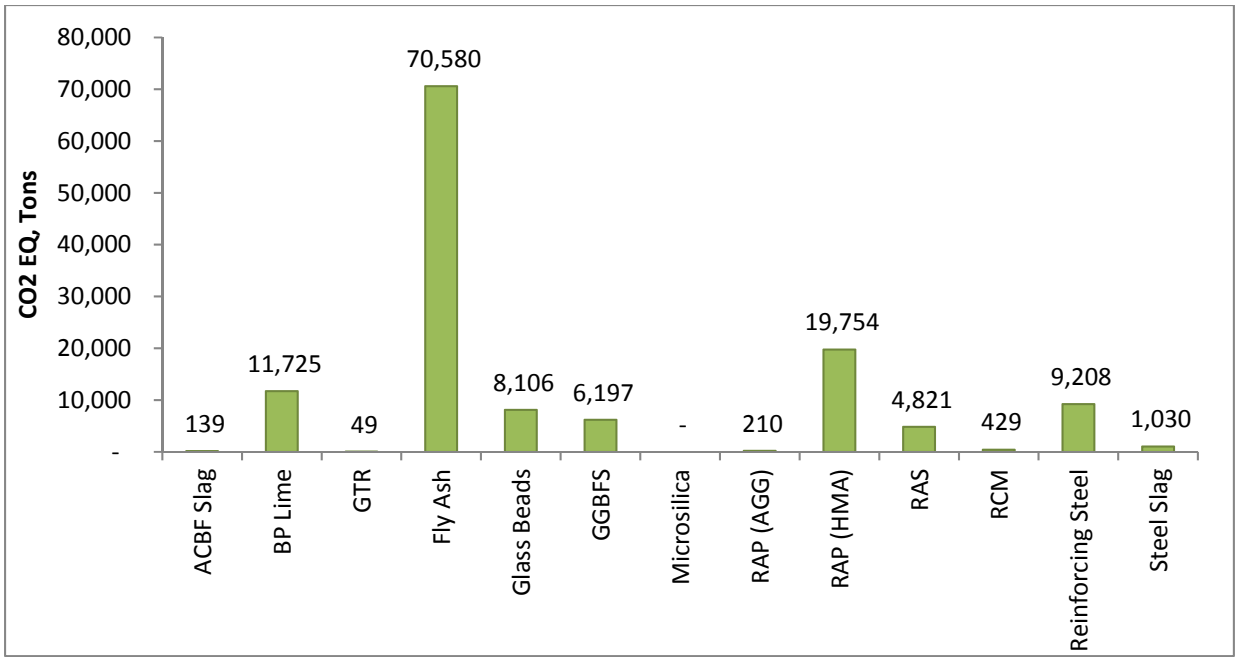

Figure 5. CO_2EQ saved by recycled material in 2015.

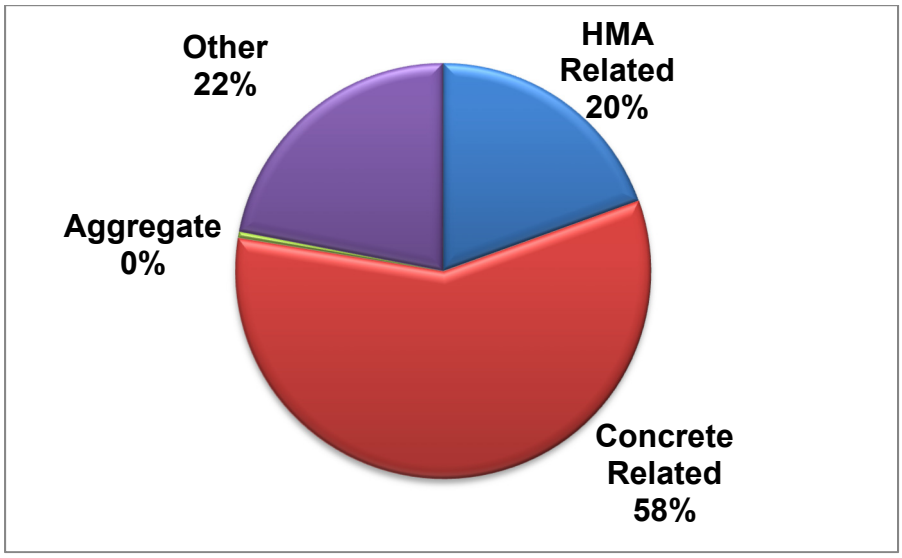

Figure 6. CO_2EQ saved by related use in 2015.

CHAPTER 5: SUSTAINABILITY RESEARCH ACCOMPLISHMENTS AND INITIATIVES

During 2015, IDOT had six sustainability-related studies under way with ICT. These efforts focused on aggregate and HMA use of recycled materials. Each of these studies resulted in an interim or final report. Five of the studies have concluded, with work continuing on the sixth. A brief status of each effort is provided. Two new material sustainability research efforts were initiated in 2015.

5.1 SUSTAINABILITY RESEARCH ACCOMPLISHMENTS DURING 2015

5.1.1 ICT-R27-124 Evaluation of Aggregate Subgrade Materials Used as Pavement Subgrade/Granular Subbase

This research study was undertaken to evaluate the adequacy and field performances of IDOT's new aggregate subgrade specifications. A state-of-the-art image analysis technique was used to characterize the size and shape, as well as the texture and angularity properties of selected aggregate subgrade materials. For field evaluation, 24 combinations of pavements were constructed over subgrade with controlled low immediate bearing value (IBV) or unsoaked California bearing ratio (CBR) strength properties. RAP-capped construction platforms consistently exhibited a higher magnitude of rutting. Performances of flexible pavement sections were governed by the as-constructed HMA thicknesses, which varied considerably during the paver operation because of RAP subbase sinkage and the weak subgrade. Adequate validation and potential revisions to current IDOT specifications were recommended. The study concluded with publication of a final report (Kazmee and Tutumluer 2015).

5.1.2 ICT-R27-125 Sustainable Aggregates Production: Green Applications for Aggregate By-Products

Increased emphasis in the construction industry on sustainability and recycling requires production of aggregate gradations with lower dust (cleaner aggregates) and smaller maximum sizes—hence, increasing the amount of quarry by-products (QBs). QBs are usually less than 1/4 in. (6 mm) in size. This report provides findings of an industry survey conducted among Illinois aggregate producers on the annual production rate, excess QBs generated, and current application areas of QBs. In addition, a detailed laboratory study was conducted to characterize the engineering properties of QB materials produced in the primary, secondary, and tertiary aggregate production stages from four different quarries operating in the State of Illinois. Recommendations were made on potential strategies to utilize excess fines by incorporating QB materials in pavement construction. The study concluded with publication of a final report (Tutumluer et al. 2015). A second phase of this project is under way (R27-168; see summary in Section 5.2 of this report). Accelerated test sections will be constructed based on the recommendation of this study.

5.1.3 ICT-R27-128: Testing Protocols to Ensure Performance of High Asphalt Binder Replacement Mixes Using RAP and RAS

The goal of this research project was to develop procedures that will help ensure that HMA mixes using recycled materials are not prone to premature performance problems from excessive cracking. A new mixture performance criterion—the flexibility index (FI)—was developed as part of this research. The FI was shown to be a better screening parameter than fracture energy alone. The testing specification protocol was balloted and accepted by the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Materials in 2015 as a provisional test method (AASHTO TP 124—Determining the Fracture Potential of Asphalt Mixtures Using Semicircular Bend Geometry (SCB) at Intermediate Temperature). The adoption of the provisional standard has been further advanced by the production of testing equipment to meet laboratory needs of researchers, states, and consultants wishing to adopt the testing protocol. IDOT designated the test and flexibility index determination as the Illinois Flexibility Index Test, or I-FIT. As states and HMA researchers use the test, it is expected that improvements will be made to the standard. The study concluded with publication of a final report (Al-Qadi et al. 2015).

5.1.4 R27-161: Construction and Performance Monitoring of Various Asphalt Mixes

This study was originally based on five sites/locations in the Joliet area selected for evaluation of the field performance of mixes that incorporate varying proportions of recycled materials. Tasks included a pre-construction pavement evaluation, construction survey and quality assurance, laboratory characterization of materials collected at the time of production, post-construction survey, and in-service field surveys over the life of the study. In 2015, the study was amended to include additional projects that were constructed in 2013 to demonstrate the use of total recycle asphalt (TRA). The study includes HMA mixes with and without RAS with varying percentages of asphalt binder replacement and different asphalt binders. The overall experiment is summarized in Appendix D.

A 2015 interim report that covers projects constructed in 2014, early performance after the 2014/2015 winter, and a summary of performance on the 2013 TRA projects was published (Lippert et al. 2016). The 2015 construction efforts of the remaining sections, along with performance updates of all the sections, is expected to be published in 2016. The study is projected to conclude on schedule in December 2017.

5.1.5 ICT-R27-SP28: Evaluation of the Impacts of Re-Refined Engine Oil Bottoms (ReOB) on Performance Graded Asphalt Binders and Asphalt Mixtures

This study evaluated the properties of asphalt binder modified with re-refined engine oil bottoms (ReOB), or the non-distillation fraction of re-refined waste engine oils, and their effect on asphalt mixture benchmark performance tests. The effects of asphalt binder aging were evaluated on compacted mix samples using various laboratory aging procedures (short term, long term, and extended long term). While the work was completed in 2015, the final report was published in 2016 (Ozer et al. 2016).

5.1.6 ICT-R27-SP29, Thermodynamics Between RAP/RAS and Virgin Aggregates During Asphalt Concrete Production—A Literature Review

In HMA plants, virgin aggregates are heated and dried separately before being mixed with RAP/RAS and virgin asphalt binder. To avoid burning of aged binder coating, RAP/RAS materials are not heated or dried directly by a burner; instead, they are heated and dried indirectly by the hot virgin aggregates. In this study, thermodynamics and heat transfer principles were used to predict virgin aggregate temperature for drying and heating RAP/RAS at a drum plant. Among many results, it was shown that virgin aggregates become superheated (more than 1,000°F) when both virgin aggregate and RAP moisture content were in the range of 3% to 5% and the material proportions were in the range of 30% to 50%. The size of virgin aggregates and RAP/RAS, the moisture content of virgin aggregates and RAP/RAS, and the mix proportion of virgin aggregates and RAP/RAS were the major contributing parameters in predicting virgin aggregate temperature in the drum plant. The plant's moisture content data indicated that virgin coarse aggregates hold a lower amount of moisture compared with virgin fine aggregates. However, in comparing same-size virgin aggregates and RAP, RAP contained a higher amount of moisture. The reason might be that the aged binder coating of RAP holds moisture better than virgin aggregates do. Also, RAS contains a higher amount of moisture compared with RAP of the same size. The study concluded with publication of a final report (Hossain et al. 2015).

5.2 PROJECTS INITIATED IN 2015

5.2.1 R27-162 Chemical and Compositional Characterization of Recycled Binders

This study began in January 2015 and focuses on understanding how the addition of recycled binder from RAP and RAS affects the structural and compositional characteristics/properties of virgin/aged binder blends and how that translates to the binder's physical characteristics and the performance of mixes during service life. A report is expected at the end of 2016.

5.2.1 R27-168 Field Performance Evaluations of Sustainable Aggregate By-Product Applications (Phase II)

This study is the next phase of R27-125 as discussed in Section 5.1 of this report and is intended to determine from field performance evaluations the most successful sustainable/green applications utilizing large quantities of QBs in road construction. Full-scale test sections will be constructed to demonstrate innovative and sustainable uses of QB applications. The constructed pavement sections will be tested using the University of Illinois' accelerated pavement testing equipment to evaluate field performances of the most promising QB applications. The study will produce draft specifications for beneficial QB utilization, which is expected to have an immediate impact on sustainable construction practices in the State of Illinois by reducing total energy consumption and greenhouse gas emissions per ton of aggregate production and resulting in significant savings on IDOT construction projects. A report is expected in 2018.

CHAPTER 6: CONCLUSIONS

The goal of this report is to provide a single-source summary of 2015 sustainability efforts in highway materials that meets the reporting requirement of Illinois Public Act 097-0314. On the basis of the 2015 efforts, the following conclusions can be made:

- In 2015, recycled materials used totaled 2,009,972 tons, which is a 22% increase over 2014 quantities.
- The 2015 reclaimed and recycled materials are valued at $59,715,613, a 3% increase. The reason for the slight increase (i.e., compared with a larger increase in quantities) is that 2015 saw deflationary pressures on many commodity-related materials, especially those that are crude oil related or have a major transportation component.
- Use of reclaimed asphalt shingles (RAS) in 2015 increased 47% from 2014 levels to 55,362 tons.
- Life-cycle assessment (LCA) was used to provide a better picture of the true environmental benefits of the various materials recycled. Using LCA and available information, it is estimated that carbon dioxide–equivalent emissions were reduced by 132,247 tons in 2015. The majority of the reduction is from the use of fly ash and ground granulated blast furnace slag to replace cement, followed by reclaimed asphalt pavement (RAP) use in hot mix asphalt (HMA) pavements.
- Illinois continues to actively seek improved recycling and sustainability through research. In 2015, six projects related to material sustainability were under way. Each project produced an interim or final report.
- Illinois Center for Transportation research developed testing protocols for an Illinois method of testing semi-circular beams at intermediate temperatures in conjunction with the calculation of the flexibility index (FI). The Illinois Department of Transportation presented the test method to the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Materials in 2015. The procedure was adopted as a provisional test method. The anticipated future adoption of FI for HMA is expected to help ensure crack-resistant mixes in Illinois and nationally.

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APPENDIX A: RECYCLED AND RECLAIMED MATERIAL QUANTITIES USED AND EQUIVALENT VALUES, 2015

Material	Unit Equivalent Value	Quantity[1] Tons	Total Equivalent Value to Department	CO_2 Equivalent (Kg)[7] Savings per Ton of Material Use	CO_2 Equivalent Savings Tons[7]
Air-Cooled Blast Furnace Slag	$7.00	9,668	$67,676	13	139
By-Product Lime	$35.00	11,562	$404,670	920	11,725
Fly Ash	$15.00	71,621	$1,074,315	894	70,579
Glass Beads[2]	$626.00	7,916	$4,955,166	929	8,106
Ground Granulated Blast Furnace Slag	$85.00	7,368	$626,280	763	6,197
Ground Tire Rubber[3]	$500.00	26.2	$13,083	1704	49
Microsilica	$500.00	2.0	$1,000	Not Available (NA)	NA
Reclaimed Asphalt Pavement Used for HMA	$29.31	1,054,135	$30,896,697	17	19,754
Reclaimed Asphalt Pavement Used for Aggregate	$7.00	238,291	$1,668,037	0.8	210
Reclaimed Asphalt Shingles[4]	$40.00	55,362	$1,872,560	79	4,821
Recycled Concrete Material	$7.50	486,027	$3,645,203	0.8	429
Steel Reinforcement[5]	$999.84	13,052	$13,050,167	640	9,208
Steel Slag	$20.00	54,942	$1,098,840	17	1,030
Wet-Bottom Boiler Slag[6]	NA	NA	NA	NA	NA
Totals	—	**2,009,972**	**$59,715,613**	—	**132,247**

[1] Quantities were calculated from amounts assigned to projects in calendar year 2015. Prior to summation of values, metric values were converted to English values using factors located in Appendix B of the *Standard Specifications for Road and Bridge Construction.*

[2] Glass beads use is based on tested and approved quantities and not projects assigned through MISTIC.

[3] Crumb rubber: This material quantity was calculated as 5% of the quantity of hot-poured joint sealant used in 2015.

[4] Reclaimed asphalt shingle quantities are from a survey of contractor records with the exception of one contractor whose quantities were not available directly due to a business merger. These quantities were obtained from information on file in MISTIC.

[5] Steel reinforcement: The IDOT monthly steel index was averaged for the year and used to represent the value of just the steel contained in these products. This approach does not include the epoxy coating value in the calculation of the material being recycled, a more accurate representation.

[6] Wet-bottom boiler slag: No records were found in MISTIC that indicated WBBS was used for any IDOT projects in 2015.

[7] Based on typical haul distances for Illinois and industrial averages between virgin material and recycled/reclaimed material found in the literature.

APPENDIX B: RECYCLING SPECIAL PROVISIONS

APPENDIX B1

AGGREGATE SUBGRADE IMPROVEMENT (D-1)

Effective: February 22, 2012
Revised: March 3, ~~November 1,~~ 2014~~5~~

Add the following Section to the Standard Specifications:

"**SECTION 303. AGGREGATE SUBGRADE IMPROVEMENT**

303.01 Description. This work shall consist of constructing an aggregate subgrade improvement.

303.02 Materials. Materials shall be according to the following.

Item	Article/Section
(a) Coarse Aggregate	1004
(b) Reclaimed Asphalt Pavement (RAP) (Notes 1, 2 and 3)	1031

Note 1. Crushed RAP, from either full depth or single lift removal, may be mechanically blended with aggregate gradation CS 01 ~~or CS 02~~ but shall not exceed 40 percent by weight of the total product. The top size of the Coarse RAP shall be less than 4 in. (100 mm) and well graded.

Note 2. RAP having 100 percent passing the 1 1/2 in (37.5 mm) sieve and being well graded, may be used as capping aggregate in the top 3 in. (75 mm) when aggregate gradation~~s~~ CS 01 ~~or CS 02 are~~is used in lower lifts. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders. The final product shall not contain more than 40 percent by weight of RAP.

Note 3. The RAP used for aggregate subgrade improvement shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

303.03 Equipment. The vibratory machine shall be according to Article 1101.01, or as approved by the Engineer. The calibration for the mechanical feeders shall have an accuracy of ± 2.0 percent of the actual quantity of material delivered.

303.04 Soil Preparation. The stability of the soil shall be according to the Department's Subgrade Stability Manual for the aggregate thickness specified.

303.05 Placing Aggregate. The maximum nominal lift thickness of aggregate gradations CS 01 or CS 02 shall be 24 in. (600 mm).

303.06 Capping Aggregate. The top surface of the aggregate subgrade shall consist of a minimum 3 in. (75 mm) of aggregate gradations CA 06 or CA 10. When Reclaimed Asphalt Pavement (RAP) is used, it shall be crushed and screened where 100 percent is passing the 1 1/2 in. (37.5 mm) sieve and being well graded. RAP that has been fractionated to size will not be permitted for use in capping. Capping aggregate will not be required when the aggregate subgrade improvement is used as a cubic yard pay item for undercut applications. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders.

303.07 Compaction. All aggregate lifts shall be compacted to the satisfaction of the Engineer. If the moisture content of the material is such that compaction cannot be obtained, sufficient water shall be added so that satisfactory compaction can be obtained.

303.08 Finishing and Maintenance of Aggregate Subgrade Improvement. The aggregate subgrade improvement shall be finished to the lines, grades, and cross sections shown on the plans, or as directed by the Engineer. The aggregate subgrade improvement shall be maintained in a smooth and compacted condition.

303.09 Method of Measurement. This work will be measured for payment according to Article 311.08.

303.10 Basis of Payment. This work will be paid for at the contract unit price per cubic yard (cubic meter) for AGGREGATE SUBGRADE IMPROVEMENT or at the contract unit price per square yard (square meter) for AGGREGATE SUBGRADE IMPROVEMENT, of the thickness specified.

Add the following to Section 1004 of the Standard Specifications:

"**1004.06 Coarse Aggregate for Aggregate Subgrade Improvement.** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate shall be crushed gravel, crushed stone, or crushed concrete. The top 12 inches of the aggregate subgrade improvement shall be 3 inches of capping material and 9 inches of crushed gravel, crushed stone or crushed concrete. In applications where greater than 36 inches of subgrade material is required, rounded gravel, meeting the CS01 gradation, may be used beginning at a depth of 12 inches below the bottom of pavement.

(b) Quality. The coarse aggregate shall consist of sound durable particles reasonably free of deleterious materials. Non-mechanically blended RAP may be allowed up to a maximum of 5.0 percent.

(c) Gradation.

(1) The coarse aggregate gradation for total subgrade thicknesses of 12 in. (300 mm) or greater shall be CS 01~~ or CS 02~~.

Grad No.	COARSE AGGREGATE SUBGRADE GRADATIONS Sieve Size and Percent Passing				
	8”	6”	4”	2”	#4
CS 01	100	97 ± 3	90 ± 10	45 ± 25	20 ± 20
~~CS 02~~		~~100~~	~~80 ± 10~~	~~25 ± 15~~	

Grad No.	COARSE AGGREGATE SUBGRADE GRADATIONS (Metric) Sieve Size and Percent Passing				
	200 mm	150 mm	100 mm	50 mm	4.75 mm
CS 01	100	97 ± 3	90 ± 10	45 ± 25	20 ± 20
~~CS 02~~		~~100~~	~~80 ± 10~~	~~25 ± 15~~	

(2) The 3 in. (75 mm) capping aggregate shall be gradation CA 6 or CA 10.

APPENDIX B-2

FRICTION AGGREGATE (~~BDE~~D-1)

Effective: January 1, 2011
Revised: ~~November 1, 2014~~July 24, 2015

Revise Article 1004.01(a)(4) of the Standard Specifications to read:

"(4) Crushed Stone. Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.

a. Carbonate Crushed Stone. Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0 percent or more magnesium oxide (MgO). Limestone shall contain less than 11.0 percent magnesium oxide (MgO).

b. Crystalline Crushed Stone. Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase."

Revise Article 1004.03(a) of the Standard Specifications to read:

"**1004.03 Coarse Aggregate for Hot-Mix Asphalt (HMA).** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate for HMA shall be according to the following table.

Use	Mixture	Aggregates Allowed
Class A	Seal or Cover	Allowed Alone or in Combination [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete

Use	Mixture	Aggregates Allowed
HMA Low ESAL	Stabilized Subbase or Shoulders	<u>Allowed Alone or in Combination</u> [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[1/] Crushed Concrete
HMA High ESAL Low ESAL	Binder IL-19.0 or IL-19.0L SMA Binder	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Concrete[3/]
HMA High ESAL Low ESAL	C Surface and Leveling Binder IL-9.5 or IL-9.5L SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[4/] Crushed Concrete[3/]
HMA High ESAL	D Surface and Leveling Binder IL-9.5 SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination</u> [5/]: Crushed Gravel Carbonate Crushed Stone (other than Limestone)[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[4/] Crushed Concrete[3/]
		<u>Other Combinations Allowed:</u> *Up to...* — *With...* 25% Limestone — Dolomite

<table>
<tr><th>Use</th><th>Mixture</th><th colspan="2">Aggregates Allowed</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>50% Limestone</td><td>Any Mixture D aggregate other than Dolomite</td></tr>
<tr><td>75% Limestone</td><td>Crushed Slag (ACBF) or Crushed Sandstone</td></tr>
<tr><td rowspan="6">HMA
High ESAL</td><td rowspan="6">E Surface
IL-9.5

SMA
Ndesign 80
Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/]:

~~Crushed Gravel~~
Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag
~~Crushed Concrete~~[3/]

No Limestone.</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Dolomite[2/]</td><td>Any Mixture E aggregate</td></tr>
<tr><td>75% Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
<tr><td>75% Crushed Gravel[2/] or Crushed Concrete[3/]</td><td>Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF), or Crushed Steel Slag</td></tr>
</table>

<table>
<tr><th>Use</th><th>Mixture</th><th colspan="2">Aggregates Allowed</th></tr>
<tr><td rowspan="4">HMA
High ESAL</td><td rowspan="4">F Surface
IL-9.5

SMA
Ndesign 80
Surface</td><td colspan="2">Allowed Alone or in Combination [5/]:

Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag
No Limestone.</td></tr>
<tr><td colspan="2">Other Combinations Allowed:</td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Crushed Gravel[2/], Crushed Concrete[3/], or Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
</table>

1/ Crushed steel slag allowed in shoulder surface only.
2/ Carbonate crushed stone and/or crushed gravel shall not be used in SMA Ndesign 80. In SMA Ndesign 50, carbonate crushed stone shall not be blended with any of the other aggregates allowed alone in Ndesign 50 SMA binder or Ndesign 50 SMA surface.
3/ Crushed concrete will not be permitted in SMA mixes.
4/ Crushed steel slag shall not be used as leveling binder.
5/ When combinations of aggregates are used, the blend percent measurements shall be by volume."

APPENDIX B-3

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1) – *(MAJOR REVISIONS ONLY)*

Effective: November 1, 2012
Revised: ~~August 15, 2014~~January 2, 2015

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

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1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(a) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of ~~2.500~~2.300 shall be used for mix design purposes.

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APPENDIX B-4

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1) – *(MAJOR REVISIONS ONLY)*

Effective: November 1, 2012
Revise: ~~January 2, 2015~~April 2, 2015

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

~

1031.06 Use of FRAP and/or RAS in HMA. The use of FRAP and/or RAS shall be a Contractor's option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(c) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0% by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts indicated in the table below for a given N Design.

Max Asphalt Binder Replacement for FRAP with RAS Combination

HMA Mixtures 1/ 2/ 4/	Maximum % ABR		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified 3/
30L	50	40	~~10~~30
50	40	35	~~10~~30
70	40	30	~~10~~30
90	40	30	~~10~~ 4/ 30
4.75 mm N-50			~~30~~40
SMA N-80			~~20~~30

1/ For HMA "All Other" (shoulder and stabilized subbase) N-30, the percent asphalt binder replacement shall not exceed 50% of the total asphalt binder in the mixture.

2/ When the binder replacement exceeds 15 percent for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 percent, the required virgin asphalt binder grade shall be PG64-28.

3/ When the ABR for SMA or IL-4.75 is 15 percent or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds 15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

4/ ~~For polymerized surface mix used for overlays, with up to 10 percent ABR, an SBS PG70-22 will be required. However if used in full depth HMA, an SBS PG70-28 will be required.~~When FRAP or RAS is used alone, the maximum percent asphalt binder replacement designated on the table shall be reduced by 10 percent.

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APPENDIX B-5

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1)

Effective: November 1, 2012
Revised: ~~April 2~~July 24, 2015

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

1031.01 Description. Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material resulting from cold milling or crushing an existing hot-mix asphalt (HMA) pavement. RAP will be considered processed FRAP after completion of both crushing and screening to size. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Bureau of Materials and Physical Research Policy Memorandum "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Bureau of Materials and Physical Research approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 90 percent passing the #4 (4.75 mm) sieve. RAS shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1031.02 Stockpiles. RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. Additional processed RAP (FRAP) shall be stockpiled in a separate working pile, as designated in the QC Plan, and only added to

the sealed stockpile when test results for the working pile are complete and are found to meet tolerances specified herein for the original sealed FRAP stockpile. Stockpiles shall be sufficiently separated to prevent intermingling at the base. All stockpiles (including unprocessed RAP and FRAP) shall be identified by signs indicating the type as listed below (i.e. “Non- Quality, FRAP -#4 or Type 2 RAS”, etc…).

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, Superpave HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. All FRAP shall be processed prior to testing and sized into fractions with the separation occurring on or between the #4 (4.75 mm) and ½ in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP in the coarse fraction shall pass the maximum sieve size specified for the mix the FRAP will be used in.

(2) Restricted FRAP (B quality) stockpiles shall consist of RAP from Class I, Superpave (High ESAL), or HMA (High ESAL). If approved by the Engineer, the aggregate from a maximum 3.0 inch single combined pass of surface/binder milling will be classified as B quality. All millings from this application will be processed into FRAP as described previously.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, Superpave HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed (FRAP) prior to testing. Conglomerate RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(4) Conglomerate “D” Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from HMA shoulders, bituminous stabilized subbases or Superpave (Low ESAL)/HMA (Low ESAL) IL-19.0L binder mixture. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as “Non-Quality”.

RAP or FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, plant cleanout etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall be sufficiently separated to prevent intermingling at the base. Each stockpile shall be signed indicating what type of RAS is present.

However, a RAS source may submit a written request to the Department for approval to blend mechanically a specified ratio of type 1 RAS with type 2 RAS. The source will not be permitted to change the ratio of the blend without the Department prior written approval. The Engineer's written approval will be required, to mechanically blend RAS with any fine aggregate produced under the AGCS, up to an equal weight of RAS, to improve workability. The fine aggregate shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The fine aggregate shall be one that is approved for use in the HMA mixture and accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of three years.

1031.03 Testing. FRAP and RAS testing shall be according to the following.

(a) FRAP Testing. When used in HMA, the FRAP shall be sampled and tested either during processing or after stockpiling. It shall also be sampled during HMA production.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) Incoming Material. For testing as incoming material, washed extraction samples shall be run at a minimum frequency of one sample per 2000 tons (1800 metric tons) or once per week, whichever comes first.

(3) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Before extraction, each field sample of FRAP, shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS shall be sampled and tested during stockpiling according to Bureau of Materials and Physical Research Policy Memorandum, “Reclaimed Asphalt Shingle (RAS) Sources”. The Contractor shall also sample as incoming material at the HMA plant.

(1) During Stockpiling. Washed extraction and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 1000 tons (900 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS shall be in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

(2) Incoming Material. For testing as incoming material at the HMA plant, washed extraction shall be run at the minimum frequency of one sample per 250 tons (227 metric tons). A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). The incoming material test results shall meet the tolerances specified herein.

The Contractor shall obtain and make available all test results from start of the initial stockpile sampled and tested at the shingle processing facility in accordance with the facility’s QC Plan.

Before extraction, each field sample shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

1031.04 Evaluation of Tests. Evaluation of tests results shall be according to the following.

(a) Evaluation of FRAP Test Results. All test results shall be compiled to include asphalt binder content, gradation and, when applicable (for slag), G_{mm}. A five test average of results from the original pile will be used in the mix designs. Individual extraction test results run thereafter, shall be compared to the average used for the mix design, and will be accepted if within the tolerances listed below.

Parameter	FRAP
No. 4 (4.75 mm)	± 6 %
No. 8 (2.36 mm)	± 5 %
No. 30 (600 μm)	± 5 %
No. 200 (75 μm)	± 2.0 %
Asphalt Binder	± 0.3 %
G_{mm}	± 0.03 1/

1/ For stockpile with slag or steel slag present as determined in the current Manual of Test Procedures Appendix B 21, "Determination of Reclaimed Asphalt Pavement Aggregate Bulk Specific Gravity".

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the FRAP stockpile shall not be used in Hot-Mix Asphalt unless the FRAP representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

The Contractor shall maintain a representative moving average of five tests to be used for Hot-Mix Asphalt production.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the Illinois Test Procedure, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)" or Illinois Modified AASHTO T-164-11, Test Method A.

(b) Evaluation of RAS Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. A five test average of results from the original pile will be used in the mix designs. Individual test results run thereafter, when compared to the average used for the mix design, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5 %
No. 16 (1.18 mm)	± 5 %
No. 30 (600 μm)	± 4 %
No. 200 (75 μm)	± 2.5 %
Asphalt Binder Content	± 2.0 %

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the RAS shall not be used in Hot-Mix Asphalt unless the RAS representing those tests is removed from

the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

(c) Quality Assurance by the Engineer. The Engineer may witness the sampling and splitting conduct assurance tests on split samples taken by the Contractor for quality control testing a minimum of once a month.

The overall testing frequency will be performed over the entire range of Contractor samples for asphalt binder content and gradation. The Engineer may select any or all split samples for assurance testing. The test results will be made available to the Contractor as soon as they become available.

The Engineer will notify the Contractor of observed deficiencies.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits.

Test Parameter	Acceptable Limits of Precision	
% Passing:[1/]	FRAP	RAS
1/2 in.	5.0%	
No. 4	5.0%	
No. 8	3.0%	4.0%
No. 30	2.0%	3.0%
No. 200	2.2%	2.5%
Asphalt Binder Content	0.3%	1.0%
G_{mm}	0.030	

1/ Based on washed extraction.

In the event comparisons are outside the above acceptable limits of precision, the Engineer will immediately investigate.

(d) Acceptance by the Engineer. Acceptable of the material will be based on the validation of the Contractor's quality control by the assurance process.

1031.05 Quality Designation of Aggregate in RAP and FRAP.

(a) RAP. The aggregate quality of the RAP for homogenous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, Superpave/HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from Superpave/HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, Superpave/HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Fractionated RAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant prequalified by the Department for the specified testing. The consultant shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the BMPR Aggregate Lab for MicroDeval Testing, according to Illinois Modified AASHTO T 327. A maximum loss of 15.0 percent will be applied for all HMA applications. The fine aggregate portion of the fractionated RAP shall not be used in any HMA mixtures that require a minimum of “B” quality aggregate or better, until the coarse aggregate fraction has been determined to be acceptable thru a MicroDeval Testing.

1031.06 Use of FRAP and/or RAS in HMA. The use of FRAP and/or RAS shall be a Contractor’s option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(d) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(e) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0% by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts indicated in the table below for a given N Design.

Max Asphalt Binder Replacement for FRAP with RAS Combination

HMA Mixtures [1/ 2/ 4/]	Maximum % ABR		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified [3/]
30L	50	40	30
50	40	35	30
70	40	30	30
90	40	30	30
4.75 mm N-50			40
SMA N-80			30

5/ For HMA “All Other” (shoulder and stabilized subbase) N-30, the percent asphalt binder replacement shall not exceed 50% of the total asphalt binder in the mixture.

6/ When the binder replacement exceeds 15 percent for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 percent, the required virgin asphalt binder grade shall be PG64-28.

7/ When the ABR for SMA or IL-4.75 is 15 percent or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery

shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds 15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

8/ When FRAP or RAS is used alone, the maximum percent asphalt binder replacement designated on the table shall be reduced by 10 percent.

1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(c) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(d) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of 2.300 shall be used for mix design purposes.

1031.08 HMA Production. HMA production utilizing FRAP and/or RAS shall be as follows.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAS and FRAP feed system to remove or reduce oversized material. If material passing the sizing device adversely affects the mix production or quality of the mix, the sizing device shall be set at a size specified by the Engineer.

If during mix production, corrective actions fail to maintain FRAP, RAS or QC/QA test results within control tolerances or the requirements listed herein the Contractor shall cease production of the mixture containing FRAP or RAS and conduct an investigation that may require a new mix design.

(a) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

(b) HMA Plant Requirements. HMA plants utilizing FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAS and FRAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate RAS and FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS and FRAP are printed in wet condition.)

i. When producing mixtures with FRAP and/or RAS, a positive dust control system shall be utilized.

j. Accumulated mixture tonnage.

k. Dust Removed (accumulated to the nearest 0.1 ton)

(2) Batch Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

f. RAS and FRAP weight to the nearest pound (kilogram).

g. Virgin asphalt binder weight to the nearest pound (kilogram).

h. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

1031.09 RAP in Aggregate Surface Course and Aggregate Shoulders. The use of RAP or FRAP in aggregate surface course and aggregate shoulders shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except "Non-Quality" and "FRAP". The testing requirements of Article 1031.03 shall not apply. RAP used to construct aggregate surface course and aggregate shoulders shall be according to the current Bureau of Materials and Physical Research's Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications"

(b) Gradation. ~~One hundred percent of the RAP material shall pass the 1-1/2 in. (37.5mm) sieve. The RAP material shall be reasonably well graded from coarse to fine. RAP material that is gap-graded, FRAP, or single sized will not be accepted for use as Aggregate Surface Course and Aggregate Shoulders."~~The RAP material shall meet the gradation requirements for CA 6 in accordance with Art.1004.01 (c), except the requirements for the minus No. 200 (75µm) sieve will not apply. The sample for the RAP material shall be air dried to constant weight prior to being tested for gradation."

APPENDIX B-6

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (BDE) – *(MAJOR REVISIONS ONLY)*

Effective: November 1, 2012
Revise: January 2, 2015

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

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1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(e) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(f) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of ~~2.500~~2.300 shall be used for mix design purposes.

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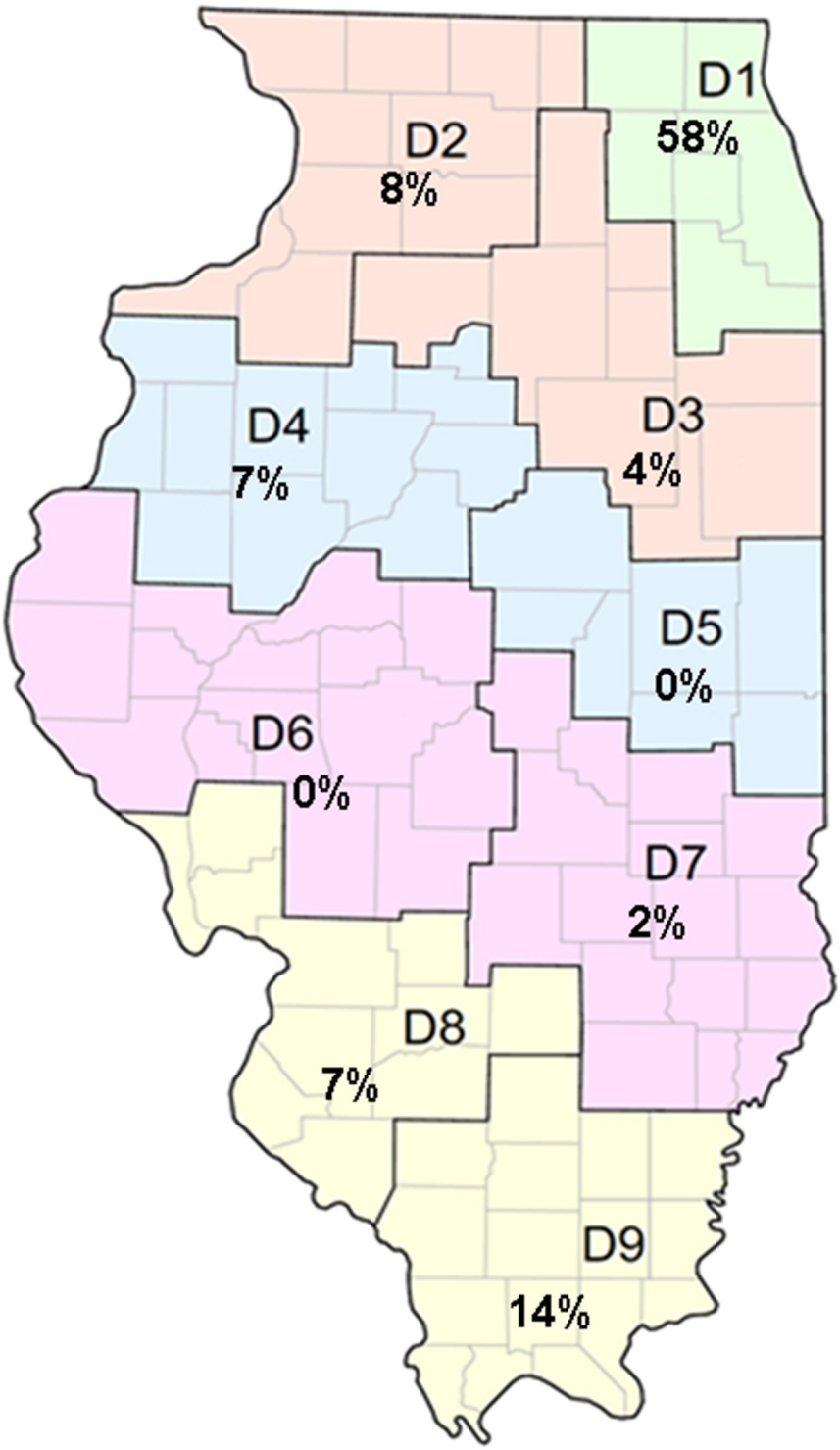
APPENDIX C: PERCENTAGE OF RAS USED BY EACH DISTRICT IN CALENDAR YEAR 2015



APPENDIX D: EXPERIMENTAL FEATURES OF PROJECT R27-161

April 26, 2013 Letting Projects														
Construction Year	Project	Letting Item[1]	Contract	Net Length (mi.)	Surface Mix Details							Mix Designs	
					Dir.	Mix	ABR %	RAS[3] %	RAP[3] %	Virgin PG	Surface Tons	Surface	Level Binder
2013	26th Street (Chicago Heights) from Western Ave to East End Ave	4	60L62	2.0	Both	N50 TRA[2]	60	4.6	51	52-28	3,060	81BIT137M	81BIT121M
2013	Harrison Street (Hillside) from IL 38/Roosevelt Rd. to Wolf Rd.	28	60N67	1.1	Both	N50 TRA[2]	56	5.0	53	52-28	2,131	81BIT338K	81BIT300K
2013	Richards Street (Joliet) from 5th Ave to Manhattan Road	31	60P70	0.9	Both	N50 TRA	37	None	27	58-28	2,223	81BIT138Z	81BIT137Z
2013	Wolf Road (Hillside) from IL 38/Roosevelt Rd. to Harrison Street	9	60M30	0.5	Both	N70 Mix D	20	None	30	58-28	1,382	81BIT306K	81BIT300K
June 13, 2014 Letting Projects														
Construction Year	Project	Letting Item[1]	Contract	Net Length (mi.)	Surface Mix Details							Mix Designs	
					Dir.	Mix	ABR %	RAS[3] %	RAP[3] %	Virgin PG	Surface Tons	Surface	Level Binder
2014	Crawford Ave/Pulaski Rd from 172nd to US Rt. 6	30	60Y03	1.5	S	N70-30% ABR	30	5.0	10	58-28	2,150	81BIT157M	81BIT147M
					N	N70-15% ABR	15	2.5	5	64-22	2,150	81BIT156M	
2014	US 52 From Chicago St. (IL 53) to Laraway Road	29	60Y02	3.3	E	N70-30% ABR	30	3.1	20	58-28	2,320	81BIT140M	81BIT141M
					W	N70-30% ABR	30	None	34	58-28	2,320	81BIT159M	
2015	US 52 from Laraway Road to Gouger Road	16	60N08	3.3	Both	N70 TRA[2]	48	5.0	39	52-34	5,236	81BIT185M	81BIT163M
2015	US 52 from Gouger Road to Second Street	15	60N07	1.5	Both	N70 TRA[2]	48	5.0	39	58-28	3,014	81BIT185M	81BIT163M
2015	Washington Street from Bridggs Street to US 30	31	60Y04	1.9	W	N70-30% ABR	30	3.1	20	58-34	1,580	81BIT177M	81BIT163M
					E	N70-30% ABR	30	None	34	58-34	1,580	81BIT159M	

[1] April 26, 2013 or June 13, 2014, IDOT letting item number

[2]Total recycle asphalt (100% recycled aggregate with high ABR)

[3]Percent of mixture that is RAP and RAS contributing to the indicated ABR%.

Additional Note: Maximum percent of RAS allowed in total mix by specification is 5%.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