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CONSTRUCTION AND PERFORMANCE MONITORING OF VARIOUS ASPHALT MIXES IN ILLINOIS: 2015 INTERIM REPORT

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16. Abstract
A series of five experimental projects were constructed to better determine the life-cycle cost and performance of pavement overlays using various types and combinations of recycled materials—namely, reclaimed asphalt pavement (RAP), recycled asphalt shingles (RAS) and crushed concrete. The asphalt binder replacement (ABR) varied from 15% to 48% in the experimental sections. The study of these projects prior to construction, during construction, and for a short monitoring period after construction is intended to determine the impact of various pavement conditions, pavement cross-sections, mix designs, and material properties on the ultimate performance of the hot-mix asphalt (HMA) overlay. This interim report documents the construction and testing to date on two of the five projects in the study—Crawford Avenue/Pulaski Road and US 52 (IL 52 to Laraway Road)—that were constructed in 2014. Distress and profile surveys were conducted before and after construction. Samples were obtained of the HMA surface and binder courses and were tested for basic properties, plus Cantabro, stability/flow, Texas overlay cracking potential, fracture energy, flexibility index, fatigue, modulus, creep, and Hamburg rutting. Presented are early performance trends and baseline conditions that future performance can be compared against. Also included in this report is an update of performance on three total recycle asphalt (TRA) sections and a comparison section constructed in 2013 with ABR's ranging from 20% to 60%.

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EXECUTIVE SUMMARY

Recent efforts to increase recycling raised questions about the durability and cracking potential of hot-mix asphalt (HMA) being constructed in Illinois. Mixes using reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) can replace a substantial part of virgin asphalt binder in new HMA, the main cost component of the mix. To be truly sustainable and to reduce life-cycle cost, mixes with high asphalt binder replacement (ABR) must perform equivalent to virgin or low recycle HMA.

To better determine the life-cycle cost and performance of pavement overlays using higher amounts of RAP and RAS, a series of five experimental projects were constructed. The ABR level in the experiment varied from a low of 15% to a high of 48%. The study of these projects prior to construction, during construction, and for a short monitoring period after construction is intended to determine the impact of various pavement conditions, pavement cross-sections, mix designs, and material properties on the ultimate performance of the HMA overlay. This interim report documents the construction and testing to date on the two projects constructed in 2014—namely, Crawford Avenue/Pulaski Road and US 52 (IL 52 to Laraway Road). Distress and profile surveys were conducted, and mix samples were obtained of HMA surface and binder courses, which were tested for basic properties, plus Cantabro, stability/flow, Texas overlay cracking potential, fracture energy, flexibility index (FI), fatigue, modulus, creep and Hamburg rutting.

The self-propelled cold milling (milling) specifications (1101.16) remain essentially unchanged since the practice was adopted in the 1980s. Highly variable milled cross-sections were witnessed on the projects observed in this study. The variability was caused when worn/lost teeth were replaced in the milling head, but it can be prevented with specification changes and enforcement to address the issue.

Crawford Avenue/Pulaski Road is showing much more reflective cracking than US 52 thus far. Initial reviews indicate that some of the longitudinal cracking distress can be related back to cross-section details of how the level binder edge is constructed.

The mixes in this project were tested in accordance with the newly developed Illinois semi-circular bending test (IL-SCB). The results of this test are then used to determine the flexibility index (FI). A high FI value indicates less cracking potential, and a low FI value indicates higher cracking potential. Because there are several variations of SCB test procedures being explored across the country, IDOT has named the IL-SCB test and FI calculation process the Illinois Flexibility Index Test (I-FIT) to indicate a distinctively different test procedure.

For Crawford Avenue/Pulaski Road, the FI values were 4.9 for the PG 64-22 surface mix with 15% ABR from both RAP and RAS and 3.5 for the PG 58-28 surface mix using 30% ABR from both RAP and RAS. The FI values for surface mixes on US 52 were 5.1 for the RAP + RAS mix and 10.5 for the RAP-only mix. Both US 52 mixes used a PG 58-28 with 30% ABR. Thus far, US 52 shows an insignificant level of transverse cracking distress, which correlates well to the higher FI values.

Aside from the various mixes used in this study, different cross-sections are present on a given project and may impact study results. The main differences in cross-sections are overlays of bare concrete pavement or second-generation (or older) overlay that is a mill-and-fill-type HMA pavement rehabilitation. Data by cross-section are presented as well as by surface mix for the study. US 52 was a mill and fill of an existing HMA overlay resulting in little transverse cracking, while a majority of Crawford Avenue/Pulaski Road was bare concrete with higher levels of transverse cracking. Performance by cross-section will be documented during the study on these and other sections in the study.

Also included in this report is an update of performance of the three total recycle asphalt (TRA) sections and a comparison section constructed in 2013. The ABR on these sections varied from 20% to 60%. The 26th Street section required centerline joint patching for approximately 20% of the project length. A section on Wolf Road that used typical District 1 and standard specifications with a 20% ABR mix using RAP only and a PG 58-28 asphalt binder has less distress and at lower levels than any of the TRA sections. It has to be noted that the underlying pavement of the TRA sections paved in 2013 was distressed prior to overlay and the condition of the supporting pavement may contribute to the distresses seen in the TRA overlays. Another factor for consideration is that Wolf Road was previously patched and fairly sound at the time of overlay.

Pre-existing pavement distresses and repairs aside, many of the distresses in the 2013 TRA sections are related strictly to the surface mix. The distresses and levels of distress suggest the 2013 TRA mixes are “dry” compared with conventional mixes such as that used on Wolf Road. The use of high-absorption aggregates such as recycled concrete and slags increase the risk of “dry” mixes.

CONTENTS

CHAPTER 1: INTRODUCTION

According to the National Weather Service, the winter of 2013–2014 was the coldest on record in the Chicago area. After a welcomed spring thaw, the amount of pavement cracking on newly constructed pavements became a concern. Questions were raised as to whether the resulting cracking was related to the harsh winter or whether performance was being impacted by specifications allowing increased use of recycled materials containing aged and brittle asphalt.

The use of reclaimed asphalt pavement (RAP) in Illinois' hot-mix asphalt (HMA) is not new and dates back to the early 1980s. Use of RAP was relatively unchanged until the late 2000s, when allowable percentages of RAP could be increased if materials were sized or fractionated similar to virgin aggregates. In 2010, the Illinois Department of Transportation (IDOT) followed the Illinois Tollway in adopting the use of recycled asphalt shingles (RAS) in HMA. Because of the cost reductions for construction, the percentage of allowable asphalt binder replacement (ABR) was increased year to year from 2010 to 2013. To show that very high levels of ABR were possible, IDOT in 2013 demonstrated the use of total recycle asphalt (TRA), which allowed up to 60% ABR with only recycled materials for aggregate.

Upfront costs are important, but so are annual maintenance costs, traffic interruptions for repairs, safety of the motoring public, and pavement longevity. Another way to look at this is that every year of pavement life is worth 5% to 7% of the upfront construction cost, based on typical HMA pavement life of 15 to 16 years (Wolters et al. 2008). High-recycle mixes can reduce construction cost 10% to 20%, but if early repairs are needed and the overall life is reduced, the savings may not be realized.

This study was designed to follow the laydown and early-life performance of five construction projects using eight different surface mix designs, including TRA. Two of the projects were completed in 2014; the remaining three projects were under construction in 2015. Material sampling and testing will establish material properties of the mixes at the time of construction. Annual coring and distress surveys will be used to document the changes the pavement experiences with time. The mixes are also being examined under the Illinois semi-circular bending (IL-SCB) test method developed in ICT project R27-128, "Testing Protocols to Ensure Performance of High Asphalt Binder Replacement Mixes Using RAP and RAS" (Al-Qadi et al. 2015) to determine the flexibility index (FI). Because there are several variations of SCB test procedures being explored across the country, the Illinois Department of Transportation (IDOT) has named the IL-SCB test and FI calculation process the Illinois Flexibility Index Test with the acronym "I-FIT" to indicate a distinctively different SCB test and analysis. The FI is expected to provide the much-needed prediction link between mix properties at production and long-term performance. This test may be performed during the mix design and production stages (phases) of work.

This interim report documents the construction and early baseline performance of the two projects constructed in 2014—namely, Crawford Avenue/Pulaski Road and US 52 from IL 52 (Chicago Street) to Laraway Road. Basic information for the original 2013 TRA projects is recapped, and short-term performance is documented along with performance trends to date in an effort to continue to monitor the TRA sections constructed prior to this study (Lippert et al. 2014).

CHAPTER 2: RESEARCH PROJECT DESCRIPTION

2.1 STUDY GOAL

The goal of this study is to document the testing, construction, and performance of surface mixes with a variety with ABR levels, ABR types, and different asphalt binder grades to allow the evaluation and comparison of the impact of recycled materials on pavement performance. Five projects will be closely documented in this study. The work includes two projects with TRA mixes and three projects having mixes with various ABR levels.

2.2 SECTION PARAMETERS

The study matrix is presented in Table 1. The last three projects listed are not presented in this report because they are under construction as of this writing. The study evaluates a variety of mixes with different ABR levels and types (RAS and RAP). Virgin asphalt binder grades are also varied to determine the ability of softer asphalt grades to counter aged asphalt from recycled materials. The 2013 TRA projects had limited documentation during construction; what data are available were presented previously (Lippert et al. 2014).

Table 1. Project and Parameter Summary

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, Letting Item Number.
[2]Total recycle asphalt (100% recycled aggregate with high ABR).
[3]Percentage of mixture that contributes to the indicated ABR%—maximum 5% of RAS allowed in total mix by specification.

The main tasks in this study are as follows:

- Document in detail the pavement condition prior to construction.
- Monitor construction work for issues (cross-sectional or installation) that may present performance problems later.
- Collect quality assurance information for the record.
- Sample mixes and pavement for laboratory material characterization with time.
- Monitor pavement performance with time and present performance trends.
- Provide reporting of data available during the study period.

In the chapters that follow, documentation to date is presented for the 2014 projects constructed. Because of the length of some test procedures, future reports will present test results that could not be completed at this time.

CHAPTER 3: PRE-EXISTING CONDITIONS AND PROPOSED IMPROVEMENTS

This chapter provides project location, pre-existing conditions, and proposed improvements for the two projects constructed in 2014. For projects let and constructed in 2013, available information is provided in a previous report (Lippert et al. 2014).

3.1 CRAWFORD AVENUE/PULASKI ROAD

This project begins approximately 60 ft south of 172nd Street and extends in a northerly direction for a distance of 9,909 ft (1.88 mi) to US 6 (159th Street) through the City of Country Club Hills and the City of Markham in Cook County, as shown in Figure 1.

Two resurfacing omissions for bridges and their approaches are within the project located as follows:

I-80 approaches and bridge: Sta. 18+88 to Sta. 28+30

I-57 approaches and bridge: Sta. 84+18 to Sta. 96+05

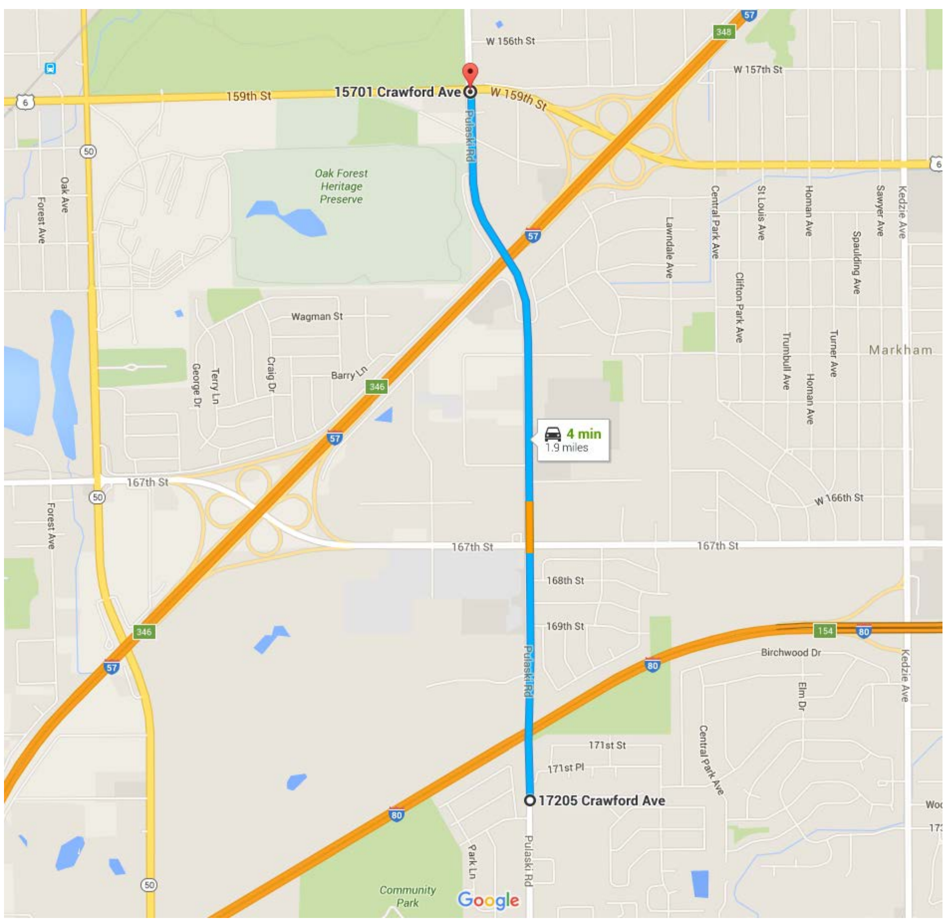

Figure 1. Improvement on Crawford Avenue/Pulaski Road (map data: Google).

3.1.1 Traffic Characteristics

The posted speed limits on the project are 40 and 45 mph. Traffic along the section varies. From the 2010 traffic information, the peak traffic along the project is located just north of I-80, with a two-way average daily traffic (ADT) of 22,400. Truck counts are not available for the section.

3.1.2 Existing Pavement Cross-Section

Existing cross-section details can be found in Appendix A. Because of changing pavement cross-sections along the improvement, there were three distinct sections at the time of construction, as follows.

Segment 1. Southernmost two-lane segment. The south end of the project consists of the original bare 10-in PCC two-lane pavement with aggregate shoulders. Figure 2 shows the condition of the southern segment in 2012.

Figure 2. Crawford Avenue/Pulaski Road looking north at start of improvement (image: Google).

Segment 2. Between I-80 and I-57. North of I-80, the section widens to a five-lane section: two lanes in each direction, with turn lanes on a mountable median. The pavement in this segment consists of the original bare 10-in PCC pavement with a curb and gutter. Figure 3 shows the condition of the center segment in 2012.

Figure 3. Segment 2 of Crawford Avenue/
Pulaski Road looking north to 169th Street (image: Google).

Segment 3. North of I-57. This segment cross-section has five lanes, with the center lane for turning movements. The pavement consists of a 2.5-in HMA overlay over a 10-in PCC pavement with a curb and gutter. Figure 4 shows the condition of the north segment in 2012.

Figure 4. North segment of Crawford Avenue/
Pulaski Road looking north to US 6 (image: Google).

3.1.3 Pre-Construction Distress Survey
On September 29, 2014, prior to the improvement, the project was surveyed and distresses mapped by the Bureau of Materials and Physical Research (BMPR). The survey consisted of walking the sections with field sheets representing the pavement and related stationing. Data were recorded by mapping and coding the distress as outlined in the BMPR Pavement Distress Manual (IDOT 2012a). The survey will provide a record of cracks and joints that can be compared with reflective distress over the evaluation period.

A survey summary by station is provided in Appendix B. For the purpose of clearly monitoring distress over time, the taper areas were omitted from the summaries. Turn lanes and median lanes were not surveyed.

No record of coring of these projects in advance was presented. Pavement coring may provide additional details to designers when selecting milling depth of the cross-section (i.e., cold-milling depth to remove damaged asphalt and minimize scabbing/potholes caused by too shallow a depth). Proper milling depth results in a surface that will hold up better under traffic during construction and reduce the risk of quantity overruns of level binder.

3.1.4 Pre-Construction Rutting and Ride Quality
For pre-construction rutting and ride quality, BMPR arranged for a data collection run by IDOT's video survey vendor. The data were collected in each lane and direction of the project on August 12 and 15, 2014. Values of international roughness index (IRI) and rutting were determined every 0.1 mi. Areas of paving omissions for bridges were removed from the data, as were tapers, so that only uniform cross-sections of pavement were represented. For the project, the data were summarized for the three uniform segments as noted above for each direction, lane, and wheel path. The data are presented in Appendix C.

3.1.5 Proposed Improvement Work
The improvement was let as Item 30, Contract 60Y03, on IDOT's June 13, 2014, letting bulletin. Electronic plans and specifications are available on IDOT's website (IDOT 2014b). The letting documents indicate that the surface mix was to be TRA; however, the surface mixes were changed as indicated in Table 1 to provide specific ABR, RAP/RAS, and PG binder combinations for this study.

Each segment improvement was different, as follows:

> *Segment 1. Southernmost two-lane segment.* This segment was cold-milled at the edge of the pavement at a nominal depth of 1.5 in, which tapered to zero at a distance of 6 ft from the pavement edge. After tacking, an IL 4.75-mm level binder was placed at a thickness of 1 in for a width of 11 ft of the 12-ft lane, leaving the outside foot of milled PCC pavement exposed. The level binder was tacked and the 1.5 in of surface course placed on the full 12-ft width of the pavement. This resulted in the outside foot of the pavement being a nominal 2.5 in of surface mix and a 1-in "step" from level binder to non-level binder in the surface at the pavement edge. As part of the improvement, asphalt shoulders were added.
>
> *Segment 2. Between I-80 and I-57.* The two-lane and taper area were improved similar to Segment 1 above. In the five-lane section, the mountable median (shown in Figure 3 above) was removed by cold-milling. In the outside lane, the pavement edge was milled to remove 1.5 in of pavement adjacent to the gutter, which was tapered to zero at the center of the outside lane. After tacking, an IL 4.75-mm level binder was placed 1 in thick

up to 6 ft from the pavement edge, thus not covering the milled taper from the center of the lane to the gutter. After tacking, the nominal 1.5 in of surface mix was placed over the level binder, and a 1-in “step” resulted in the cross-section where the level binder ends such that the surface mix is 2.5 in thick at the edge of the level binder, tapering to 1.5 in at the gutter.

Segment 3. North of I-57. The existing overlay was cold-milled 2.5 in, the full width of the segment. After tacking, an IL 4.75-mm level binder was placed at a thickness of 1 in gutter to gutter, followed by a tack coat and the 1.5 in of surface mix.

Details of the various proposed cross-sections are shown on the plans (IDOT 2014b). Key cross-sections are presented in Appendix A.

3.2 US 52 – IL 53 TO LARAWAY ROAD

This improvement on US 52 (FAP 852) begins approximately 53 ft east of the centerline of IL 53 (Chicago Street) and extends in a southeasterly direction for a total distance of 17,465 ft (3.31 mi) to a point approximately 104 ft east of the centerline of Laraway Road. The project is located within the City of Joliet and unincorporated Will County, as shown in Figure 5.

Three resurfacing omissions for box culverts are within the project located as follows:

Sta. 81+74 to Sta. 82+03	Box Culvert
Sta. 112+19 to Sta. 112+60	Box Culvert
Sta. 158+46 to Sta. 158+85	Box Culvert

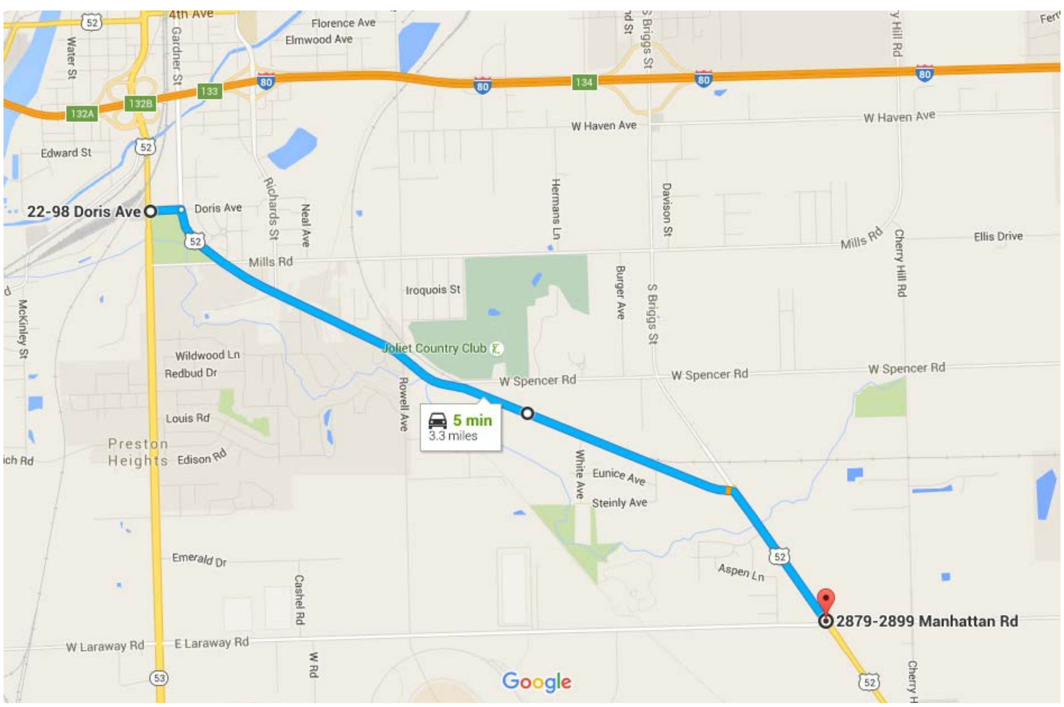

Figure 5. **Improvement on US 52 – IL 53 (Chicago Street) to Laraway Road (map data: Google).**

3.2.1 Traffic Characteristics

The posted speed limit on the project is 35 mph (Doris Avenue) and 55 mph (Manhattan Road). Traffic along the section varies. From the 2013 traffic information, the peak traffic along the project is located just off IL 53, with a two-way ADT of 9,350. The two-way truck ADT was 240 vehicles at the same location.

3.2.2 Existing Pavement Cross-Section

Because of changing pavement cross-sections along the improvement, there were three distinct sections at the time of construction, as follows.

Segment 1. Doris Avenue four-lane segment. The west end of the project consists of a four-lane HMA overlay section. Lane 1 in each direction (passing lane) was originally a 9 in ± PCC pavement. The section was widened with a bituminous base course to add Lane 2 in each direction (driving lane), at which time the entire cross-section was overlaid. Figure 6 shows the condition of this segment in 2013.

Figure 6. Doris Avenue looking east (image: Google).

Segment 2. Doris Avenue to Laraway Road. The bulk of US 52 consists of a two-lane highway that is an overlay of a 9-in ± thick PCC pavement widened with a bituminous base course on each side. The result is a 12-ft lane with a 19-in-wide HMA safety shoulder on each side. Within this main segment is an intersection area that differs and has been broken out as Segment 3 described below. Figure 7 shows the condition of Segment 2.

Figure 7. US 52 looking southeast near Laraway Road (image: Google).

Segment 3. Central intersection segment. This part of US 52 consists of a two-lane section that is an overlay of a 9-in ± thick PCC pavement widened with a bituminous base course on each side. A 4 ft, 10-in bituminous shoulder, tapers, and turn lanes are the main differences between this segment and Segment 2 above. Figure 8 shows the condition of the intersection area in 2013.

Figure 8. Intersection segment of US 52 looking southeast (image: Google).

Details of the various existing cross-sections are shown on the plans. Key cross-sections are presented in Appendix A.

3.2.3. Pre-Construction Distress Survey

Prior to construction on September 9 and 25, 2014, the project was surveyed and distresses mapped by BMPR. The survey consisted of walking the sections with field sheets representing the pavement and related pavement stationing. Data were recorded by mapping and coding the distress as outlined in the BMPR Pavement Distress Manual (IDOT 2012a). The survey will provide a record of cracks and joints that can be compared with reflective distress over the evaluation period.

A distress survey summary is provided in Appendix B. For the purpose of clearly monitoring pavement distress over time, different cross-sections were broken out into separate segments and directions. This was done to associate performance with unique underlying pavement conditions and the experimental surface mix. Turn lanes were not surveyed.

No record of coring of these projects in advance was presented. Pavement coring may provide additional details to designers when selecting milling depth of the cross-section (i.e., cold-milling depth to remove damaged asphalt and minimize scabbing/potholes caused by too shallow a depth). Proper milling depth results in a surface that will hold up better under construction traffic and reduce the risk of quantity overruns of level binder.

3.2.4 Pre-Construction Rutting and Ride Quality

For pre-construction rutting and ride quality, BMPR arranged for a data collection run by IDOT's video survey vendor. The data were collected in each lane and direction of the project on August 12 and 15, 2014. The data were analyzed by 0.1-mi segments, with paving omissions and bridges removed from the data so that only the pavement was represented. For the project, the data were summarized for the three segments as noted above for each direction, lane, and wheel path. The data are presented in Appendix C.

3.2.5 Proposed Improvement Work

The project was let as Item 29, Contract 60Y02, on IDOT's June 13, 2014, letting. Electronic plans and specifications are available online on IDOT's website (IDOT 2014a). The work consisted primarily of HMA surface removal, variable-depth PCC removal, pavement patching, frame and lid adjustment, resurfacing with leveling binder and HMA surface course, grading and shaping shoulders, placement of thermoplastic pavement markings, raised reflective pavement markers, detector loop replacement, and all incidental and collateral work necessary to complete the project. The letting documents indicate that the surface mix was to be TRA; however, the surface mixes were changed as indicated in Table 1 to provide specific ABR, RAP/RAS, and PG binder combinations for this study.

Each of the sections was treated differently. The three sections had improvements, as follows:

> *Segment 1. Doris Avenue four-lane segment.* The segment was milled to a depth 2.25 in shoulder to shoulder. After tacking, a 0.75-in thick IL 4.75-mm level binder was placed except for the outer 12 in of the pavement, leaving the outside foot of the milled PCC pavement exposed. After tacking the level binder, 1.5 in of surface was placed the full width of the pavement. This resulted in the outside foot of the pavement being a nominal 2.25 in of surface mix and a 0.75-in "step" from level binder to non-level binder in the surface at the pavement edge. Additional aggregate was added to the shoulder to complete the cross-section.

Segment 2. Doris Avenue to Laraway Road. Excluding the intersection segment noted below, the bulk of the US 52 improvement consisted of milling the surface to a depth of 2.25 in edge to edge of the safety shoulder. After tacking, a 0.75-in thick IL 4.75-mm level binder was placed except for the outer 12 in of the safety shoulder, leaving the outside foot of the milled HMA shoulder exposed. After tacking the level binder, 1.5 in of surface was placed on the full width of the pavement and shoulder. This resulted in the outside foot of the pavement being a nominal 2.25 in of surface mix and a 0.75-in "step" from level binder to non-level binder in the surface at the pavement edge. Additional aggregate was added to the shoulder to complete the cross-section.

Segment 3. Central intersection segment. This area of the improvement consisted of milling the surface to a depth of 2.5 in edge to edge of the safety shoulder. After tacking, a 1-in thick IL 4.75-mm level binder was placed except for the outer 12 in of the safety shoulder, leaving the outside foot of the milled HMA shoulder exposed. After tacking the level binder, 1.5 in of surface was placed the full width of the pavement and shoulder. This resulted in the outside 12 in of the safety shoulder being a nominal 2.5 in of surface mix and a 0.75-in "step" from level binder to non-level binder in the surface at the safety shoulder edge.

Details of the various proposed cross-sections are shown on the plans. Key cross-sections are presented in Appendix A.

CHAPTER 4: PROJECT CONSTRUCTION

This chapter presents information pertaining to the HMA overlay construction in 2014. The general sequence of construction operations for the projects was to mill the concrete and HMA overlay as shown on the plans; adjust frames and grates; perform patching and filling of cracks, joints, and flangeways with HMA; apply tack coat; place 4.75-mm level binder; tack coat the level binder, place a 9.5-mm surface course; construct shoulders; establish pavement markings; install raised pavement reflectors; and install detector loops for traffic signals. For all 2014 let projects in this study effort, D Construction, Inc. of Coal City, Illinois, was the successful bidder and prime contractor.

4.1 CRAWFORD AVENUE/PULASKI ROAD

4.1.1 Pavement Cold-Milling

Each of the segments contained different pavement cold-milling details as described above and shown in Appendix A. In general, milling per Article 440 and 1101.16 of the Standard Specifications for Road and Bridge Construction (IDOT 2012b) was used at the pavement edges to retain the curb and gutter function and taper the new surface into the existing gutter elevation. The result was that the bare concrete sections were milled down 1.5 in at the pavement edge and curb line. In Segment 3, the HMA was milled curb to curb so that the new surface elevation would remain the same as the existing elevation, once complete.

Figures 9 through 16 show the resulting milling at various areas. From the resulting texture of the milled surface on both the PCC and HMA segments, it was evident that the milling machine’s teeth were being partly replaced with new teeth upon being lost or worn. This resulted in uneven depth of milling across the pavement section. The milling operation also exposed areas of marginal concrete quality at joints and cracks, resulting in spalling and material loss in those areas that required patching or filling by hand.

4.1.2 Patching, Filling of Cracks, Joints, and Flangeways

Prior to overlay, the section was patched using Class D patches (full-depth HMA), and any wide cracks and joints were cleaned and filled with an IL 4.75-mm HMA level binder sand mix. Appendix D provides the patching schedule for Class D patches. The total plan quantity for patching was 1,515 yd^2. Patching totaled 891.92 yd^2 for the project, which represents 59% of the plan patching quantity.

Filling of cracks, joints, and flangeways with IL 4.75-mm HMA level binder required 73.06 t of material. This equates to an average of 0.25 t for every 100 lane-ft of the project.

4.1.3 Tack Coat

After repairs were complete, the pavement was cleaned then tacked. Figure 16 provides an indication of the tack on Segment 2 in the milled area. Between the level binder and surface course, a tack coat was also placed. Figure 17 shows the resulting tack coat on the level binder. In both cases, some wide “zebra striping” was evident.

4.1.4 Level Binder

The mix used for level binder was an IL 4.75-mm sand mix, which was used on the entire project. The level binder used an asphalt binder of PG 70-28 with an ABR of 35% from both RAP and RAS. For the level binder, RAS was used at a rate of 4.9% of total mix, with 54% of the ABR coming from RAP and 46% from RAS. Details of the mix design can be found in Appendix E.

It should be noted that the level binder was placed full width from 159th Street to the I-57 bridge (Segment 3). The remaining segments had the level binder placed partial width of the cross-section. On Segment 1, the outside foot was without level binder, and on Segment 2 the outside 6 ft of the pavement was without level binder. See Appendix A for cross-sectional details of how the level binder was placed. Figures 14 through 16 also illustrate this detail. As shown on the plan, the level binder was placed 1 in thick, with the machine edge forming the longitudinal edge of the level binder. No attempt was made to taper the level binder edge.

Appendix F contains the paving sequence map for the level binder. Paving sequence can be important in determining long-term performance related to compaction conditions of the mat near joints (i.e., confined or unconfined edge).

Two static three-wheel rollers were used as breakdown and intermediate rollers, as shown in Figure 14. A vibratory roller in static mode was used as a finish roller.

4.1.5 Surface Course

The surface course mixes are the main experimental feature on this project. Two mixes typical of PG grade selection policies/specifications are featured. Surface mixes on this project as well as all the projects within the 2014 let projects use an N70 mix design. All mix criteria (aggregate and volumetrics) are according to standard specifications and job special provisions; however, RAP and RAS percentages for the surface course were changed as follows:

> The northbound lanes used a mix with 15% ABR split equally between RAP and RAS with a PG 64-22 asphalt binder. This mix represents a typical “unbumped” mix as a result of being under 20% ABR in statewide specifications (15% ABR per District 1 Special Provision)—that is to say, if the plans were showing a PG 64-22 for asphalt binder, the specification controls would allow an ABR up to 20% (15% ABR per District 1 Special Provision) before “bumping” the grade down to a softer asphalt binder.
>
> The southbound lanes used a mix with 30% ABR, also split equally between RAP and RAS. Because of exceeding 20% ABR, statewide specifications (15% ABR per District 1 Special Provision) would require the contractor to “double bump” down the asphalt binder, resulting in a PG 58-28 asphalt binder that was used with this mix.

Appendix F contains the paving sequence map for the surface course. Paving sequence can be important in determining long-term performance related to confined or unconfined compaction edge conditions of the joint.

Paving was typical; however, the paver did use a 24-ft reference rather than a 30 ft. In each case of asphalt placement (all lanes, all mixtures), the grade reference was on the left side of the paver. The right side of the paver was adjusted from time to time to control material yield. The surface was paved a thickness of 1.5 in and compacted with two dual-drum vibratory rollers followed by a dual-drum vibratory roller operated in static mode as the finish roller. As noted, the partial-width level binder in the cross-section resulted in a stepped cross-section in the outer lane. The surface lift thickness varies from 1.5 in over the 6-ft width of level binder to 2.5 in tapering to 1.5 in over the outer 6 ft on the milled surface in Segment 2. The lighter area in Figures 18 through 20 define the location of the level binder, and the darker area of the surface near the curb line/pavement edge defines the single lift of surface that was placed on the milled concrete surface. Some early distress was noted at the edge of the level binder where hairline cracks formed intermittently at this “step” location. It may be possible to reduce the impacts of this transition by reducing the level binder thickness to 0.75 in and hand-luting the level binder edge to form a tapered edge to zero rather than a dropped-off edge. Placing the level course only on the inner lane with a tapered edge may be another alternative.

Figure 9. Segment 3 (159th Street to I-57) cold-milled pavement.

Figure 10. Segment 2 (between I-57 and I-80) cold-milled pavement.

Figure 11. Segment 3 (159th Street to I-57) cold-milled pavement.

Figure 12. Segment 3 (159th Street to I-57) cold-milled pavement.

Figure 13. Segment 2 (between I-57 and I-80) cold-milled pavement.

Figure 14. Segment 2 (between I-57 and I-80) level binder placed at start of cold-milled taper.

Figure 15. Segment 2 (between I-57 and I-80). Placing 4.75-mm level course from approximately 6 ft off of curb line and 6 ft from center median.

Figure 16. Segment 2 (between I-57 and I-80). Placing 4.75-mm level binder course from approximately 6 ft off of curb line. Level binder course is 1 in thick at 6 ft off of curb line, not tapered to zero.

Figure 17. Segment 2 (between I-57 and I-80). Placing surface in turn lane. Typical zebra-striped tack coat on level binder.

Figure 18. Segment 2 (between I-57 and I-80). Placing surface course installation on Pulaski. Primary straight section with cold-milling from curb to 6 ft from curb. A 24-ft longitudinal grade reference was used in lieu of the 30 ft required.

Figure 19. Segment 2 (between I-57 and I-80). Slightly cracked surface in center of photo defines edge of level binder and cold-milling taper to curb line.

Figure 20. Segment 2 (between I-57 and I-80). Slightly cracked surface (lighter surface area) defines location of level binder. Right 6 ft of lane (darker area next to curb) is cold-milling taper where the surface is 2.5 in at center of lane tapering to 1.5 in at curb.

4.2 US 52–IL 53 TO LARAWAY ROAD

4.2.1 Pavement Cold-Milling

Each of the segments contained different pavement milling details, as shown in Appendix A. In general, milling was used to retain the existing cross-section and profile. The result was that the existing HMA was milled 2.25 or 2.5 in in depth. The width of the milling varied but was edge to edge of pavement, including the safety shoulder. Figures 21 through 23 present the results.

From the resulting texture of the milled surface on both the PCC and HMA segments, it was evident that the milling machine's teeth were being partly replaced upon being lost or worn. This resulted in uneven depth of milling across the pavement section. The milling operation also exposed numerous previously installed pavement patches, as shown in Figure 21.

4.2.2 Patching, Filling of Cracks, Joints, and Flangeways

Prior to overlay, the section was patched using Class D patches (full-depth HMA), and any wide cracks and joints were cleaned and filled with an IL 4.75-mm HMA sand mix level binder. Appendix D provides the patching schedule for Class D patches. Note that the patching is located in intersection Segment 3. The total plan quantity for patching was 510 yd^2. The actual patching totaled 387.78 yd^2 for the project, which represents 76% of plan quantity.

The plan quantity for filling of cracks, joints, and flangeways with an IL 4.75-mm HMA level binder was 84 t. The project used all the plan quantity by placing 84.41 t of HMA for this operation, which equates to an average of 0.31 t for every 100 lane-ft of the project.

4.2.3 Tack Coat

The pavement was cleaned then tacked. Figure 25 shows the tack coat on the level binder lift in Segment 2, where some wide “zebra striping” was evident.

4.2.4 Level Binder

As is typical for the district, the mix used for level binder was an IL 4.75-mm sand mix, which was used on the entire project. The level binder uses an asphalt binder of PG 70-28 with an asphalt binder replacement of 32% from both RAP and RAS. For the level binder, RAS was used at a rate of 4.9% of total mix, with 51% of the ABR coming from RAP and 49% from RAS. Details of the mix design can be found in Appendix E.

Level binder was placed narrower than the pavement area to be resurfaced. The outside 12 in of the pavement or safety shoulder were not covered with the level binder. See Appendix A for cross-sectional details of how the level binder was placed. Figures 24 and 26 also show this detail. As shown on the plan, the level binder was placed at 0.75 in thick, with the machine edge forming the longitudinal joint edge of the level binder in Segments 1 and 2. Segment 3 received a 1-in.-thick level binder. Appendix F contains the paving sequence map for the level binder.

The same rolling sequence was used on this project as was used on Crawford Avenue/Pulaski Road, with two static three-wheel rollers for breakdown and intermediate rolling followed by a dual-drum vibratory roller operated in static mode.

Figure 21. Segment 2 cold-milling of roadway exposed numerous previously installed pavement patches.

Figure 22. Existing cold-milling specifications do not address variability between adjacent teeth; newer teeth result in deep grooves of 0.5 in or more across the pavement section (Segment 1 shown).

Figure 23. In Segment 2, the milling resulted in loss of material at numerous cracks and joints that had reflected through the previous HMA overlay.

Figure 24. Level course installed 1 ft narrower than cold-milling operation.

Figure 25. Typical tack coat installation; note zebra pattern.

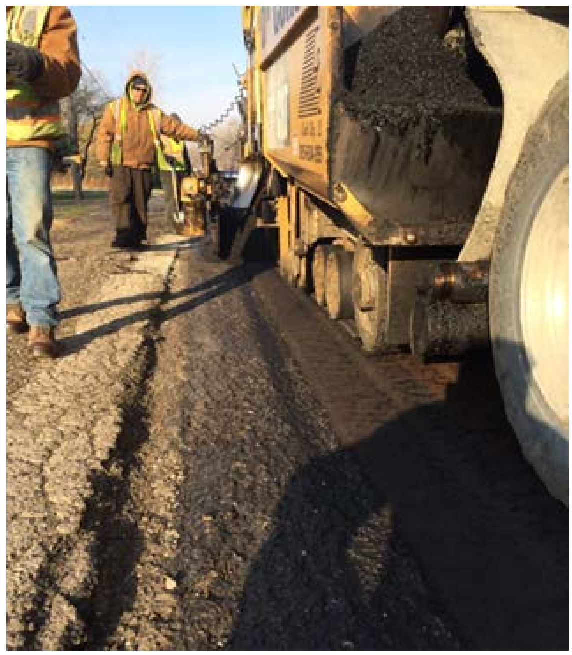

Figure 26. Surface course installation showing leveling course, lip between level and cold-milled surface, and surface course installation.

4.2.5 Surface Course

The surface course mix experiments on this project featured the use of the same basic components overall, with and without RAS. The mix is an N70 gyratory mix using PG 58-28 for the liquid binder. Both mixes used 30% ABR. All mix criteria (aggregate and volumetrics) are according to standard specifications and job special provisions; however, RAP and RAS used for the surface course were specified as follows:

> The mix in the westbound lanes used only RAP to obtain the 30% ABR.
>
> The mix in the eastbound lanes used both RAP and RAS to achieve the 30% ABR, with each material equally contributing to the ABR.

The plans would normally specify the asphalt binder as a PG 64-22, leaving the ABR content to the contractor. The statewide standard specifications would allow up to 20% ABR (15% ABR per District 1 Special Provision) before the asphalt binder grade would have to be “double bumped” to a lower PG grade. In this case, with 30% ABR, a “double bump” down to a PG 58-28 asphalt binder is required. Both mixes are in accordance with normal and common practice and represent the possible choices of different recycle levels that a contractor could choose under current specifications. The adjustment in PG grades required at higher levels of ABR is intended to result in equal or better cracking performance of mixes at lower ABR levels that do not require a grade bump. The mix details can be found in Appendix E.

Appendix F contains the paving sequence map for the surface course. Paving sequence can be important in determining long-term performance related to compaction conditions of the mat near joints (i.e., confined or unconfined edge). However, it should be noted that Segment 1 was a turnaround point in paving the project. In that area, all the lanes were laid in a short time period with limited cooling of the previous lane when the next lane was placed. The result is that the lane joints are “hot” joints and are likely to perform better over the life of the project than typical cold joints on the remainder of the project.

Paving was typical; however, the paver used a 24-ft reference rather than a 30 ft. In each case of asphalt placement (all lanes, all mixtures), the grade reference was on the left side of the paver. The right side of the paver was adjusted from time to time to control material yield. The surface was paved at a thickness of 1.5 in and compacted with two dual-drum vibratory rollers followed by a dual-drum vibratory roller operated in static mode as the finish roller. As noted, the partial use of level binder in the cross-section resulted in stepped cross-section at the outer foot of the pavement. During paving, there was some obvious distress (longitudinal cracking) when using the “step” paving detail, as shown in Figure 26. The distress is in the form of an intermittent hairline longitudinal crack, as seen in Figure 27. The outer surface lift thickness was 2.25 in in Segments 1 and 2. In Segment 3, the outer surface lift thickness was 2.5 in because of the increased level binder thickness in this segment. There is also some slight segregation along the pavement edge longitudinally.

Figure 27. Evidence of hairline crack at underlying transition from level binder to no level binder. Level binder (4.75 mm) to left of crack and milled surface to right of crack. Increased segregation also at pavement edge (right side of photo).

CHAPTER 5: POST-CONSTRUCTION SURFACE CONDITIONS

5.1 PAVEMENT PROFILE

As part of the evaluation of the projects, international roughness index (IRI) and rutting data were collected using noncontact profile equipment. Prior to construction, IDOT's profile vendor collected the profile data. After construction, ERI Inc. of Savoy, Illinois collected profile and rutting data for the study. The same equipment and data collection techniques will be used throughout the post-construction evaluation to reduce device-to-device variations in measurement technology. For IRI, all data presented are quarter-car simulations.

Post-construction IRI and rutting data were obtained on December 17, 2014, for Crawford Avenue/ Pulaski Road. Although winter was quickly closing in, the data were collected prior to the winter freeze of the subgrade. Appendix C presents the dataset of IRI and rutting by study segment, lane, direction, and wheel path. Post-construction profiles are not considered smooth and are well above the historical average of Illinois interstate pavements as indicated from the cumulative frequency curve of 2014. Interstate data are shown in Figure 28 with the overall IRI for the projects. High-quality two-lift interstate pavement overlay construction typically has an IRI of approximately 50 to 60 in/mi. Urban sections tend to have higher IRI values and rural sections tend to be smoother. The data from Crawford Avenue/Pulaski Road (urban) and US 52 segments 2 and 3 (rural) follow this general trend.

Additional IRI and rutting data were collected on March 10, 2015. This data collection run was conducted while the pavement subgrade was frozen. Just prior to the data collection, the pavement surface was starting to experience freeze–thaw conditions. The data represent the worst-case condition for ride from frost-heave conditions. These data are also presented in Appendix C. In general, the frozen profile conditions were the same as immediately after construction for Crawford Avenue/Pulaski Road. For US 52, the section saw a 15 to 20 in/mi rise in IRI for the frozen conditions from post-construction. The main differences in the sections are urban with curb and gutter for Crawford Avenue/Pulaski Road versus rural for US 52.

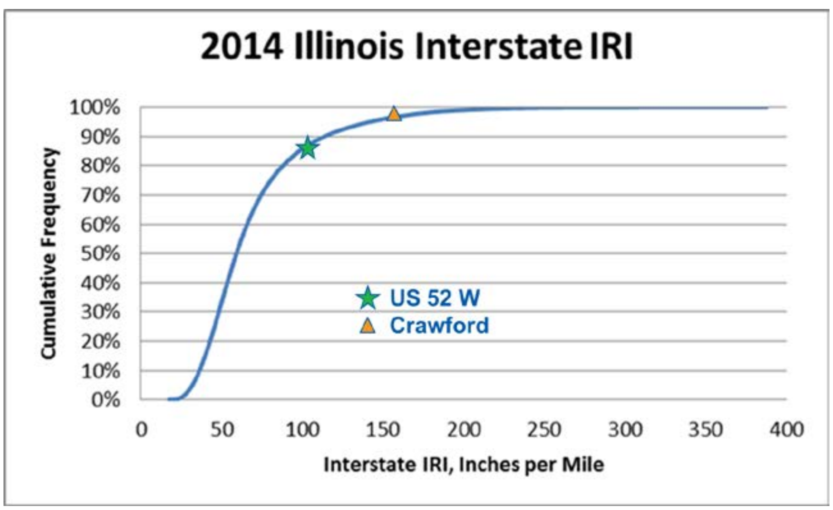

Figure 28. 2014 cumulative frequency curve of Illinois interstate IRI with average project IRI.

From the data, it can be seen that the right wheel path near the pavement edge or curb is the roughest. However, the data trend of higher right wheel path roughness is a phenomenon of all IRI data collected, even in the passing lane of sections and with different data collection devices. The paving grade reference being placed on the left side of the paver with the operator adjusting the right side for material yield may explain the difference in left and right wheel path smoothness. The statewide interstate data also show a bias of the right lane being rougher. A limited investigation found this to be a common trend in many datasets and not considered an error. Using two longitudinal grade references (one on each side) would likely produce better uniformity between the wheel paths. If using the single reference (one side), maintaining a uniform cross-slope would improve the far wheel path (right wheel path in this case) smoothness. It is important to perform a pre-pave meeting and discuss equipment requirements and use prior to paving.

The outer or right wheel path typically has more distress than the interior left. To improve smoothness, proper repairs of the pavement edge, selecting a proper milling depth to reduce scabbing, using a milling specification to improve teeth milling depth, and adopting similar milling features as the paver with respect to longitudinal smoothness and uniform cross-slope will all lead to an improved ride.

CHAPTER 6: MATERIALS TESTING

6.1 SAMPLING OF MATERIALS

As the projects were constructed, component and mix materials were collected for testing. The components included samples of the neat liquid asphalt binder, virgin aggregates, RAP, and RAS for each mixture being produced. Component aggregate, asphalt binder, and mixture sampling were all done at the HMA plant. All samples were taken jointly from the same sampling area by Illinois Center for Transportation (ICT) and IDOT Bureau of Materials and Physical Research (BMPR) teams. This was done to reduce variability of production throughout the day and to have as nearly identical materials as possible for the battery of test.

6.2 TESTING AND RESULTS

A suite of tests were chosen that would provide the most useful information for the study. The tests were then assigned to the BMPR and ICT laboratories best suited to perform the work. Table 2 presents the suite of tests, specification used, and laboratory performing the work. Note that Illinois has made a number of modifications to standardized tests to better differentiate material test results (IDOT 2015).

Tests were conducted on level binders, each of the surface mixes, and the neat liquid asphalt binder used on the projects. Results of the various tests are presented in Appendix G for Crawford Avenue/Pulaski Road and US 52 projects. Owing to the length of time for testing fatigue, these results are not presented in this report.

Table 2. HMA Mix Test Specifications with Performing Laboratory

Test	Specification	Laboratory
Quantitative extraction of bitumen from bituminous paving mixtures	AASHTO T 164-13 (Illinois Modified 01/01/15)	BMPR
Maximum specific gravity of bituminous paving mixtures	AASHTO T 209-12 (Illinois Modified 01/01/15)	BMPR
Stability and flow, 150-mm gyratory	ASTM D 1559 (Illinois Modified w/150-mm fixture)	BMPR
Marshall stability and flow of asphalt concrete, 4-in sample	ASTM D 1559	BMPR
Cantabro loss	TxDOT Test: Tex-245-F	BMPR
Resistance of compacted bituminous mixture to moisture induced damage	AASHTO T 283-07 (2011) (Illinois Modified 01/01/15)	BMPR
Texas overlay test	TxDOT Test: Tex-248-F	BMPR
Hamburg wheel-track testing of compacted hot-mix asphalt (HMA)	AASHTO T 324-11 (Illinois Modified 01/01/15)	ICT
Creep compliance/IDT strength	AASHTO T-322-07 (2011)	ICT
Fatigue	AASHTO T-321-14	ICT
Semi-circular bending with flexibility index (I-FIT)	Draft AASHTO TP 105-13 Modified for Intermediate Temperatures	ICT
Flow	AASHTO TP 79-13	ICT
Complex modulus	AASHTO T 342-11	ICT
Performance-graded asphalt binder	AASHTO M 320 (Illinois Modified/AASHTO M 332)	BMPR

BMPR = Bureau of Materials and Physical Research Laboratory

ICT= Illinois Center for Transportation

6.2.1 Complex Modulus Test Results

The results of the complex modulus tests for the experimental surface mixes are presented in Figure 29. The legend provides mix details and location. Viscoelastic characteristics of the mixes were investigated using the following plots:

- Complex modulus vs. frequency (master curve): The master curve provides linear viscoelastic characterization of asphalt mixes over a wide range of temperatures and frequencies. Complex modulus values contain elastic and viscous phases of asphalt mixes.
- Phase angle vs. frequency (phase curve): The phase angle curve indicates how the viscous phase of asphalt mixes is evolving with temperature and loading frequency (i.e., 0 degrees—very stiff or rigid; 90 degrees—very fluid or water like).
- Complex modulus vs. phase angle (black curve): The Black curve indicates how complex modulus and phase angle are correlated to each other. These curves are often used to seek fingerprints of modification of asphalt binders, such as polymer modification.
- Storage modulus (elastic part) vs. loss modulus (viscous part) (Cole–Cole curve): Cole–Cole plots are also commonly used in research to study the interaction of complex modulus components (elastic and viscous parts) of the viscoelastic materials.

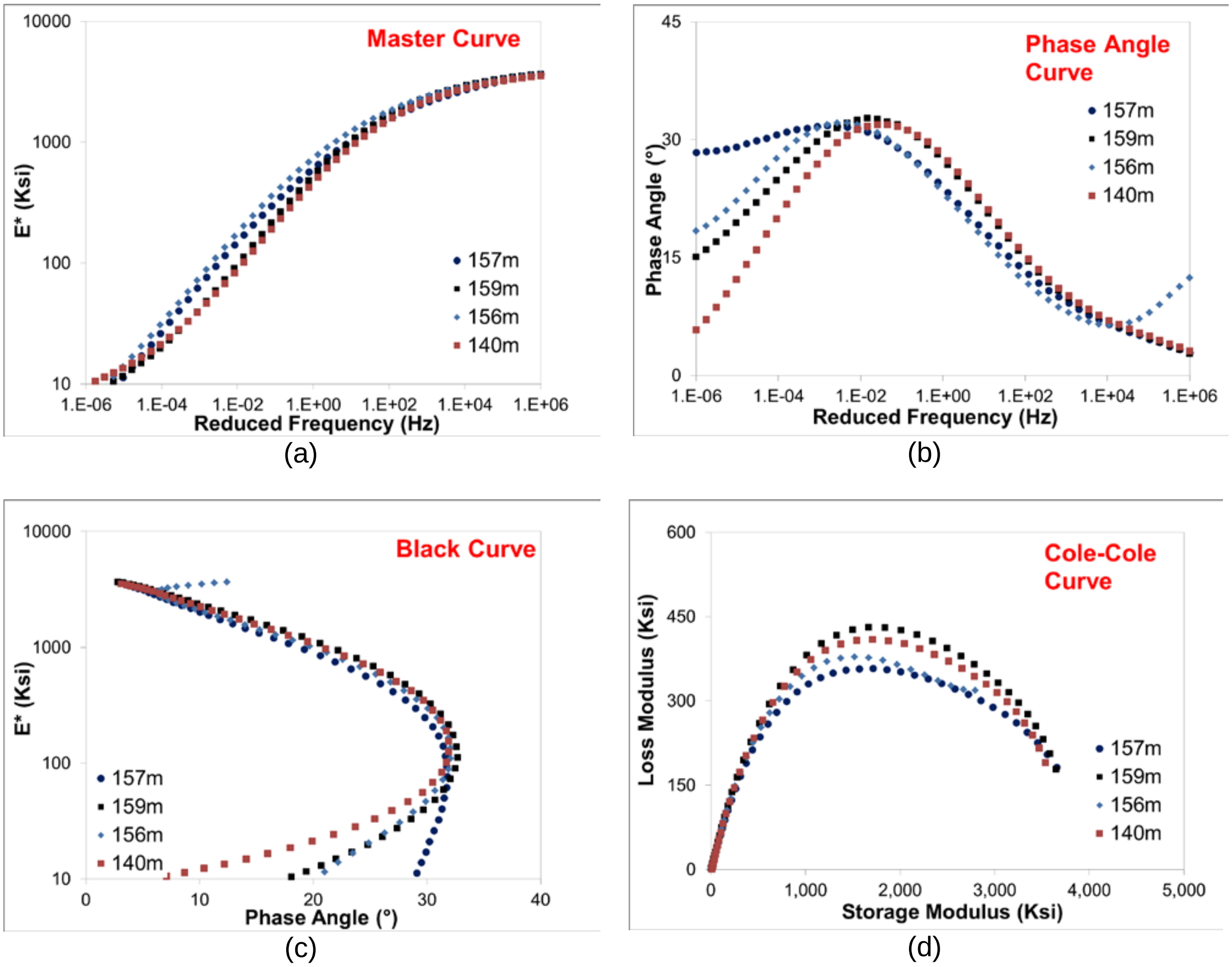

Figure 29. Viscoelastic characterization of the N70 surface mixes:
(a) master curve, (b) phase angle, (c) Black curve, (d) Cole–Cole plots.

CHAPTER 7: TOTAL RECYCLE ASPHALT PERFORMANCE

In 2012, IDOT developed the concept of total recycle asphalt (TRA), where up to 60% asphalt binder replacement (ABR) would be allowed and all aggregates would be recycled materials such as reclaimed asphalt pavement (RAP), recycled concrete, or slag by-product. In 2013, the concept had progressed to the point of building three demonstration projects to determine the performance of the mix on low-volume sections. Construction and early performance details have been previously reported, along with performance after the first winter (Lippert et al. 2014). This chapter provides a brief overview of the sections constructed, an update on performance, and data trends of the sections to date.

Three projects using the TRA specification were constructed as part of the 2013 demonstration. The TRA projects are located as follows:

1. 26th Street in Park Forest/Chicago Heights
2. Harrison Street in Hillside
3. Richards Street in Joliet

In addition, a nearby section of Wolf Road constructed during the same period was selected as a comparison section. All projects were on the April 26, 2013, IDOT letting (IDOT 2013). These projects were surveyed for distress before and after construction and annually by BMPR following the bureau's Pavement Distress Manual (IDOT 2012a), with the exception of Wolf Road. Wolf Road was selected as a comparison section after construction of the overlay was complete. For this reason, a "in-person" pre-construction distress survey was not conducted on this segment. Google Street View photo records of 2011 were used to conduct the pre-construction distress survey.

Although the demonstration projects were constructed under similar specifications, the contractor was given a number of recycling options for aggregate. The result was that two projects had similar mixes using recycled concrete and steel slag as raw feedstock aggregate, and one used only steel slag. Table 3 provides the resulting mixes, asphalt binder selection, and ABR.

Table 3. 2013 TRA Project Mix Summary

	26th Street	Harrison Street	Richards Street	Wolf Road
Material	Percent	Percent	Percent	Percent
Crushed Stone (Coarse)	Not Used	Not Used	Not Used	51.3
Stone Sand	Not Used	Not Used	Not Used	8.0
Natural Sand	Not Used	Not Used	Not Used	10.0
Fine FRAP	51.5	26.0	24.0	5.0
Coarse FRAP	Not Used	27.0	6.0	25.0
Crushed Concrete	30.0	27.0	Not Used	Not Used
Steel Slag (Fine)	Not Used	Not Used	24.0	Not Used
Steel Slag (Coarse)	15.0	15.0	45.5	Not Used
Mineral Filler	Not Used	Not Used	0.5	0.7
Reclaimed Asphalt Shingles (RAS)	3.5	5.0	Not Used	Not Used
Added Asphalt Grade	PG 52-28	PG 52-28	PG 58-28	PG 58-28
Added Asphalt Content (PG XX-28)	2.7	2.7	3.4	4.7
Total AC Content	6.7	6.5	5.4	5.9
Total ABR	60	56	37	20
Minimum Air Voids	3.0	3.0	3.0	4.0
Voids in Mineral Aggregate (VMA)	15.1	14.9	14.7	14.9
N-Design	50	50	50	70

Richards Street did not use RAS as part of the ABR, and steel slag was the feedstock aggregate. The result was that Richards Street had significantly less ABR (37%) than Harrison Street or 26th Street at 56% and 60%, respectively.

7.1 TOTAL RECYCLE ASPHALT DEMONSTRATION PROJECT DETAILS

Cross-sections of the existing and proposed improvement are located in Appendix A. In the following subsections, location maps and project descriptions are provided for each project.

7.1.1 26th Street in Chicago Heights, Illinois

This project is located on 26th Street (FAU 1633) and begins approximately 230 ft east of the centerline of Western Avenue and extends easterly to a point approximately 80 ft west of the centerline of East End Avenue, for a total distance of 10,640 ft (2.02 mi). Let as Contract 60L62, the project is located in the Village of Park Forest and the City of Chicago Heights in Cook County. Figure 30 presents the location of the section.

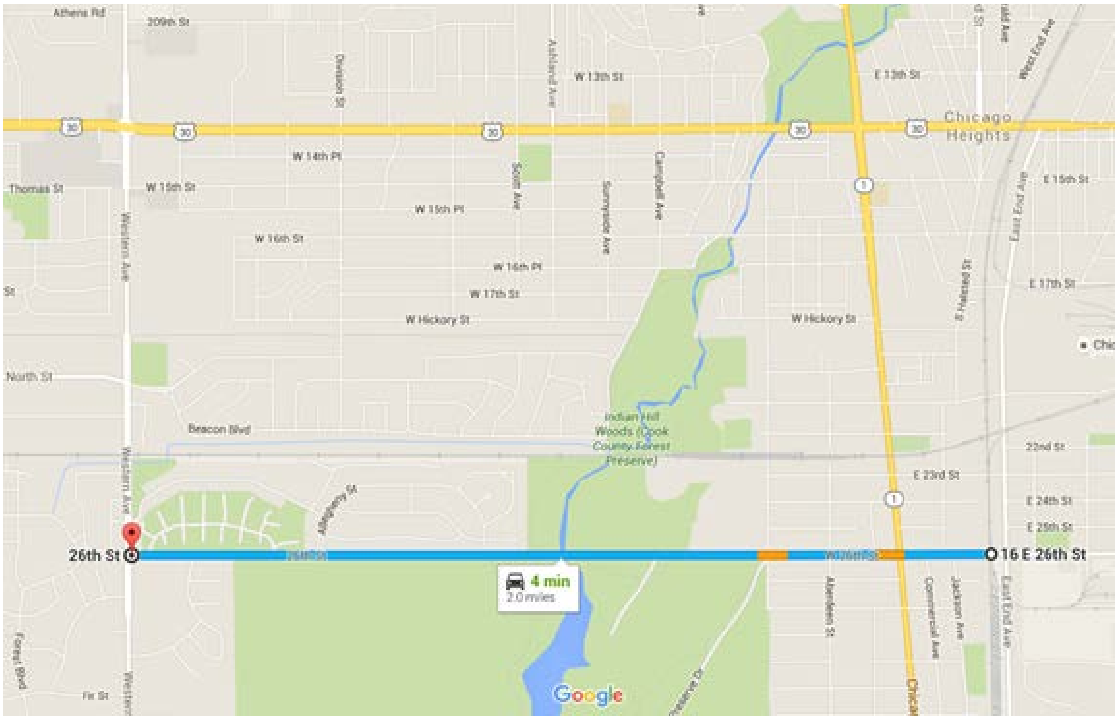

Figure 30. Improvement on 26th Street (map data: Google).

7.1.2 Harrison Street in Hillside, Illinois

This project begins at a point on the centerline of Harrison Street (FAU 1427) approximately 77 ft north of IL 38 (Roosevelt Road) and extends north and then east to approximately 59 ft west of Wolf Road. Let as Contract 60N67, the project is located within the Village of Hillside in Cook County. This project has a gross and net length of 5,927.6 ft (1.12 mi). Figure 31 presents the location of the section.

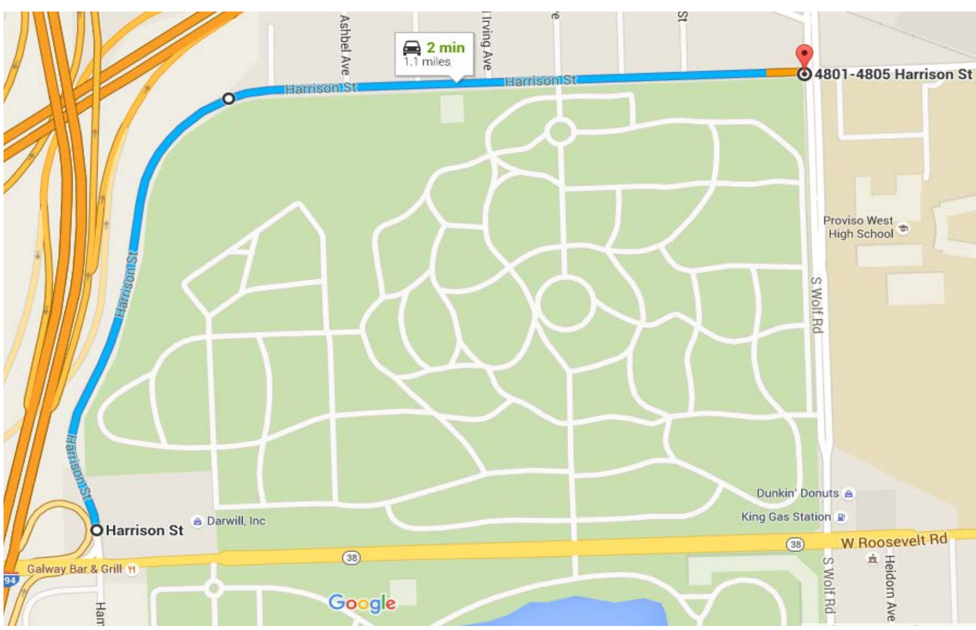

Figure 31. Improvement on Harrison Street (map data: Google).

7.1.3 Richards Street in Joliet, Illinois

The resurfacing improvement of Richards Street begins at 5th Avenue and extends in a southerly direction approximately 5,364 ft (1.015 mi) to Manhattan Road. Let as Contract 60P70, the improvement is located in the City of Joliet and Lockport Township, Will County. Figure 32 presents the location of the section.

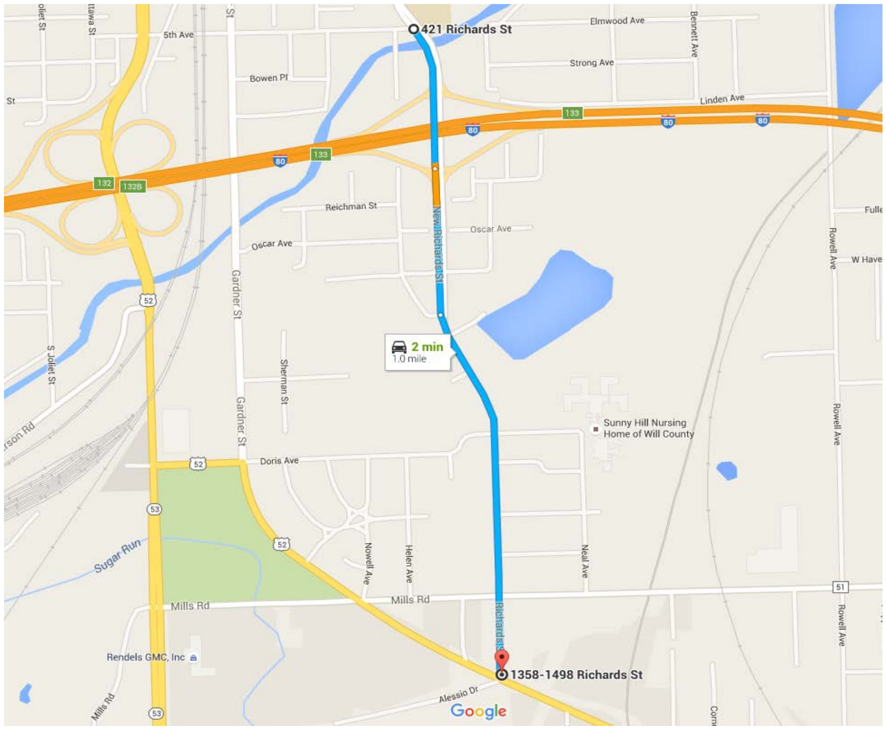

Figure 32. Improvement on Richards Street (map data: Google).

7.1.4 Wolf Road in Hillside, Illinois (Comparison Section)

The resurfacing improvement of this project begins at a point on the centerline of Wolf Road at IL 38 (Roosevelt Road) and extends in a northerly direction to 135 ft north of Harrison Street. Let as Contract 60M30, the project is within the Village of Hillside in Cook County. This project has a gross and net length of 2,638 ft (0.50 mi). Figure 33 presents the location of the section.

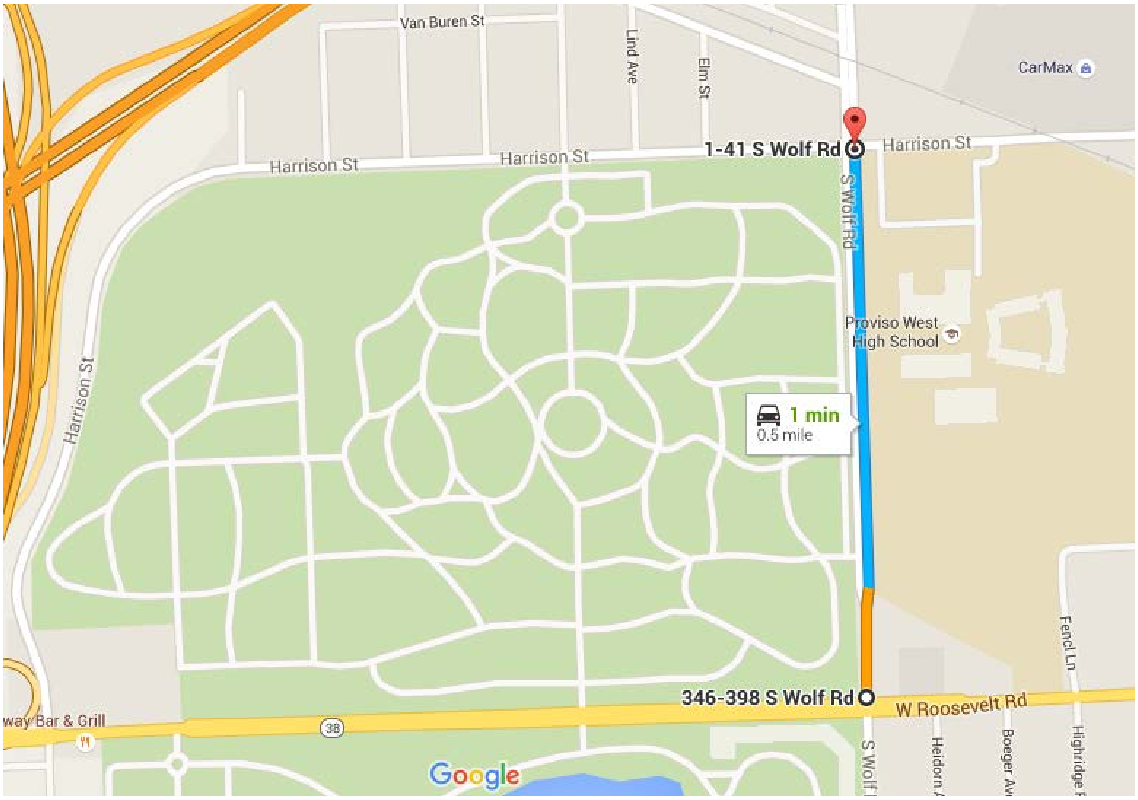

Figure 33. Improvement on Wolf Road (map data: Google).

7.2 PAVEMENT PERFORMANCE

7.2.1 Distress Surveys

Distress survey data have been collected on the sections using established distress criteria (IDOT 2012a). The datasets consist of pre-construction (2013), post-construction (2013), spring 2014, and spring 2015. Summaries of the distress surveys by section and date are presented in Appendix H. To present data trends, the data summaries have been plotted on stacked bar charts by distress type, as shown in Figures 34 through 44. As noted above, the preconstruction distress surveys of Wolf Road were conducted via Google Street View. The survey was limited to pavement joints, cracks, and patches. The number of cracks and joints are considered to be accurate; however, the patch area is an estimate based on policy minimum patch lengths and estimated lengths of longer patches. Wolf Road was extensively patched prior to overlay; therefore, Figure 38 was developed to present post-construction patching conditions.

Part of the annual distress survey is to take photos at similar locations with each survey to provide a visual progression of distress with time. Typical photos representing each section are presented in Appendix I.

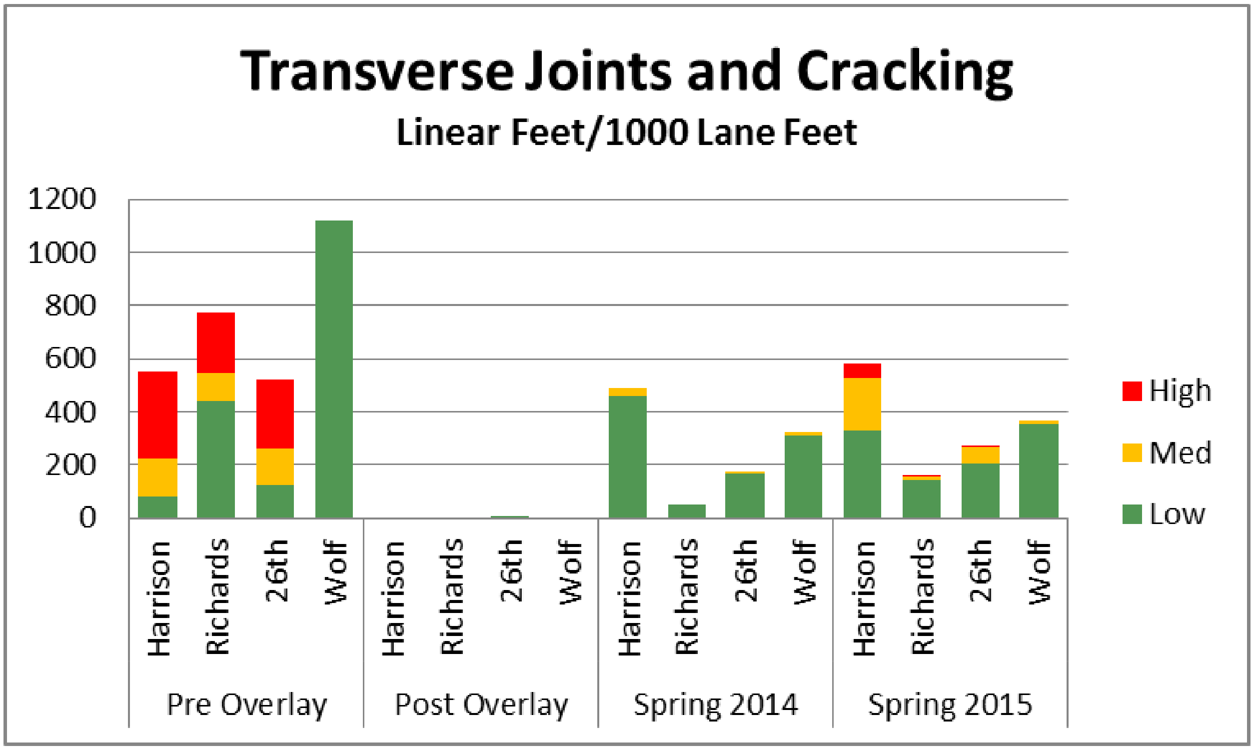

Figure 34. Transverse joints and cracks by distress level for TRA projects.

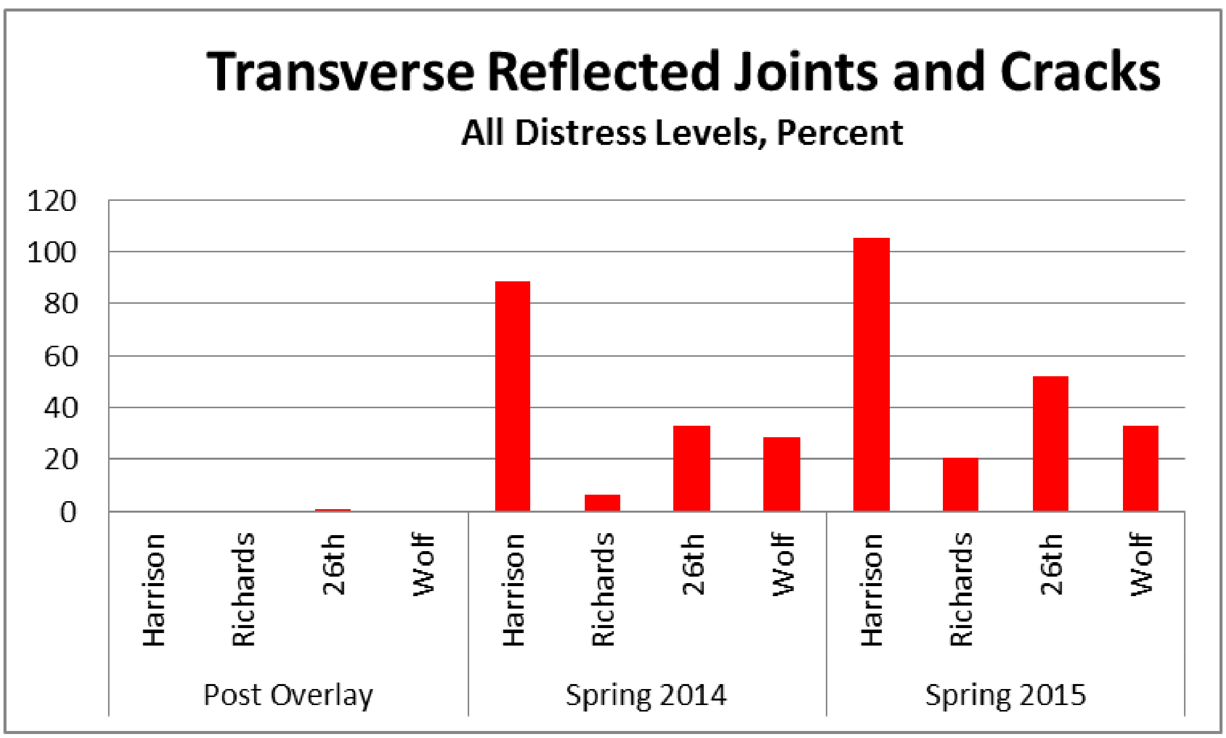

Figure 35. Percentage of crack and joint length reflected through overlay for TRA projects.

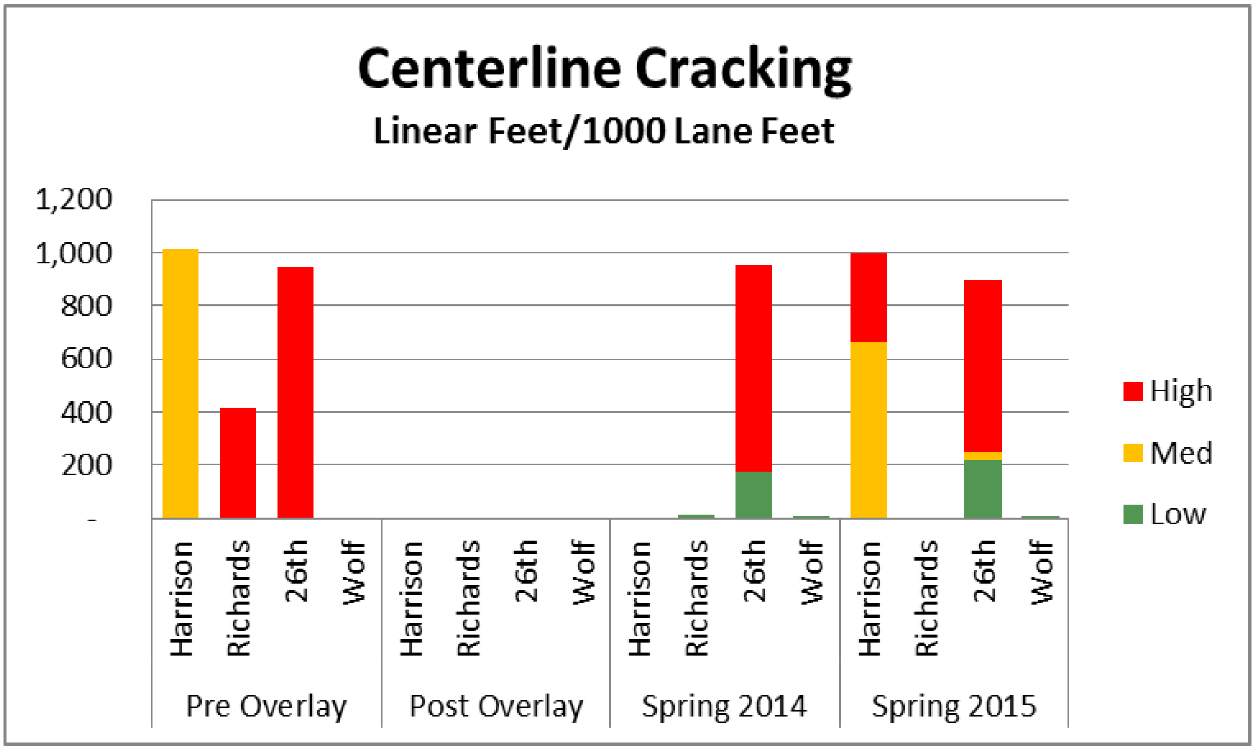

Figure 36. Centerline cracking by distress level for TRA projects.

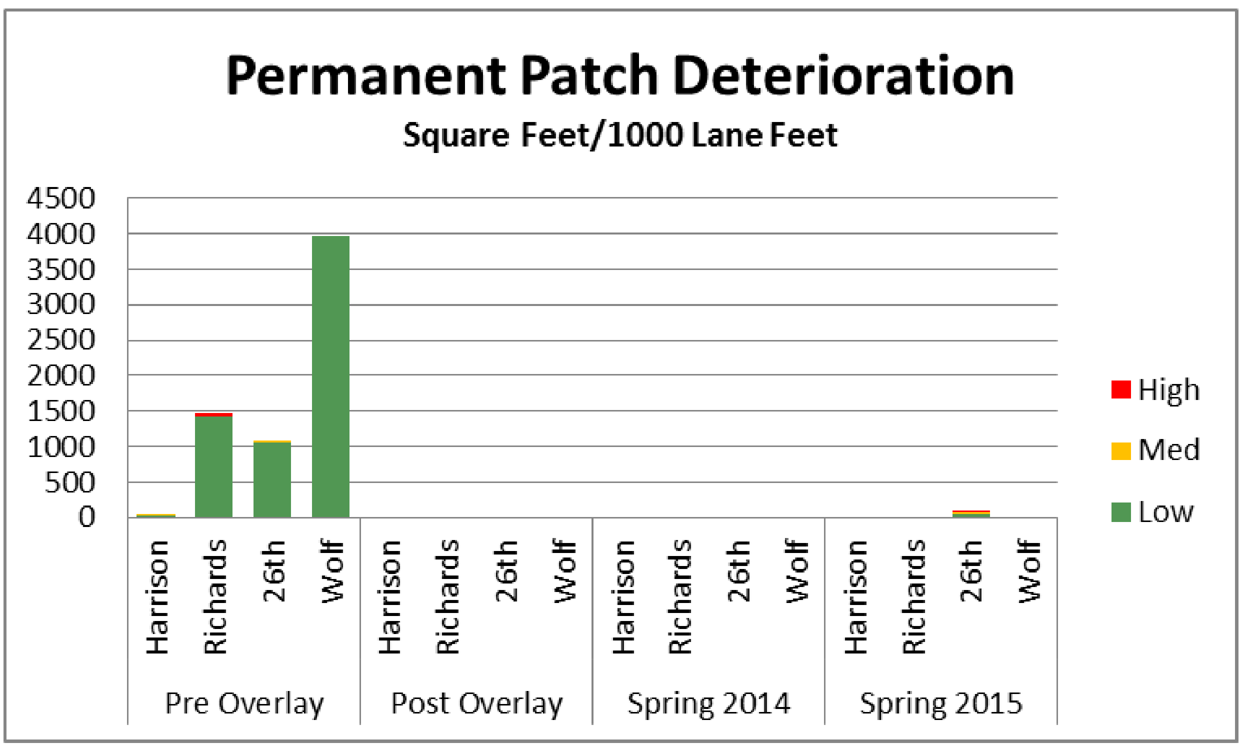

Figure 37. Permanent patching deterioration for TRA projects.

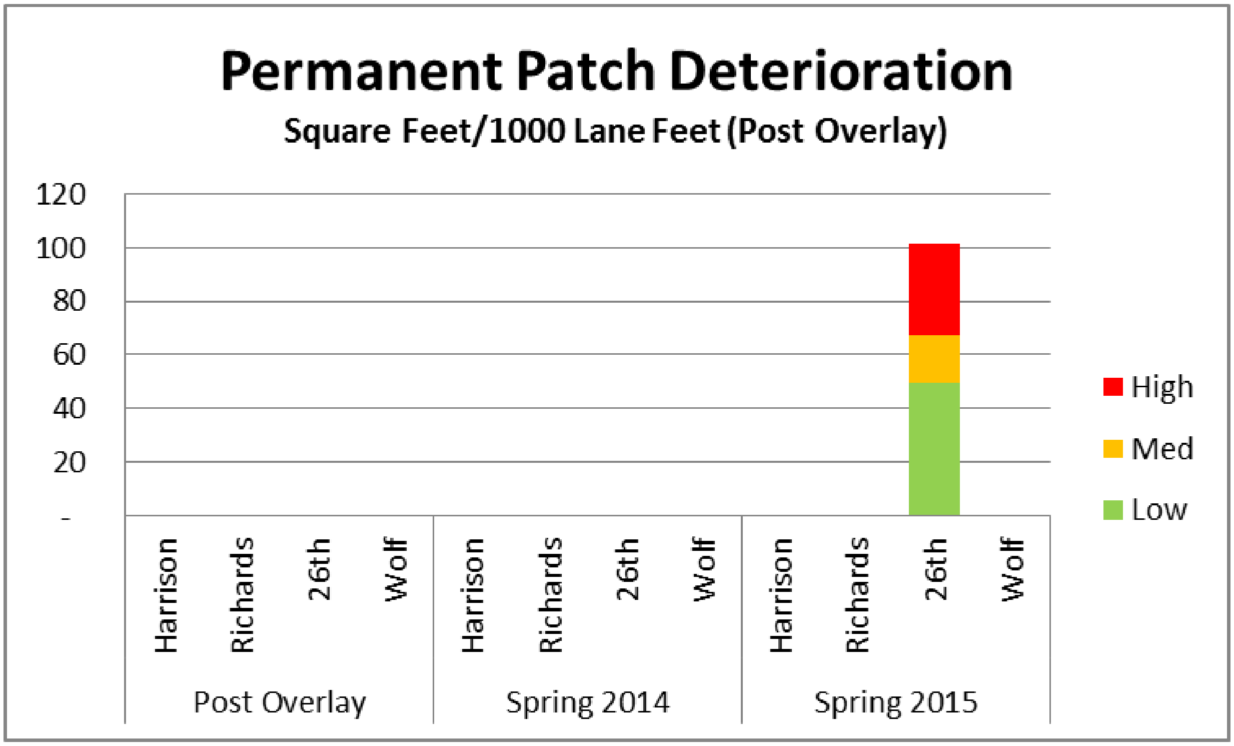

Figure 38. Permanent patching deterioration for TRA projects (post-overlay only).

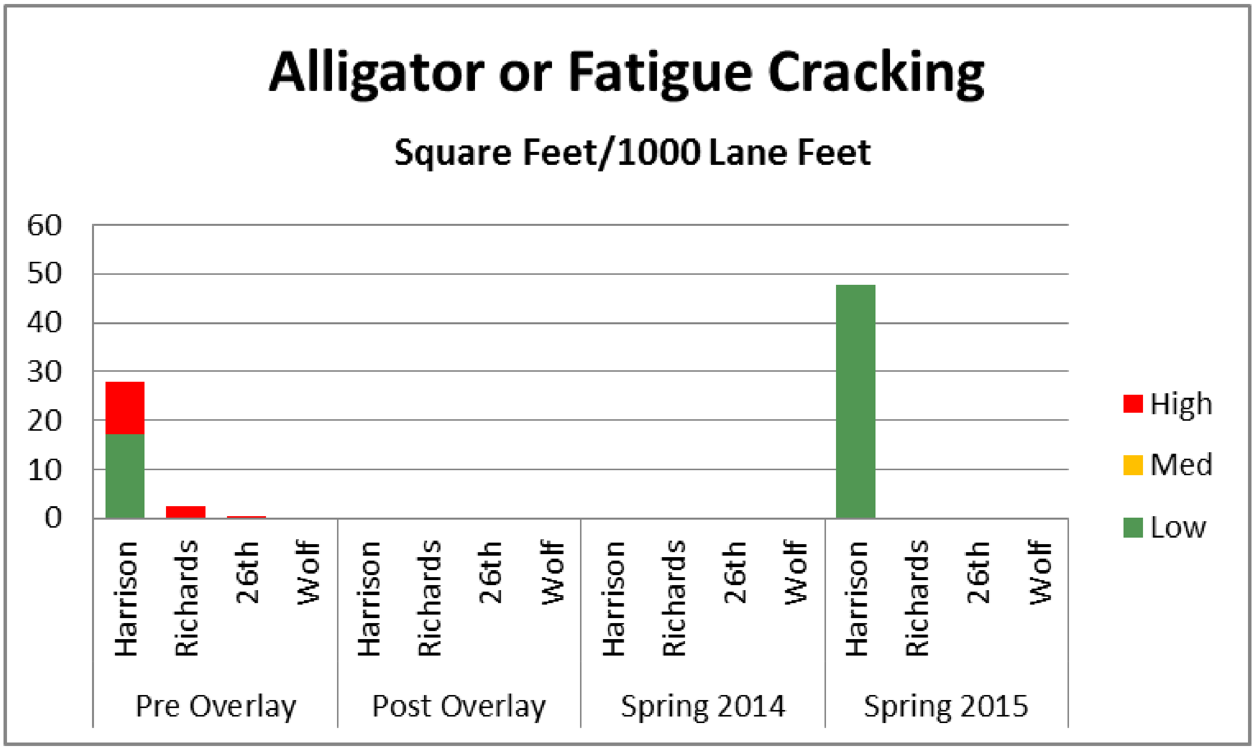

Figure 39. Centerline cracking by distress level for TRA projects.

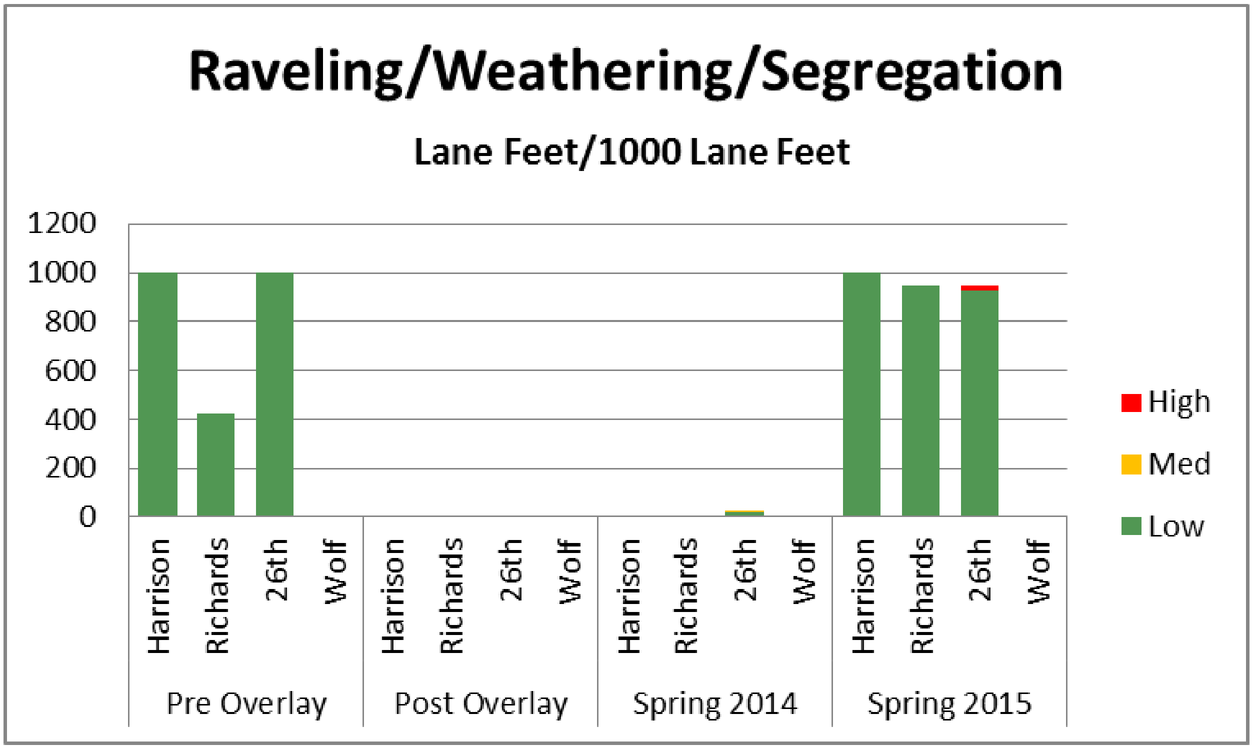

Figure 40. Raveling/weathering/segregation by distress level for TRA projects.

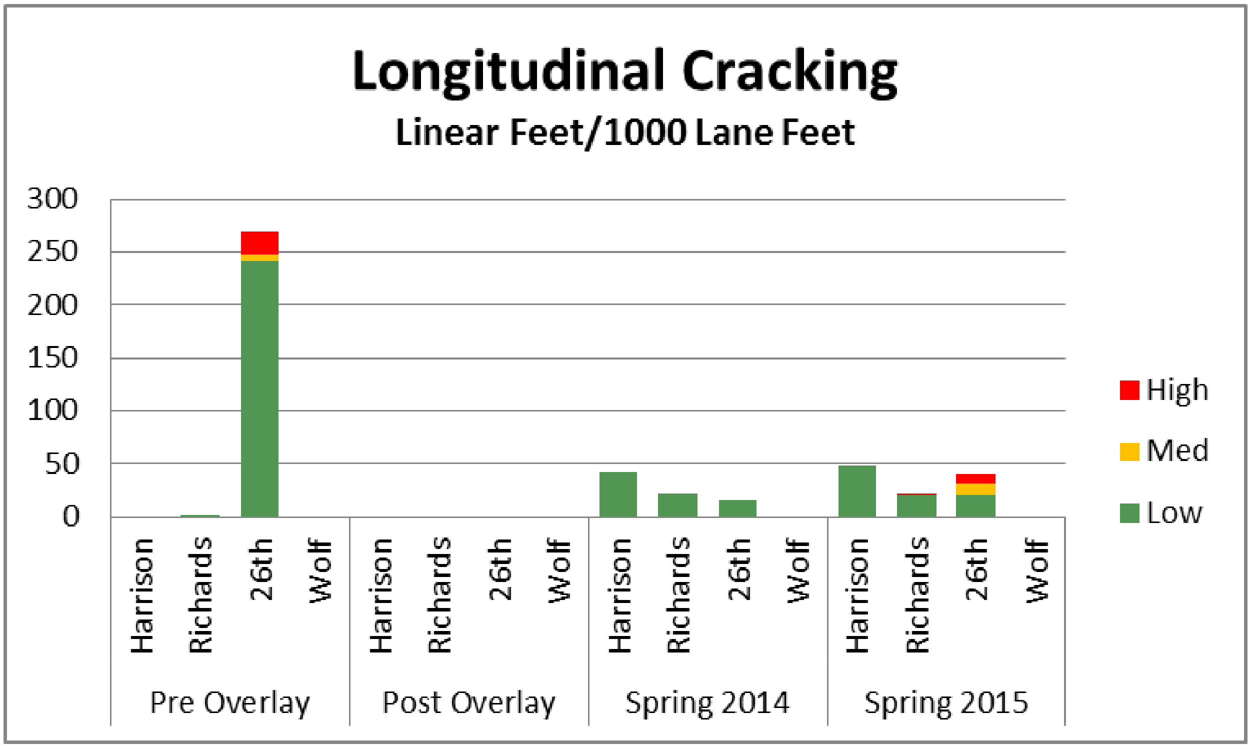

Figure 41. Longitudinal cracking by distress level for TRA projects.

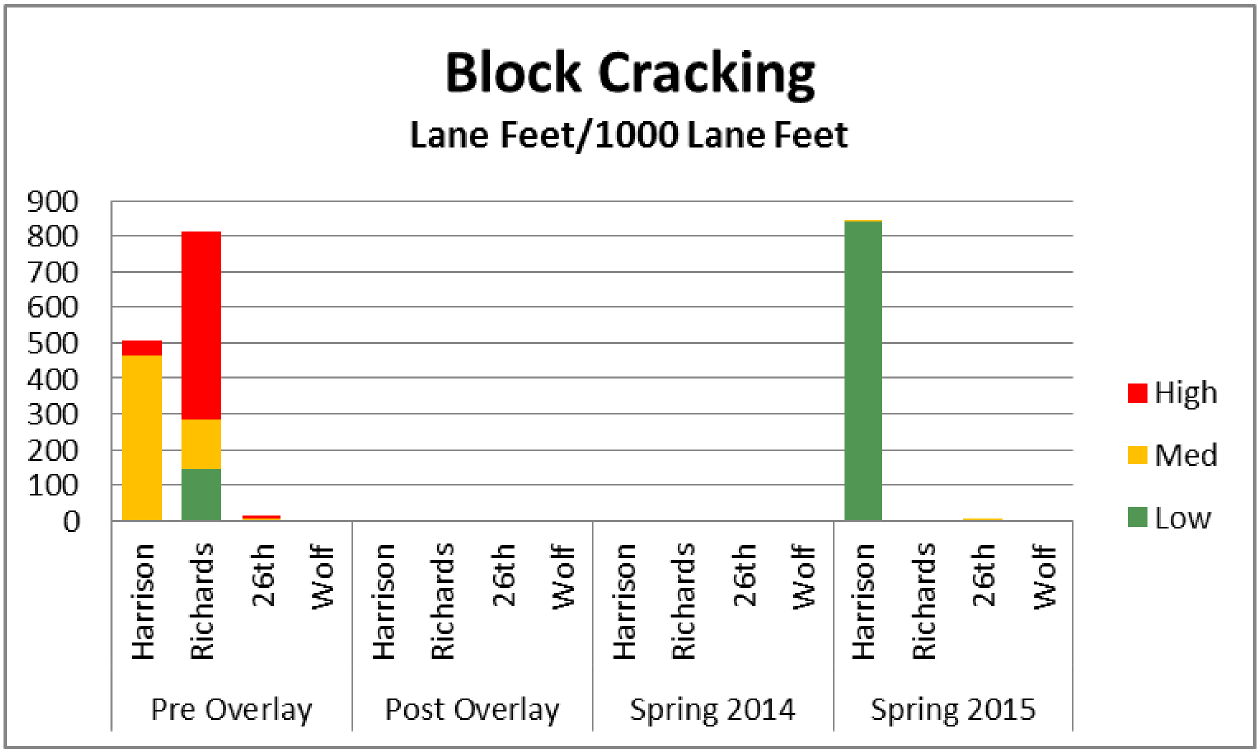

Figure 42. Block cracking by distress level for TRA projects.

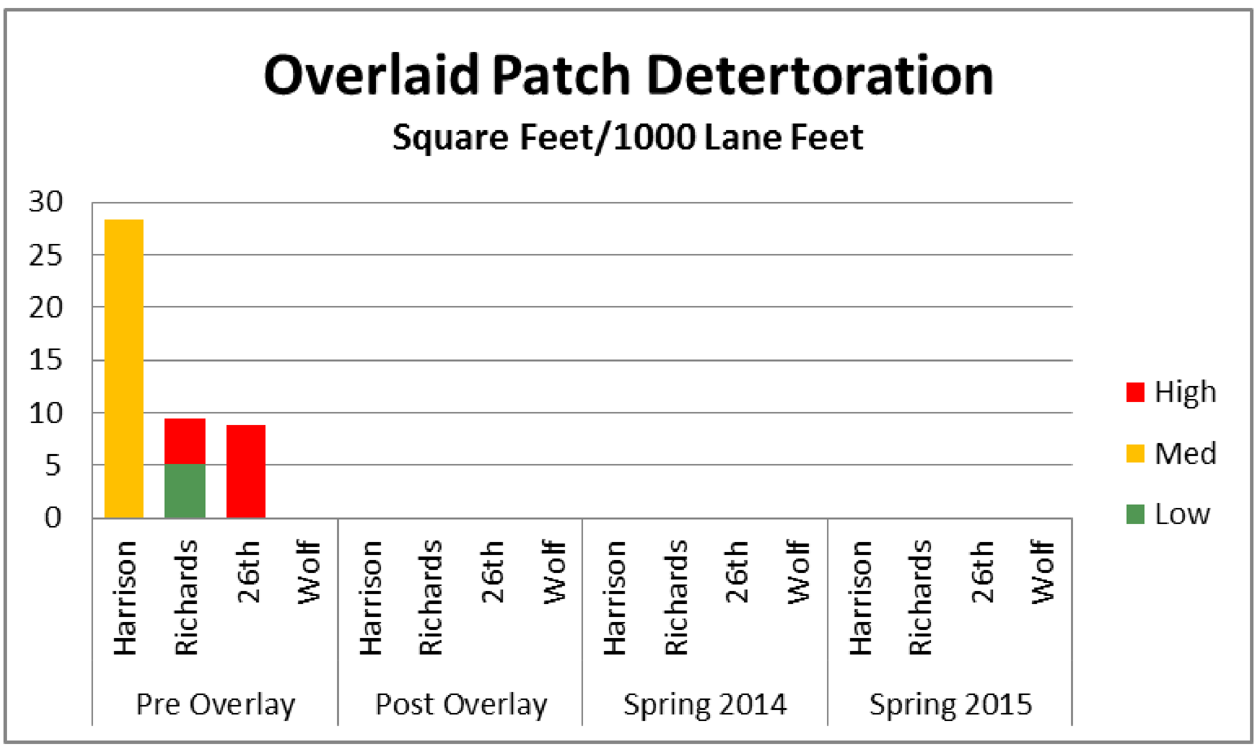

Figure 43. Overlaid patch deterioration by distress level for TRA projects.

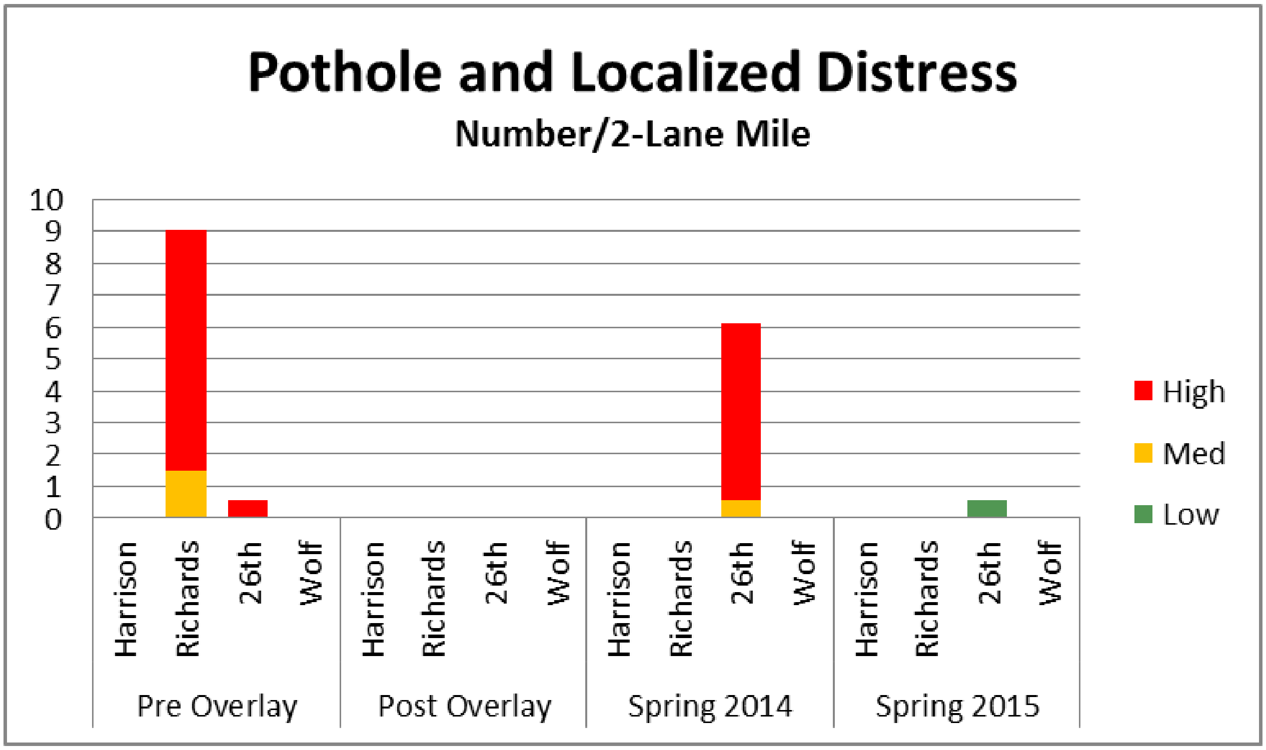

Figure 44. Pothole and localized distress by distress level for TRA projects.

7.2.2 Performance Summary

Based on data collected to date, along with the data presented in Figures 34 through 44, and Appendixes H and I, the following summary comments are offered.

7.2.2.1 26th Street Pavement Performance

After the winter of 2013–2014, it was evident that the centerline joint was not performing as expected; it showed significant amounts of high-severity distress along the project. The extent and severity of the centerline distress was more common to a pavement many years older. Several areas of the joint were repaired by milling partial depth along the centerline joint and replacing the material with new HMA. In 2014, approximately 20% of the joint length was treated that way to repair the most distressed areas. Unfortunately, the repair work was low-quality and showed premature distress in the spring 2015 survey. The loss of material at the centerline joint resulting in high severity ratings and the existence of raveling/weathering/segregation distress throughout the section is consistent with pavements constructed with a “dry” mix. Dry mixes are those for which there is insufficient asphalt binder available to coat the aggregate properly, resulting in a thin film thickness. Recycled concrete aggregate and slag aggregates may have absorption rates greater than natural aggregates and contribute to this problem. Appendix H provides a summary of distress data progression from 2014 through 2015.

7.2.2.2 Harrison Street Pavement Performance

After the winter of 2013–2014, little distress was noted other than transverse cracking from underlying joints and cracks. The pre-overlay survey indicated that the majority of transverse joints and cracks were distressed at a high severity. By measuring reflective cracking as a percentage of linear feet of pre-overlay transverse joints and cracks to the linear feet of cracks in the overlay, it was found that the reflection rate was 88% after the first winter and 105% after the second winter. Note that patching performed as part of the improvement increased the number of possible reflective joints in the section and contributes to values over 100%. Also, after the second winter, other distresses such as block cracking, raveling/weathering/segregation, and centerline cracking began to appear. Appendix H provides a summary of distress data progression to 2015.

7.2.2.3 Richards Street Pavement Performance

After the winter of 2013–2014, little distress was noted other than transverse cracking from underlying joints and cracks at a rate of 7% and an area of fatigue cracking representing 1% of the lane-feet of the section. After the second winter, additional fatigue cracking was evident and at a higher severity level totaling just under 3% of the section lane-feet. Fatigue cracking is typically an indication of a structural and material problems. Other distresses such as raveling/weathering/ segregation and longitudinal cracking began to appear in 2015, which are more closely related to the properties of the surface material. At this point, comparing the three TRA sections with each other, Richards Street is the best-performing, with the lowest amount of pavement distress. Appendix H provides a summary of distress data progression to 2015.

7.2.2.4 Wolf Road Pavement Performance

After the winter of 2013–2014, little distress was noted other than transverse cracking from underlying joints and cracks at a rate of 29%. After the second winter, additional transverse cracking was evident at a rate of 33%. Other distresses are absent from the section. Comparing the three TRA sections with Wolf Road, Wolf Road is performing markedly better at this point than any of the TRA sections. It should be noted that Wolf Road was extensively patched in the years prior to the overlay in this study. As a result, the concrete pavement upon which the overlay was placed was in better condition than the underlying pavement of the TRA sections under study.

CHAPTER 8: SUMMARY, OBSERVATIONS, AND RECOMMENDATIONS

8.1 SUMMARY

The main purpose of this study is to document pre-existing conditions and construction procedures, characterize the materials used in the construction, and monitor the resulting performance of five experimental sections. The experiments used hot-mix asphalt (HMA) surface mixes that contain reclaimed asphalt pavement (RAP) with and without recycled asphalt shingles (RAS) at a variety of asphalt binder replacement (ABR) levels. To counter brittle asphalt from recycled sources, softer grades of PG asphalt binders were evaluated. This report serves to document the construction of two of the five projects—namely Crawford Avenue/Pulaski Road and the Western segment of US 52. Also provided is an update of the original total recycle asphalt (TRA) projects that contained 100% recycled aggregate.

8.2 KEY OBSERVATIONS

Cold-milling heads and the resulting surfaces do not have sufficient controls and allow deep grooving of the pavement surface when well-worn teeth are replaced with isolated new teeth in the milling head.

Tack coat applications have greatly improved since the adoption of new specifications; however, there is still slight “zebra striping” of the tack across the mat.

Design seems to be placing sufficient quantity of patching on plans; however, the plan quantities were not fully used for either Crawford Avenue/Pulaski Road or US 52.

The amount of crack filling seems excessive for both projects, with wide reflective distress indicating that some cracks and/or joints that were filled should have been patched, or that slightly deeper milling would have removed the damaged asphalt. Coring during the planning phase would assist in engineering the milling depth.

The partial-width level binder (one-half lane on Crawford Avenue/Pulaski Road and 1 ft less than surface width on US 52, producing a thickness “step” in the surface lift) is resulting in hairline cracking of the surface at the edge of the level binder. This cross-section detail was adopted early in the use of 4.75 mixes in District 1 to prevent the surface mix from moving on the very smooth level binder. For these projects, the surface course being placed did not seem to move under the rollers. Improved tack coat applications may have mitigated the need for the “step” detail.

Pre-existing conditions of the 2013 TRA projects were worse than the comparison section on Wolf Road.

While the 2013 TRA projects under observation are limited, there does appear to be a correlation between ABR and percentage of transverse joint and crack reflection rates. Additional data from the 2014 let projects will greatly assist in the evaluation of this relationship. However, this needs to be reviewed always in the context of exiting pavement conditions

For the 2013 TRA projects, distresses seen (i.e., centerline cracking and raveling/weathering/segregation) are typical of pavement with low asphalt film thickness. This suggests that the asphalt binder “available” in some of the mixes was below levels desirable for good performance.

8.3 RECOMMENDATIONS

Core the existing overlay to determine depth of cracks and asphalt layers, then adjust mill depth accordingly, would assist in reducing thin HMA layers that degrade under traffic.

Consider adopting cold-milling specifications that limit the variability of the milled surface. Such specifications are used by other states and are available.

Monitor tack coat applications for uniformity. The amount of “zebra striping” observed on these projects would be considered the maximum limit that would be allowed.

Patch any cracks/joints wider than 2 in and with a length of 3 or more ft.

Reevaluate the need for partial-width use of level binder. If partial-width use of level binder is to continue, consider adding a tapered edge detail by hand-luting.

Use grade reference devices of adequate length and consider using them on both sides. At a minimum, discourage “chasing yield” and implement cross-slope controls.

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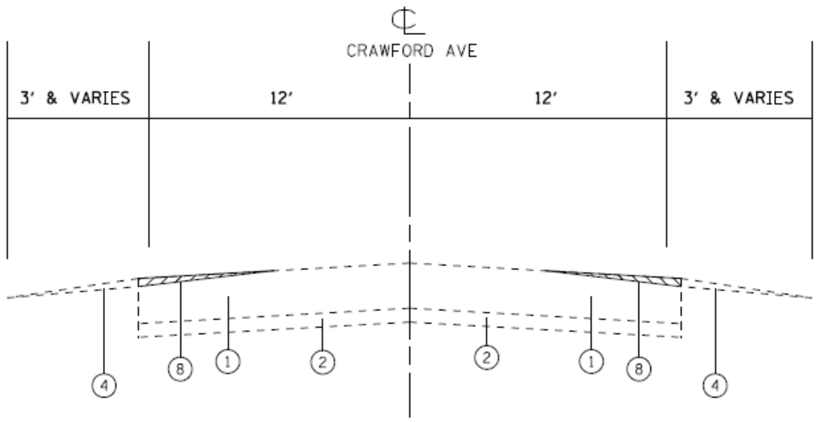
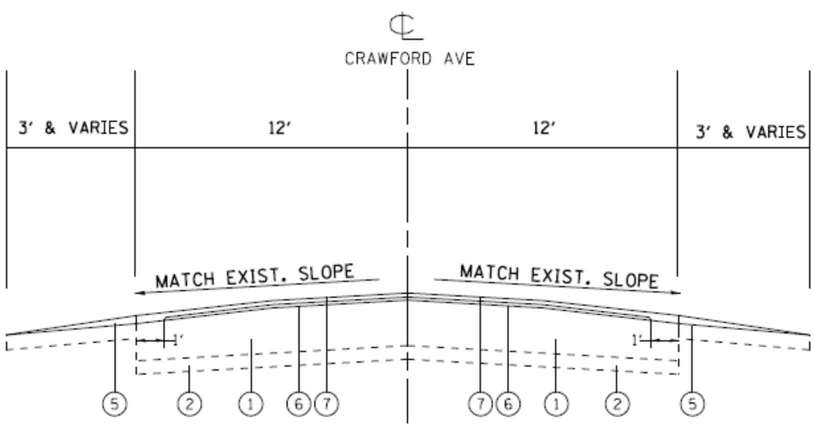
APPENDIX A: EXISTING AND PROPOSED CROSS-SECTIONS

APPENDIX A-1: CRAWFORD AVENUE/PULASKI ROAD

SEGMENT 1: SOUTHERN TWO-LANE SECTION



EXISTING TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 12+81 TO 18+88



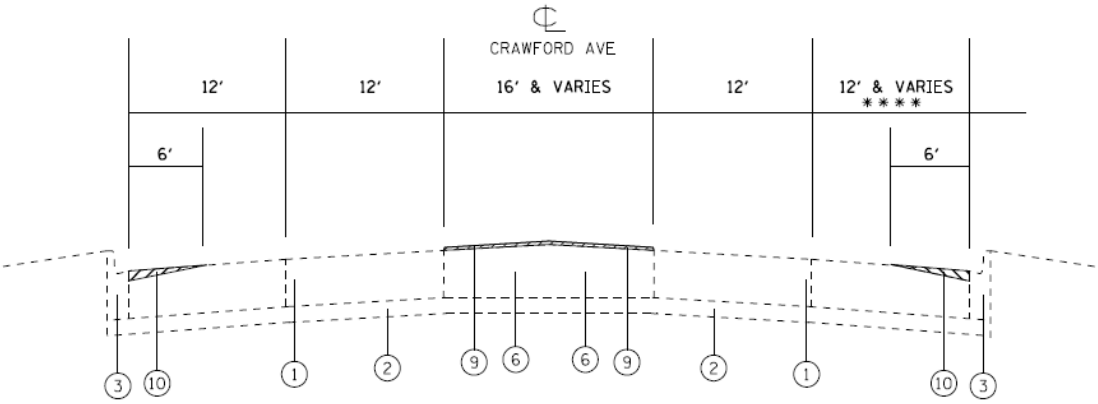
PROPOSED TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 12+81 TO 18+88

LEGEND

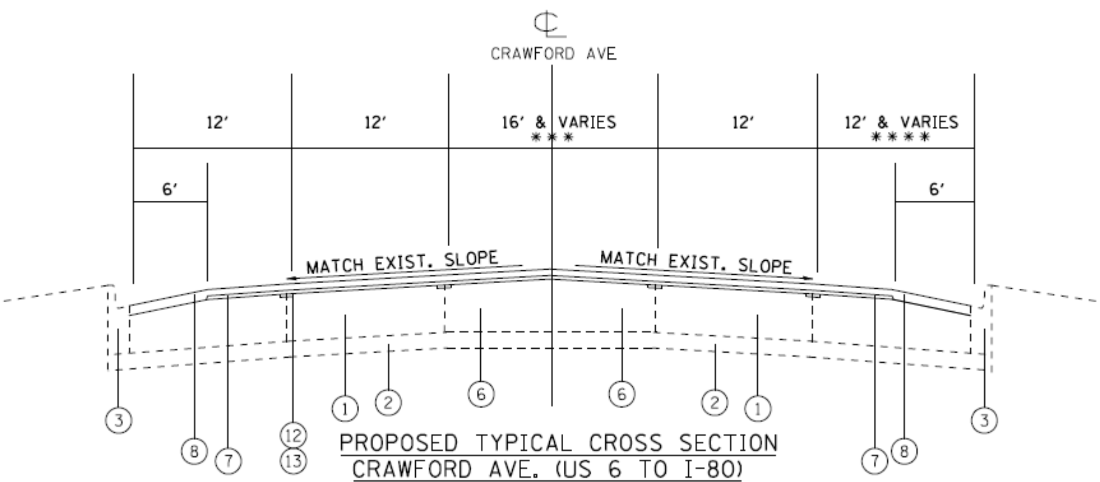
1. EXISTING 10" PCC PAVEMENT
2. EXISTING SUB-BASE GRANUALAR MATERIAL 6"
3. EXISTING COMB. CURB & GUTTER, TYPE B-6.24
4. EXISTING AGGREGATE SHOULDER
5. PROPOSED AGGREGATE WEDGE SHOULDER, TYPE B (SEE AGGREGATE SHOULDER DETAIL)
6. PROPOSED POLYMERIZED LEVELING BINDER, IL-4.75, N50, 1"
7. PROPOSED HOT-MIX ASPHALT SURFACE COUSE, MIX "D", N70, 1 1/2"
8. PROPOSED P.C.C. SURFACE REMOVAL (VAR. DEPTH)
9. EXISTING HMA SHOULDER, 8"
10. PROPOSED HMA SHOULDER (SEE H.M.A. SHOULDER DETAIL), 1 1/2"
11. PROPOSED HMA SURFACE REMOVAL, 1 1/2"

APPENDIX A-2: CRAWFORD AVENUE/PULASKI ROAD

SEGMENT 2: CENTER MULTI-LANE SECTION BETWEEN I-57 AND I-80



EXISTING TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 37+80 TO STA 59+64
FROM STA. 73+60 TO STA 80+32



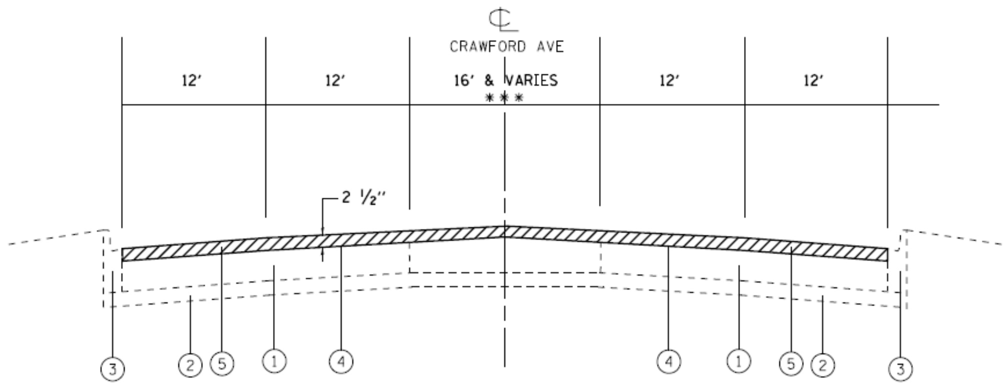
PROPOSED TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 37+80 TO STA 59+64
FROM STA. 73+60 TO STA 80+32

LEGEND

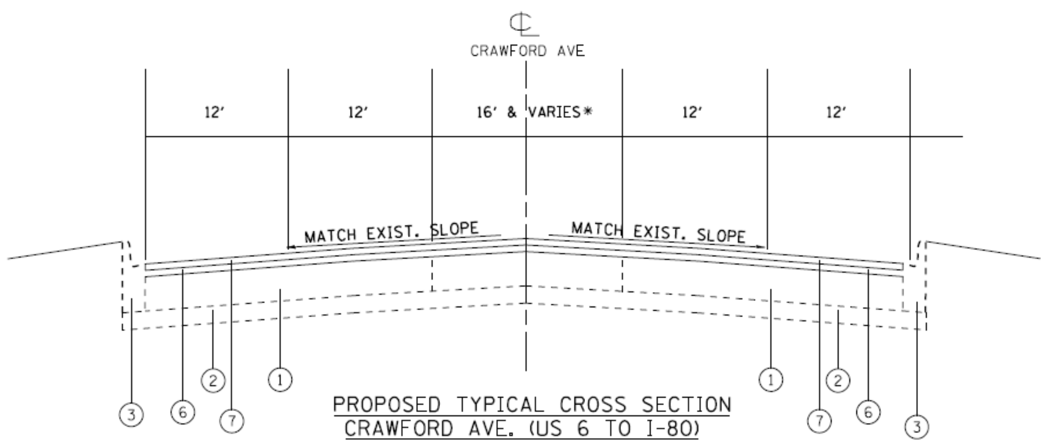
1. EXISTING 10" PCC PAVEMENT
2. EXISTING SUB-BASE GRANUALAR MATERIAL 6"
3. EXISTING COMB. CURB & GUTTER, TYPE B-6.24
4. EXISTING COMB. CURB & GUTTER, TYPE M-2.12
5. EXISTING P.C.C. MOUNTABLE CONCRETE MEDIAN
6. EXISTING P.C.C. CONCRETE CORREGATED MEDIAN
7. PROPOSED POLYMERIZED LEVELING BINDER, IL-4.75, N50, 1"
8. PROPOSED HOT-MIX ASPHALT SURFACE COUSE, MIX "D", N70, 1 1/2"
9. PROPOSED MEDIAN REMOVAL, PARTIAL DEPTH
10. PROPOSED P.C.C. SURFACE REMOVAL (VAR. DEPTH)
11. PROPOSED POLYMERIZED LEVELING BINDER, IL-4.75, N50, VARABLE DEPTH
12. PROPOSED PARTIAL DEPTH REMOVAL, 3" (SEE DETAIL A)
13. PROPOSED BINDER COURSE, IL-19.0, N70 (SEE DETAIL A)

APPENDIX A-3: CRAWFORD AVENUE/PULASKI ROAD

SEGMENT 3: MULTI-LANE SECTION NORTH OF I-57



EXISTING TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 96+05 TO 111+90



PROPOSED TYPICAL CROSS SECTION
CRAWFORD AVE. (US 6 TO I-80)
FROM STA. 96+05 TO 111+90

LEGEND

(1) EXISTING 10" PCC PAVEMENT

(2) EXISTING SUB-BASE GRANUALAR MATERIAL 6"

(3) EXISTING COMB. CURB & GUTTER, TYPE B-6.24

(4) EXISTING HOT MIX ASPHALT PAVEMENT, ± 2 ½"

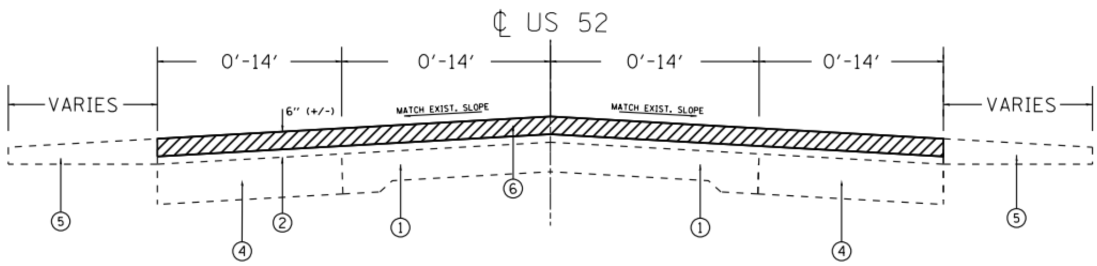
(5) PROPOSED H.M.A. REMOVAL ± 2 ½"

(6) PROPOSED POLYMERIZED LEVELING BINDER, IL-4.75, N50, 1"

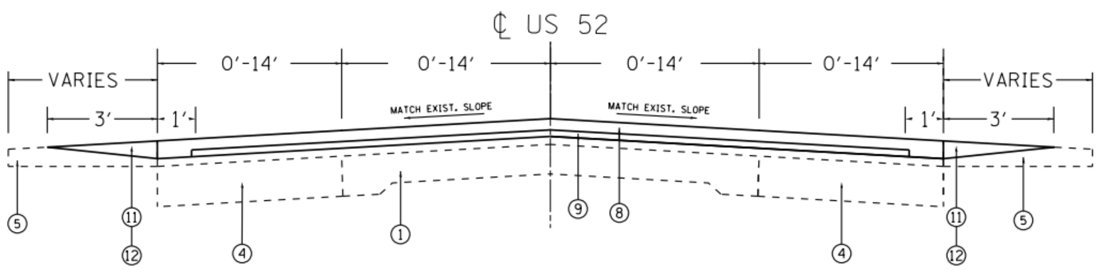
(7) PROPOSED HOT-MIX ASPHALT SURFACE COUSE, MIX "D", N70, 1 1/2"

APPENDIX A-4: US 52 (IL 53 TO LARAWAY ROAD)

SEGMENT 1: DORIS AVENUE FOUR-LANE SEGMENT



EXISTING TYPICAL SECTION
STATION:
10+53 TO 18+85



PROPOSED TYPICAL SECTION
STATION:
10+53 TO 18+85

LEGEND

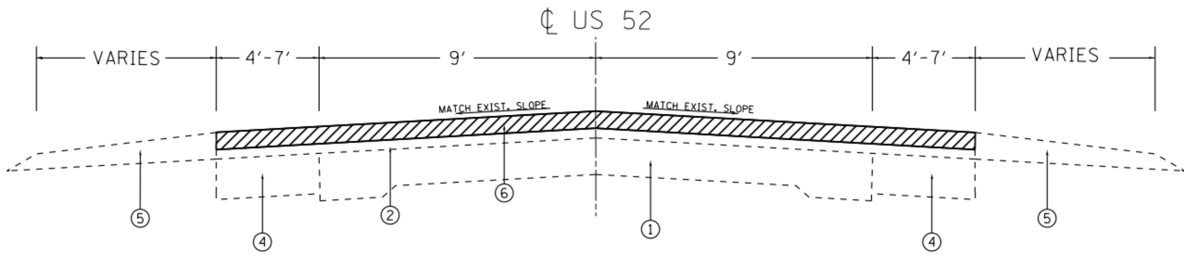
1. EXIST. PCC BASE COURSE, 9"(±)
2. EXIST. HOT-MIX ASPHALT SURFACE (BEFORE MILLING), 6"(±)

2A. EXIST. HOT-MIX ASPHALT SURFACE (BEFORE MILLING), 2 1/2"(±)

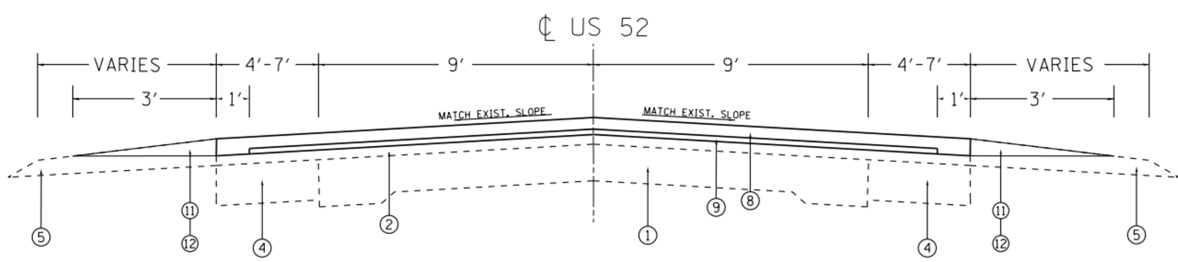
3. EXIST. BIT. SHOULDER
4. EXIST. BIT. BASE COURSE WIDENING
5. EXIST. AGGREGATE SHOULDER TYPE B
6. PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/4"
7. PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/2"
8. PROP. HOT-MIX ASPHALT SURFACE COURSE, MIX "D". N70, 1 1/2"
9. PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX "D". N50, 3/4"
10. PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX "D". N50, 1"
11. PROP. AGGREGATE WEDGE SHOULDER, TYPE B
12. PROP. GRADING AND SHAPING SHOULDERS

APPENDIX A-5: US 52 (IL 53 TO LARAWAY ROAD)

SEGMENT 2: DORIS AVENUE TO LARAWAY ROAD



EXISTING TYPICAL SECTION
STATION:
18+85 TO 144+70
158+85 TO 185+18



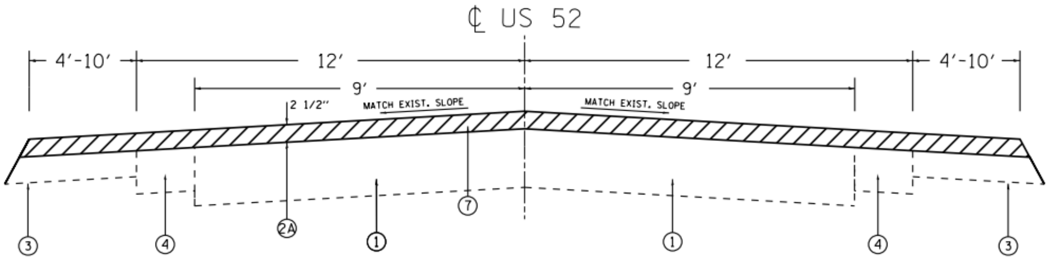
PROPOSED TYPICAL SECTION
STATION:
18+85 TO 144+70
158+85 TO 185+18

LEGEND

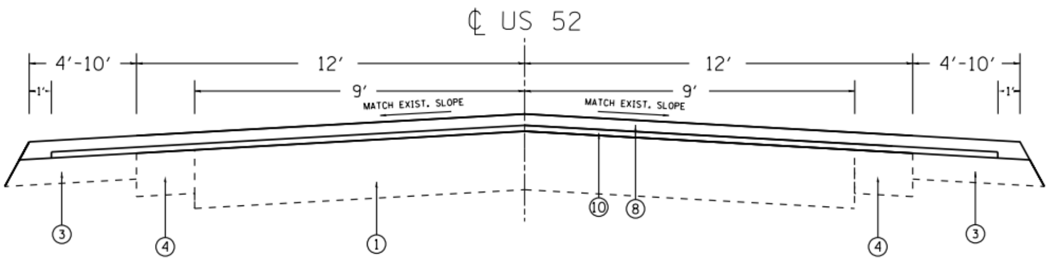
1. EXIST. PCC BASE COURSE, 9"(±)
2. EXIST. HOT-MIX ASPHALT SURFACE (BEFORE MILLING), 6"(±)
3. EXIST. BIT. SHOULDER
4. EXIST. BIT. BASE COURSE WIDENING
5. EXIST. AGGREGATE SHOULDER TYPE B
6. PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/4"
7. PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/2"
8. PROP. HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N70, 1 1/2"
9. PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX "D", N50, 3/4"
10. PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX "D", N50, 1"
11. PROP. AGGREGATE WEDGE SHOULDER, TYPE B
12. PROP. GRADING AND SHAPING SHOULDERS

APPENDIX A-6: US 52 (IL 53 TO LARAWAY ROAD)

SEGMENT 3: CENTRAL INTERSECTION SEGMENT



EXISTING TYPICAL SECTION
STATION:
144+70 TO 158+85



PROPOSED TYPICAL SECTION
STATION:
144+70 TO 158+85

LEGEND

① EXIST. PCC BASE COURSE, 9''(±)

② EXIST. HOT-MIX ASPHALT SURFACE (BEFORE MILLING), 6''(±)

②A EXIST. HOT-MIX ASPHALT SURFACE (BEFORE MILLING), 2 1/2''(±)

③ EXIST. BIT. SHOULDER

④ EXIST. BIT. BASE COURSE WIDENING

⑤ EXIST. AGGREGATE SHOULDER TYPE B

⑥ PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/4''

⑦ PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 2 1/2''

⑧ PROP. HOT-MIX ASPHALT SURFACE COURSE, MIX ''D''. N70, 1 1/2''

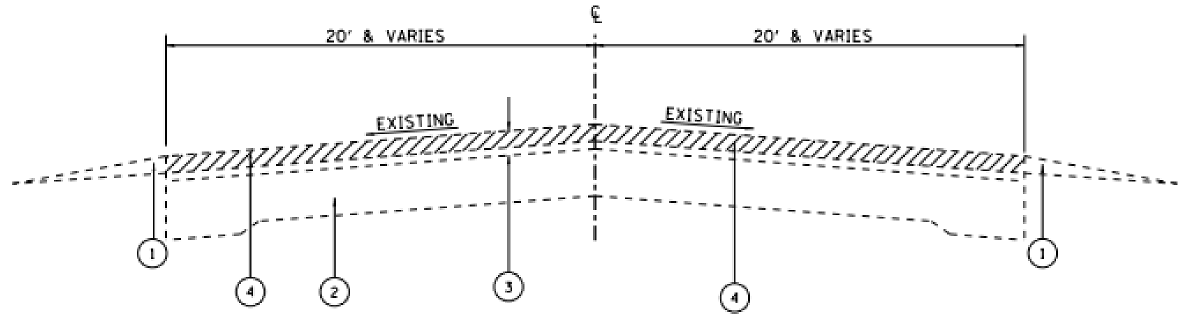
⑨ PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX ''D''. N50, 3/4''

⑩ PROP. POLYMERIZED LEVELING BINDER (MACHINE METHOD), MIX ''D''. N50, 1''

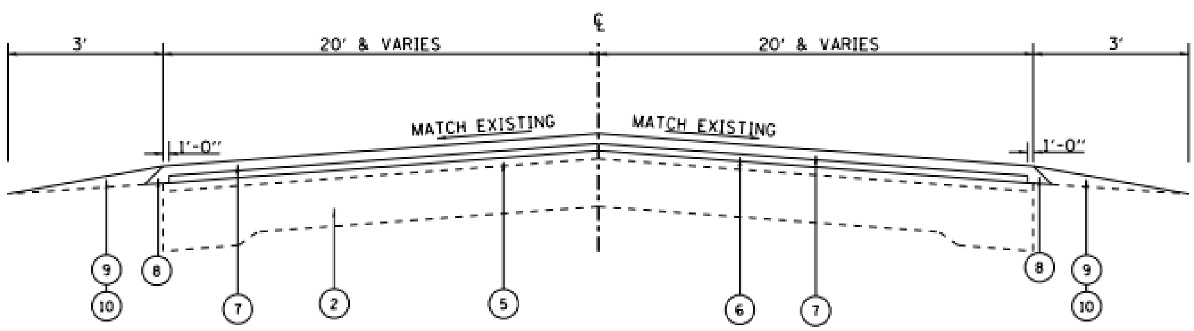
⑪ PROP. AGGREGATE WEDGE SHOULDER, TYPE B

⑫ PROP. GRADING AND SHAPING SHOULDERS

APPENDIX A-7: 26TH STREET



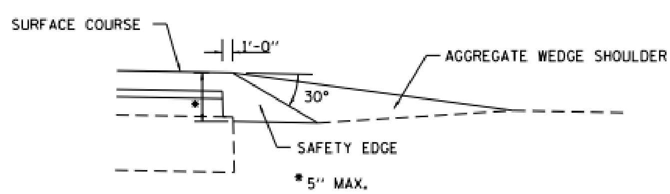
EXISTING TYPICAL SECTION
26TH STREET (WESTERN AVE. - EAST END AVE.)



PROPOSED TYPICAL SECTION
26TH STREET (WESTERN AVE. - EAST END AVE.)

LEGEND

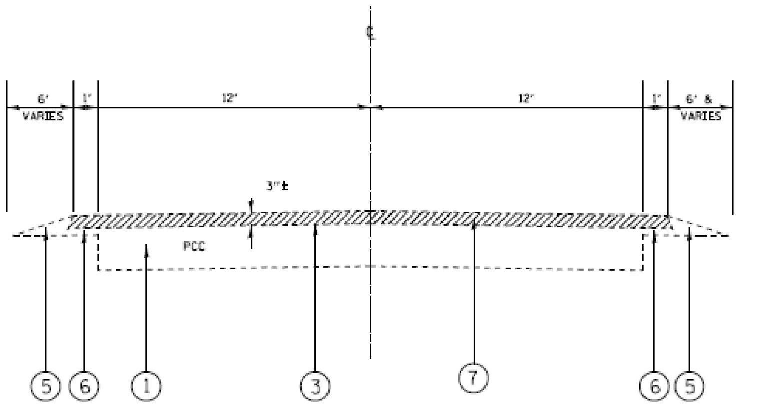
1. EXISTING AGGREGATE SHOULDERS
2. EXISTING P.C. CONCRETE PAVEMENT ± 9.0"
3. EXISTING HMA SURFACE COURSE ± 5 3/4 "
4. PROPOSED HMA SURFACE REMOVAL (2¼")
5. EXISTING HMA SURFACE OVERLAY AFTER MILLING, ± 3.5"
6. PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50 (3/4")
7. PROPOSED HMA SURFACE COURSE, MIX "D", N50 (1½")
8. PROPOSED SAFETY EDGE SHOULDER
9. PROPOSED AGGREGATE WEDGE SHOULDER, TYPE B
10. PROPOSED GRADING AND SHAPING SHOULDERS



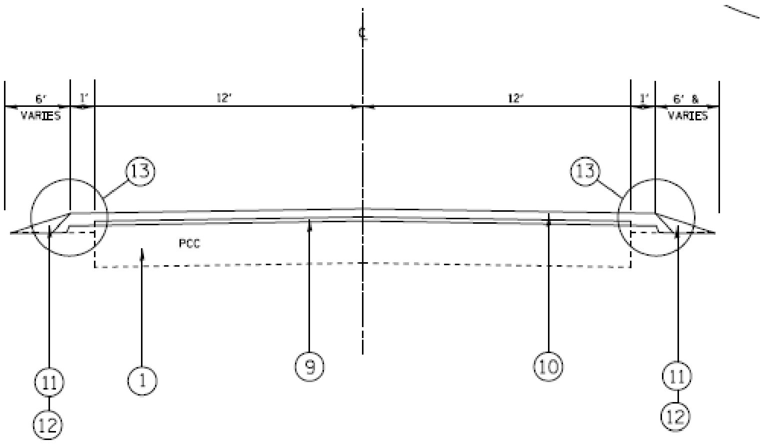
SAFETY EDGE DETAIL

SAFETY EDGE TREATMENT SHALL BE APPLIED TO PAVED SHOULDER OF 1 FT OR LESS THAT IS ADJACENT TO AGGREGATE / EARTH SHOULDER.

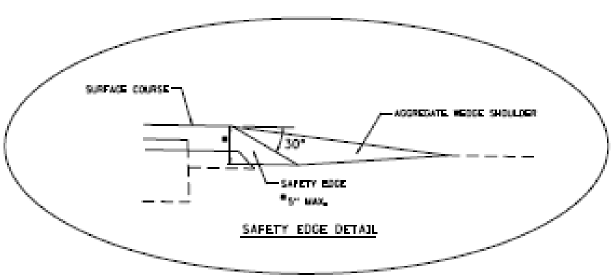
APPENDIX A-8: HARRISON STREET, TWO-LANE SEGMENT



EXISTING TYPICAL SECTION
HARRISON STREET
STA. 2+62 TO STA. 39+18



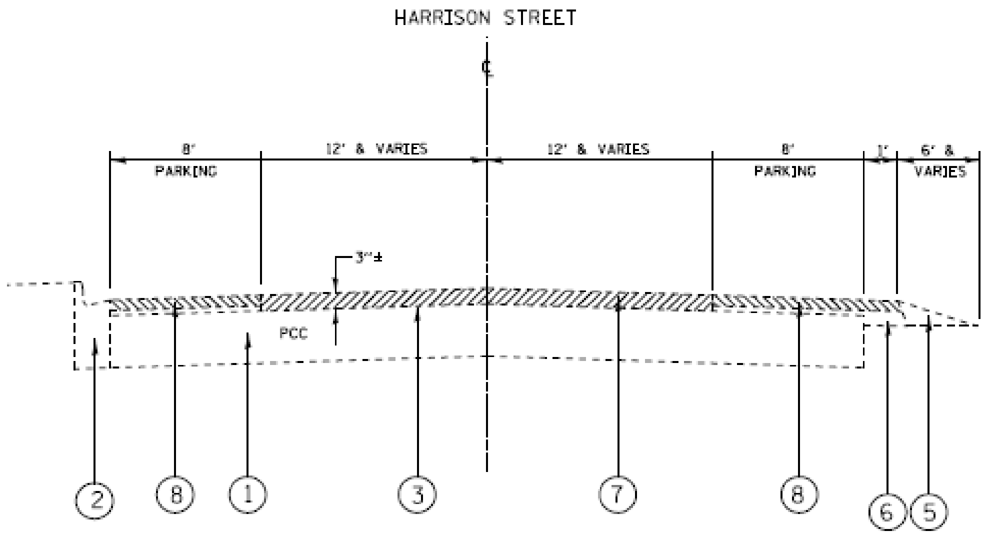
PROPOSED TYPICAL SECTION
HARRISON STREET
STA. 2+62 TO STA. 39+18



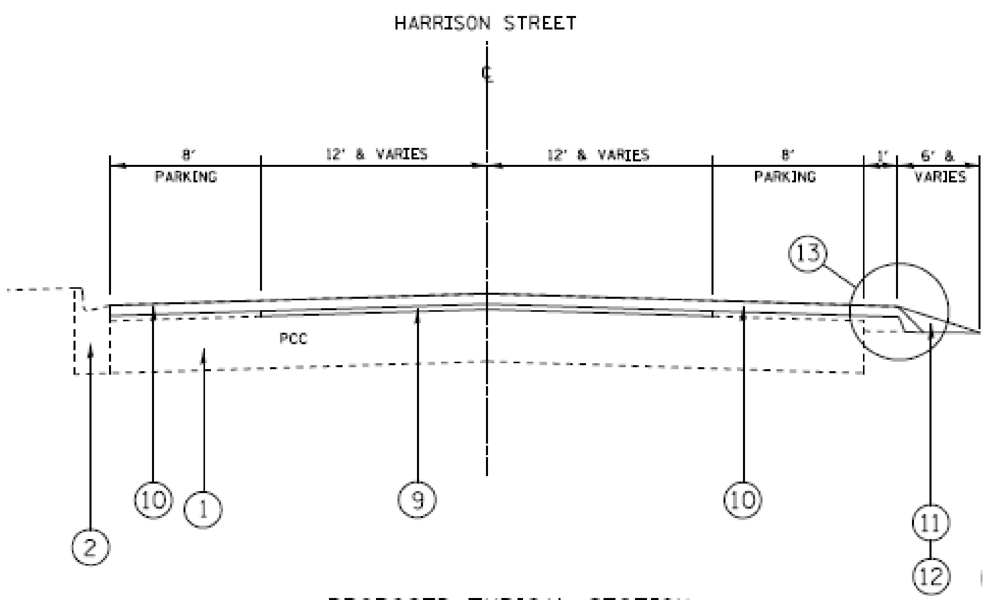
LEGEND:

(1) EXISTING PCC BASE COURSE, 10" (±)
(2) EXISTING CURB & GUTTER
(3) EXISTING HOT-MIX ASPHALT SURFACE, 3" (±)
(4) EXISTING HOT-MIX ASPHALT BASE, 7"(±)
(5) EXISTING AGGREGATE SHOULDERS
(6) EXISTING HOT-MIX ASPHALT SAFETY SHOULDER
(7) PROPOSED HOT-MIX ASPHALT SURFACE REMOVAL, 3"
(8) PROPOSED HOT-MIX ASPHALT SURFACE REMOVAL, 2"
(9) PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50, 1"
(10) PROPOSED HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50, 2"
(11) PROPOSED AGGREGATE WEDGE SHOULDER, TYPE B
(12) PROPOSED GRADING AND SHAPING SHOULDERS
(13) PROPOSED SAFETY EDGE (SEE DETAIL)

APPENDIX A-8: HARRISON STREET, MULTI-LANE PCC SEGMENT

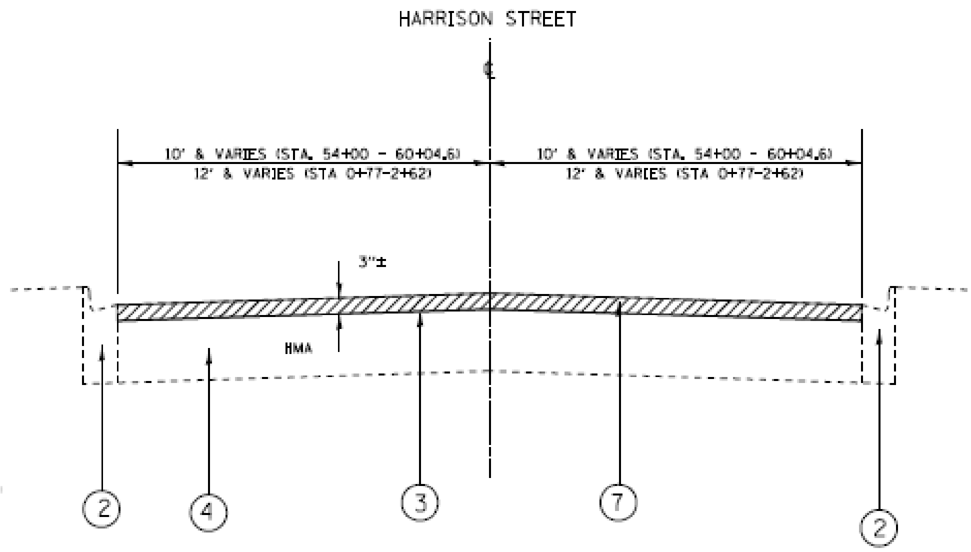


EXISTING TYPICAL SECTION
HARRISON STREET
STA. 39+18 TO STA. 54+00

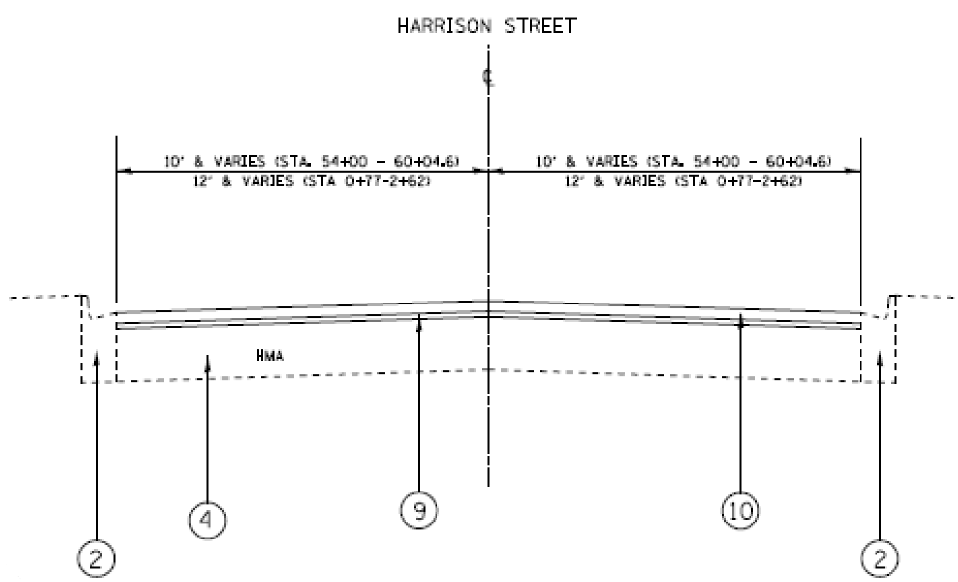


PROPOSED TYPICAL SECTION
HARRISON STREET
STA. 39+18 TO STA. 54+00

APPENDIX A-8: HARRISON STREET, HMA SEGMENT

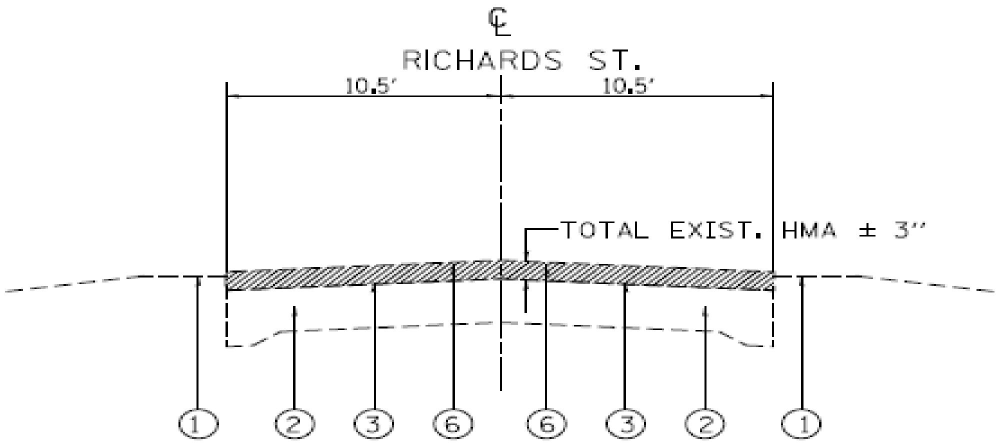


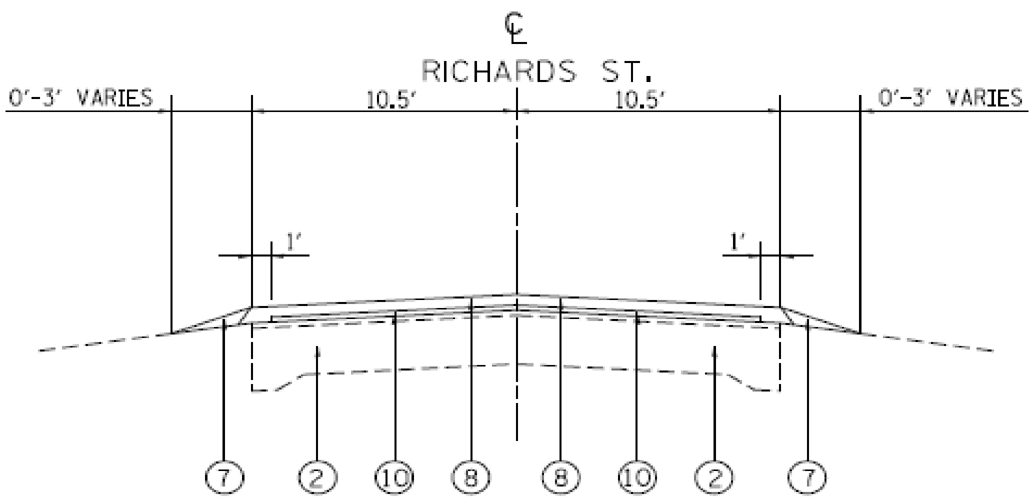
EXISTING TYPICAL SECTION
HARRISON STREET
STA. 0+77 TO STA. 2+62
STA. 54+00 TO STA. 60+04.6



PROPOSED TYPICAL SECTION
HARRISON STREET
STA. 0+77 TO STA. 2+62
STA. 54+00 TO STA. 60+04.6

APPENDIX A-9: RICHARDS STREET, TWO-LANE SEGMENT

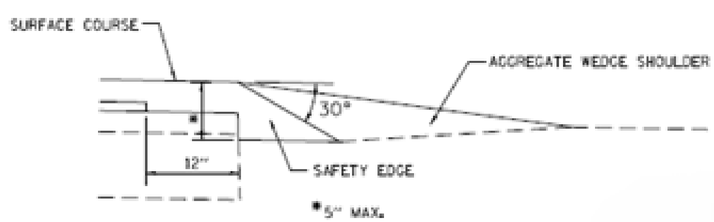




PROPOSED TYPICAL SECTION
RICHARDS ST.
STA. 00+13.3 TO STA. 30+00

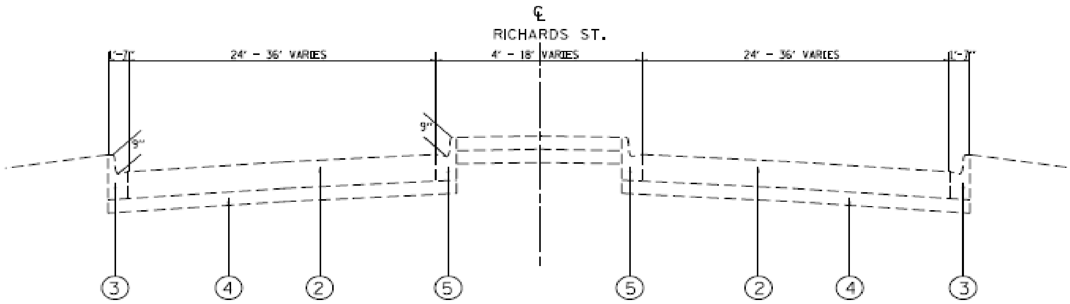
LEGEND

1. EXIST. AGGREGATE
2. EXIST. PCC BASE COURSE, (±10″
3. EXIST. COMBINATION CONCRETE CURB AND GUTTER, TYPE B 6.
4. EXIST. STABILIZED SUBBASE
5. EXIST. COMBINATION CONCRETE CURB AND GUTTER, TYPE B 9.
6. PROP. HOT-MIX ASPHALT SURFACE REMOVAL - 3″
7. PROP. AGGREGATE WEDGE SHOULDER, TYPE B
8. PROP. HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50, 2″
9. PROP. HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50, 1½″
10. PROP. POLYMERIZED LEVELING BINDER (MM), IL-4.75, N50, 1″
11. PROP. PCC SURFACE REMOVAL, VARIABLE DEPTH
12. PROP. MEDIAN REMOVAL, VARIABLE DEPTH

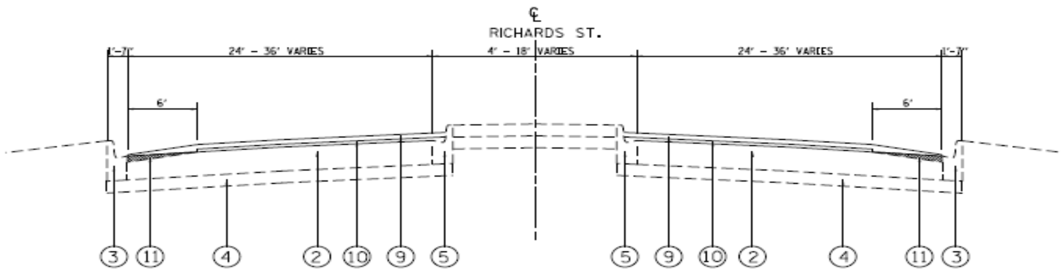


SAFETY EDGE DETAIL

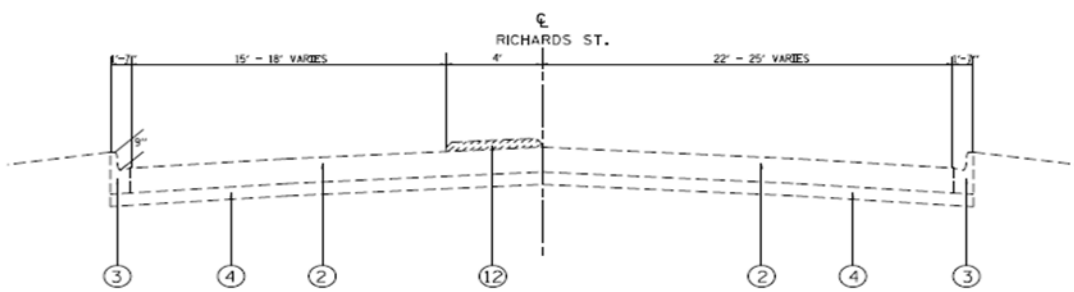
APPENDIX A-9: RICHARDS STREET, MULTI-LANE SEGMENT



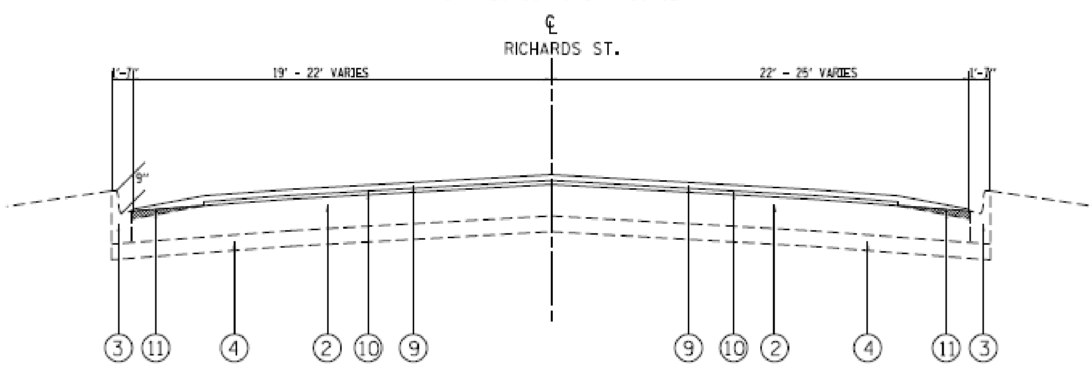
EXISTING TYPICAL SECTION
RICHARDS ST.
STA. 30+82 TO STA. 53+63.3



PROPOSED TYPICAL SECTION
RICHARDS ST.
STA. 30+82 TO STA. 53+63.3

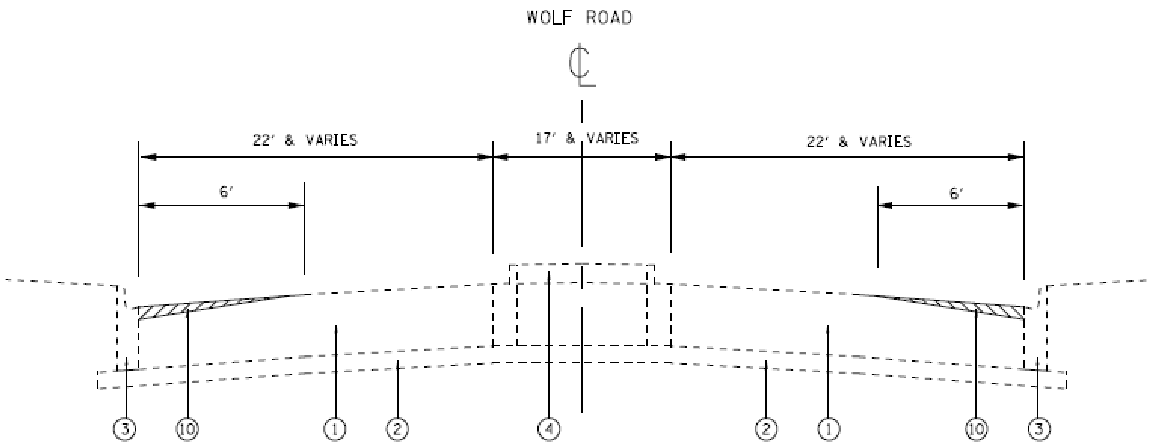


EXISTING TYPICAL SECTION
RICHARDS ST.
STA. 30+00 TO STA. 30+82

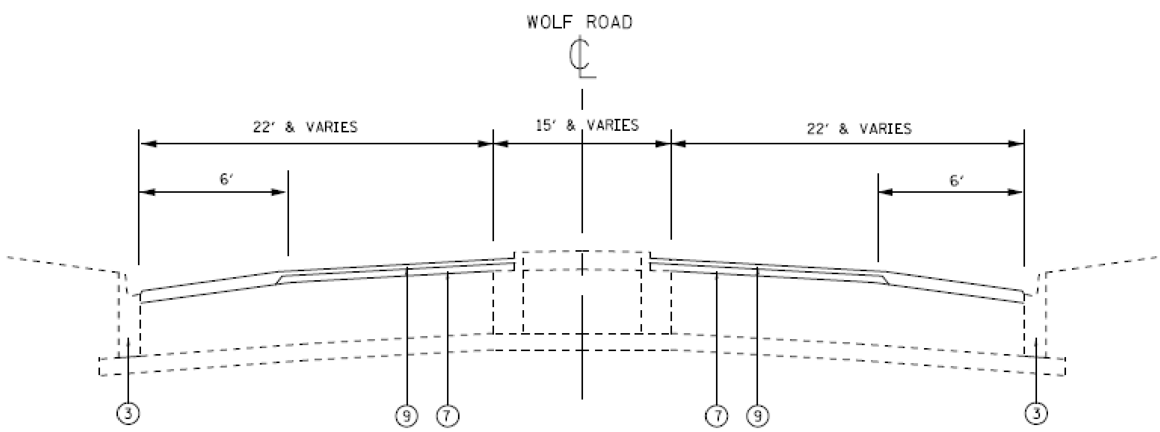


PROPOSED TYPICAL SECTION
RICHARDS ST.
STA. 30+00 TO STA. 30+82

APPENDIX A-10: WOLF ROAD, SOUTH SECTION



EXISTING TYPICAL ROADWAY SECTION
STA. 4+22 TO STA. 28+94



PROPOSED TYPICAL SECTION
STA. 4+22 TO STA. 28+94

LEGEND:

(1) EXISTING P.C.C. PAVEMENT, 10"

(2) EXISTING STABILIZED SUB-BASE

(3) EXISTING COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.12

(4) EXISTING LANDSCAPE MEDIAN

(5) EXISTING HOT-MIX ASPHALT SURFACE, ±3"

(6) PROPOSED HOT-MIX ASPHALT SURFACE REMOVAL, 2 1/4"

(7) PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50, 1"

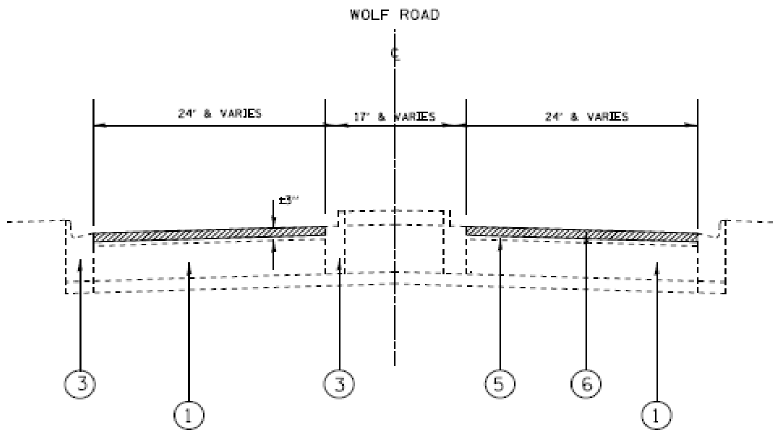
(8) PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50, 3/4"

(9) PROPOSED HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N70, 1 1/2"

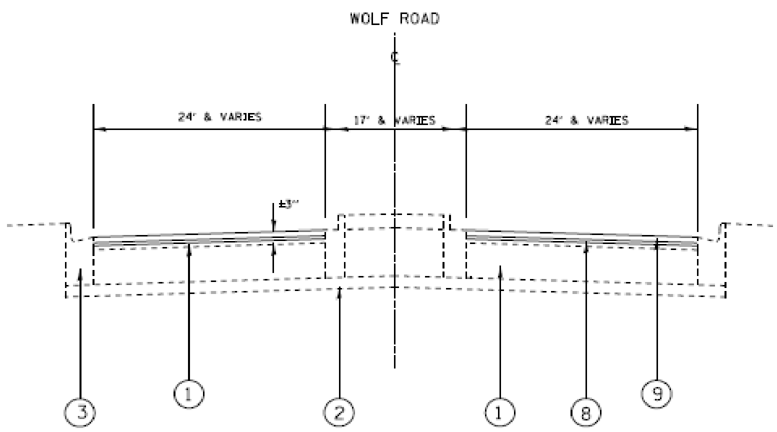
(10) PROPOSED P.C.C. SURFACE REMOVAL (VARIABLE DEPTH)
(SEE 'HMA TAPER AT EDGE OF P.C.C. PAVEMENT' DETAIL)

(11) PROPOSED MEDIAN REMOVAL, PARTIAL DEPTH

APPENDIX A-10: WOLF ROAD, HARRISON INTERSECTION SECTION



EXISTING TYPICAL SECTION
WOLF ROAD
STA. 28+94 TO STA. 30+60



PROPOSED TYPICAL SECTION
WOLF ROAD
STA. 28+94 TO STA. 30+60

LEGEND:

(1) EXISTING P.C.C. PAVEMENT, 10"

(2) EXISTING STABILIZED SUB-BASE

(3) EXISTING COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.12

(4) EXISTING LANDSCAPE MEDIAN

(5) EXISTING HOT-MIX ASPHALT SURFACE, ±3"

(6) PROPOSED HOT-MIX ASPHALT SURFACE REMOVAL, 2 1/4"

(7) PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50, 1"

(8) PROPOSED POLYMERIZED LEVELING BINDER (MACHINE METHOD), IL-4.75, N50, 3/4"

(9) PROPOSED HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N70, 1 1/2"

(10) PROPOSED P.C.C. SURFACE REMOVAL (VARIABLE DEPTH)
(SEE 'HMA TAPER AT EDGE OF P.C.C. PAVEMENT' DETAIL)

(11) PROPOSED MEDIAN REMOVAL, PARTIAL DEPTH

APPENDIX B: DISTRESS SURVEY SUMMARIES

APPENDIX B-1: CRAWFORD AVENUE/PULASKI ROAD, SEGMENT 1

DISTRESS SUMMARY

Crawford Avenue/Pulaski Road - Segment 1 North Bound (15% ABR, PG 64-22 w/ RAP and RAS) Surface Mix: 81BIT156M																	
		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Block Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**		19	121	**140**	-	-	-	-				-				-
Longitudinal Cracking	**Linear Feet**				-	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				-	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**				-	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				-	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		19		**19**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	96	48	324	**468**	14	-	-	**14**				-				-
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 607			**Centerline Joint Feet in Section = 607**						Note Centerline Joint is shared between 2 mixes							

Crawford Avenue/Pulaski Road - Segment 1 South Bound (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT157M																	
		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Block Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**				-	-	-	-	-				-				-
Longitudinal Cracking	**Linear Feet**				-	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				-	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**				-	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				-	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		19		**19**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	180	48	276	**504**	-	-	-	-				-				-
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 607			**Centerline Joint Feet in Section = 607**						Note Centerline Joint is shared between 2 mixes							

APPENDIX B-2: CRAWFORD AVENUE/PULASKI ROAD, SEGMENT 2

DISTRESS SUMMARY

Crawford Avenue/Pulaski Road - Segment 2 North Bound Lanes 1 and 2 (15% ABR, PG 64-22 w/ RAP and RAS) Surface Mix: 81BIT156M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Block Cracking	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Centerline Cracking	**Linear Feet**				**-**	-	-	-	**-**				-				-
Corner Break	**Each**	5		1													
Longitudinal Cracking	**Linear Feet**	63		2	**65**	-	-	-	**-**				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	**-**				-				-
Permanent Patch Deterioration	**Square Feet**	11,890		108	**11,998**	-	-	-	**-**				-				-
Pothole and Localized Distress	**Each**	3		4	**7**	-	-	-	**-**				-				-
Raveling/Weathering/Segregation	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Transverse Cracking	**Linear Feet***	4,770	292	2,088	**7,150**	1,595	72	-	**1,667**				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 9,836 **Centerline Joint Feet in Section = 4,918**

Crawford Avenue/Pulaski Road - Segment 2 South Bound Lanes 1 and 2 (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT157M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Block Cracking	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Centerline Cracking	**Linear Feet**				**-**	-	-	-	**-**				-				-
Longitudinal Cracking	**Linear Feet**	81	15	203	**299**	-	-	-	**-**				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	**-**				-				-
Permanent Patch Deterioration	**Square Feet**	10,796			**10,796**	-	-	-	**-**				-				-
Pothole and Localized Distress	**Each**			1	**1**	-	-	-	**-**				-				-
Raveling/Weathering/Segregation	**Lane-Feet**				**-**	-	-	-	**-**				-				-
Transverse Cracking	**Linear Feet***	5,292	515	1,986	**7,793**	1,640	-	-	**1,640**				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 9,836 **Centerline Joint Feet in Section = 4,918**

APPENDIX B-3: CRAWFORD AVENUE/PULASKI ROAD, SEGMENT 3

DISTRESS SUMMARY

Crawford Avenue/Pulaski Road - Segment 3 North Bound Lanes 1 and 2 (15% ABR, PG 64-22 w/ RAP and RAS) Surface Mix: 81BIT156M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**	45			**45**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**		1,585		**1,585**	200	-	-	**200**				-				-
Longitudinal Cracking	**Linear Feet**				-	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				-	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**	1,156		544	**1,700**	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				-	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		3,170		**3,170**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	492	592	768	**1,852**	36	-	-	**36**				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 3,170 **Centerline Joint Feet in Section = 1,585**

Crawford Avenue/Pulaski Road - Segment 3 South Bound Lanes 1 and 2 (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT157M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**			79	**79**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**				-	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**		1,585		**1,585**	895	-	-	**895**				-				-
Longitudinal Cracking	**Linear Feet**				-	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				-	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**				-	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				-	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		3,170		**3,170**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	72	1,488	312	**1,872**	7	-	-	**7**				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 3,170 **Centerline Joint Feet in Section = 1,585**

APPENDIX B-4: US 52 (IL 53 TO LARAWAY ROAD), SEGMENT 1

DISTRESS SUMMARY

US 52 (IL 53 to Laraway Road) - Segment 1 East Bound (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT140M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**			156	**156**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**	300	894		**1,194**	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**	150		447	**597**	-	-	-	-				-				-
Center of Lane Cracking	**Linear Feet**																
Longitudinal Cracking	**Linear Feet**	26			**26**	26	-	-	26				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**				**-**	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				**-**	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		1,194		**1,194**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	204	248	204	**656**	-	-	-	-				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 1,194 **Centerline Joint Feet in Section = 597**

US 52 (IL 53 to Laraway Road) - Segment 1 West Bound (30% ABR, PG 58-28 w/ RAP only) Surface Mix: 81BIT159M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				**-**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**		1,194		**1,194**	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**	597			**597**	-	-	-	-				-				-
Center of Lane Cracking	**Linear Feet**																
Longitudinal Cracking	**Linear Feet**				**-**	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**				**-**	-	-	-	-				-				-
Pothole and Localized Distress	**Each**				**-**	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**		1,194		**1,194**	-	-	-	-				-				-
Transverse Cracking	**Linear Feet***	204	408	120	**732**	-	-	-	-				-				-

*** Linear feet of cracking measured in lieu of occurrences**

Lane Feet in Section = 1,194 **Centerline Joint Feet in Section = 597**

APPENDIX B-5: US 52 (IL 53 TO LARAWAY ROAD), SEGMENT 2

DISTRESS SUMMARY

US 52 (IL 53 to Laraway Road) - Segment 2 East Bound (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT140M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**		40	371	**411**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**	14,674	715		**15,389**	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**				**-**	-	-	-	-				-				-
Center of Lane Cracking	**Linear Feet**			89													
Longitudinal Cracking	**Linear Feet**	7		36	**43**	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**	1,934	96		**2,030**	-	-	-	-				-				-
Pothole and Localized Distress	**Each**	7	3		**10**	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**	1,000	14,218	171	**15,389**	22	-	-	22				-				-
Transverse Cracking	**Linear Feet***	2,255	4,336	924	**7,515**	196	-	-	196				-				-
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 15,388			**Centerline Joint Feet in Section = 15,388**						Note Centerline Joint is shared between 2 mixes							

US 52 (IL 53 to Laraway Road) - Segment 2 West Bound (30% ABR, PG 58-28 w/ RAP only) Surface Mix: 81BIT159M

		Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**				**-**	-	-	-	-				-				-
Block Cracking	**Lane-Feet**	14,754	643		**15,397**	-	-	-	-				-				-
Centerline Cracking	**Linear Feet**	500	8,925	4,983	**14,408**	1,078	-	-	1,078				-				-
Center of Lane Cracking	**Linear Feet**			18													
Longitudinal Cracking	**Linear Feet**		225		**225**	-	-	-	-				-				-
Overlaid Patch Detertoration	**Square Feet**				**-**	-	-	-	-				-				-
Permanent Patch Deterioration	**Square Feet**	1,500	216		**1,716**	-	-	-	-				-				-
Pothole and Localized Distress	**Each**	12	9	4	**25**	-	-	-	-				-				-
Raveling/Weathering/Segregation	**Lane-Feet**	1,000	14,397		**15,397**	53	-	-	53				-				-
Transverse Cracking	**Linear Feet***	2,423	4,680	1,279	**8,382**	113	-	-	113				-				-
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 15,388			**Centerline Joint Feet in Section = 15,388**						Note Centerline Joint is shared between 2 mixes							

APPENDIX B-6: US 52 (IL 53 TO LARAWAY ROAD), SEGMENT 3

DISTRESS SUMMARY

US 52 (IL 53 to Laraway Road) - Segment 3 East Bound (30% ABR, PG 58-28 w/ RAP and RAS) Surface Mix: 81BIT140M

Distress Type	Unit	Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
		Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total
Alligator or Fatigue Cracking	Lane-Feet				-	-	-	-	-				-				-
Block Cracking	Lane-Feet	1,361			1,361	-	-	-	-				-				-
Centerline Cracking	Linear Feet				-	-	-	-	-				-				-
Center of Lane Cracking	Linear Feet																
Longitudinal Cracking	Linear Feet				-	-	-	-	-				-				-
Overlaid Patch Detertoration	Square Feet				-	-	-	-	-				-				-
Permanent Patch Deterioration	Square Feet		84	168	252	-	-	-	-				-				-
Pothole and Localized Distress	Each	3	1	6	10	-	-	-	-				-				-
Raveling/Weathering/Segregation	Lane-Feet		1,361		1,361	-	-	-	-				-				-
Transverse Cracking	Linear Feet*	270	168	168	606	20	-	-	20				-				-

* Linear feet of cracking measured in lieu of occurrences

Lane Feet in Section = 1,415 | Centerline Joint Feet in Section = 1,415 | Note Centerline Joint is shared between 2 mixes

US 52 (IL 53 to Laraway Road) - Segment 3 West Bound (30% ABR, PG 58-28 w/ RAP only) Surface Mix: 81BIT159M

Distress Type	Unit	Pre Overlay Distress Level (2014)				Post Overlay Distress Level (2015)				Spring 2016 Distress Level				Spring 2017 Distress Level			
		Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total
Alligator or Fatigue Cracking	Lane-Feet				-	-	-	-	-				-				-
Block Cracking	Lane-Feet	1,361			1,361	-	-	-	-				-				-
Centerline Cracking	Linear Feet		693		693	-	-	-	-				-				-
Center of Lane Cracking	Linear Feet																
Longitudinal Cracking	Linear Feet				-	-	-	-	-				-				-
Overlaid Patch Detertoration	Square Feet				-	-	-	-	-				-				-
Permanent Patch Deterioration	Square Feet	528	228	180	936	-	-	-	-				-				-
Pothole and Localized Distress	Each	-	1	2	3	-	-	-	-				-				-
Raveling/Weathering/Segregation	Lane-Feet	-	1,361		1,361	-	-	-	-				-				-
Transverse Cracking	Linear Feet*	432	294	36	762	24	-	-	24				-				-

* Linear feet of cracking measured in lieu of occurrences

Lane Feet in Section = 1,415 | Centerline Joint Feet in Section = 1,415 | Note Centerline Joint is shared between 2 mixes

APPENDIX C: AUTOMATED DISTRESS DATA - RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

APPENDIX C-1: CRAWFORD AVENUE/PULASKI ROAD AUTOMATED DISTRESS DATA, AUGUST 15, 2014

PRE-CONSTRUCTION RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

Crawford Avenue/Pulaski Road																
Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	N	1	8/15/2014	2-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	297	96	197	0.150	0.070	0.110
1	S	1	8/12/2014	2-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	373	335	354	0.300	0.190	0.245
2	N	1 (PL)	8/15/2014	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	232	227	229	0.141	0.115	0.128
2	N	2 (DL)	8/15/2014	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	256	308	282	0.168	0.263	0.215
2	S	1 (PL)	8/15/2014	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	244	237	240	0.180	0.133	0.155
2	S	2 (DL)	8/12/2014	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	231	277	253	0.163	0.236	0.198
3	N	1 (PL)	8/15/2014	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	205	213	209	0.178	0.108	0.144
3	N	2 (DL)	8/15/2014	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	245	292	269	0.124	0.206	0.164
3	S	1 (PL)	8/15/2014	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	200	224	212	0.265	0.168	0.215
3	S	2 (DL)	8/12/2014	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	269	340	305	0.245	0.283	0.264
Direction	N	All	Aug. 2014	All	N70-15% ABR	15	Y	Y	64-22	240	257	249	0.153	0.176	0.164
Direction	S	All	Aug. 2014	All	N70-30% ABR	30	Y	Y	58-28	234	263	248	0.193	0.200	0.195

APPENDIX C-2: CRAWFORD AVENUE/PULASKI ROAD AUTOMATED DISTRESS DATA DECEMBER 17, 2014

POST-CONSTRUCTION RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

Crawford Avenue/Pulaski Road																
Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	N	1	12/17/2014	2-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	111	138	125	0.015	0.018	0.018
1	S	1	12/17/2014	2-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	118	142	130	0.026	0.022	0.023
2	N	1 (PL)	12/17/2014	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	93	159	126	0.019	0.032	0.025
2	N	2 (DL)	12/17/2014	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	115	183	149	0.012	0.024	0.018
2	S	1 (PL)	12/17/2014	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	107	169	138	0.014	0.031	0.023
2	S	2 (DL)	12/17/2014	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	96	167	131	0.010	0.027	0.019
3	N	1 (PL)	12/17/2014	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	103	164	134	0.012	0.034	0.023
3	N	2 (DL)	12/17/2014	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	91	147	119	0.017	0.037	0.026
3	S	1 (PL)	12/17/2014	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	108	163	136	0.020	0.030	0.025
3	S	2 (DL)	12/17/2014	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	97	145	121	0.014	0.027	0.021
Direction	N	All	12/17/2014	All	N70-15% ABR	15	Y	Y	64-22	103	166	134	0.015	0.029	0.022
Direction	S	All	12/17/2014	All	N70-30% ABR	30	Y	Y	58-28	102	164	133	0.014	0.029	0.021

APPENDIX C-3: CRAWFORD AVENUE/PULASKI ROAD AUTOMATED DISTRESS DATA, MARCH 10, 2015

WINTER 2015 FROZEN GRADE RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

Crawford Avenue/Pulaski Road

Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	N	1	3/10/2015	2-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	128	163	145	0.015	0.037	0.026
1	S	1	3/10/2015	2-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	125	141	133	0.020	0.050	0.033
2	N	1 (PL)	3/10/2015	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	94	156	125	0.012	0.030	0.021
2	N	2 (DL)	3/10/2015	5-Lane Bare PCC	N70-15% ABR	15	Y	Y	64-22	103	163	133	0.009	0.040	0.025
2	S	1 (PL)	3/10/2015	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	107	161	134	0.008	0.031	0.020
2	S	2 (DL)	3/10/2015	5-Lane Bare PCC	N70-30% ABR	30	Y	Y	58-28	95	148	122	0.012	0.021	0.016
3	N	1 (PL)	3/10/2015	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	106	177	141	0.013	0.044	0.029
3	N	2 (DL)	3/10/2015	5-Lane HMA Overlay of PCC	N70-15% ABR	15	Y	Y	64-22	104	140	122	0.017	0.073	0.047
3	S	1 (PL)	3/10/2015	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	114	167	140	0.029	0.034	0.032
3	S	2 (DL)	3/10/2015	5-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	110	174	142	0.021	0.066	0.044
Direction	N	All	3/10/2015	All	N70-15% ABR	15	Y	Y	64-22	100	161	131	0.011	0.042	0.027
Direction	S	All	3/10/2015	All	N70-30% ABR	30	Y	Y	58-28	104	157	131	0.014	0.032	0.023

APPENDIX C-4: US 52 – IL 53 (CHICAGO STREET) TO LARAWAY ROAD, AUTOMATED DISTRESS DATA, AUGUST 15, 2014

PRE-CONSTRUCTION RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

US 52 - IL 53 (Chicago St.) to Laraway Road																
Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	E	2 (DL)	8/15/2014	4-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	NA	NA	NA	0.13	0.16	0.15
1	W	2 (DL)	8/12/2014	4-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	NA	NA	NA	0.18	0.12	0.15
2	E	1 (DL)	8/15/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	164	212	188	0.21	0.22	0.02
2	W	1 (DL)	8/15/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	179	240	210	0.20	0.25	0.23
3	E	1 (DL)	8/15/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	292	319	305	0.26	0.29	0.28
3	W	1 (DL)	8/12/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	274	340	307	0.25	0.30	0.28
Direction	E	All	Aug. 2014	HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	171	215	193	0.20	0.22	0.15
Direction	W	All	Aug. 2014	HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	200	260	230	0.21	0.22	0.22

NA = Data not available

APPENDIX C-5: US 52 – IL 53 (CHICAGO STREET) TO LARAWAY ROAD, AUTOMATED DISTRESS DATA, DECEMBER 17, 2014

POST-CONSTRUCTION RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

US 52 - IL 53 (Chicago St.) to Laraway Road															
Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	E	2 (DL)	12/17/2014	4-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	61	134	97	0.015	0.024	0.020
1	W	2 (DL)	12/17/2014	4-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	67	91	79	0.018	0.013	0.017
2	E	1 (DL)	12/17/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	77	89	83	0.014	0.012	0.013
2	W	1 (DL)	12/17/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	72	84	78	0.012	0.010	0.011
3	E	1 (DL)	12/17/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	100	92	96	0.007	0.013	0.011
3	W	1 (DL)	12/17/2014	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	95	115	105	0.018	0.013	0.015
Direction	E	All	12/17/2014	HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	78	90	84	0.013	0.013	0.011
Direction	W	All	12/17/2014	HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	73	86	80	0.013	0.013	0.017

APPENDIX C-6: US 52 – IL 53 (CHICAGO STREET) TO LARAWAY ROAD, AUTOMATED DISTRESS DATA, DECEMBER 17, 2014

WINTER 2015 FROZEN CONSTRUCTION RUTTING AND INTERNATIONAL ROUGHNESS INDEX (IRI)

US 52 - IL 53 (Chicago St.) to Laraway Road															
Segment	Dir.	Lane	Test Date	Orginal Pavement Type	Overlay Surface Mix					IRI (Inches/Mile)			Rut (Inches)		
					Mix	ABR %	RAS	RAP	Virgin PG	Left WP	Right WP	Ave	Left WP	Right WP	Ave
1	E	2 (DL)	3/10/2015	4-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	58	121	89	0.014	0.078	0.047
1	W	2 (DL)	3/10/2015	4-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	74	94	84	0.019	0.020	0.019
2	E	1 (DL)	3/10/2015	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	96	121	108	0.012	0.029	0.020
2	W	1 (DL)	3/10/2015	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	93	104	98	0.011	0.024	0.017
3	E	1 (DL)	3/10/2015	2-Lane HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	110	116	113	0.004	0.025	0.016
3	W	1 (DL)	3/10/2015	2-Lane HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	128	153	140	0.025	0.037	0.030
Direction	E	All	3/10/2015	HMA Overlay of PCC	N70-30% ABR	30	Y	Y	58-28	95	121	108	0.012	0.030	0.021
Direction	W	All	3/10/2015	HMA Overlay of PCC	N70-30% ABR	30	N	Y	58-28	95	107	101	0.012	0.025	0.018

APPENDIX D: PATCHING SCHEDULES

APPENDIX D-1: CRAWFORD AVENUE/PULASKI ROAD PATCHING SCHEDULE

Route	Section	Pavement Type	Direction	Lane	Patch Station	Length (Feet)	Area (Sq. Yds.)
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	13.29	7.10	9.07
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	13.58	7.20	9.12
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	13.75	6.90	8.89
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	14.00	6.90	8.89
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	14.12	10.40	13.30
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	14.34	6.30	8.40
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	14.80	6.50	8.88
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	15.00	6.40	8.75
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	15.13	3.80	8.92
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	15.40	6.30	8.26
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	15.58	6.30	8.47
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	15.80	6.00	8.40
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	16.20	19.10	26.10
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	16.90	26.50	36.20
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	17.05	5.80	7.80
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	17.40	10.40	14.20
Crawford/Pulaski	1	2-Lane Bare PCC	SB	1	17.65	33.20	45.40
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	35.25	13.90	19.15
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	38.70	20.60	27.47
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	43.25	22.60	30.13
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	43.84	6.10	8.13
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	45.30	6.70	8.93
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	45.70	6.40	8.75
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	46.25	9.80	13.28
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	47.70	20.70	27.37
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	48.10	7.80	10.40
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	56.50	6.50	8.67
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	61.00	6.90	9.28
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	63.44	5.30	6.42
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	64.00	5.50	6.91
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	67.60	5.80	7.86

APPENDIX D-1: CRAWFORD AVENUE/PULASKI ROAD PATCHING SCHEDULE (CONTINUED)

Route	Section	Pavement Type	Direction	Lane	Patch Station	Length (Feet)	Area (Sq. Yds.)
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	71.30	6.70	8.93
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	80.88	6.70	8.19
Crawford/Pulaski	2	5-Lane Bare PCC	NB	1	81.10	6.80	8.16
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	29.20	19.70	27.36
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	34.75	6.30	8.54
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	35.24	5.90	7.87
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	37.25	7.20	9.60
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	38.15	8.50	11.33
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	41.30	7.80	10.49
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	44.70	8.10	10.80
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	46.80	6.00	8.00
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	67.60	6.00	7.27
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	72.43	6.50	8.02
Crawford/Pulaski	2	5-Lane Bare PCC	SB	1	76.50	6.60	7.99
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	67.50	6.40	8.68
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	72.40	6.40	8.46
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	76.50	6.40	8.89
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	80.60	26.80	35.70
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	80.60	26.80	31.00
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	81.25	6.30	8.75
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	81.25	6.80	8.24
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	82.00	11.80	15.90
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	82.00	11.80	14.60
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	82.40	10.60	9.54
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	82.55	8.30	11.50
Crawford/Pulaski	2	5-Lane Bare PCC	SB	2	82.55	10.40	9.36
Crawford/Pulaski	2	5-Lane Bare PCC	167th Street Intersection			6.50	9.03
Crawford/Pulaski	2	5-Lane Bare PCC	167th Street Intersection			6.50	10.40
Crawford/Pulaski	2	5-Lane Bare PCC	167th Street Intersection			7.40	14.88
Crawford/Pulaski	2	5-Lane Bare PCC	167th Street Intersection			11.00	48.89
Crawford/Pulaski	2	5-Lane Bare PCC	167th Street Intersection			6.90	13.03
Crawford/Pulaski	3	5-Lane HMA Overlay of PCC	NB	2	104.60	7.20	30.72
Crawford/Pulaski	3	5-Lane HMA Overlay of PCC	NB	2	108.70	15.00	20.00
					Total Area		891.92

APPENDIX D-2: US 52 (IL 52 TO LARAWAY ROAD) PATCHING SCHEDULE

Location	Segment	Direction	Length (Ft.)	Width (Ft.)	Area (Sq. Yd.)			
					Type II	Type III	Type IV	Total
144+74	3	EB	62	4			27.56	27.56
145+36	3	EB	108	7			84.00	84.00
146+14	3	EB	6	13	8.67			8.67
146+44	3	EB	6	14	9.33			9.33
146+73	3	WB	5	21	11.67			11.67
148+43	3	EB	199	4			88.44	88.44
148+75	3	WB	6	11.5	7.67			7.67
149+10	3	WB	21	10		23.33		23.33
N Limit*	3	EB	24	4	10.67			10.67
152+80	3	WB	6	17	11.33			11.33
153+30	3	WB	6	18	12.00			12.00
153+50	3	WB	6	18	12.00			12.00
153+80	3	WB	76	4			33.78	33.78
154+35	3	WB	6	17	11.33			11.33
155+09	3	WB	38	6			25.33	25.33
155+30	3	WB	6	16	10.67			10.67
	Note: * Intersection area			Total	105.33	23.33	259.11	387.78

APPENDIX E: LEVEL BINDER AND SURFACE COURSE MIX DESIGNS

APPENDIX E-1: CRAWFORD AVENUE/PULASKI ROAD, MIX 81BIT147M: 4.75 LEVEL BINDER – PG 70-28 – 35% ABR W/RAP & RAS

IDOT Lab Verification No.: ---> [illegible]   Ver. 10.00-04.15.[illegible]   DATE: [illegible]

Producer Number & Name --> 6116-06 Sandeno East | Hazel Crest <--- Plant Location   81BIT147M

Material Code Number ---> 19510R HMA N60 4.75 REC SURF

Plant Bin #	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	ASPHALT
Size			042CM11	032CM16	038FM20	037FM02	038FM20CRS	004MF01			017FM98	017FM0400	10130
Source (PROD #)			50312-04	50312-04	50312-04	52600-06	5312-04	50312-64			6616-06	50315-12	1757-03
(NAME)			Hanson	Hanson	Hanson	Moose Lk	Hanson	Hanson			Southwind	Sandeno East	Seneca
(LOC)			Thornton	Thornton	Thornton	Niles, MI	Thornton	Thornton			Thornton	Hazel Crest	Lemont
(ADD. INFO)													SBS PG 70-28
									0.0	0.0	25.0	4.5	< AB in RAP
Aggregate Blend:												Plan PG Grade >	PG 70-28
	0.0	0.0	0.0	0.0	45.0	16.0	0.0	1.0	0.0	0.0	4.0	34.0	100.0
Mixture Blend:													Totals:
	0.0	0.0	0.0	0.0	41.5	14.8	0.0	0.9	0.0	0.0	4.9	32.9	100.0

Agg No. / Sieve Size	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	Aggregate Blend	Mixture Comp Spec
1" (25.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
3/4"(19.0mm)	100.0	100.0	88.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
1/2" (12.5mm)	100.0	100.0	44.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
3/8" (9.5mm)	100.0	100.0	19.0	96.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
No.4 (4.75mm)	100.0	100.0	5.0	29.0	98.0	97.0	96.0	100.0	100.0	100.0	95.0	74.0	90	90-100
No.8 (2.36mm)	100.0	100.0	4.0	7.0	81.0	87.0	65.0	100.0	100.0	100.0	85.0	54.0	73	70-90
No.16 (1.18mm)	100.0	100.0	3.0	5.0	50.0	77.0	19.0	100.0	100.0	100.0	67.0	40.0	52	50-65
No.30 (600μm)	100.0	100.0	3.0	4.0	31.0	57.0	13.0	100.0	100.0	100.0	50.0	30.0	36	35-55
No.50 (300μm)	100.0	100.0	3.0	4.0	18.0	23.0	5.0	100.0	100.0	100.0	40.0	19.0	21	15-30
No.100 (150μm)	100.0	100.0	2.0	3.0	10.0	3.0	4.0	95.0	100.0	100.0	35.0	12.0	11	10-18
No.200(75μm)	100.0	100.0	2.1	3.0	5.3	1.1	2.9	90.0	100.0	100.0	26.5	8.6	7.5	7-9
Bulk Sp Gr	1.000	1.000	2.573	2.669	2.676	2.591	2.662	2.900	1.000	1.000	2.500	2.660	2.651	Dust/AB
Absorption, %	1.00	1.00	1.40	1.79	1.20	1.20	1.80	1.00	1.00	1.00	1.00	1.00	1.11	Ratio
												SP GR AB	1.031	0.97

SUMMARY OF SUPERPAVE GYRATORY DESIGN DATA

DATA for N-int.	6								
	AB, %MIX	Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Pba
MIX 1	6.7	2.121	2.467	14.0	25.4	44.7	11.34	5.51	1.28
MIX 2	7.2	2.157	2.445	11.8	24.5	51.9	12.72	6.08	1.21
MIX 3	7.7	2.170	2.427	10.6	24.5	56.7	13.85	6.58	1.21
MIX 4	8.2	2.177	2.412	9.7	24.6	60.4	14.87	7.04	1.26

DATA for N-des.	50									
		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	6.7	2.306	2.467	6.5	18.8	65.3	12.32	5.51	2.741	1.28
MIX 2	7.2	2.326	2.445	4.9	18.6	73.8	13.72	6.08	2.736	1.21
MIX 3	7.7	2.341	2.427	3.5	18.5	80.9	14.94	6.56	2.736	1.21
MIX 4	8.2	2.352	2.412	2.5	18.6	86.6	16.06	7.04	2.740	1.26

Hamburg Wheel Information	
Sample No. Passes	15000
Sample Wheel Depth	5.13

TSR Information	
Conditioned	128.7
Unconditioned	151.3
TSR	0.85
CA Strip Rating	1
FA Strip Rating	1
Additive Prod #	
Additive Product Name	
Additive %	

OPTIMUM DESIGN DATA @ Ndes

GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa)	VMA	VFA	Gse	Gsb	TSR	RCY AB	Virgin AB	ABR
	7.72			Target								
50	7.7	2.341	2.426	3.5	18.5	81.1	2.736	2.651	0.85	2.71	5.01	35.1

10/08 mod 7.5

REMARKS LINE 1

REMARKS LINE 2

BITUMINOUS MIXTURE AGED 1 HOURS @ 295

Lab Preparing Design: PP

Designing Lab Mix#:

Designing Lab Name: D Const.

Tested by : [signature]

Reviewed by :

Verified by:

Final Approval :

81BIT147M

APPENDIX E-2: CRAWFORD AVENUE/PULASKI ROAD, MIX: 81BIT156M – SURFACE COURSE NORTH BOUND LANES – PG 64-22 – 15% ABR W/RAP & RAS

IDOT Lab Verification No.: —>

Ver. 11.01-07.07.14

DATE: 09/02/14

TPN7015%

~~[illegible]~~
48BIT VS87
81BIT156M

Producer Number & Name —>	5116-06	Sandeno East	Hazel Crest <— Plant Location
Material Code Number —>	19524R	HMA SC N70 D REC 9.5mm	

Plant Bin #	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	ASPHALT
Size				032CM16	028FM20	037FM02		004MF01			017FM98	017FM0400	10127
Source (PROD #)				50312-04	50312-04	52600-06		50312-04			6616-06	50315-12	Senneca
(NAME)				Hanson	Hanson	Moose Lk		Hanson			Southwind	Sandeno East	1757-05
(LOC)				Thornton	Thornton	Niles, MI		Thornton			Thornton	Hazel Crest	Lemont
(ADD. INFO)													PG 64-22
									0.0	0.0	25.0	4.5	< AB in RAP
Aggregate Blend:												Plan PG Grade >	PG 64-22
	0.0	0.0	0.0	65.0	15.0	12.0	0.0	1.0	0.0	0.0	2.0	5.0	100.0
Mixture Blend:													Totals:
	0.0	0.0	0.0	61.3	14.2	11.3	0.0	0.9	0.0	0.0	2.5	4.9	100.0

Agg No. / Sieve Size	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	Aggregate Blend	Mixture Comp Spec
1" (25.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
3/4" (19.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
1/2" (12.5mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
3/8" (9.5mm)	100.0	100.0	100.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97	90-100
No.4 (4.75mm)	100.0	100.0	100.0	29.0	98.0	97.0	100.0	100.0	100.0	100.0	95.0	74.0	52	32-69
No.8 (2.36mm)	100.0	100.0	100.0	7.0	81.0	87.0	100.0	100.0	100.0	100.0	85.0	54.0	33	32-52
No.16 (1.18mm)	100.0	100.0	100.0	5.0	50.0	77.0	100.0	100.0	100.0	100.0	67.0	40.0	24	10-32
No.30 (600µm)	100.0	100.0	100.0	4.0	31.0	57.0	100.0	100.0	100.0	100.0	50.0	30.0	18	
No.50 (300µm)	100.0	100.0	100.0	4.0	18.0	23.0	100.0	100.0	100.0	100.0	40.0	19.0	11	4-15
No.100 (150µm)	100.0	100.0	100.0	3.0	10.0	3.0	100.0	95.0	100.0	100.0	35.0	12.0	6	3-10
No.200(75µm)	100.0	100.0	100.0	3.0	5.3	1.1	100.0	90.0	100.0	100.0	26.5	8.8	4.7	4-6
Bulk Sp Gr	1.000	1.000	1.000	2.669	2.676	2.591	1.000	2.900	1.000	1.000	2.500	2.660	2.659	Dust/AB
Absorption, %	1.00	1.00	1.00	1.70	1.20	1.20	1.00	1.00	1.00	1.00	1.00	1.00	1.45	Ratio
												SP GR AB	1.031	0.83

SUMMARY OF SUPERPAVE GYRATORY DESIGN DATA

DATA for N-int.	7								
	AB, %MIX	Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Pba
MIX 1	5.2	2.129	2.512	15.3	24.1	36.7	8.84	4.28	0.97
MIX 2	5.7	2.148	2.494	13.9	23.8	41.8	9.96	4.78	0.98
MIX 3	6.2	2.137	2.478	13.8	24.6	44.1	10.86	5.24	1.02
MIX 4	6.7	2.127	2.460	13.5	25.4	46.6	11.82	5.73	1.04

Hamburg Wheel Information	
Sample No. Passes	10000
Sample Wheel Depth	3.50

DATA for N-des.	70									
		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	5.2	2.373	2.512	5.5	15.4	64.1	9.85	4.28	2.727	0.97
MIX 2	5.7	2.395	2.494	4.0	15.1	73.6	11.10	4.78	2.728	0.98
MIX 3	6.2	2.410	2.478	2.7	15.0	81.7	12.25	5.24	2.731	1.02
MIX 4	6.7	2.420	2.460	1.6	15.1	89.2	13.45	5.73	2.732	1.04

TSR Information	
Conditioned	129.2
Unconditioned	144.1
TSR	0.90
CA Strip Rating	1
FA Strip Rating	1
Additive Prod #	
Additive Product Name	
Additive %	

OPTIMUM DESIGN DATA @ Ndes

GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa) Target	VMA	VFA	Gse	Gsb	TSR	RCY AB	Virgin AB	ABR
70	5.7	2.394	2.494	4.0	15.1	73.5	2.728	2.659	0.90	0.9	4.8	14.9

REMARKS LINE 1

REMARKS LINE 2

BITUMINOUS MIXTURE AGED 1 HOURS @ 295

Lab Preparing Design: PP

Designing Lab Mix#: TPN7015%

Tested by : ______________________

Verified by: ______________________

APPENDIX E-3: CRAWFORD AVENUE/PULASKI ROAD, MIX: 81BIT157M – SURFACE COURSE SOUTH BOUND LANES – PG 58-28 – 30% ABR W/RAP & RAS

81BIT157M
48BITVS89

IDOT Lab Verification No.: —> | Ver. 11.01-07.07.14 | DATE: 09/19/14

TPN7030%

Producer Number & Name —>	5116-06	Sandeno East	Hazel Crest	<— Plant Location
Material Code Number —>	19524R	HMA SC N70 D REC 9.5mm		

Plant Bin #	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	ASPHALT
Size				032CM16	023FM20	027FM02		004MF01			017FM98	017FM0400	10126
Source (PROD #)				50312-04	50312-04	52600-06		50312-04			6616-06	50315-12	Seneca
(NAME)				Hanson	Hanson	Moose Lk		Hanson			Southwind	Sandeno East	1757-06
(LOC)				Thornton	Thornton	Niles, MI		Thornton			Thornton	Hazel Crest	Lemont
(ADD. INFO)													PG 58-28
									0.0	0.0	25.0	4.5	< AB in RAP
Aggregate Blend:												Plan PG Grade >	PG 58-28
	0.0	0.0	0.0	62.0	13.0	10.0	0.0	1.0	0.0	0.0	4.0	10.0	100.0
Mixture Blend:													Totals:
	0.0	0.0	0.0	58.4	12.2	9.4	0.0	0.9	0.0	0.0	5.0	9.9	100.0
											1.25	.4455	= 1.6955

Agg No. / Sieve Size	#7	#6	#5	#4	#3	#2	#1	MF	RCY	RCY	RAS #2	RAP #1	Aggregate Blend	Mixture Comp Spec
1" (25.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
3/4" (19.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
1/2" (12.5mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
3/8" (9.5mm)	100.0	100.0	100.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97	90-100
No.4 (4.75mm)	100.0	100.0	100.0	29.0	98.0	97.0	100.0	100.0	100.0	100.0	95.0	74.0	53	32-69
No.8 (2.36mm)	100.0	100.0	100.0	7.0	81.0	87.0	100.0	100.0	100.0	100.0	85.0	54.0	33	32-52
No.16 (1.18mm)	100.0	100.0	100.0	5.0	60.0	77.0	100.0	100.0	100.0	100.0	67.0	40.0	25	10-32
No.30 (600µm)	100.0	100.0	100.0	4.0	31.0	57.0	100.0	100.0	100.0	100.0	50.0	30.0	18	
No.50 (300µm)	100.0	100.0	100.0	4.0	18.0	23.0	100.0	100.0	100.0	100.0	40.0	19.0	12	4-15
No.100 (150µm)	100.0	100.0	100.0	3.0	10.0	3.0	100.0	95.0	100.0	100.0	35.0	12.0	7	3-10
No.200 (75µm)	100.0	100.0	100.0	3.0	6.3	1.1	100.0	90.0	100.0	100.0	26.5	6.6	5.5	4-6
Bulk Sp Gr	1.000	1.000	1.000	2.669	2.676	2.691	1.000	2.900	1.000	1.000	2.500	2.660	2.656	Dust/AB
Absorption, %	1.00	1.00	1.00	1.70	1.20	1.20	1.00	1.00	1.00	1.00	1.00	1.00	1.42	Ratio
												SP GR AB	1.031	0.94 ← 1.0

SUMMARY OF SUPERPAVE GYRATORY DESIGN DATA

DATA for N-int. 7	AB, %MIX	Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Pba
MIX 1	5.3	2.140	2.519	15.1	23.7	36.5	8.66	4.17	1.19
MIX 2	5.8	2.155	2.499	13.8	23.6	41.6	9.80	4.69	1.18
MIX 3	6.3	2.158	2.478	12.9	23.9	45.9	10.95	5.23	1.14
MIX 4	6.8	2.165	2.461	12.0	24.0	49.9	12.01	5.72	1.16

2.740-2.736 = .004 OK

Hamburg Wheel Information	
Sample No. Passes	10000
Sample Wheel Depth	2.10 ≤12.5mm

DATA for N-des. 70		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	5.3	2.378	2.519	5.6	15.2	63.2	9.62	4.17	2.740	1.19
MIX 2	5.8	2.397	2.499	4.1	15.0	72.8	10.90	4.69	2.739	1.18
MIX 3	6.3	2.408	2.478	2.8	15.1	81.3	12.22	5.23	2.736	1.14
MIX 4	6.8	2.419	2.461	1.7	15.1	88.7	13.42	5.72	2.738	1.16

TSR Information		
Conditioned	124.9	>60psi
Unconditioned	141.2	<200psi
TSR	0.88	>0.85
CA Strip Rating	1	
FA Strip Rating	1	
Additive Prod #		
Additive Product Name		
Additive %		

OPTIMUM DESIGN DATA @ Ndes

GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa)	VMA	VFA	Gse	Gsb	TSR	RCY AB	Virgin AB	ABR
	5.83			Target								
70	5.8	2.398	2.498	4.0	15.0 (min 15.0)	73.3 (65-75)	2.739	2.656	0.88	1.70	4.13	29.2

REMARKS LINE 1
REMARKS LINE 2

BITUMINOUS MIXTURE AGED 1 HOURS @ 295

MAX ABR=30%
1.6955 / 5.83 = .29.08

TPN7030%

Lab Preparing Design: PP
Designing Lab Mix#: TPN7030%
Designing Lab Name: D Con

Tested by: [signature]
Verified by:
Reviewed by:
Final Approval:

APPENDIX E-4: US 52 (IL 53 TO LARAWAY RD), MIX 81BIT141M: 4.75 LEVEL BINDER – PG 70-28 – 35% ABR W/RAP & RAS

IDOT Lab Verification No.: —> 48BITVR01 | Ver. 10.00-04.16.13 | DATE: 02/04/14

Producer Number & Name —>	5116-05	D Construction	Rockdale	<— Plant Location
Material Code Number —>	19510R	HMA N50 4.75 REC SURF		

BIT141M

Plant Bin #	#7	#6	#5	#4	#3	#2	#1	MF	FRAP #4	RAS #3	RCY	RCY	ASPHALT
Size	038FM20	037FM02	038FM22					004MF01	017FM0400	017FM98			10130
Source (PROD #)	51872-15	50990-54	51872-15					5116-05	5116-05	6616-06			1757-05
(NAME)	LaFarge	KellyCo	LaFarge					D Const	D Const	Southwind			Seneca
(LOC)	Joliet	Norway	Joliet					Rockdale	Rockdale	Thornton			Lemont
(ADD. INFO)													SBS PG 70-28
									4.4	25.0	0.0	0.0	< AB in RAP
Aggregate Blend:												Plan PG Grade >	PG 70-28
	43.3	22.0	0.0	0.0	0.0	0.0	0.0	0.7	30.0	4.0	0.0	0.0	100.0
Mixture Blend:													Totals:
	39.9	20.3	0.0	0.0	0.0	0.0	0.0	0.7	28.9	4.9	0.0	0.0	100.0

Agg No. / Sieve Size	#7	#6	#5	#4	#3	#2	#1	MF	FRAP #4	RAS #3	RCY	RCY	Aggregate Blend	Mixture Comp Spec
1" (25.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
3/4"(19.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
1/2" (12.5mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
3/8" (9.5mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
No.4 (4.75mm)	100.0	97.0	58.0	100.0	100.0	100.0	100.0	100.0	73.0	95.0	100.0	100.0	91	90-100
No.8 (2.36mm)	80.0	83.0	20.0	100.0	100.0	100.0	100.0	100.0	47.0	85.0	100.0	100.0	71	70-90
No.16 (1.18mm)	58.0	67.0	12.0	100.0	100.0	100.0	100.0	100.0	35.0	67.0	100.0	100.0	54	50-65
No.30 (600µm)	32.0	47.0	8.0	100.0	100.0	100.0	100.0	100.0	32.0	50.0	100.0	100.0	37	35-55
No.50 (300µm)	25.0	20.0	6.0	100.0	100.0	100.0	100.0	95.0	21.0	40.0	100.0	100.0	24	15-30
No.100 (150µm)	11.0	6.0	4.0	100.0	100.0	100.0	100.0	90.0	13.0	35.0	100.0	100.0	12	10-18
No.200(75µm)	4.9	3.9	2.4	100.0	100.0	100.0	100.0	85.0	8.8	26.5	100.0	100.0	7.2	7-9
Bulk Sp Gr	2.716	2.689	2.678	1.000	1.000	1.000	1.000	2.900	2.660	2.500	1.000	1.000	2.662	Dust/AB
Absorption, %	0.80	1.30	1.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	Ratio
												SP GR AB	1.040	0.92

SUMMARY OF SUPERPAVE GYRATORY DESIGN DATA

DATA for N-int.	8								
	AB, %MIX	Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Pba
MIX 1	7.3	2.163	2.448	11.6	24.7	52.8	13.04	6.27	1.11
MIX 2	7.8	2.167	2.432	10.9	24.9	56.3	14.04	6.74	1.16
MIX 3	8.3	2.197	2.419	9.2	24.3	62.3	15.13	7.16	1.24
MIX 4	8.8	2.209	2.403	8.1	24.3	66.8	16.25	7.65	1.26

DATA for N-des.	50									
		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	7.3	2.344	2.448	4.3	18.4	76.9	14.13	6.27	2.740	1.11
MIX 2	7.8	2.344	2.432	3.6	18.8	80.8	15.19	6.74	2.743	1.16
MIX 3	8.3	2.369	2.419	2.1	18.4	88.7	16.31	7.16	2.748	1.24
MIX 4	8.8	2.378	2.403	1.0	18.5	94.4	17.49	7.65	2.761	1.26

Hamburg Wheel Information	
Sample No. Passes	20000
Sample Wheel Depth	-2.03

TSR Information	
Conditioned	155.1
Unconditioned	180.3
TSR	0.92
CA Strip Rating	1
FA Strip Rating	1
Additive Prod #	
Additive Product Name	
Additive %	

OPTIMUM DESIGN DATA @ Ndes

GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa)	VMA	VFA	Gse	Gsb	TSR	RCY AB	Virgin AB	ABR
	7.84			Target								
50	7.8	2.346	2.431	3.5	18.8	81.4	2.743	2.662	0.92	2.50	5.34	31.9

REMARKS LINE 1

REMARKS LINE 2

BITUMINOUS MIXTURE AGED 2 HOURS @ 305

Lab Preparing Design: PP

Designing Lab Mix#: 81BIT095M

Designing Lab Name: D Const

Tested by : ____________ Verified by: ____________

Reviewed by : ____________ Final Approval : ____________

BIT141M

APPENDIX E-5: US 52 (IL 53 TO LARAWAY ROAD), MIX 81BIT159M: N70 SURFACE – PG 58-28 – 30% ABR W/ RAS ONLY

APPENDIX E-6: US 52 (IL 53 TO LARAWAY ROAD), MIX 81BIT140M: N70 SURFACE – PG 58-28 – 30% ABR W/RAP & RAS

IDOT Lab Verification No.: —>

Ver. 11.01-07.07.14

DATE: October 21 2014

DC14003

Producer Number & Name —> 5116-05 | D Construction | Rockdale <— Plant Location

Material Code Number —> 19524R HMA N70 REC SURFACE

Plant Bin #	#7	#6	#5	#4	#3	#2	#1	MF	FRAP #4	FRAP #3	RCY	RCY	ASPHALT
Size		032CM16			038FM22	038FM20		004MF02	017CM1204	017FM0400			10126
Source (PROD #)		51972-15			51972-15	51972-15		5116-05	5116-05	5116-05			1757-05
(NAME)		Lafarge			Lafarge	Lafarge		D Const.	D Const.	D Const.			Seneca
(LOC)		Joliet			Joliet	Joliet		Rockdale	Rockdale	Rockdale			Lemont
(ADD. INFO)													PG 58-28
< AB in RAP									3.8	6.0	0.0	0.0	Plan PG Grade > PG 64-22
Aggregate Blend:	0.0	30.0	0.0	0.0	29.5	6.0	0.0	0.5	14.0	20.0	0.0	0.0	100.0
Mixture Blend:	0.0	28.2	0.0	0.0	27.7	5.6	0.0	0.5	13.7	20.0	0.0	0.0	Totals: 100.0

Agg No. / Sieve Size	#7	#6	#5	#4	#3	#2	#1	MF	FRAP #4	FRAP #3	RCY	RCY	Aggregate Blend	Mixture Comp Spec
1" (25.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
3/4" (19.0mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	
1/2" (12.5mm)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
3/8" (9.5mm)	100.0	97.0	100.0	100.0	100.0	100.0	100.0	100.0	92.0	100.0	100.0	100.0	98	90-100
No.4 (4.75mm)	100.0	36.0	100.0	100.0	100.0	100.0	100.0	100.0	45.0	99.0	100.0	100.0	61	32-69
No.8 (2.36mm)	100.0	7.0	100.0	100.0	58.0	100.0	100.0	100.0	25.0	78.0	100.0	100.0	32	32-52
No.16 (1.18mm)	100.0	5.0	100.0	100.0	20.0	80.0	100.0	100.0	20.0	59.0	100.0	100.0	24	10-32
No.30 (600µm)	100.0	4.0	100.0	100.0	12.0	58.0	100.0	100.0	17.0	43.0	100.0	100.0	17	
No.50 (300µm)	100.0	4.0	100.0	100.0	8.0	32.0	100.0	100.0	13.0	29.0	100.0	100.0	13	4-15
No.100 (150µm)	100.0	4.0	100.0	100.0	6.0	25.0	100.0	95.0	9.0	19.0	100.0	100.0	9	3-10
No.200 (75µm)	100.0	3.3	100.0	100.0	4.0	11.0	100.0	90.0	6.7	13.3	100.0	100.0	6.0	4-6
Bulk Sp Gr	1.000	2.659	1.000	1.000	2.678	2.716	1.000	2.900	2.660	2.660	1.000	1.000	2.669	Dust/AB Ratio
Absorption, %	1.00	1.80	1.00	1.00	1.70	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.00
												SP GR AB	1.040	

Hamburg Wheel Information	
Sample No. Passes	10000
Sample Wheel Depth	5.03

SUMMARY OF SUPERPAVE GYRATORY DESIGN DATA

DATA for N-Ini. 7	AB, %MIX	Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Pba
MIX 1	5.0	2.129	2.555	16.7	24.2	31.2	7.55	3.69	1.38
MIX 2	5.5	2.146	2.533	15.3	24.0	36.4	8.73	4.23	1.34
MIX 3	6.0	2.159	2.517	14.2	24.0	40.7	9.74	4.69	1.39
MIX 4	6.5	2.167	2.494	13.1	24.1	45.6	11.00	5.28	1.31

TSR Information	
Conditioned	106.2
Unconditioned	106.6
TSR	1.00
CA Strip Rating	1
FA Strip Rating	1
Additive Prod #	
Additive Product Name	
Additive %	

DATA for N-des. 70		Gmb	Gmm	Voids (Pa)	VMA	VFA	Vbe	Pbe	Gse	Pba
MIX 1	5.0	2.380	2.555	6.9	15.3	55.2	8.44	3.69	2.767	1.38
MIX 2	5.5	2.401	2.533	5.2	15.0	65.2	9.77	4.23	2.764	1.34
MIX 3	6.0	2.414	2.517	4.1	15.0	72.7	10.89	4.69	2.768	1.39
MIX 4	6.5	2.425	2.494	2.8	15.1	81.6	12.31	5.28	2.762	1.31

OPTIMUM DESIGN DATA @ Ndes GYRATIONS	AB	Gmb	Gmm	%VOIDS (Pa) Target	VMA	VFA	Gse	Gsb	TSR	RCY AB	Virgin AB	ABR
70	6.03 / 6.0	2.415	2.518	4.0	15.0	73.3	2.768	2.669	1.00	1.72	4.31	28.5

BITUMINOUS MIXTURE AGED 1 HOURS @ 295

REMARKS LINE 1

REMARKS LINE 2

Tested by :

Reviewed by :

Verified by:

Final Approval :

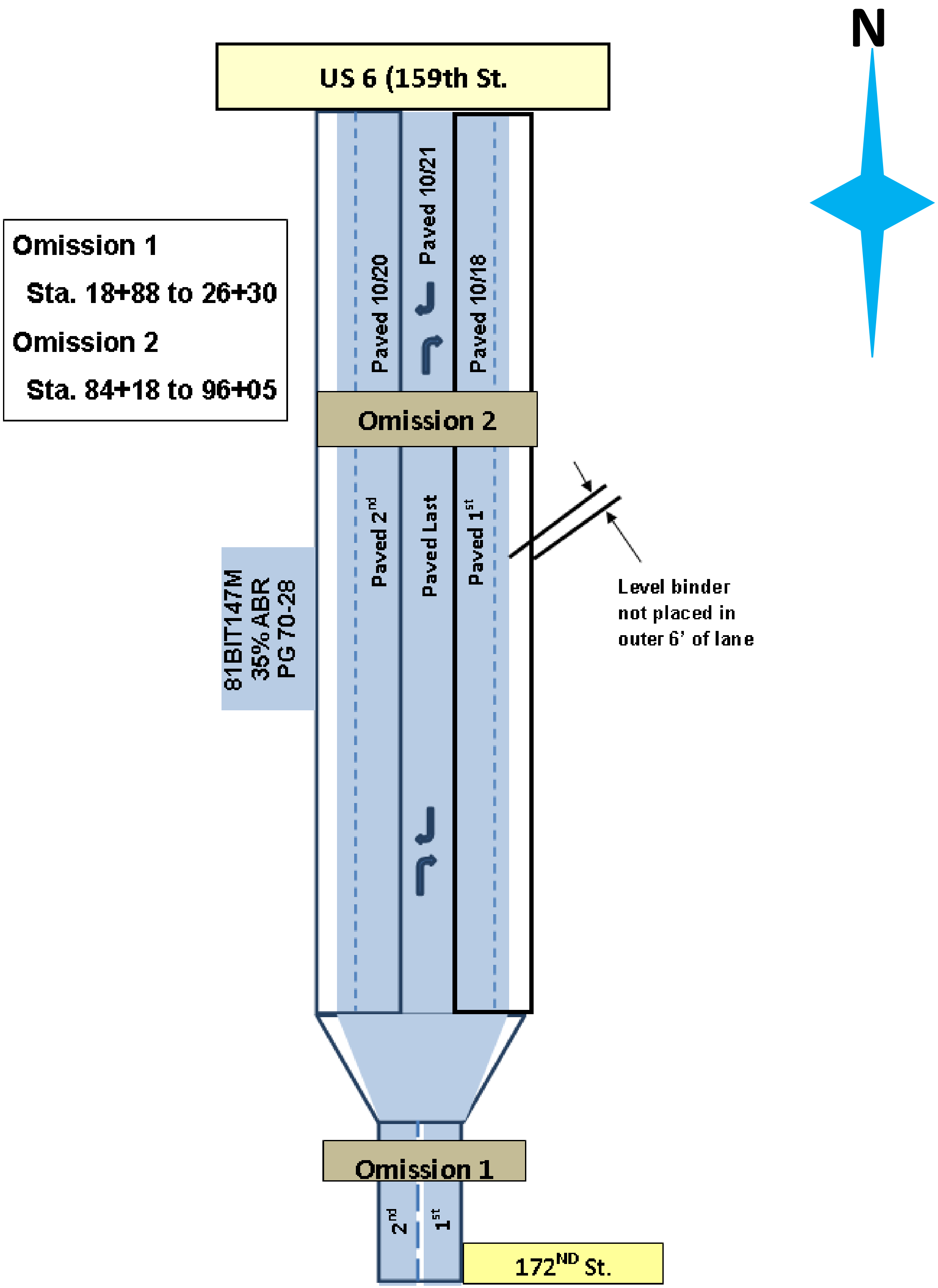
Lab Preparing Design IL

DC14003

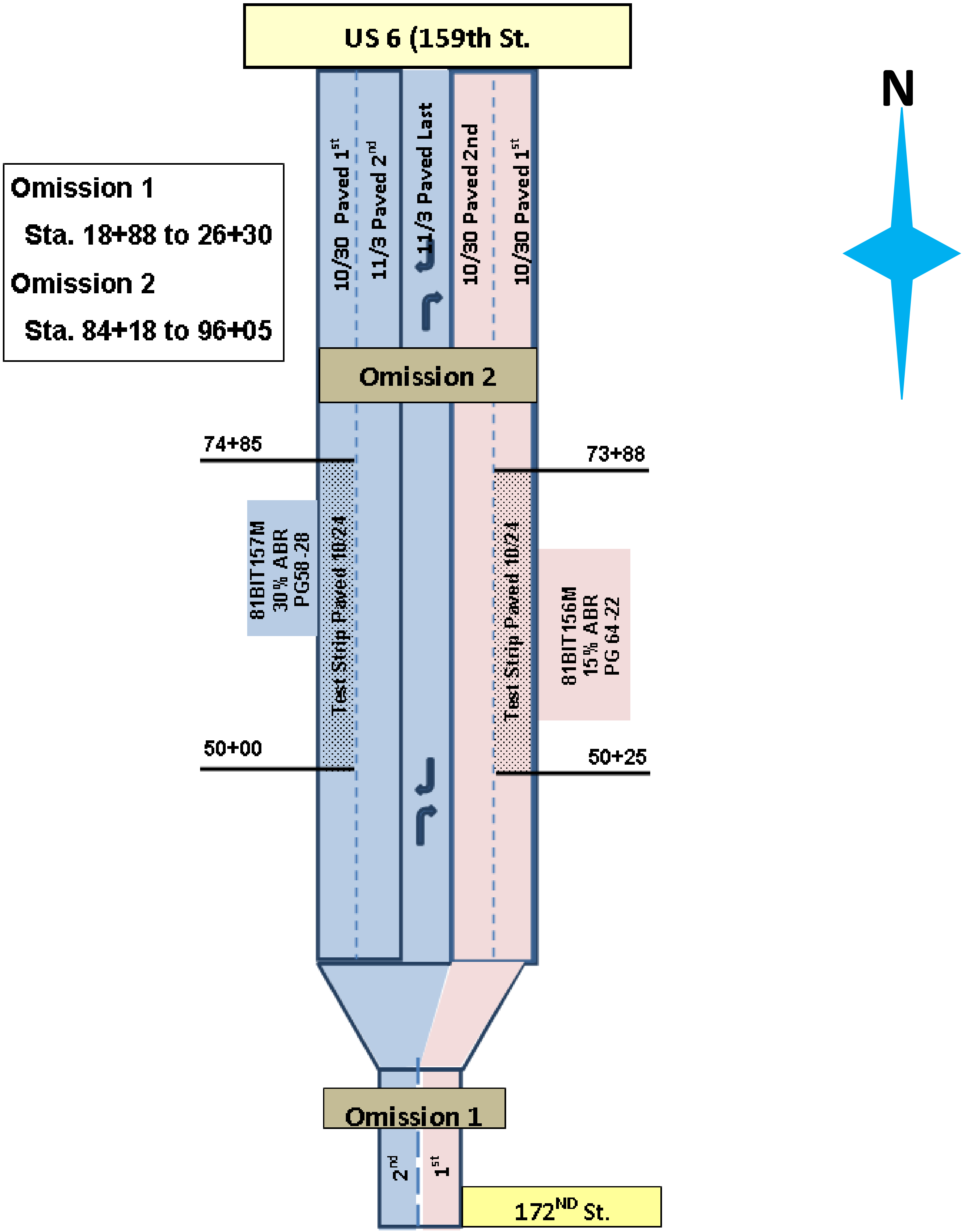
DC14003

APPENDIX F: PAVING SEQUENCE OF LEVEL BINDER AND SURFACE COURSE

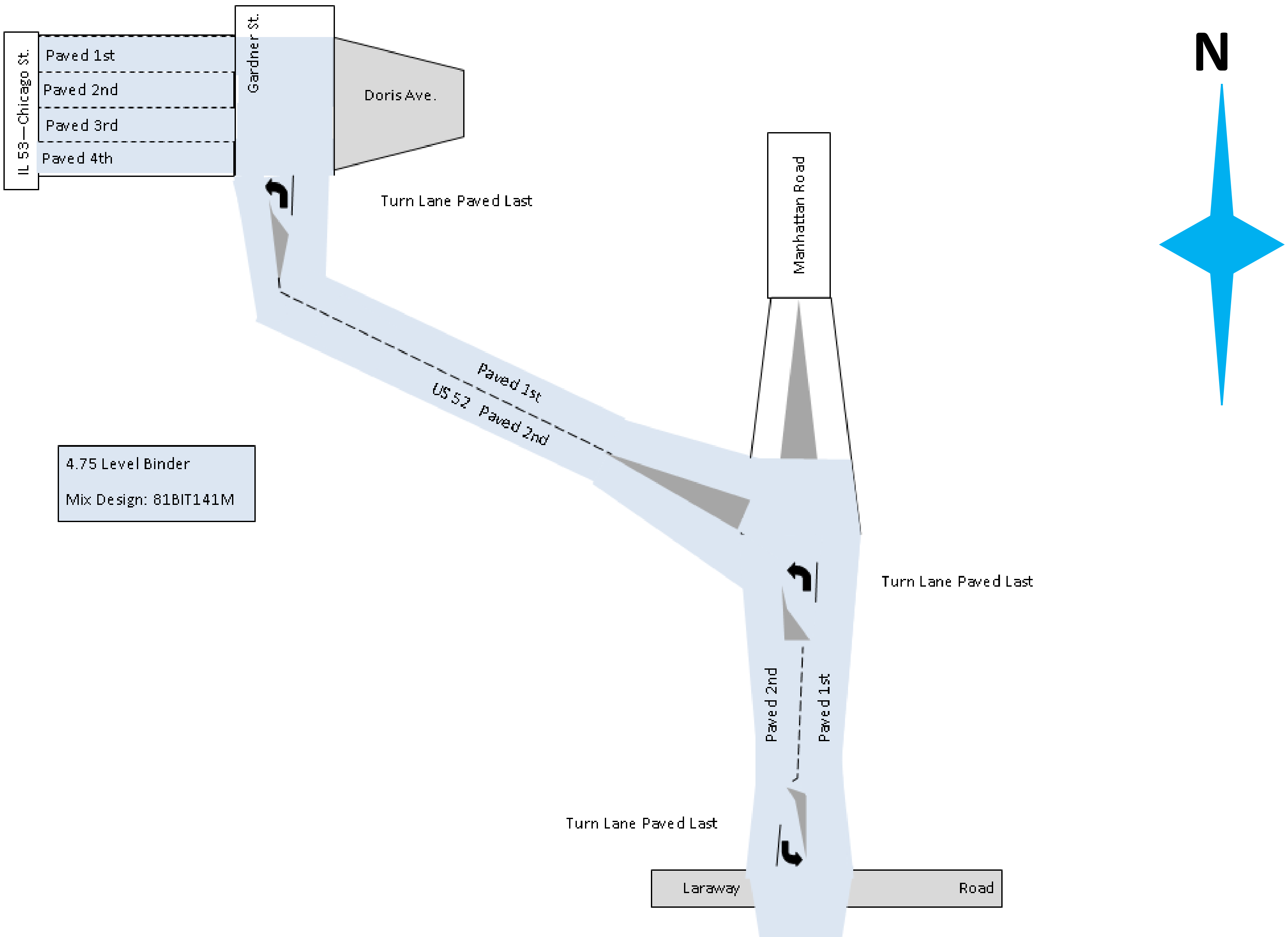
APPENDIX F-1: CRAWFORD AVENUE/PULASKI ROAD, LEVEL BINDER PAVING SEQUENCE



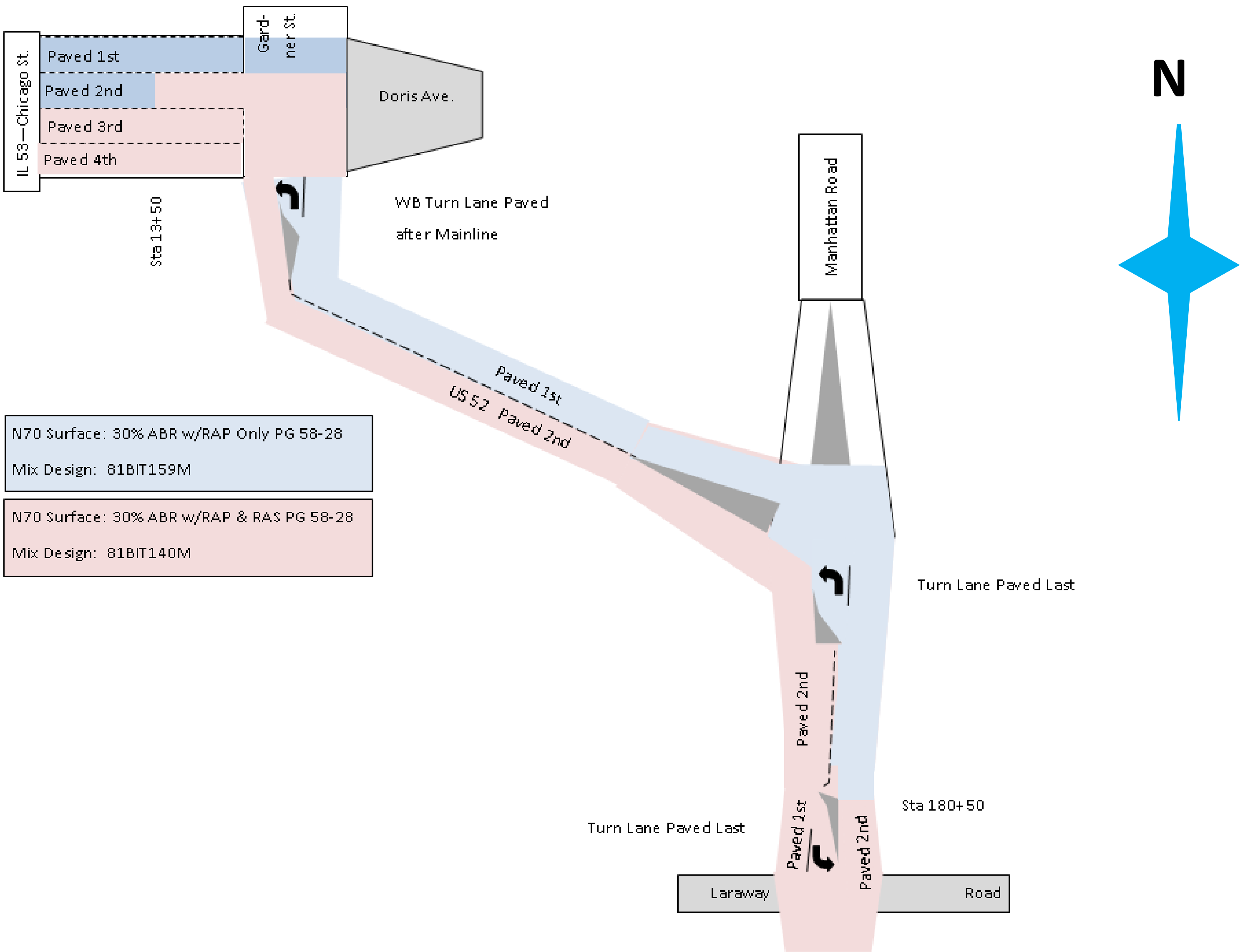
APPENDIX F-2: CRAWFORD AVENUE/PULASKI ROAD, SURFACE COURSE PAVING SEQUENCE



APPENDIX F-3: US 52 (IL 53 TO LARAWAY ROAD) , LEVEL BINDER PAVING SEQUENCE



APPENDIX F-4: US 52 (IL 53 to LARAWAY ROAD), SURFACE COURSE PAVING SEQUENCE



APPENDIX G: LABORTORY TESTING SUMMARIES

APPENDIX G-1: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT147M

Crawford Avenue/Pulaski Road 4.75 Level Binder from 172nd to US Rt. 6					
Mix Design	**Contract**	**ABR**	**RAS**	**RAP**	**PG Grade**
81BIT147M	60Y03	30%	YES	YES	70-28

Crawford/Pulaski Contract 60Y03 MIX: 81BIT147M

N 50 4.75 Level Binder PG 70-28

Mix Properties

Experimental Properties	
PG Grade	58-28
ABR	30%
RAP	Yes
RAS	Yes

Maximum Density Gmm			
Design	2.426	Sample	2.429

Extraction			
Sieve inch	% Design	Sample % Passing	% Diff.
3/4			0.0
1/2			0.0
3/8	100	100	0.0
#4	90	91	0.7
#8	73	70	-3.0
#16	52	48	-4.0
#30	36	32	-4.0
#50	21	18	-3.0
#100	11	9	-1.7
#200	7.5	6.4	-1.1
AC %	7.7	8.0	0.3

Stability and Flow 150mm Gyratory

4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow
1	7700	3	1	4250	N/A	4	4350	N/A	1	3100	N/A
2	7700	4	2	4100	N/A	5	3500	N/A	2	3000	N/A
3	7700	3	3	4200	N/A	6	4000	N/A	3	2950	N/A
Average	7700	3.3	**Average**	4183	N/A	**Average**	3950	N/A	**Average**	3017	N/A

Stability and Flow 4-inch Sample @ 4% Voids

Marshall			Cored from 150 Gyratory		
Brick No.	Stability	Flow	Brick No.	Stability	Flow
1	3100	2	2	3375	2
2	3225	1	3	3300	2
3	3075	2	4	3125	1
Average	3133	1.7	**Average**	3267	1.7

Cantabro Loss

7% Voids		10% Voids		12% Voids	
Brick No.	% Loss	Brick No.	% Loss	Brick No.	% Loss
5	1.9	1	2.0	1	2.2
3	2.9	5	2.0	2	2.7
4	2.9	4	1.9	4	2.1
Average	2.6	Average	2.0	Average	2.3

Tensile Strength and Tensile Strength Ratio

Conditioned				Unconditioned			
Brick No.	Load	Tensile Strength	Strip Rating C/F	Brick No.	Load	Tensile Strength	Strip Rating C/F
1	4000	115.5	1/1	2	4800	138.6	1/1
5	3900	112.3	1/1	6	4800	138.2	1/1
7	4200	121	1/1	8	4950	142.6	1/1
Average		116.3	1/1	**Average**		139.8	1/1
Tensile Strength Ratio			0.83				

Texas Overlay Tester

Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks
2T	1000	2.613	79.3	1
2B	1000	2.481	81.2	1
3T	769	2.668	93.1	1
3B	762	2.668	93.1	1
4T	757	2.548	93.2	1
4B	733	2.612	93.2	1
Average	837	2.598	88.9	1

APPENDIX G-1: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT147M (CONTINUED)

Level Binder Mix: 81BIT147M PG Grade 70-28			
Hamburg Displacement, mm			
		Pass Criteria	Ultimate
Brick Pairs		15,000	20,000
H2	H6	2.9	3.0
H4	H5	2.6	2.9
H1 7.0	H3 7.1	3.1	3.3
Maximum Displacement		3.1	3.3
Average Displacement		2.9	3.1

SCB with Flexibility Index (FI)					
Replicate Name	Fracture Energy (LLD)	Peak Load	Slope	FI	FI AVERAGE
147M-B1.dat	2110.80	4.15	-4.94	4.27	5.27
147M-B2.dat	2215.49	4.04	-4.67	4.75	
147M-T1.dat	2259.78	4.05	-3.03	7.45	
147M-T2.dat	2177.31	4.09	-4.73	4.60	

APPENDIX G-2: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT156M

Crawford Avenue/Pulaski Road Northbound Surface from 172nd to US Rt. 6

Mix Design	Contract	ABR	RAS	RAP	PG Grade
81BIT156M	60Y03	15%	YES	YES	64-22

Crawford/Pulaski Contract 60Y03 MIX 81BIT156M

Northbound Lanes N 70 D Surface PG64-22 ABR 15% w/ RAP and RAS

Mix Properties

Level Binder Properties	
PG Grade	64-22
ABR	14.9%
RAP	Yes
RAS	Yes

Maximum Density Gmm			
Design	2.494	Sample	2.508

Extraction			
Sieve inch	% Design	Sample % Passing	% Diff.
3/4			0.0
1/2	100	100	0.0
3/8	97	97	0.0
#4	52	53	1.0
#8	33	32	-1.0
#16	24	23	-1.0
#30	18	17	-1.0
#50	11	10	-1.0
#100	6	6	-0.2
#200	4.7	4.7	0.0
AC %	5.7	5.6	-0.1

Stability and Flow 150mm Gyratory

4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow
1	5800	3	1	3900	2	3	3850	2	3	3350	3
2	6100	2	2	3850	3	5	3700	3	4	3250	3
3	6100	2	3	4100	2	6	3600	3	5	3500	3
Average	6000	2.3	Average	3950	2.3	Average	3717	2.7	Average	3367	3.0

Stability and Flow 4-inch Sample @ 4% Voids

Marshall			Cored from 150 Gyratory		
Brick No.	Stability	Flow	Brick No.	Stability	Flow
7	3600	1.5	1	3000	1
8	3300	1.5	2	2850	2
9	3500	2	3	2900	2
Average	3467	1.7	Average	2917	1.7

Cantabro Loss

7% Voids		10% Voids		12% Voids	
Brick No.	% Loss	Brick No.	% Loss	Brick No.	% Loss
1	9.6	7	8.1	2	10.1
4	8.4	5	7.8	3	9.5
3	8.8	8	7.1	4	9.9
Average	8.9	Average	7.7	Average	9.8

Tensile Strength and Tensile Strength Ratio

Conditioned				Unconditioned			
Brick No.	Load	Tensile Strength	Strip Rating C/F	Brick No.	Load	Tensile Strength	Strip Rating C/F
5	5100	146.9	1/1	6	5800	167.1	1/1
8	5100	146.9	1/1	9	5200	149.8	1/1
11	4800	138.2	1/1	10	5100	146.9	1/1
Average		144.0	1/1	Average		154.6	1/1
	Tensile Strength Ratio			0.93			

Texas Overlay Tester

Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks
1T	370	2.426	93.1	1
1B	311	2.451	93.4	1
2T	247	2.381	93	1
3T	260	2.569	93.2	1
3B	422	2.542	93.1	1
Average	322	2.47	93.2	1

APPENDIX G-2: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT156M (CONTINUED)

Hamburg Displacement, mm			
Surface Mix: 81BIT156M PG Grade 64-22			
		Pass Criteria	Ultimate
Brick Pairs		7,500	20,000
H1	H2	2.4	3.0
H3	H6	1.8	2.4
H5	H4	1.9	2.4
H3	H6	0.6	0.7
Maximum Displacement		**2.4**	**3.0**
Average Displacement		**1.7**	**2.1**

SCB with Flexibility Index (FI)					
Replicate Name	**Fracture Energy (LLD)**	**Peak Load**	**Slope**	**FI**	**FI AVERAGE**
156M-B1.dat	**2205.09**	**4.03**	**-3.49**	**6.32**	**4.94**
156M-B2.dat	**2024.84**	**3.97**	**-4.60**	**4.40**	
156M-T1.dat	**2185.79**	**4.00**	**-4.65**	**4.70**	
156M-T2.dat	**1935.40**	**4.14**	**-4.45**	**4.35**	

APPENDIX G-3: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT157M

Crawford Avenue/Pulaski Road Southbound Surface from 172nd to US Rt. 6					
Mix Design	**Contract**	**ABR**	**RAS**	**RAP**	**PG Grade**
BIT157M	60Y03	30%	YES	YES	58-28

Crawford/Pulaski Contract 60Y03 MIX 81BIT157M

Southbourn Lanes N 70 D Surface PG58-28 ABR 30% w/ RAP and RAS

Mix Properties

Level Binder Properties	
PG Grade	58-28
ABR	29.2%
RAP	Yes
RAS	Yes

Maximum Density Gmm			
Design	2.431	**Sample**	2.438

Extraction

Sieve inch	% Design	Sample % Passing	% Diff.
3/4			0.0
1/2	100	100	0.0
3/8	97	97	0.0
#4	53	53	-0.5
#8	33	32	-1.0
#16	25	23	-2.0
#30	18	17	-1.0
#50	12	11	-1.0
#100	7	7	0.0
#200	5.5	5.5	0.0
AC %	5.8	5.7	-0.1

Stability and Flow 150mm Gyratory

4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**
1	6100	2	1	4000	3	3	3800	3	1	3000	3
2	5900	2	2	3800	4	4	3600	3	2	2750	3
3	5300	2	3	4150	3	5	3700	2	4	3100	3
Average	5767	2.0	**Average**	3983	3.3	**Average**	3700	2.7	**Average**	2950	3.0

Stability and Flow 4-inch Sample @ 4% Voids

Marshall			Cored from 150 Gyratory		
Brick No.	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**
3	3400	1	4	2400	1
5	3150	1	5	2500	1
6	3300	1	6	2350	1
Average	3283	1.0	**Average**	2417	1.0

Cantabro Loss

7% Voids		10% Voids		12% Voids	
Brick No.	**% Loss**	**Brick No.**	**% Loss**	**Brick No.**	**% Loss**
1	5.4	3	6.5	3	6.5
2	4.5	4	6.7	4	5.3
3	4.9	5	6.4	5	7.3
Average	4.9	**Average**	6.5	**Average**	6.4

Tensile Strength and Tensile Strength Ratio

Conditioned				Unconditioned			
Brick No.	**Load**	**Tensile Strength**	**Strip Rating C/F**	**Brick No.**	**Load**	**Tensile Strength**	**Strip Rating C/F**
2	4250	122.4	1/1	3	4400	126.7	1/1
5	4200	121.0	1/1	4	4500	129.6	1/1
7	4200	121.0	1/1	6	4450	128.2	1/1
Average		121.5	1/1	Average		128.2	1/1
Tensile Strength Ratio			0.95				

Texas Overlay Tester

Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks
1T	311	2.189	93.2	1
1B	242	2.307	93	1
2T	746	2.169	93.1	1
2B	246	2.228	93.2	1
3T	269	2.319	93	1
3B	288	2.14	93.5	1
Average	350	2.23	93.2	1

APPENDIX G-3: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT157M (CONTINUED)

Hamburg Displacement, mm			
Surface Mix: 81BIT157M PG Grade 58-28			
		Pass Criteria	Ultimate
Brick Pairs		5,000	20,000
H1	H5	1.9	2.6
H4	H5	2.4	3.2
H2	H3	2.6	3.6
H1	H6	2.2	3.1
Maximum Displacement		**2.6**	**3.6**
Average Displacement		**2.3**	**3.1**

SCB with Flexibility Index (FI)					
Replicate Name	**Fracture Energy (LLD)**	**Peak Load**	**Slope**	**FI**	**FI AVERAGE**
157M-B1.dat	1687.58	4.14	-5.31	3.18	3.53
157M-B2.dat	1942.53	4.18	-4.90	3.96	
157M-T1.dat	2064.95	4.37	-5.53	3.74	
157M-T2.dat	1843.91	4.14	-5.72	3.23	

APPENDIX G-4: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT141M

US 52 4.75 Level Binder from IL 53 (Chicago Street) to Laraway Road					
Mix Design	Contract	ABR	RAS	RAP	PG Grade
81BIT141M	60Y02	35%	YES	YES	70-28

US 52 Contract 60Y02 MIX 81BIT141M

4.75 Level Binder N 50 D PG70-28 ABR 35% w/ RAP and RAS

Mix Properties

Level Binder Properties	
PG Grade	70-28
ABR	35%
RAP	Yes
RAS	Yes

Maximum Density Gmm			
Design	2.431	Sample	2.438

Extraction			
Sieve inch	% Design	Sample % Passing	% Diff.
3/4			
1/2			
3/8	100	100	0.0
#4	91	91	0.0
#8	71	73	2.0
#16	54	51	-3.0
#30	37	35	-2.0
#50	24	23	-1.0
#100	12	14	2.0
#200	7.2	7.0	-0.2
AC %	7.8	7.7	-0.1

Stability and Flow 150mm Gyratory											
4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow
1	4500	3	1	3900	3.5	2	3500	3	2	2800	4
2	4400	3	2	3900	4	3	3700	2	3	2700	4
3	4450	3	3	4000	3.5	4	3700	3	4	2750	4
Average	4450	3.0	Average	3933	3.7	Average	3633	2.7	Average	2750	4.0

Stability and Flow 4-inch Sample @ 4% Voids					
Marshall			Cored from 150 Gyratory		
Brick No.	Stability	Flow	Brick No.	Stability	Flow
3	2875	2	1	2600	1
4	3075	2	3	2700	1
5	2975	2	4	2650	1
Average	2975	2.0	Average	2650	1.0

Cantabro Loss					
7% Voids		10% Voids		12% Voids	
Brick No.	% Loss	Brick No.	% Loss	Brick No.	% Loss
2	2.9	2	2.6	2	2.9
3	2.5	3	3.2	3	2.6
4	2.7	4	2.6	4	3.3
Average	2.7	Average	2.8	Average	2.9

Tensile Strength and Tensile Strength Ratio							
Conditioned				Unconditioned			
Brick No.	Load	Tensile Strength	Strip Rating C/F	Brick No.	Load	Tensile Strength	Strip Rating C/F
3	4150	264.2	1/1	4	4700	299.2	1/1
5	4300	273.7	1/1	6	4700	299.2	1/1
7	4200	267.4	1/1	8	4700	299.2	1/1
Average		268.4	1/1	Average		299.2	1/1
Tensile Strength Ratio				0.90			

Texas Overlay Tester				
Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks

APPENDIX G-4: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT141M (CONTINUED)

Hamburg Displacement, mm			
Level Binder Mix: 81BIT141M PG Grade 70-28			
		Pass Criteria	Ultimate
Brick Pairs		15,000	20,000
H1 7.0	H4 7.0	2.7	2.9
H2 7.1	H3 7.1	3.4	3.7
H5 7.0	H6 6.8	3.1	3.2
Maximum Displacement		3.4	3.7
Average Displacement		3.1	3.3

SCB with Flexibility Index (FI)					
Replicate Name	Fracture Energy (LLD)	Peak Load	Slope	FI	FI AVERAGE
141M-B1.dat	2095.54	3.72	-3.94	5.32	5.13
141M-B2.dat	2093.12	3.66	-3.96	5.29	
141M-T1.dat	1983.84	3.94	-3.77	5.26	
141M-T2.dat	1890.31	3.81	-4.07	4.64	

APPENDIX G-5: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT140

US 52 East Bound Surface from IL 53 (Chicago Street) to Laraway Road					
Mix Design	**Contract**	**ABR**	**RAS**	**RAP**	**PG Grade**
81BIT140	60Y02	30%	YES	YES	58-28

US 52 Contract 60Y02 MIX 81BIT140M

Eastbound Lane N 70 D Surface Course PG 58-28 ABR 30% w/ RAP and RAS

Mix Properties

Experimental Properties	
PG Grade	58-28
ABR	30%
RAP	Yes
RAS	Yes

Maximum Density Gmm			
Design	2.502	**Sample**	2.524

Extraction			
Sieve inch	% Design	Sample % Passing	% Diff.
3/4			0.0
1/2	100	100	0.0
3/8	97	98	1.0
#4	61	53	-8.0
#8	37	32	-5.0
#16	28	22	-6.0
#30	19	16	-3.0
#50	13	11	-2.0
#100	8	7	-1.0
#200	5.5	4.6	-0.9
AC %	5.8	5.5	-0.3

Stability and Flow 150mm Gyratory

4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**
1	5000	2.5	2	2750	2.5	2	2650	2.5	1	2000	2
2	5000	2	3	2950	2.5	3	2500	2	2	2000	2.5
3	5200	2	4	2850	2	4	2700	2	3	2000	2
Average	5067	2.2	**Average**	2850	2.3	**Average**	2617	2.2	**Average**	2000	2.2

Stability and Flow 4-inch Sample @ 4% Voids

Marshall			Cored from 150 Gyratory		
Brick No.	**Stability**	**Flow**	**Brick No.**	**Stability**	**Flow**
2	2750	1	2	2150	3
3	2850	1	3	2200	2.5
4	2675	0.5	4	2025	2
Average	2758	0.8	**Average**	2125	2.5

Cantabro Loss

7% Voids		10% Voids		12% Voids	
Brick No.	**% Loss**	**Brick No.**	**% Loss**	**Brick No.**	**% Loss**
2	5.3	3	4.3	1	4.7
3	4.8	4	5.1	2	3.9
4	4.2	5	4.4	3	4.0
Average	4.8	**Average**	4.6	**Average**	4.2

Tensile Strength and Tensile Strength Ratio

Conditioned				Unconditioned			
Brick No.	**Load**	**Tensile Strength**	**Strip Rating C/F**	**Brick No.**	**Load**	**Tensile Strength**	**Strip Rating C/F**
2	2800	80.6	1/1	4	3000	86.4	1/1
5	3000	86.4	1/1	6	3300	95.0	1/1
6	3000	86.4	1/1	7	3100	89.3	1/1
Average		84.5	1/1	Average		90.2	1/1
Tensile Strength Ratio		0.94					

Texas Overlay Tester

Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks

APPENDIX G-5: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT140 (CONTINUED)

Hamburg Displacement, mm			
Surface Mix: 81BIT140M PG Grade 58-28			
		Pass Criteria	Ultimate
Brick Pairs		5,000	20,000
H2 7.3	H6 7.4	2.7	3.8
H4 7.1	H5 7.3	2.6	4.0
H1 7.0	H3 6.9	2.5	3.7
Maximum Displacement		2.7	4.0
Average Displacement		2.6	3.8

SCB with Flexibility Index (FI)					
Replicate Name	Fracture Energy (LLD)	Peak Load	Slope	FI	FI AVERAGE
140M-B1.dat	1779.44	3.07	-2.65	6.71	6.18
140M-B2.dat	1958.12	3.16	-2.95	6.64	
140M-T1.dat	1643.45	3.25	-3.95	4.16	
140M-T2.dat	1716.17	2.88	-2.38	7.22	

APPENDIX G-6: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT159M

US 52 West Bound Surface from IL 53 (Chicago Street) to Laraway Road					
Mix Design	**Contract**	**ABR**	**RAS**	**RAP**	**PG Grade**
81BIT159M	60Y02	30%	NO	YES	58-28

US 52 Contract 60Y02 MIX: 81BIT159M

Westbound Lane N 70 D Surface Course PG 58-28

Mix Properties

Experimental Properties	
PG Grade	58-28
ABR	30%
RAP	Yes
RAS	No

Maximum Density Gmm			
Design	2.516	Sample	2.511

Extraction			
Sieve inch	% Design	Sample % Passing	% Diff.
3/4	100	100	0.0
1/2	100	100	0.0
3/8	98	98	0.0
#4	61	57	-4.0
#8	32	30	-2.0
#16	24	20	-4.0
#30	17	15	-2.0
#50	13	11	-2.0
#100	9	8	-1.0
#200	6.0	6.1	0.1
AC %	6.0	6.0	0.0

Stability and Flow 150mm Gyratory

4% Voids			8% Voids			10% Voids			12% Voids		
Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow	Brick No.	Stability	Flow
1	4950	2	1	3350	3	1	3000	3	2	2400	3
2	4800	3	2	3250	2.5	2	2900	3	3	2500	2.5
3	5280	3	3	3200	3	3	2850	3	4	2500	2.5
Average	5010	2.7	**Average**	3267	2.8	**Average**	2917	3.0	**Average**	2467	2.7

Stability and Flow 4-inch Sample @ 4% Voids

Marshall			Cored from 150 Gyratory		
Brick No.	Stability	Flow	Brick No.	Stability	Flow
3	2725	1	2	2225	2
4	2850	1	3	2150	1
5	2825	1	4	2150	2
Average	2800	1.0	**Average**	2175	1.7

Cantabro Loss

7% Voids		10% Voids		12% Voids	
Brick No.	% Loss	Brick No.	% Loss	Brick No.	% Loss
1	5.2	2	6.1	2	4.0
2	4.5	3	5.4	3	5.0
3	4.7	4	5.3	4	5.6
Average	4.8	**Average**	5.6	**Average**	4.9

Tensile Strength and Tensile Strength Ratio

Conditioned				Unconditioned			
Brick No.	Load	Tensile Strength	Strip Rating C/F	Brick No.	Load	Tensile Strength	Strip Rating C/F
2	3450	99.4	1/1	5	3750	108.0	1/1
3	3600	104.0	1/1	6	3700	106.6	1/1
4	3900	112.6	1/1	7	3850	110.9	1/1
Average		105.3	1/1	**Average**		108.5	1/1
Tensile Strength Ratio		0.97					

Texas Overlay Tester

Specimen No.	Cycles Tested	Initial Load (kPa)	Reduction of Load %	No. of Cracks

APPENDIX G-6: LABORATORY TEST RESULTS ON PLANT SAMPLED MIX 81BIT159M (CONTINUED)

Hamburg Displacement, mm			
Surface Mix: 81BIT159M PG Grade 58-28			
		Pass Criteria	Ultimate
Brick Pairs		5,000	20,000
H3	H6	3.1	5.0
H2	H5	3.0	4.3
Maximum Displacement		3.1	5.0
Average Displacement		3.1	4.7

SCB with Flexibility Index (FI)					
Replicate Name	Fracture Energy (LLD)	Peak Load	Slope	FI	FI AVERAGE
159M-B1.dat	2008.90	3.03	-2.23	9.02	10.46
159M-B2.dat	2031.33	3.06	-1.93	10.51	
159M-T1.dat	1850.71	3.26	-2.72	6.80	
159M-T2.dat	2602.26	3.16	-1.68	15.52	

APPENDIX G-7: LABORATORY TEST RESULTS ON NEAT ASPHALT BINDERS

	PG 70-28 Mod. Seneca-Lemont, IL *(Level Binder)* *Mix: 81BIT147M*	**PG 58-28** Seneca-Lemont, IL *(Surface Coarse)* *Mix: 81BIT157M*	**PG 64-22** Seneca-Lemont, IL *(Surface Coarse)* *Mix 81BIT156M*	**PG 70-28 Mod.** Seneca-Lemont, IL *(Level Binder)* *Mix: 81BIT141M*	**PG 58-28** Seneca-Lemont, IL *(Surface Coarse)* *Mix: 81BIT140M and 81BIT159M*	**Spec: AASHTO M320 Table 1 / IL PG+**
Date Sampled	10/20/2014	10/30/14	10/30/2014	11/11/14	12/02/14	----
Specific Gravity 15.6C	1.032	1.034	1.040	1.029	1.032	----
Flash (C.O.C.), °C	318	326	346	Not determ. / water	338	**230 min.**
Rotational Viscosity @ 135°C, Pa-s	0.990	0.336	0.474	1.060	0.339	**3.0 max.**
Mass Loss RTFO, %	-0.262	-0.176	-0.184	-0.395	-0.170	**1.00 max.**
Original DSR, kPa	1.31	1.44	1.48	1.33	1.43	**1.00 min.**
Phase Angle (delta °)	70.7	86.8	87.0	67.2	86.8	**----**
RTFO DSR, kPa	2.83	3.67	3.89	3.15	3.71	**2.20 min.**
PAV DSR, kPa	1850	4380	3870	1740	3910	**5000 max.**
BBR, m-value	0.333	0.337	0.330	0.322	0.332	**0.300 min.**
BBR, Stiffness, MPa	190	218	184	168	203	**300 max.**
Force Ratio @ 4°C *(unaged)*	0.83	NA	NA	1.11	NA	**0.30 min.**
Elastic Recovery @ 25°C (RTFO), % *(ASTM D6084 Proc. A)*	88	NA	NA	92	NA	**60 min.**
Separation of Polymer	0	NA	NA	0	NA	**2.0 °C max.**
True high temp. grade	PG 74.9	PG 61.8	PG 68.2	PG 75.4	PG 61.6	
MSCR results: (inform. purposes only)	tested @ 64C	tested @ 58C	tested @ 64C	tested @ 64C	tested @ 58C	**Spec: AASHTO M332**
***Jnr* @ 3.2 kPa, 1/kPa (RTFO)**	0.61	2.57	2.63	0.32	2.60	**4.5 max. for "S" 2.0 max. for "H" 1.0 max. for "V" 0.5 max for "E"**
% *Jnr* difference, (b/twn 0.1 & 3.2 kPa)	48.7	9.20	7.0	38.7	10.5	**75 max.**
% Recovery @ 3.2 kPa	53.0	0.8	0.6	70.6	0.9	-----
PG Grade	PG 64**V**-28	PG 58**S**-28	PG 64**S**-22	PG 64**E**-28	PG 58**S**-28	

APPENDIX H: TOTAL RECYCLE DISTRESS SUMMARIES

APPENDIX H-1: 26TH STREET TOTAL RECYCLE ASPHALT SECTION

26th Street																	
		Pre Overlay Distress Level				Post Overlay Distress Level				Spring 2014 Distress Level				Spring 2015 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**	2	-	2	**4**	-	-	-	-	-	-	-	-				-
Block Cracking	**Lane-Feet**	-	125	138	**263**	-	-	-	-	-	-	-	-		25		**25**
Centerline Cracking	**Linear Feet**	-	-	9,000	**9,000**	-	-	-	-	1,641	10	7,389	**9,040**	2073	310	6164	**8,547**
Longitudinal Cracking	**Linear Feet**	4,600	94	430	**5,124**	-	-	-	-	288	-	-	**288**	397	190	175	**762**
Overlaid Patch Detertoration	**Square Feet**	-	-	168	**168**	-	-	-	-	-	-	-	**-**				**-**
Permanent Patch Deterioration	**Square Feet**	19,958	720	-	**20,678**	-	-	-	-	-	-	-	**-**	944	330	652	**1,926**
Pothole and Localized Distress	**Each**	-	-	1	**1**	-	-	-	-	-	1	10	**11**	1			**1**
Raveling/Weathering/Segregation	**Lane-Feet**	-	-	-	**-**	4	-	-	**4**	369	10	-	**379**	17571	57	372	**18,000**
Transverse Cracking	**Linear Feet***	2,362	2,557	4,990	**9,909**	36	-	-	**36**	3,251	36	-	**3,287**	3955	1166	58	**5,179**
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 19,000			**Centerline Joint Feet in Section = 9,500**													

APPENDIX H-2: HARRISON STREET TOTAL RECYCLE ASPHALT SECTION

Harrison Street																	
		Pre Overlay Distress Level				Post Overlay Distress Level				Spring 2014 Distress Level				Spring 2015 Distress Level			
Distress Type	**Unit**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**	**Low**	**Med**	**High**	**Total**
Alligator or Fatigue Cracking	**Lane-Feet**	202	-	130	**332**	-	-	-	-	-	-	-	**-**	567	-	-	**567**
Block Cracking	**Lane-Feet**	-	5,500	500	**6,000**	-	-	-	-	-	-	-	**-**	9953	36	0	**9,989**
Centerline Cracking	**Linear Feet**	-	6,000	-	**6,000**	-	-	-	-	47	-	-	**47**	-	3,943	1,980	**5,923**
Longitudinal Cracking	**Linear Feet**	-	-	-	**-**	-	-	-	-	497	-	-	**497**	570	-	-	**570**
Overlaid Patch Detertoration	**Square Feet**	-	336	-	**336**	-	-	-	-	-	-	-	**-**	**-**	**-**	**-**	**-**
Permanent Patch Deterioration	**Square Feet**	314	108	-	**422**	-	-	-	-	-	-	-	**-**	**-**	**-**	**-**	**-**
Pothole and Localized Distress	**Each**	-	-	-	**-**	-	-	-	-	-	-	-	**-**	**-**	**-**	**-**	**-**
Raveling/Weathering/Segregation	**Lane-Feet**	-	-	-	**-**	4	-	-	**4**	4	-	-	**4**	11846	0	0	**11,846**
Transverse Cracking	**Linear Feet***	969	1,695	3,894	**6,558**	-	-	-	-	5,472	331	-	**5,803**	3,888	2,347	660	**6,895**
*** Linear feet of cracking measured in lieu of occurrences**																	
	Lane Feet in Section = 11,846			**Centerline Joint Feet in Section = 5,923**													

APPENDIX H-3: RICHARDS STREET TOTAL RECYCLE ASPHALT SECTION

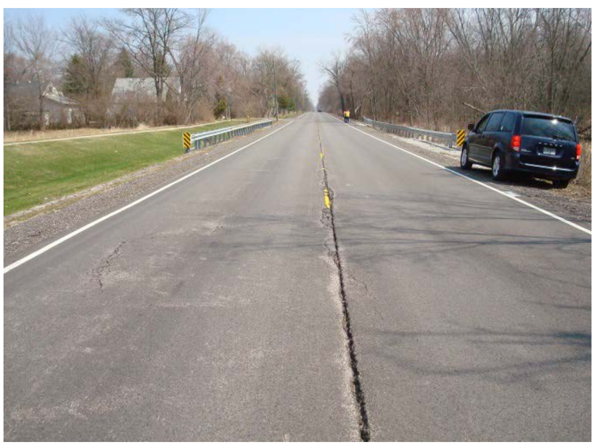
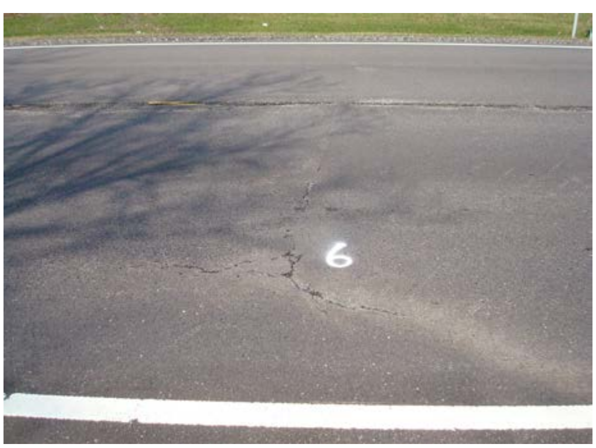
Richards Road																	
		Pre Overlay Distress Level				Post Overlay Distress Level				Spring 2014 Distress Level				Spring 2015 Distress Level			
Distress Type	Unit	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total
Alligator or Fatigue Cracking	Lane-Feet	-	-	36	**36**	-	-	-	-	172	-	-	**172**	154		215	**369**
Block Cracking	Lane-Feet	2,016	1,960	7,440	**11,416**	-	-	-	-	-	-	-	**-**				**-**
Centerline Cracking	Linear Feet	-	-	2,942	**2,942**	-	-	-	-	81	-	-	**81**	6,592			**6,592**
Longitudinal Cracking	Linear Feet	6	-	-	**6**	-	-	-	-	300	-	-	**300**	285		30	**315**
Overlaid Patch Detertoration	Square Feet	72	-	60	**132**	-	-	-	-	-	-	-	**-**				**-**
Permanent Patch Deterioration	Square Feet	19,897	204	420	**20,521**	-	-	-	-	-	-	-	**-**				**-**
Pothole and Localized Distress	Each	-	2	10	**12**	-	-	-	-	-	-	-	**-**				**-**
Raveling/Weathering/Segregation	Lane-Feet	-	-	-	**-**	-	-	-	-	-	-	-	**-**	13,334			**13,334**
Transverse Cracking	Linear Feet*	6,215	1,464	3,203	**10,882**	-	-	-	-	720	-	-	**720**	2,000	202	36	**2,238**
* Linear feet of cracking measured in lieu of occurrences																	
	Lane Feet in Section = 14,052			Centerline Joint Feet in Section = 7,026													

APPENDIX H-4: WOLF ROAD COMPARISON SECTION

Wolf Road																	
		Pre Overlay Distress Level**				Post Overlay Distress Level				Spring 2014 Distress Level				Spring 2015 Distress Level			
Distress Type	Unit	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total
Alligator or Fatigue Cracking	Lane-Feet	-	-	-	-	-	-	-	-	-	-	-	-				-
Block Cracking	Lane-Feet	-	-	-	-	-	-	-	-	-	-	-	-				-
Centerline Cracking	Linear Feet	-	-	-	-	-	-	-	-	52	-	-	**52**	52			**52**
Longitudinal Cracking	Linear Feet	-	-	-	-	-	-	-	-	-	-	-	-				-
Overlaid Patch Detertoration	Square Feet	-	-	-	-	-	-	-	-	-	-	-	-				-
Permanent Patch Deterioration	Square Feet	39,144	-	-	**39,144**	-	-	-	-	-	-	-	-				-
Pothole and Localized Distress	Each	-	-	-	-	-	-	-	-	-	-	-	-				-
Raveling/Weathering/Segregation	Lane-Feet	-	-	-	-	-	-	-	-	-	-	-	-				-
Transverse Cracking	Linear Feet*	11,058	-	-	**11,058**	-	-	-	-	3,080	108	-	**3,188**	3512	108		**3,620**
* Linear feet of cracking and joints				**Estimated from Google street view (2011) survey section length 2470													
	Lane Feet in Section = 9,880			Centerline Joint Feet in Section = 4,940													

APPENDIX I: TOTAL RECYCLE ASPHALT PHOTOS 2014 AND 2015

APPENDIX I-1: 26TH STREET TOTAL RECYCLE ASPHALT SECTION

2014	2015
	
	
	

APPENDIX I-2: HARRISON STREET TOTAL RECYCLE ASPHALT SECTION

2014	2015
	
	
	

APPENDIX I-3: RICHARDS STREET TOTAL RECYCLE ASPHALT SECTION

2014	2015
	
	
	

APPENDIX I-4: WOLF ROAD COMPARISON SECTION

2014	2015
	
	
	

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