LONG-TERM PLANNING TOOL FOR PAVEMENT ASSETS

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Word count: 2,887 words text + 11 tables/figures x 250 words (each) = 5,637 words

August 1, 2016

ABSTRACT

One of the primary challenges for any transportation agency is to balance and prioritize their needs with respect to maintaining and upgrading their infrastructure assets. For an agency like the Illinois Tollway, the need to align incoming revenue with future maintenance, rehabilitation, capacity enhancements, and reconstruction for their pavements has led to the development of the Pavement Asset Master Plan (PAMP).

The PAMP contains basic information about every segment of the Tollway network, its past and current condition, recent traffic levels, and future anticipated maintenance, rehabilitation, and reconstruction activities. The future activities are specific to the mainline and shoulders and are based on predicted performance which was generated using the AASHTO PavementME software, actual experience of pavement performance over time which is based on the Tollway's pavement management system data collected over the past 15 years, and engineering judgement.

Since the original version of the PAMP was created five years ago, it has become an important resource for communicating the plan for how Tollway pavements will be maintained and rehabilitated, and it has become an integral part of the long-range planning and budgeting activities at the Tollway. Future enhancements may include the development of a version of the PAMP for all of the Tollway ramp pavements and a bridge PAMP for the 600-plus structures that are part of the Tollway network.

Keywords: Long-term Planning, Pavement Assets, Pavement Maintenance Schedules, Pavement Rehabilitation Schedules.

INTRODUCTION

The Illinois Tollway is responsible for a pavement network that consists of over 250 centerline miles of Interstate pavement that serves more than 1.4 million users daily in the Chicagoland and northern Illinois region. As a toll agency, the Illinois Tollway is very concerned with the relationship between incoming cash flow (tolls collected from users) and expenses (which include the ongoing maintenance, rehabilitation, capacity expansion, and planned replacement and reconstruction of pavements and bridges).

One of the Tollway's tools for long-term planning of pavement-related maintenance, rehabilitation, and reconstruction is the Pavement Asset Management Plan (PAMP). This paper describes the origins of the PAMP, the various components, and the role that the PAMP plays in helping the Tollway to communicate the anticipated needs for the network, 40, 50, and even 60-plus years into the future.

BACKGROUND

In 2011, as a means of organizing pertinent data associated with each of the various Tollway corridors and their respective segments, a document was created that would provide a quick reference with respect to the details of a segment. At that time, there were approximately 10 years of pavement management system data that had been collected, which provided a snapshot of performance over time. Performance criteria chosen for inclusion in the PAMP were the Condition Rating System (CRS) index, International Roughness Index (IRI), and remaining service life (RSL). All of these performance criteria had been collected and/or calculated for over 10 years at that point, and when plotted over time, the data showed the performance that had been achieved by the various Tollway pavements.

In addition to the "over-time" plots, charts of the most recent IRI and RSL were plotted by milepost and direction of travel, so that the degree of uniformity (or lack thereof) present in a segment could also be evaluated. Tollway segments were originally established to match the predominant pavement type (usually associated with paving contract limits) with the intention of grouping together stretches of pavement that were similar in cross-section, construction year, and expected performance. Over time, differences in performance have been noted that have resulted in adjustments to the segments, in an attempt to ensure that expected performance (and associated maintenance and rehabilitation activities and timing) make the most sense moving forward.

While the original PAMP was created to serve as an internal resource for the Tollway's materials contractor, it became part of the Tollway's long-range planning process after a 2011 meeting to discuss "50-year" pavement planning. It was at this time that standard chronologies for pavement maintenance and rehabilitation were developed for the three primary types of pavement on the Tollway: jointed-plain concrete (JPC), continuously-reinforced concrete (CRC), and full-depth hot-mix asphalt (HMA). With the addition of these future plans for each segment of Tollway pavement to the snapshots of current performance and performance-over-time, all of the essential components were together in one living document.

PAMP CONTENTS

There are currently 26 mainline segments contained in the PAMP, with three new segments to be added to the next version of the document. There is also a segment for the mile-long ramps that connect I-88 (Reagan) and I-294 (Tri-State). The 30 segments are organized into six corridors, as listed below:

- Tri-State (I-294 and I-94)
- Eden's Spur (I-94)
- Jane Addams (I-90)
- Reagan (I-88)
- Veteran's (I-355)
- Elgin-O'Hare (I-390 and I-490)

For each of these corridors, the most recent four years of traffic data are presented by milepost, so that variations along the corridor, and between the corridors, can be seen easily. Changes in traffic level from year to year can also be noted using these corridor-specific charts. All data presented in the charts is taken from the annual traffic report generated by the Tollway's traffic consultant.[1] Figures 1 and 2 show the total average annual daily traffic (AADT) and average annual daily truck traffic (AADTT) for the Tri-State Tollway, respectively.

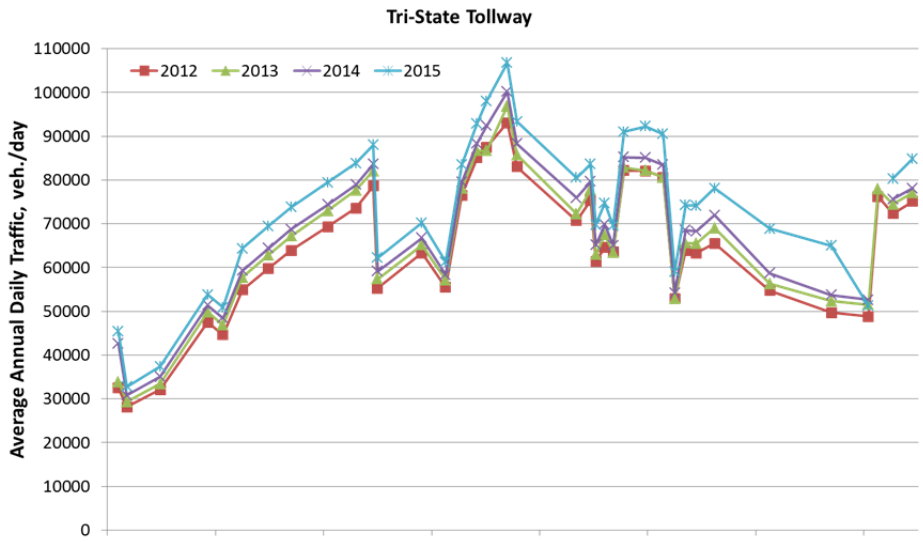

FIGURE 1. Total AADT for Tri-State, 2012 through 2015.

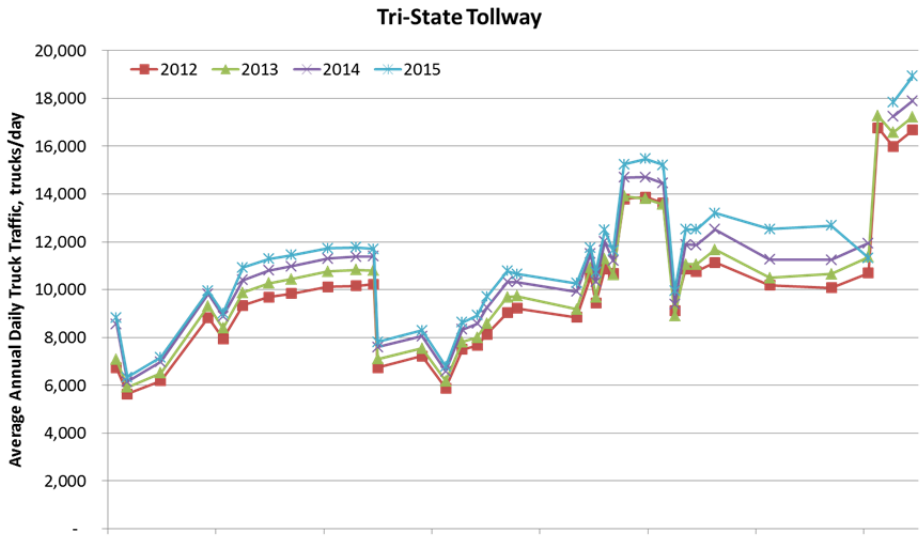

FIGURE 2. Total AADTT for Tri-State, 2012, through 2015.

The cross-streets and intersections used to define the various segments are shown on the chart, making it easy to pick out the highest AADT area of the corridor (near Balmoral) and the highest AADTT for the corridor (at the east end between 167th and I-394).

After the presentation of the latest traffic data, the segment-specific data are presented. The segment data begin with the predominant mainline structure, showing both the pavement layers present, as well as the year of construction for the segment. Figure 3 shows the mainline structure information for a segment along the Tri-State.

Tri-State Tollway (I-294)

159th to 95th

MP. 6.2 to 17.5

Maintenance Unit: **M1**

Predominant Mainline Structure

MP 6.2 – 17.5

Lanes 1 - 4	
CRCP (2008)	12 in
HMA (2008)	3 in
CA-6/RAP (2008)	3 in
PGE (2008)	9 in

FIGURE 3. Example of segment cross-section information.

The presentation of performance-over-time data includes CRS and IRI, as shown in figures 4 and 5. The CRS value is calculated according to the rating system developed by the Illinois Department of Transportation (DOT) and is based on a combination of visual surface distresses (i.e., fatigue cracking, mid-panel cracking) and sensor data (i.e., roughness, rutting, faulting) collected using an automated digital survey vehicle (2).

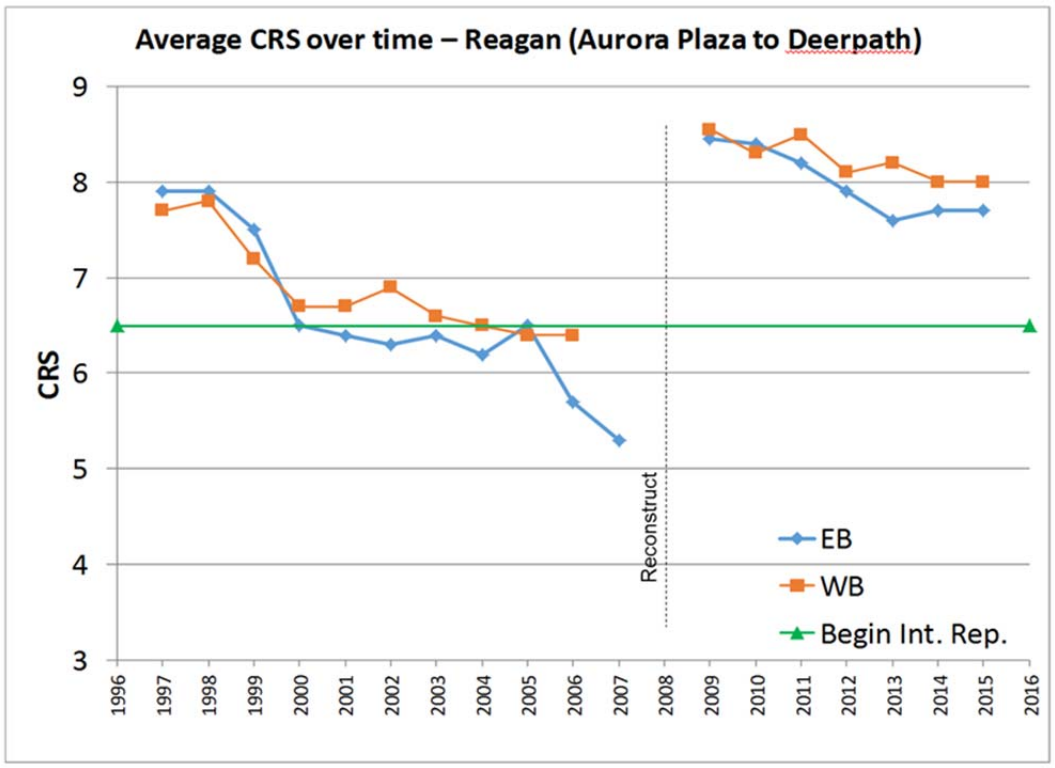

FIGURE 4. CRS over time for Reagan segment (Aurora Plaza to Deerpath).

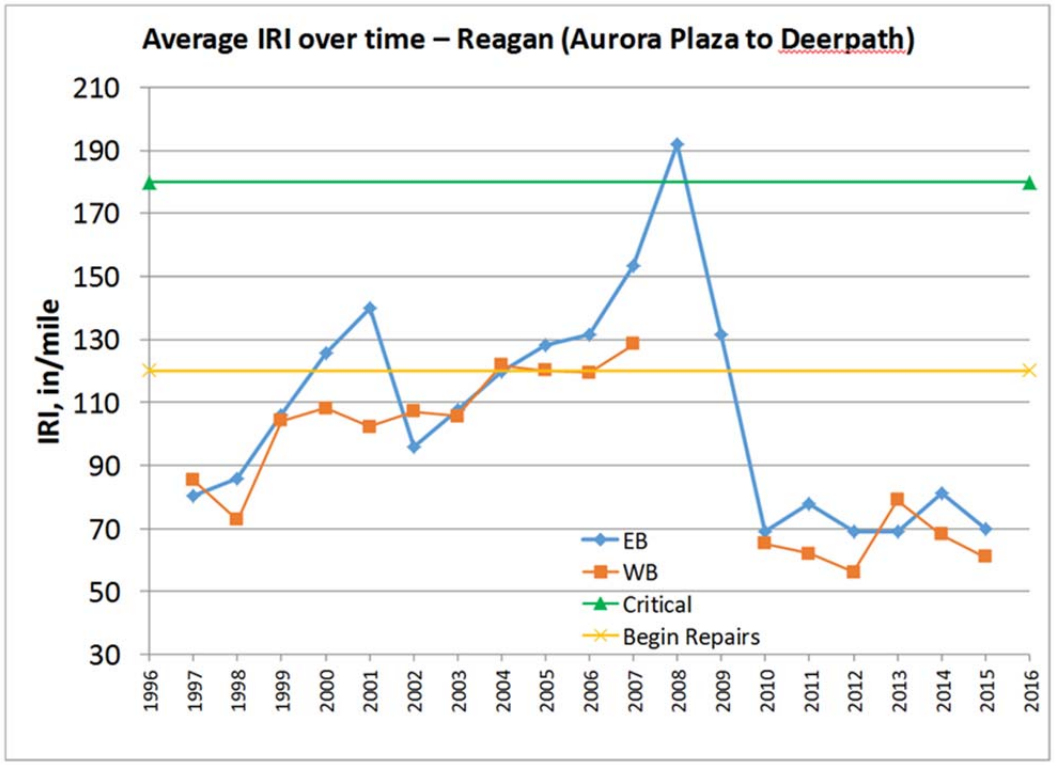

FIGURE 5. IRI over time for Reagan segment (Aurora Plaza to Deerpath).

Within the PAMP, these two figures are shown on the same page, with the same timeline along the x-axis, so that direct comparisons can be made between falling CRS and increasing IRI. Where appropriate, reconstruction activities are shown on the charts, indicating where major activities have been performed to improve the CRS values and decrease the roughness (IRI) along the mainline pavements.

The final component of the performance snapshots for a PAMP segment are the CRS and RSL values by milepost for a given segment, as shown in figures 6 and 7. In addition to showing consistency (or not) along the length of a PAMP segment, the data are presented in both directions, so that significant differences in performance can be identified and investigated.

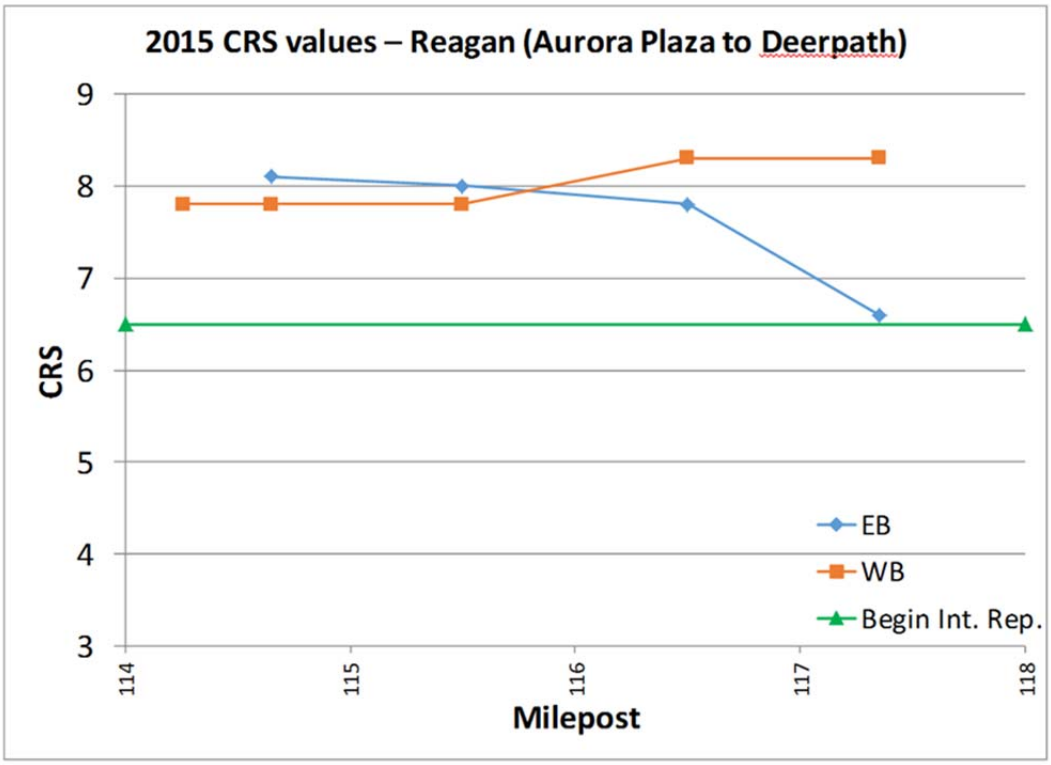

FIGURE 6. CRS by milepost for Reagan segment (Aurora Plaza to Deerpath).

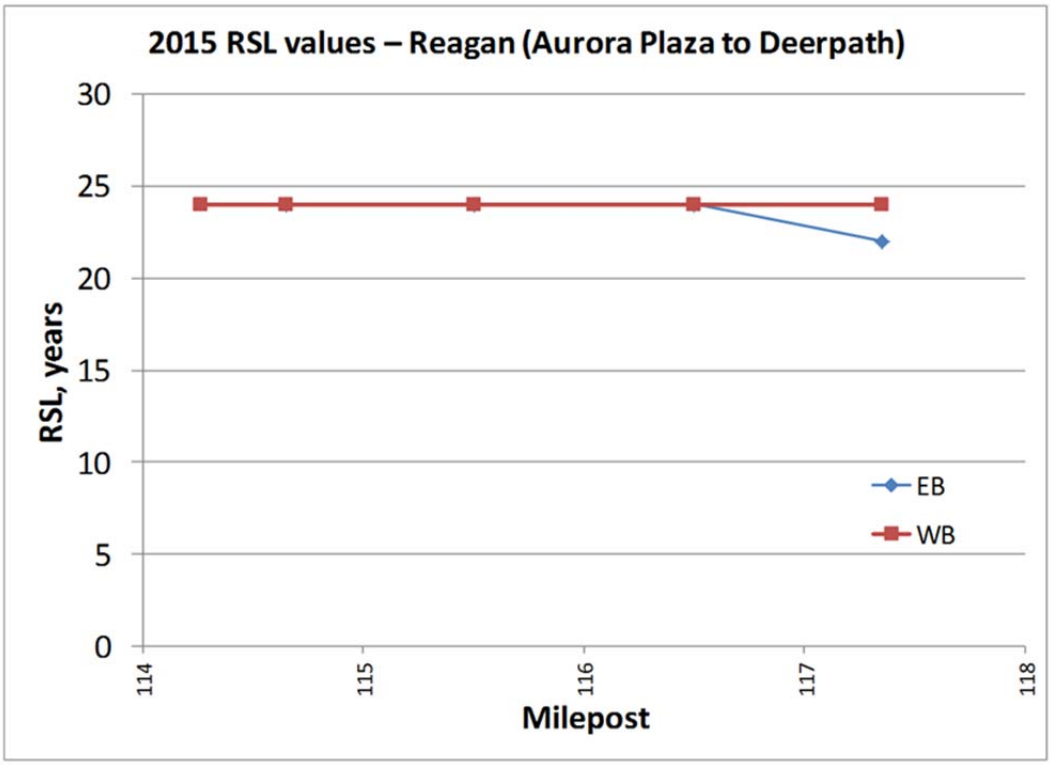

FIGURE 7. RSL by milepost for Reagan segment (Aurora Plaza to Deerpath).

The next component of the information compiled for each segment is the schedule of planned maintenance, rehabilitation, and reconstruction information, based on the mainline pavement type. Tables 1, 2, and 3 show the three generic schedules created for JPC, CRC, and HMA pavements.

TABLE 1. Illinois Tollway activity schedule – JPC pavements.

Year	Mainline activity	Shoulder activity
0	Reconstruct as JPCP with 15-ft joint spacing.	Reconstruct as WMA.
11	Seal joints (100% long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
18	Seal joints (50% long.). Patch 3.5% of area.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
25	Patch 2.5% of area. Diamond grind PCC surface. Seal joints (100% long.)	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
32	Patch 4.0% of area. Place 4-inch WMA overlay.	Remove rumble strips. Patch. Place 4-inch WMA overlay. Re-profile and adjust all guardrails as necessary.
38	Rout and seal cracks (100% long. and 100% trans.)	Rout and seal cracks (2 x CL long., 2 x CL trans.)
44	Mill 4-inch. Patch 4.0% of PCC surface area. Place 4-inch WMA overlay.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
49	Rout and seal cracks (100% long. and 100% trans.)	Rout and seal cracks (2 x CL long., 2 x CL trans.)
54	Mill 4-inch. Patch 5.0% of PCC surface area. Place 4-inch WMA overlay.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
58	Rout and seal cracks (100% long. and 100% trans.)	Rout and seal cracks (2 x CL long., 2 x CL trans.)
62	*RECONSTRUCTION*	*RECONSTRUCTION*

TABLE 2. Illinois Tollway activity schedule – CRC pavements.

Year	Mainline activity	Shoulder activity
0	Reconstructed as CRCP.	Reconstructed as HMA.
13	Patch 0.1% of PCC surface area with class A.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
17	N/A	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
25	Patch 1.0% of PCC surface area with class A. Diamond grind PCC surface.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
33	Patch 1.0% of PCC surface area with class A. Place 4-inch WMA overlay.	Remove rumble strips. Patch. Place 4-inch WMA overlay. Re-profile and adjust all guardrails as necessary.
40	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.)
48	Mill 4-inch. Patch 0.5% of PCC surface area with class A. Place 4-inch WMA overlay.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
55	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
63	Mill 4-inch. Patch 0.5% of PCC surface area with class A. Place 4-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
70	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
78	*RECONSTRUCTION*	*RECONSTRUCTION*

TABLE 3. Illinois Tollway activity schedule – HMA pavements.

Year	Mainline activity	Shoulder activity
0	Reconstructed as full-depth HMA.	Reconstructed as HMA.
4	Rout and seal (100% long)	none
10	Rout and seal cracks (50% long. for random, in-lane long.) Patch 0.3% of surface area.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
15	Mill 2-inch. Patch 1.0% of surface area. Place 2-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
23	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.) Patch 0.3% of surface area.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
30	Mill 4-inch. Patch 1.0% of surface area. Place 4-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
38	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.) Patch 0.3% of surface area.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
45	Mill 2-inch. Patch 1.0% of surface area. Place 2-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
53	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.) Patch 0.3% of surface area.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
60	Mill 4-inch. Patch 1.0% of surface area. Place 4-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.

These tables show the generic timing for each activity, relative to the time of construction (Year 0). For a specific segment where the actual year of construction is known, the table is modified to show both the generic timing (based on Year 0) and the actual timing (based on the actual year of construction). Figure 8 shows the maintenance and rehabilitation timing for a Tri-State CRC segment constructed in 2006, which given the 78 year life span the Tollway expects for a CRC pavement (including HMA overlays as rehabilitation activities), means that the Tollway has extended the planning window through the year 2084. Other segments have planning windows that extend into the 22nd century.

Tri-State Tollway (I-294)

I-394 to 171st

MP0 0 to 4.8

Maintenance Unit: M1

CRCP with Year (0) = 2006

Year	Mainline activity	Shoulder activity
2006 (0)	Reconstructed as CRCP.	Reconstructed as HMA.
2017 (11)	Patch 0.1% of PCC surface area with class A.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
2024 (18)	N/A	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
2032 (26)	Patch 1.0% of PCC surface area with class A. Diamond grind PCC surface.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
2039 (33)	Patch 1.0% of PCC surface area with class A. Place 4-inch WMA overlay.	Remove rumble strips. Patch. Place 4-inch WMA overlay. Re-profile and adjust all guardrail as necessary.
2046 (40)	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.)
2054 (48)	Mill 4-inch. Patch 0.5% of PCC surface area with class A. Place 4-inch WMA overlay.	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
2061 (55)	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
2069 (63)	Mill 4-inch. Patch 0.5% of PCC surface area with class A. Place 4-inch WMA overlay.	Mill and inlay 2-inch. Full-depth WMA patch 2.0% of area.
2076 (70)	Rout and seal cracks (100% long. plus 50% long. for random, in-lane long.)	Rout and seal cracks (2 x CL long., 2 x CL trans.) Microsurface.
2084 (78)	*RECONSTRUCTION*	*RECONSTRUCTION*

FIGURE 8. Activity schedule for Tri-State segment.

The final piece of information for each of the Tollway segments is a general notes section where other relevant information is captured during the semi-annual review meetings held between the Tollway, their general engineering consultant, and the materials consultant. Examples of this information include alternative timelines impacted by other corridor activities (i.e., I-355 being impacted by work to be done on I-294), different alternatives that might be considered (i.e., segments that may be constructed as JPC, CRC, or HMA depending on the outcome of the Tollway's pavement type selection process), and impacts due to observed pavement performance (i.e., mill-and-overlay may be pushed back in time as distress and roughness development are proceeding at a slower-than-anticipated pace).

PAMP Uses

The primary purpose of the PAMP is to provide a living document showing all of the major maintenance and rehabilitation activities anticipated for the next 50 to 80 years for all segments of the Tollway network. By meeting twice yearly to discuss, review, and revise the PAMP, the Tollway administration is provided an up-to-date plan for what the Tollway's technical staff expects to be needed in order to keep the Tollway network at the highest level of service possible for their customers, while living within the Tollway's anticipated revenue stream.

Another primary use for the PAMP is the arrangement of adjacent project work, so that interruptions to the traveling public are minimized. If a segment calls for a mill-and-overlay in 2023, and the adjacent segment calls for a similar activity in 2025 (as a result of staggered construction activities), the Tollway may be inclined to move both mill-and-overlay activities to the same year (either 2023, 2024, or 2025) to that the public does not experience what feels like constant, year-after-year construction activities. And if the performance of these two sections is

observed to be better than expected, it may be possible to postpone until 2026 or beyond. Having all of the planning and performance data in a single resource allows the Tollway to engage in this type of "what if" planning.

Future PAMPs

Up to this point, the Tollway PAMP has focused entirely on the pavement segments making up the mainline Tollway corridors. One of the most likely expansions of the PAMP will be to include the ramp pavements all along the Tollway network. Unlike the current PAMP, the ramp PAMP would likely have different categories of ramps for which planned activities are documented. For example, JPC ramp pavements with AADTT between 500 and 1,000 trucks per day could be assigned to a schedule of maintenance and rehabilitation activities that would differ from JPC ramps that only experience 250 to 500 trucks per day. The ramp PAMP could then consist of a listing all of the Tollway ramps with their specific characteristics (pavement type, traffic, on-off versus interstate-to-interstate, etc.).

Another critical component of the Tollway network is the various bridges that carry mainline traffic, ramp traffic, and overhead traffic (bridges over the Tollway routes for which the Tollway is still responsible). Similar to the ramp PAMP approach, all of the 600-plus bridges that are part of the Tollway network could be characterized by type (pre-stressed, pre-cast concrete; steel beam), size (lanes and number of segments), traffic, location (mainline, ramp, overhead), and age, with bridges having similar characteristics grouped together for determining the most reasonable schedule for maintenance, deck replacement, rehabilitation, and reconstruction.

SUMMARY AND CONCLUSIONS

The Illinois Tollway's PAMP contains relevant information on the traffic, pavement structure, and pavement performance for all of their mainline pavements. The Tollway has been using this living document to ensure that their long-range decisions—both financial and engineering—are made in a manner that is as efficient, transparent, and responsible as possible. The PAMP is reviewed and updated annually to ensure that the information it contains is as accurate as possible, and that it reflects the latest impacts of the Tollway's network-level decision making.

REFERENCES

1. "2015 Traffic Data Report for the Illinois Tollway System," prepared for the Illinois Tollway by CDM Smith, June 2016.
2. *Illinois Highway Information System: Roadway Information and Procedure Manual.* Illinois Department of Transportation. July 2001.