REPORT

Champaign County Pavement Management System 2018-22 Maintenance and Rehabilitation Plan

Prepared for:

Champaign County Highway Department
1605 E. Main St.
Urbana, IL 61802
Tel. (217) 384-3800

Prepared by:

Applied Research Associates, Inc.
Transportation Sector
100 Trade Centre Dr., Suite 200
Champaign, IL 61820
Tel. (217) 356-4500

May 5, 2018

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BACKGROUND

The Champaign County Highway Department maintains a pavement management system (PMS) to objectively evaluate, assess, and manage the approximately 400 lane miles of County-maintained roads in Champaign County. Applied Research Associates, Inc. (ARA) developed and manages the PMS through a multiyear contract with the County. Together, the County and ARA use the PMS to evaluate which roads to work on, what types of treatments to perform, and the timing of improvements. Ultimately, by managing their highway network through use of a PMS, Champaign County is able to make the optimal use of their annual highway pavement maintenance and construction funds.

This report presents the proposed 2018-2022 maintenance and rehabilitation plan developed jointly between ARA and the County. It also presents a 10-year network condition forecast taking into account projected needs and anticipated funding. The PMS is updated annually to reflect work performed each year and to generate an updated capital improvements program for the next 5 years. Field assessment is performed biannually.

Figure 1. Champaign County's PMS optimizes the expenditure of construction funds over the long-term by choosing the most appropriate treatment and timing for road improvements (County Highway 23, pre- and post-2017 construction).

UPDATED RECORDS

The County Highway Department performed the following maintenance and rehabilitation activities in 2017.

- CH 23 (mile 0 to 6.49): 4-in cold inplace recycling (CIR) and 3-in asphalt concrete (AC) overlay
- CH 9 (mile 13.31 to 17.06): seal coating
- CH 20 (mile 8.79 to 12.87): seal coating
- CH 22 (mile 8.52 to 15.18): seal coating

Funding Updates

There are no changes to the construction and maintenance budgets for 2018.

ROADWAY ASSESSMENT

Pavement Condition

ARA performed the biannual survey of pavement conditions in November 2017, following the completion of all construction and maintenance activities. The condition survey used an automated digital camera and global positioning systems (GPS) mounted on a survey vehicle that filmed 100 percent of the County's highway network. Figure 2 shows the digital image survey system used on this project. The vehicle also measures longitudinal pavement profile for roughness calculation, pavement rutting, and texture. ARA reviewed the digital images to calculate the amount, severity, and extent of pavement distress, which in turn we used to determine the Pavement Condition Index (PCI) of each road. The PCI method is a well-established technique for evaluating the pavement's functional and structural condition based on visual distress (ASTM D6433).

Figure 3 shows the distribution of PCI values by mileage for five years—2009, 2011, 2013, 2015, and 2017. Figure 4 displays the spatial layout of PCI values for the critical lane of each road section. In general, the predominant pavement distresses are transverse cracking (thermal cracking and reflective cracking of underlying PCC joints), longitudinal cracking of the centerline joint, longitudinal cracking due to lane widening, and fatigue (alligator) cracking in the wheelpaths. Minor distresses included block cracking, edge cracking, patching, and bleeding.

Overall, 85 percent of Champaign County's roads are in good to very good condition, while only 1.9 percent are in poor or very poor condition. While the distribution by condition has shifted slightly from year to year, the overall network PCI has been very stable, averaging 81.5 in 2017.

Figure 2. ARA's van-mounted camera and laser system captures high-resolution images.

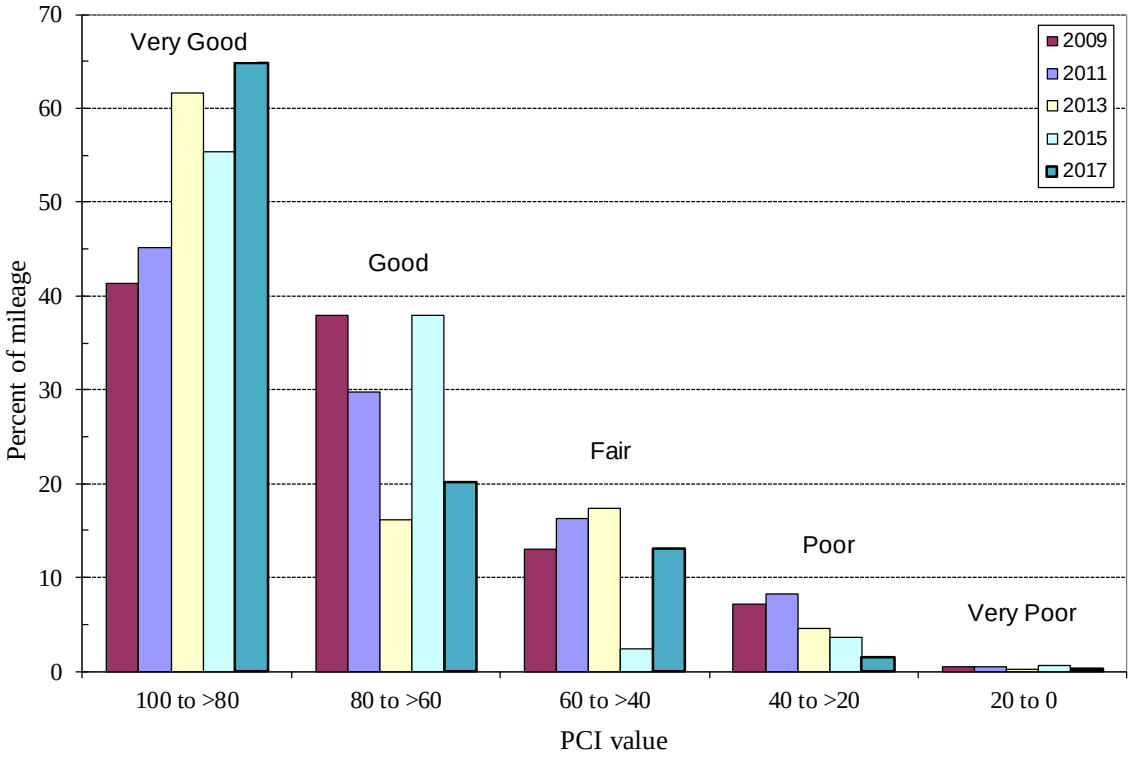

Figure 3. Condition of Champaign County's roads by mileage (5 years).

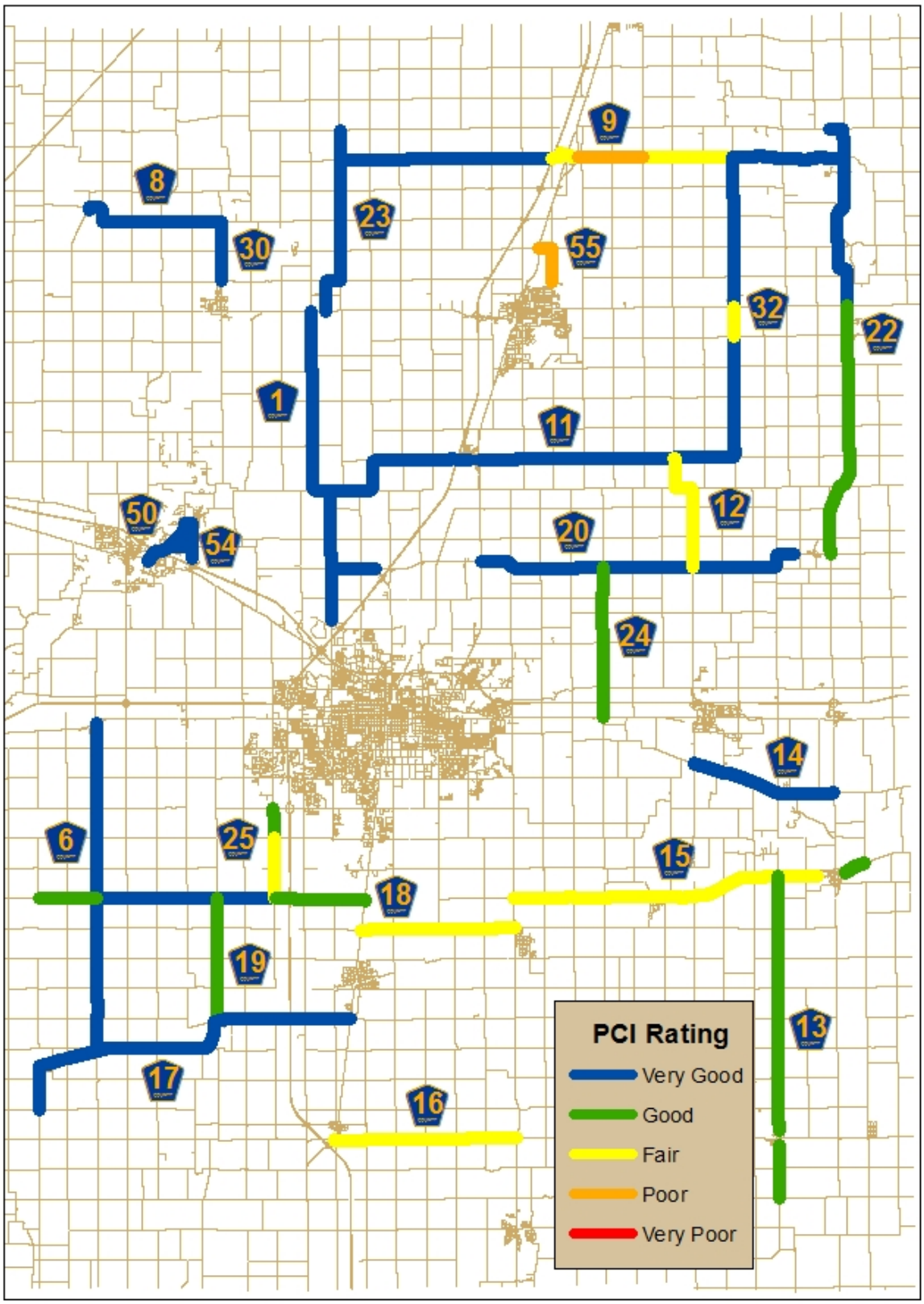

Figure 4. 2017 PCI ratings (field survey).

Roughness

The International Roughness Index (IRI) is a widely accepted measure of pavement roughness (ASTM E1926). In general, high-quality pavements are constructed at low IRI values (e.g., <100 in/mi) and IRI increases over the pavement's life due to accumulation of distress. Typically, significant user discomfort is noticed at IRI values greater than 200 in/mi, requiring functional improvement, such as AC overlay. ARA collected IRI data on all the County's roads simultaneous to video data collection using the van's onboard laser system.

Figure 5 displays the IRI results for the 2017 survey. The vast majority of roads have low roughness, with 68.1 percent of the network having IRI values less than 100 in/mi.

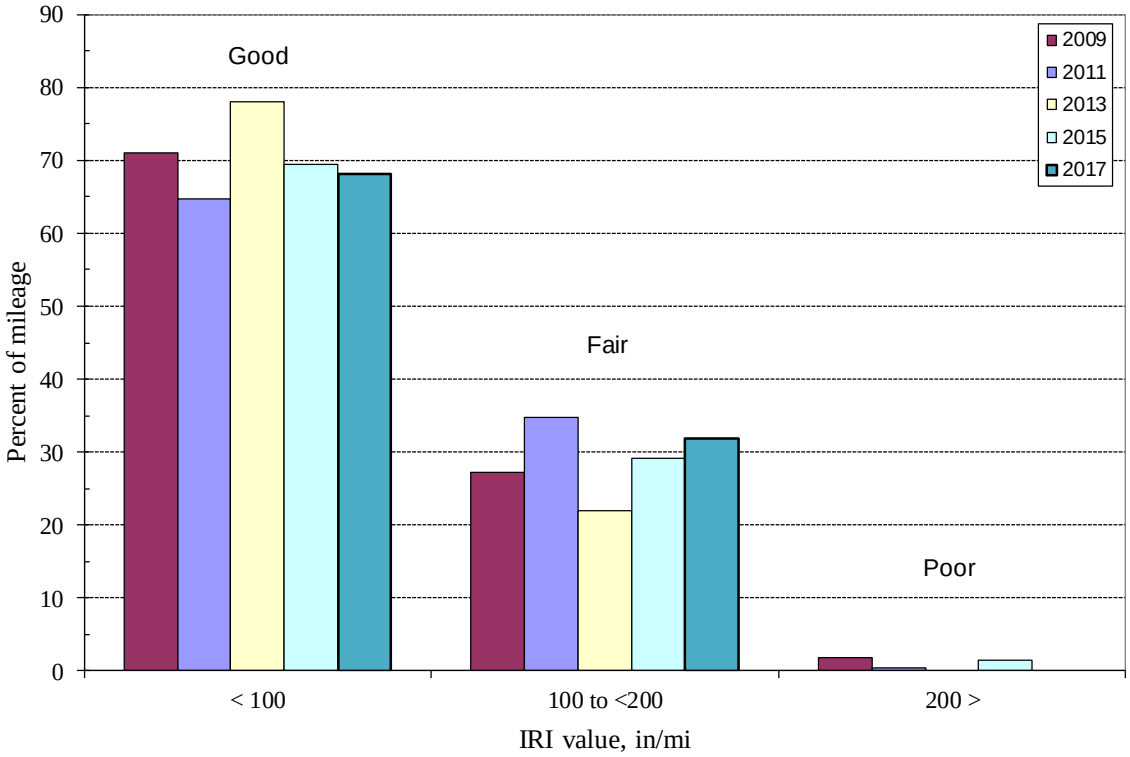

Figure 5. Roughness distribution by mileage (5years).

Rutting

Pavement rutting was measured by the video van's onboard sensors and averaged between the two wheelpaths. Typically, rutting is negligible for the first few years of pavement life and increases with age. It is important from both functional and safety aspects, as differential rutting in the wheelpaths increases roughness and excessive rutting can hold water and cause hydroplaning during rain. Figure 6 shows the rutting results. Overall, 100 percent of Champaign County highways show less than the acceptable threshold of 0.25 in of rutting.

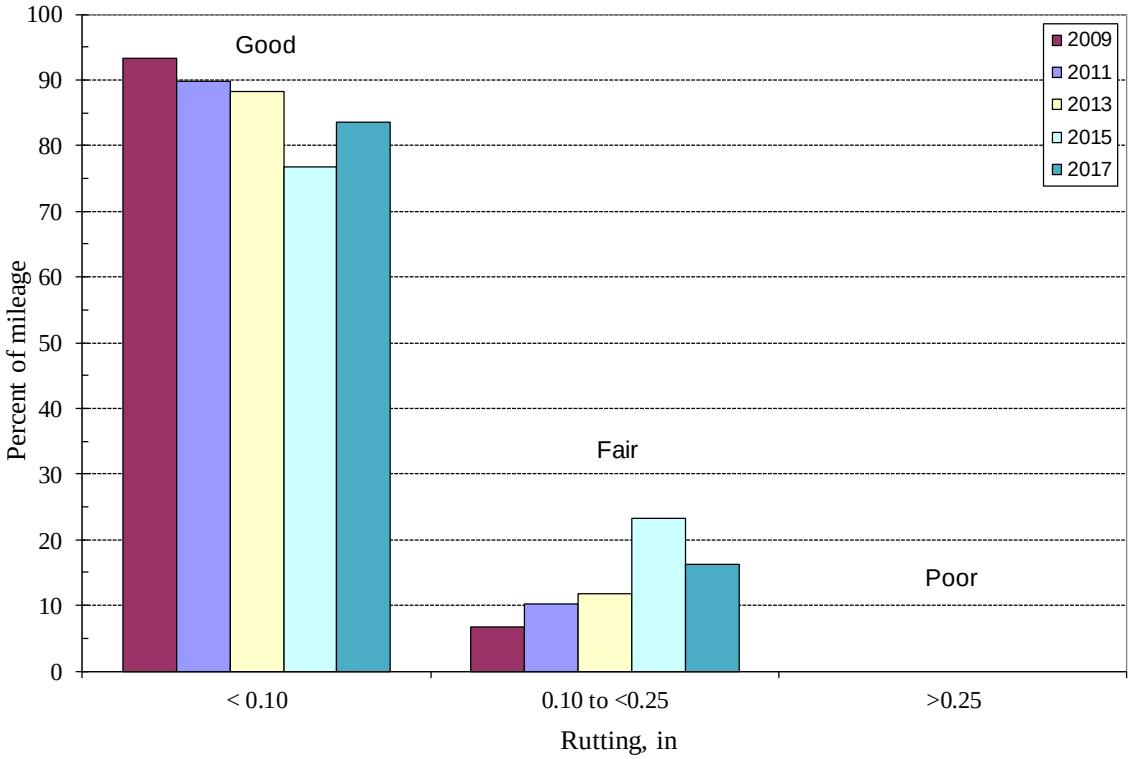

Figure 6. Rutting distribution by mileage (5years).

PMS UPDATE

ARA collects condition data on Champaign County's network biannually. This data serves as the basis for the PMS analysis in RoadCare to select roads to work on, what treatments to perform, and timing. In years when data collection is not performed, RoadCare predicts pavement condition (i.e., PCI values) based on a deterioration curve determined from historical data.

ARA summarizes all condition data on a section basis determined by road, pavement construction history, and traffic level. Figure 7 shows Champaign County's PMS sections.

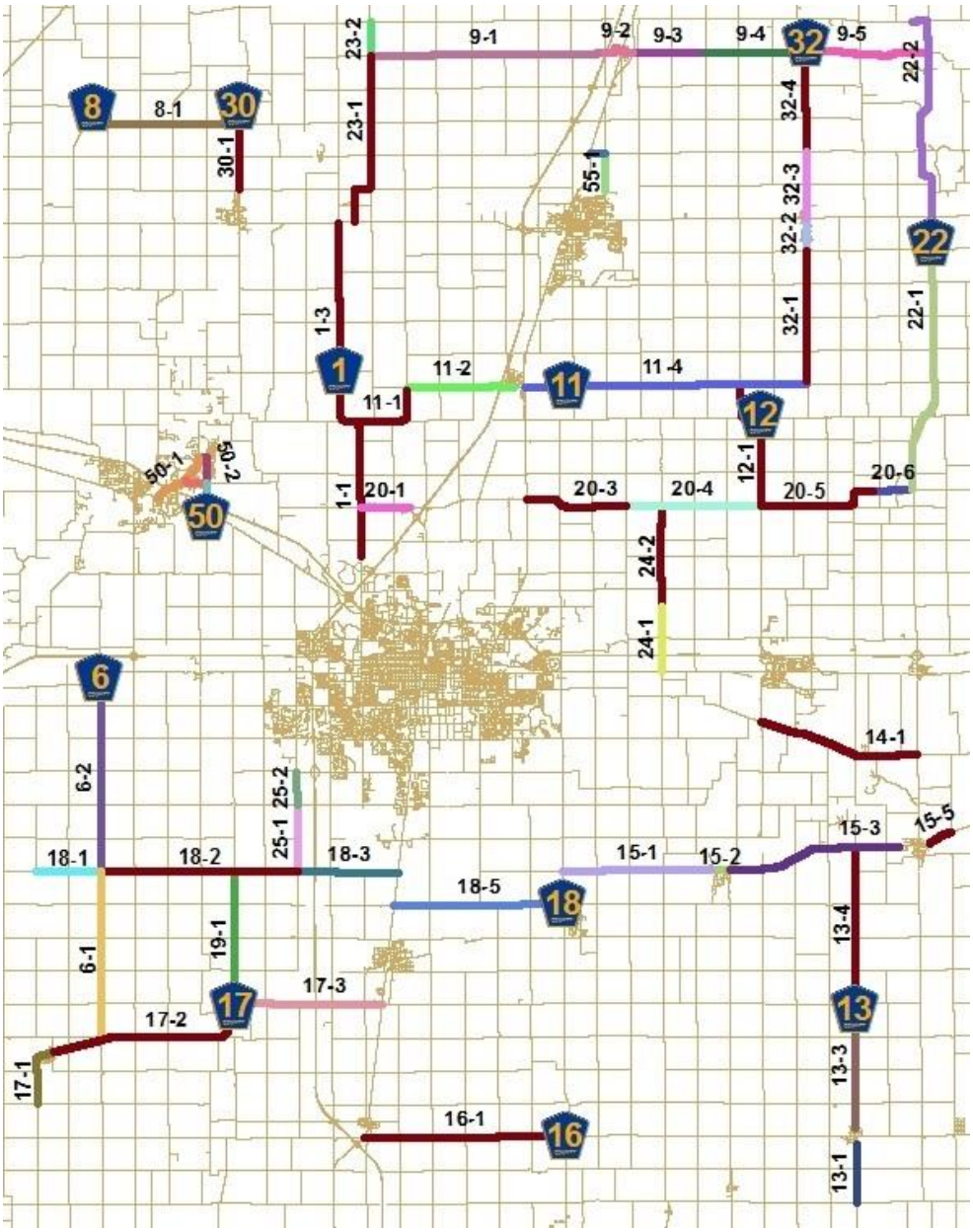

Figure 7. Champaign County PMS sections based on road, construction history, and traffic.

Pavement Performance Model

Figure 8 shows the pavement deterioration curve used in RoadCare to predict pavement deterioration in its simulation. ARA developed the original curve with historical data provided by the County and we updated it with later years' data from our surveys. The curve shows an estimated service life of 17 years before major rehabilitation is required, such as mill and thick AC overlay or cold-inplace recycling.

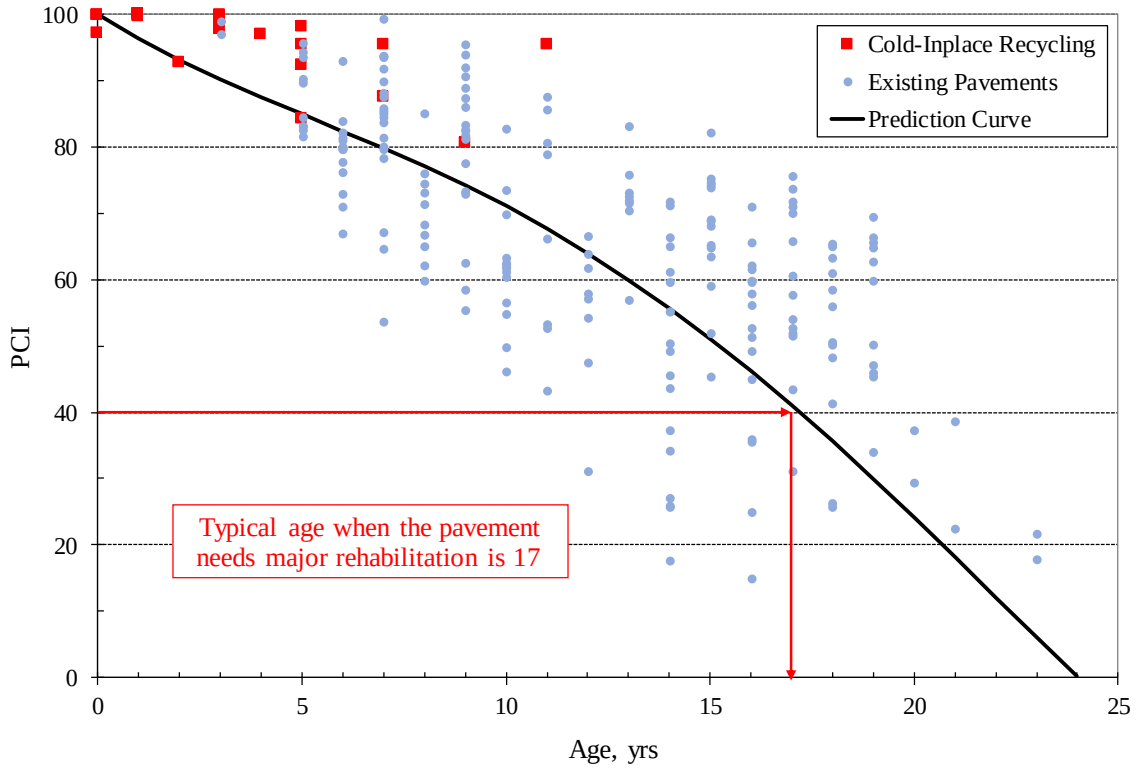

Figure 8. The typical rehabilitated pavement in Champaign County lasts 17 years before requiring its next rehabilitation.

The above figure shows the performance of CIR rehabilitation projects performed on County Highways 8, 23, 30, and portions of 9, 11, 20, and 22. Overall, the CIR projects are performing better than the prediction curve for their given age. It should be noted that several have been maintained with chip seals, which increases their PCI; however, since this is standard practice for Champaign county highways, the benefit of the surface treatment should be considered in the prediction curve. It should also be noted that the CIR projects are relatively new. The County performed their first CIR project on the easternmost section of County Highway 9 in 2006, meaning the oldest section was 11 years old at the time of the 2017 PCI survey.

Unit Costs for Treatments

Champaign County provided estimated unit cost data for typical work activities, such as placing chip seals, AC milling, and placing AC overlays. From this, ARA determined typical unit costs for each M&R alternative listed in the treatment matrix. The County provided costs on a per lane-mile basis and we subsequently converted to units of cost per square yard. Table 1 presents the estimated unit costs.

Table 1. Estimated unit costs used in RoadCare.

Activity Description	Budget Category	Unit Cost ($/sy)	Unit Cost ($/cl-mi)[a]
Crack Sealing	Maintenance	$ 0.98	$ 13,798
Distress Repair & Crack Seal	Maintenance	$ 1.54	$ 21,683
Chip (slag) Sealing	Maintenance	$ 1.99	$ 28,019
2” HIR and 2” AC Overlay	Construction	$ 19.00	$ 267,520
2” Mill and 2” AC Overlay	Construction	$ 16.00	$ 225,280
2” Mill and 3” AC Overlay	Construction	$ 21.00	$ 295,680
4” CIR and 1.5” AC Overlay	Construction	$ 21.00	$ 295,680
4” CIR and 3” AC Overlay	Construction	$ 27.00	$ 380,160
Reconstruction and 3” AC	Construction	$ 31.00	$ 436,480
Reconstruction and 4” AC	Construction	$ 36.00	$ 506,880

[a] Based on two 12-ft lanes.

Treatment Matrix

Figure 9 shows the Champaign County treatment matrix. In general, the PCI value determines the required depth of AC milling (i.e., the worse the condition, the greater the depth of milling), while the RWD deflection determines the required net increase in AC thickness, if any. If deflection currently is adequate for the given traffic level, a mill and overlay of the same thickness is sufficient. If the pavement is lacking in structural capacity, as indicated by a medium or high deflection, the matrix recommends either increasing the AC thickness or performing cold-inplace recycling (CIR) with an AC overlay.

The matrix also distinguishes between high- and low-traffic roads, recommending less extensive treatments for low-volume roads relative to high-traffic roads in the same condition. This is because low-traffic roads can tolerate less-extensive treatments than those with higher truck traffic.

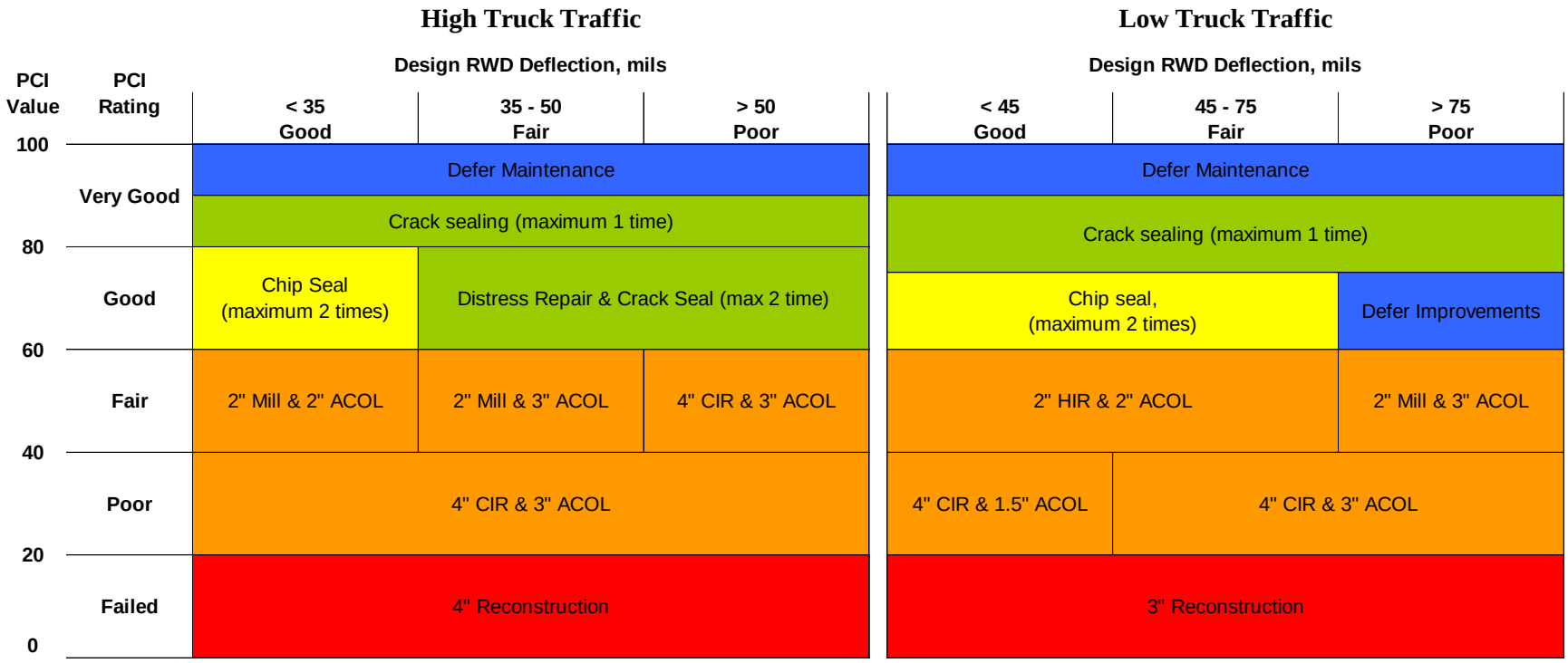

Figure 9. The Champaign County treatment matrix.

All roads rehabilitated with a new AC surface are crack sealed every year beginning in the third year after construction, and chip sealed in the fifth year after construction.

FIVE-YEAR M&R PLAN AND CONDITION FORECAST

Maintenance and Rehabilitation Plan

ARA updated the maintenance and rehabilitation plan by simulating pavement deterioration and improvements in RoadCare over a 10-year period. RoadCare simulates deterioration of each section based on the performance curve determined specifically for Champaign County roads and increases the condition rating accordingly for any road receiving a maintenance or construction treatment during the simulation period. RoadCare selects projects with the highest benefit-to-cost ratio that are feasible within the allocated budget. Additional anticipated funding from sources other than State MFT funds (such as Federal STR or State HSIP funds) are added to the annual $2,500,000 MFT construction and maintenance fund. ARA and the County Engineer finalized the maintenance and rehabilitation program based on practical considerations, such as spatial distribution of selected projects and anticipated funding.

Table 2 presents the proposed 5-year plan for 2018 to 2022. Figure 10 presents the surface treatment and rehabilitation projects for all five years. The main rehabilitation projects over the next five years include:

- 1.5” HIR and 2” AC overlay on all of CH 13 in 2018.
- 1.5” HIR and 2” AC overlay on all of CH 25 in 2018.
- 4” CIR and 3” AC overlay on all of CH 16 in 2018.
- Reconstruction on CH 9 from Ludlow to CH 32 in 2019.
- Rehabilitation on CH 18 from US 45 to SR 130 in 2020.
- Rehabilitation on CH 15 from SR 130 to Homer in 2021.
- Rehabilitation on all of CH 12 in 2022.
- Rehabilitation on all of CH 55 in 2022.

Table 3 presents the expected pavement expenditures for the next 5 years, based on the RoadCare simulation results.

Table 2. Detailed work activities for 2018 to 2022.

Year	Route	Begin MP	End MP	Activity	Cost
2018	CR13	0	10.8	1.5" HIR & 2" ACOL	$2,528,777
	CR25	0	3.04	1.5" HIR & 2" ACOL	$813,260
	CR16	0	6.13	4" CIR & 3" ACOL	$2,136,183
	CR18	0	1.96	Distress Repair & Crack Seal	$42,477
	CR20	5.69	8.79	Distress Repair & Crack Seal	$61,616
	CR22	0	8.52	Chip Seal	$199,006
2019	CR09	8.1	13.31	4" Reconstruction	$2,420,310
2020	CR18	11.97	17.1	2" Mill & 2" ACOL	$1,157,714
	CR18	0	1.96	Distress Repair & Crack Seal	$42,477
	CR18	1.96	7.94	Chip Seal	$167,498
2021	CR15	0	10.35	4" CIR & 3" ACOL	$3,935,416
	CR09	0	7.12	Chip Seal	$182,897
2022	CR12	0	4.17	4" CIR & 1.5" ACOL	$1,130,508
	CR55	0	1.57	3" Reconstruction	$1,248,260
	CR20	12.87	16.63	Distress Repair & Crack Seal	$78,152
	CR50	1.89	2.9	Chip Seal	$23,652

Table 3. Projected expenditures for 2018 to 2022.

Budget Source	2018	2019	2020	2021	2022
Maintenance	$495,317	$429,195	$391,542	$477,265	$496,689
Construction	$5,478,221	$2,420,310	$1,157,714	$3,935,417	$2,378,769
Total	$5,973,538	$2,849,505	$1,549,256	$4,412,682	$2,875,458

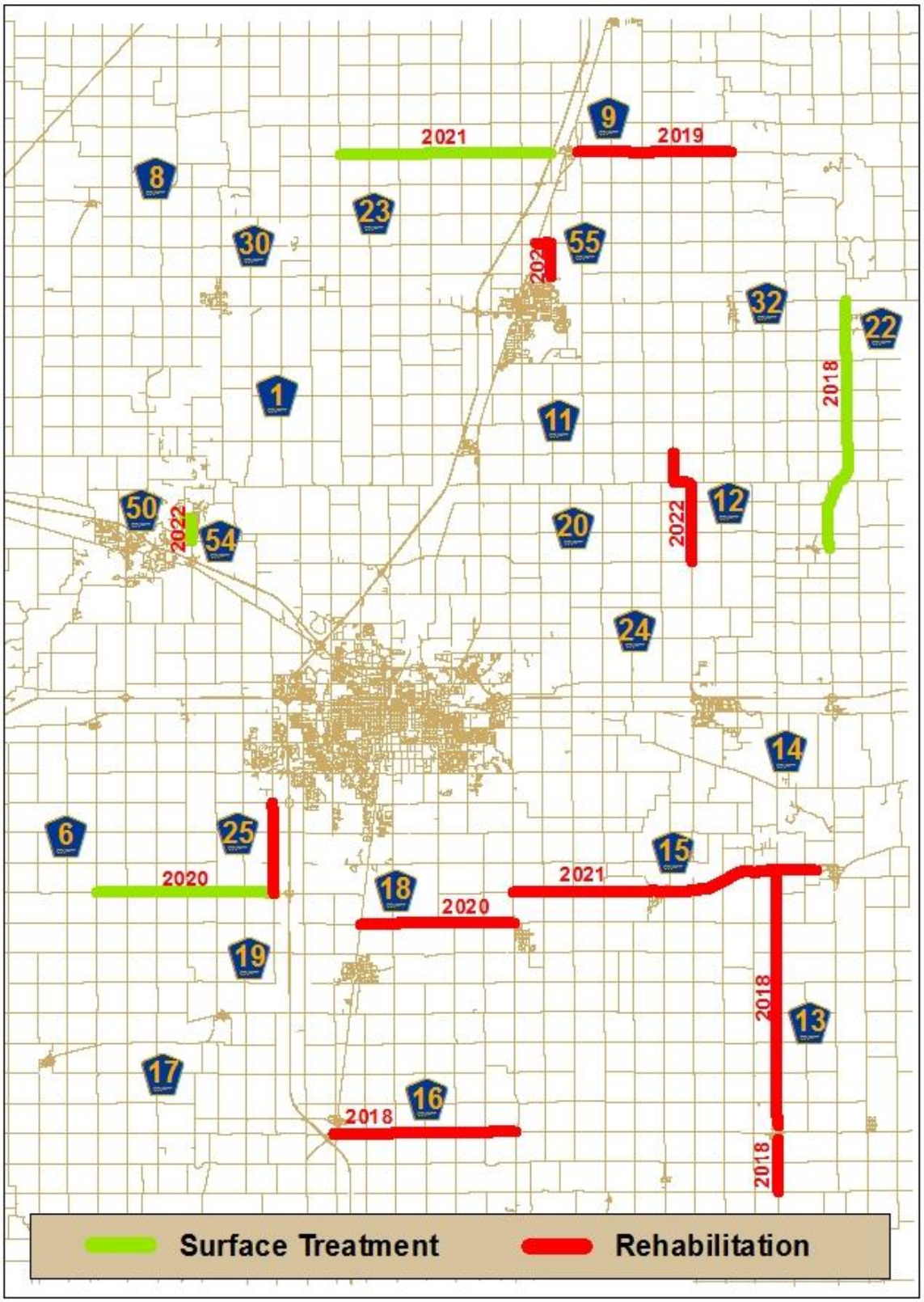

Figure 10. Rehabilitation and surface treatment plan, 2018 to 2022 (event year shown in red).

10-Year Network Condition Forecast

Figure 11 presents the RoadCare pavement condition simulation results for the next 10 years. The chart shows the predicted percentage of lane mileage in each rating category (e.g., very good, good, fair, poor, and very poor) and the predicted average network PCI. The simulation predicts that the network PCI value will remain stable over the next 10 years, averaging 81.1 (i.e., very good to good), while the percentage of pavements in good condition will increase, with a corresponding decrease in the number of pavements in very good, fair, poor, and very poor condition.

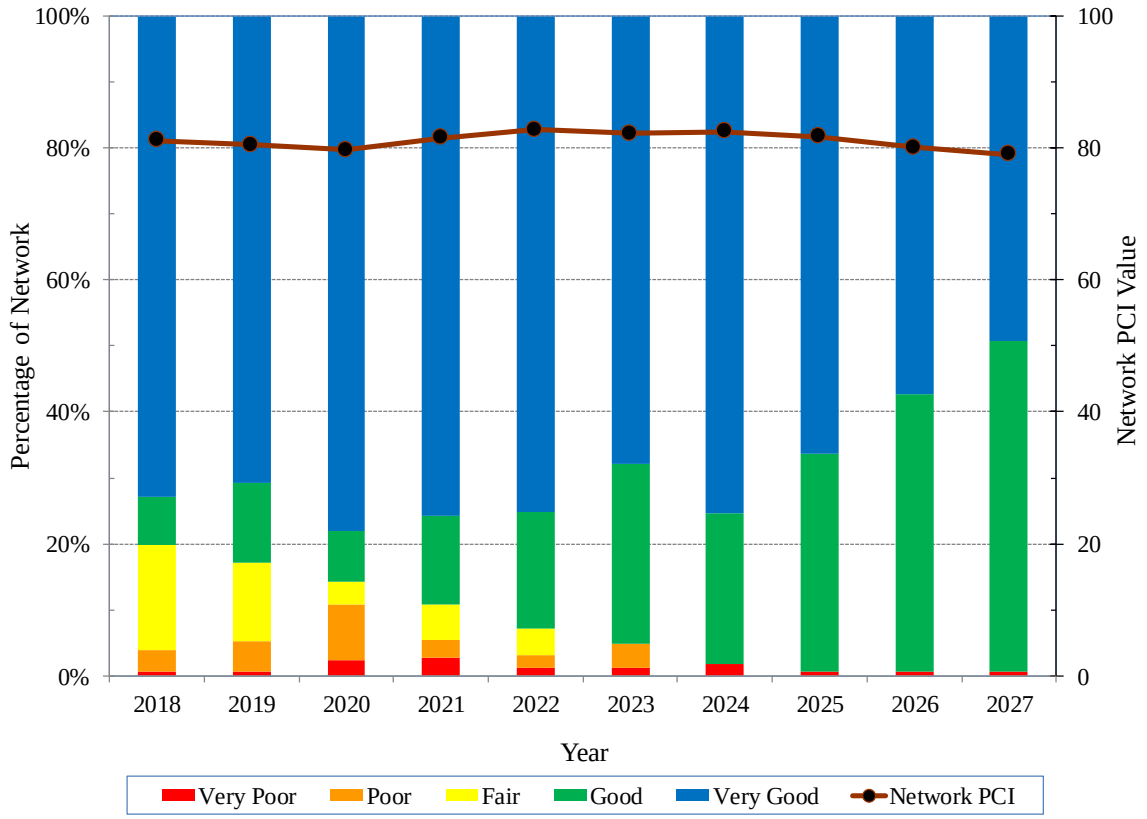

Figure 11. Predicted network condition for 2018 to 2027.

It is worthwhile to view the predicted network performance in the context of historical condition, as the County now has condition survey data from multiple past surveys to track the performance of the network over time. Figure 12 presents the network PCI value (i.e., overall performance indicator) for surveys performed in 2006, 2009, 2011, 2013, 2015, and 2017, as part of their ongoing pavement management activities. The data show that the network PCI value has increased steadily from approximately 70 to 81 since 2006, the year the County implemented their pavement management system.

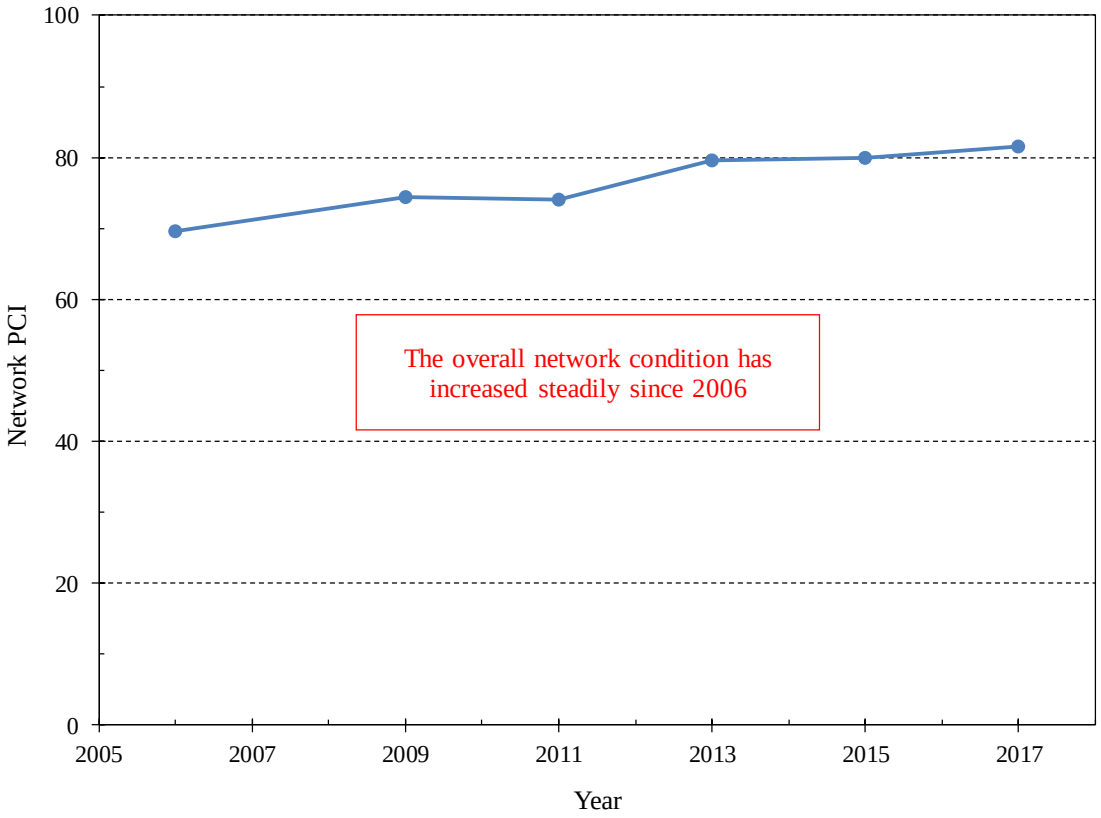

Figure 12. Historical network condition since 2006.