Stantec

Palmer Solar Pavement Assessment– Draft Report

August 16, 2019

Prepared for:

juwi Inc.
1710 29th St., Suite 1068
Boulder, CO 80301

Prepared by:

Stantec Consulting Services Inc.
3133 West Frye Road, Suite 300
Chandler, AZ 85226

Sign-off Sheet

Prepared by _____

(signature)

Morty Jim, B.Sc.

Project Manager and Reviewer _____

(signature)

Fadi Jadoun, Ph.D., P.E.

Senior Reviewer and Discipline Lead _____

(signature)

Gabe Cimini, Principal

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CL	Centerline Miles
IRI	International Roughness Index
NEG	Negative Direction Lanes
PMS	Pavement Management System
POS	Positive Direction Lanes
PQI	Pavement Quality Index
RCI	Ride Comfort Index
SDI	Surface Distress Index

EXECUTIVE SUMMARY

juwi inc. (juwi) selected Stantec Consulting Services, Inc. (Stantec) in 2019 to assess the surface condition of approximately 32.5 centerline (CL) miles of streets in El Paso County, Colorado. The streets were tested in both directions and are depicted below in Figure ES.1. The tested streets include: Squirrel Creek Road (7.6 CL miles), Peyton Hwy 463 (8 CL miles), Hanover Road (12.3 CL miles), Old Pueblo Road (1.5 CL miles) and a short section of I-25 (3.1 CL miles).
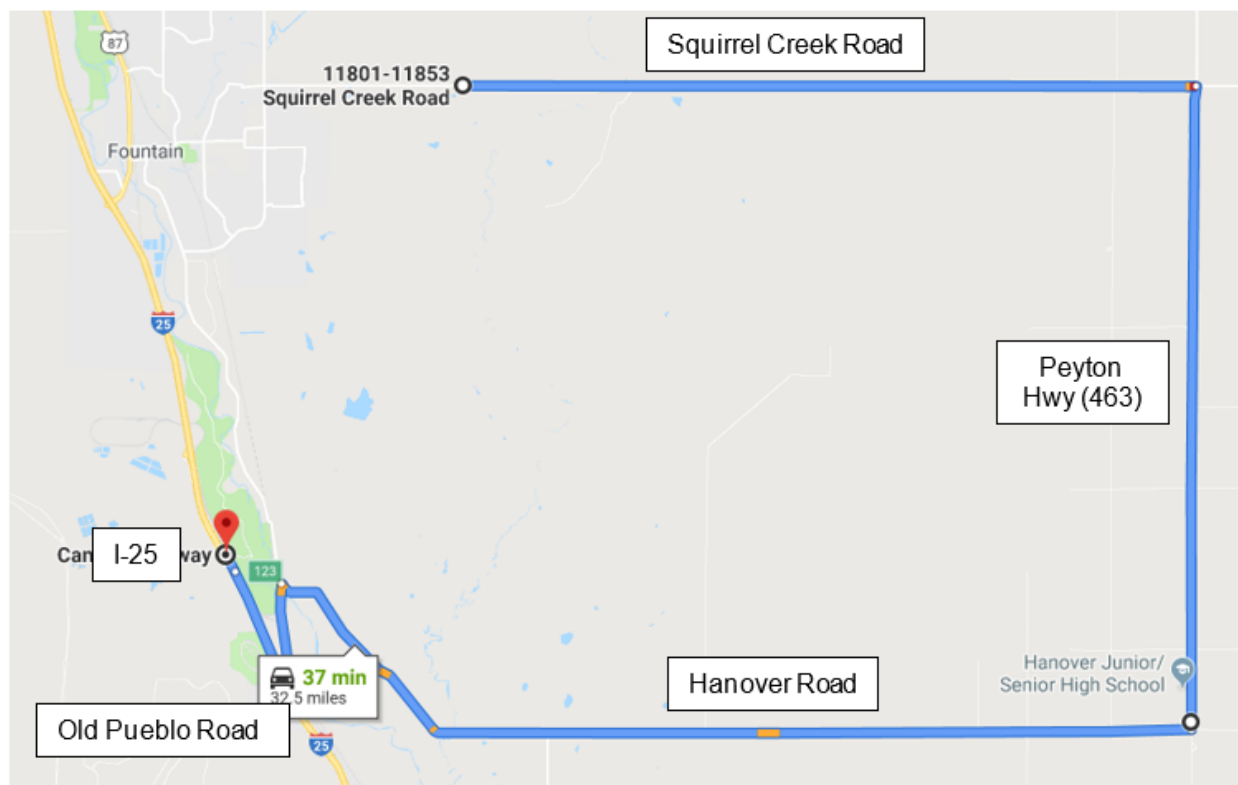
Figure ES.1: Roads Surveyed in 2019

The pavement condition of these roads (in one direction only) was evaluated by Stantec in 2018 as part of the El Paso County pavement condition assessment program. The goal of this project is to assess any accelerated damage that could have occurred on these streets due to their use by juwi to transport heavy equipment after the 2018 condition assessment took place.

Data Collection

Stantec used our semi-automated RT3000 equipment to collect the pavement surface distresses and roughness at posted speeds on July 18, 2019. For this project, pavement distresses were rated in accordance with the RoadMatrix PMA Asphalt Rating System in which 13 distresses are collected for severity and extent. This is a similar approach to that used for collecting the El Paso County pavement condition data in 2018.

Analysis Results

- It is noted that while the 3.1 CL mile section of I-25 was surveyed, it was excluded from the comparisons as it is not included in the County's pavement management system (PMS) and there is no historical performance data for comparison.

- The data collected was used to present the condition of the road network in terms of the following three performance indices. All presented results are centerline-length-weighted so that longer sections will have more weight when calculating the average performance.

    o Riding Comfort Index (RCI) – Represents the smoothness (bumpiness) of the road.

    o Surface Distress Index (SDI) – Represents the surface condition of the road (cracking, etc.

    o Pavement Quality Index (PQI) – Overall condition index, a function of the indices above.

- Performance results form 2018 and 2019 were compared at the following levels:

    o Project Level: Compares raw and calculated 2018 data with 2019 data at the project level.

    o Street Level: Compares raw and calculated 2018 data with 2019 data at the section level.

    o Street Level/Lane: Compares the 2019 raw and calculated data between the two directions.

- Project level 2018-2019 performance comparisons (PQI, RCI, SDI) are graphically presented below in Figure ES.2.

Figure ES.2: Project Level Performance Comparisons – 2018-2019

- o The information presented above in Figure ES.2 indicate a reasonable decrease in PQI, RCI and SDI from 2018 to 2019. PQI decreased by approximately 6 points from 69 in 2018 to 63 in 2019, RCI decreased by approximately 1 point from 64 in 2018 to 63 in 2019, and SDI decreased by approximately 6 points from 61 in 2018 to 55 in 2019. Depending on the condition of the road and the type of deterioration curve it follows, the annual performance drop could typically range between 0 and 8 points for the various performance indices.

- Project level 2018-2019 comparisons of IRI and Rutting data are graphically presented below in Figure ES.3.
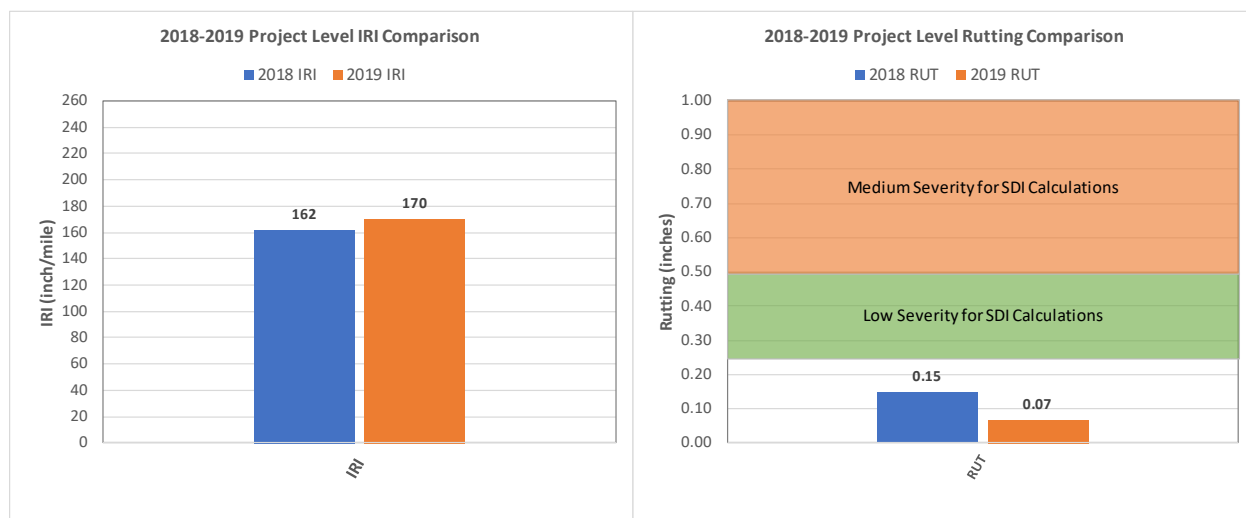
Figure ES.3: Project Level IRI and Rutting Comparisons – 2018-2019

- o The information presented above in Figure ES.3 indicate a reasonable IRI and rutting trends with an increase in IRI of approximately 8 inches/mile (162 inches/mile in 2018 to 170 inches per mile in 2019). and a negligible decrease of 0.08 inches in rutting readings (0.15 inches in 2018 to 0.07 inches in 2019). While an increase in IRI is an expected trend with age, a decrease in rut depth is not expected. This decrease however is small and could potentially be attributed to riding in a slightly different wheel path compared to 2018. Rutting on this project was generally low and mostly below the 0.25 inches threshold, which is the minimum for inclusion in the SDI calculations, as indicated by the green and orange zones shown above in Figure ES.3.

- Street level 2018-2019 performance comparisons (PQI, RCI, SDI) are graphically presented below in Figure ES.4.

  - o The results in Figure ES.4 below indicate, as expected, a decrease in the PQI, RCI and SDI performance scores from 2018 to 2019 for all four streets. With the exception of Peyton Hwy 463, PQI on the other three roads decreased between 1 and 3 points, RCI decreased approximately 2 points and SDI decreased between zero, (i.e. no decrease), and 4 points.

  - o The results for Peyton Hwy 463A indicate a somewhat larger than expected decrease in PQI and SDI. In reviewing the detailed data along the various sections of Peyton Hwy 463, it was determined that light severity raveling was overrated by the field crew which have caused the SDI to drop significantly, because raveling contributes largely to the SDI score calculations.
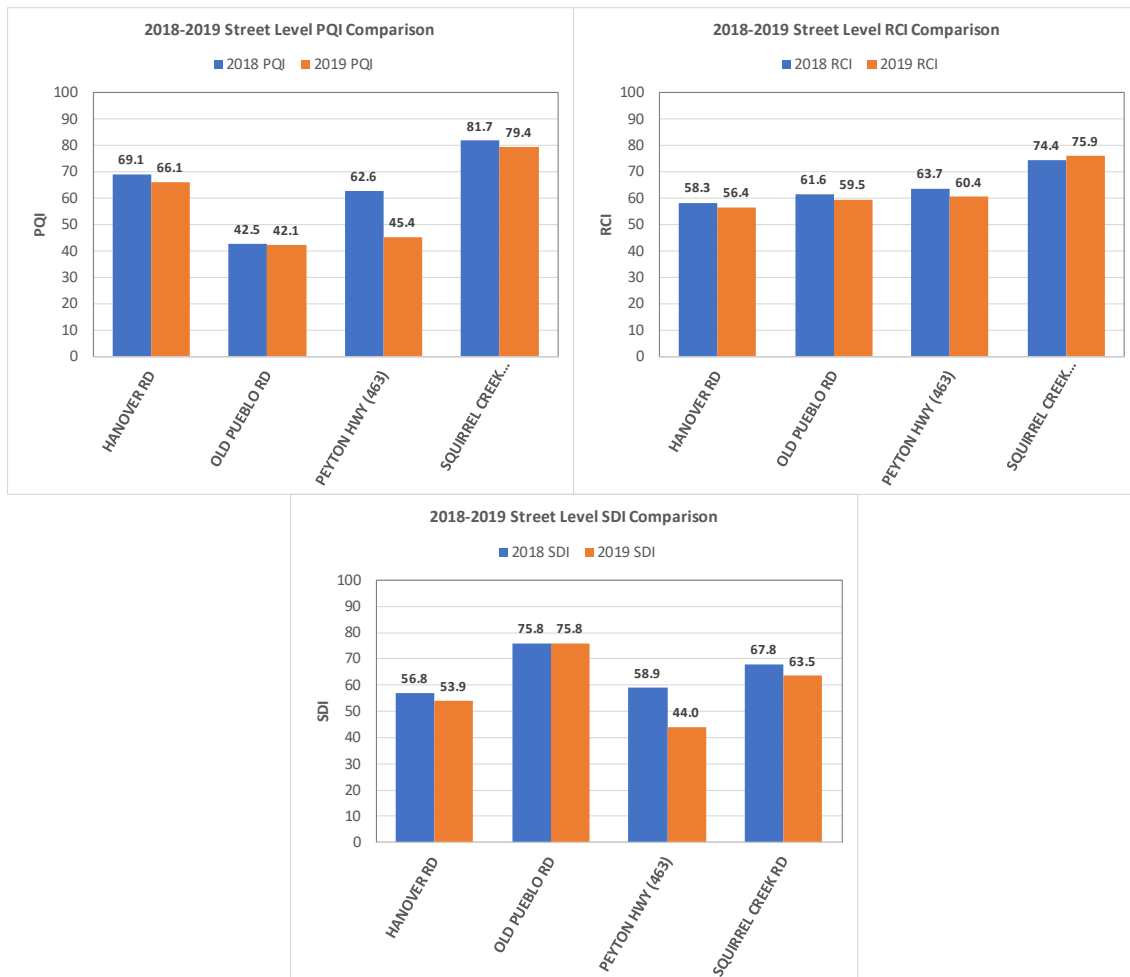
Figure ES.4: Project Level PQI, RCI and SDI Comparisons – 2018-2019

- Street level 2018-2019 IRI and Rutting comparisons are graphically presented below in Figure ES.5.

  - The results presented in Figure ES.5 indicate an increase in IRI readings in the range of 2 to 11 inches/mile, except for Peyton Hwy 463 where the IRI slightly decreased by approximately 4 inches/mile. As for rutting, the results indicate a negligible decrease (≤ 0.1 inches) on all 4 streets.

- Street/Lane level 2019 performance comparisons (PQI, RCI, SDI) are graphically presented below in Figure ES.6 for the positive and the negative lanes tested in 2019.
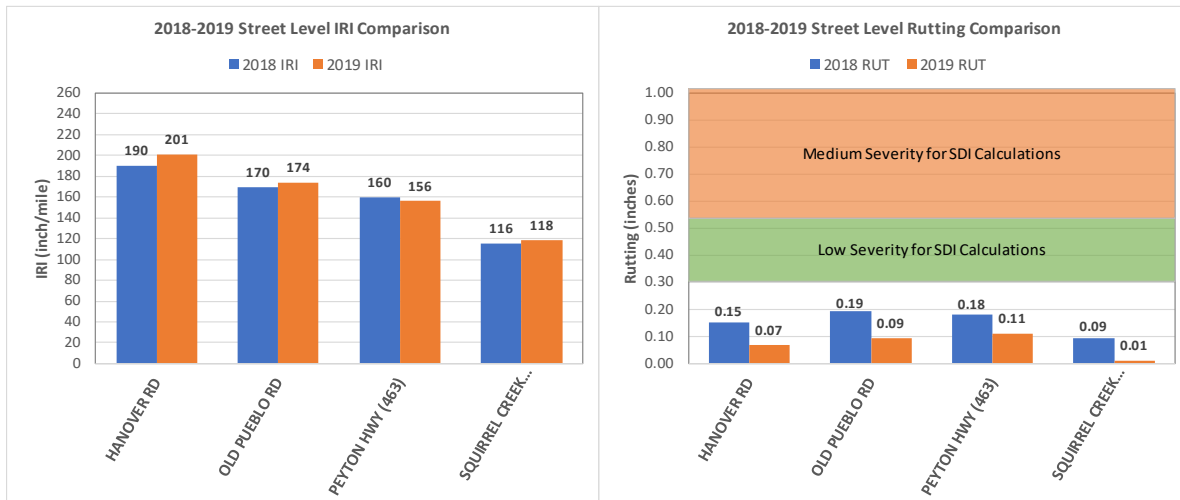
Figure ES.5: Street Level IRI and Rutting Comparisons – 2018-2019
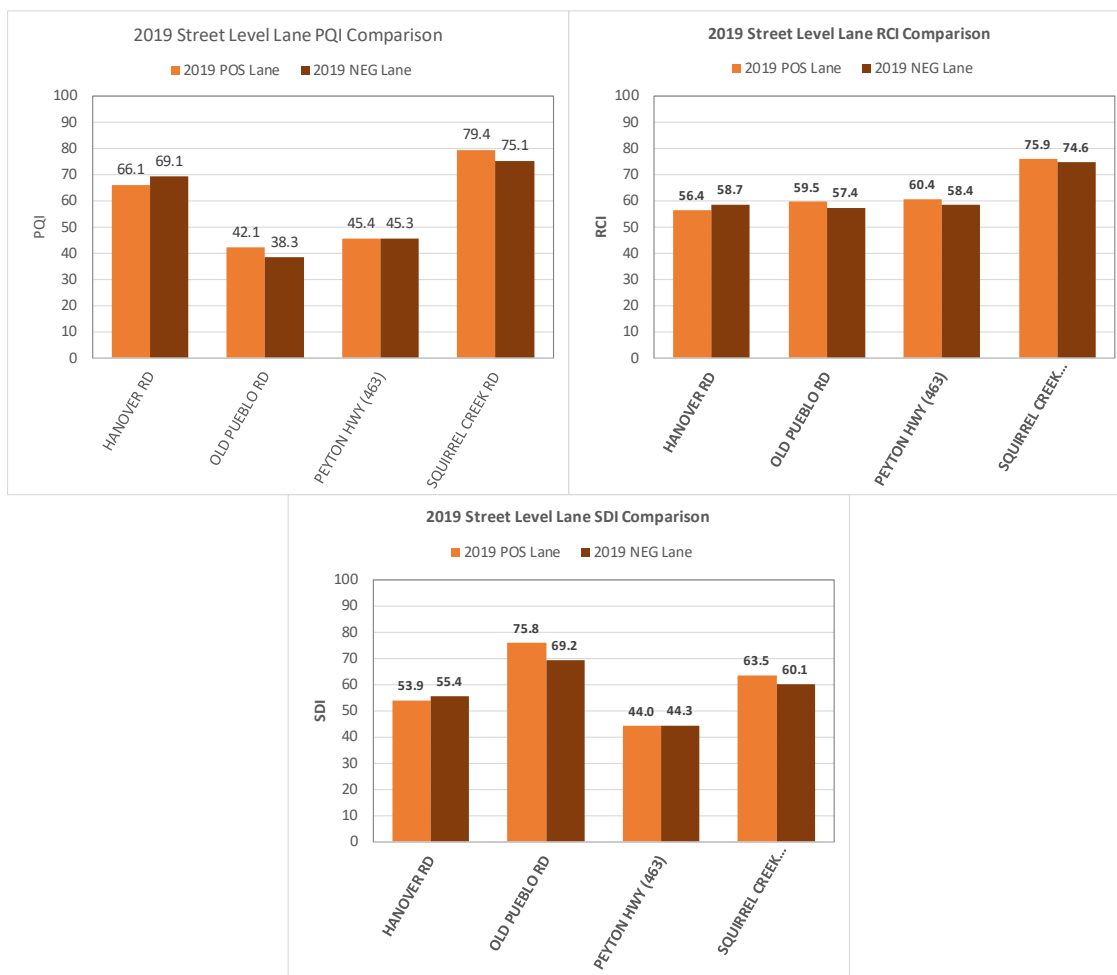
Figure ES.6: Street/Lane Level PQI, RCI, SDI Comparisons – 2019

- o The results presented in Figure ES.6 indicate comparable PQI, RCI and SDI results between the opposite direction lanes. The results indicate a difference in the range of 0 to 4 points in PQI, 1 to 3 points in RCI and 0 to 7 points in SDI between 2018 and 2019.

- o The PQI, RCI and SDI comparison results also indicate that Peyton Hwy 463 shows the closest agreement in surface distress ratings between the opposite direction lanes.

- Street/Lane level 2019 IRI and rutting comparisons are graphically presented below in Figure ES.7.
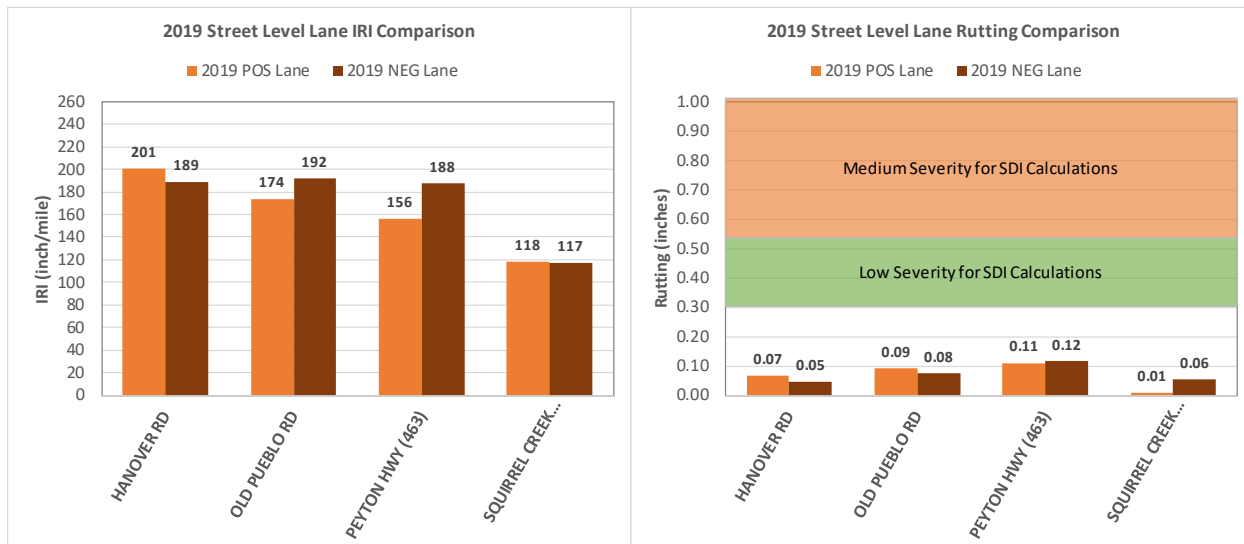
Figure ES.7: Street/Lane Level IRI and Rutting Comparisons – 2019

- o The results presented in Figure ES.7 indicate comparable IRI and rutting results between the opposite direction lanes. The results indicate a difference in the range of 1 inch/mile to 32 inches/mile in IRI and a difference of ≤ 0.05 inches in rutting. The largest difference in IRI of 32 inches/mile belongs to Peyton Hwy 463 and the smallest difference in IRI of 1 inches/mile belongs to Squirrel Creek Road.

1.0 PROJECT OVERVIEW

1.1 BACKGROUND

juwi inc. (juwi) retained Stantec Consulting Services, Inc. (Stantec) in 2019 to assess the surface condition of approximately 32.5 centerline (CL) miles of street in El Paso County, Colorado. The pavement condition of these streets (in one direction only) was evaluated by Stantec in 2018 as part of the El Paso County pavement condition assessment program. The pavement condition ratings have been then uploaded to the County's pavement management system (PMS). A map depicting the streets that were surveyed in 2019 is provided below. The streets were surveyed in both directions in 2019 for a total of approximately 65 lane miles. The streets include: Squirrel Creek Road (7.6 CL miles), Peyton Hwy 463 (8 CL miles), Hanover Road (12.3 CL miles), Old Pueblo Road (1.5 CL miles) and a short section of I-25 (3.1 CL miles).
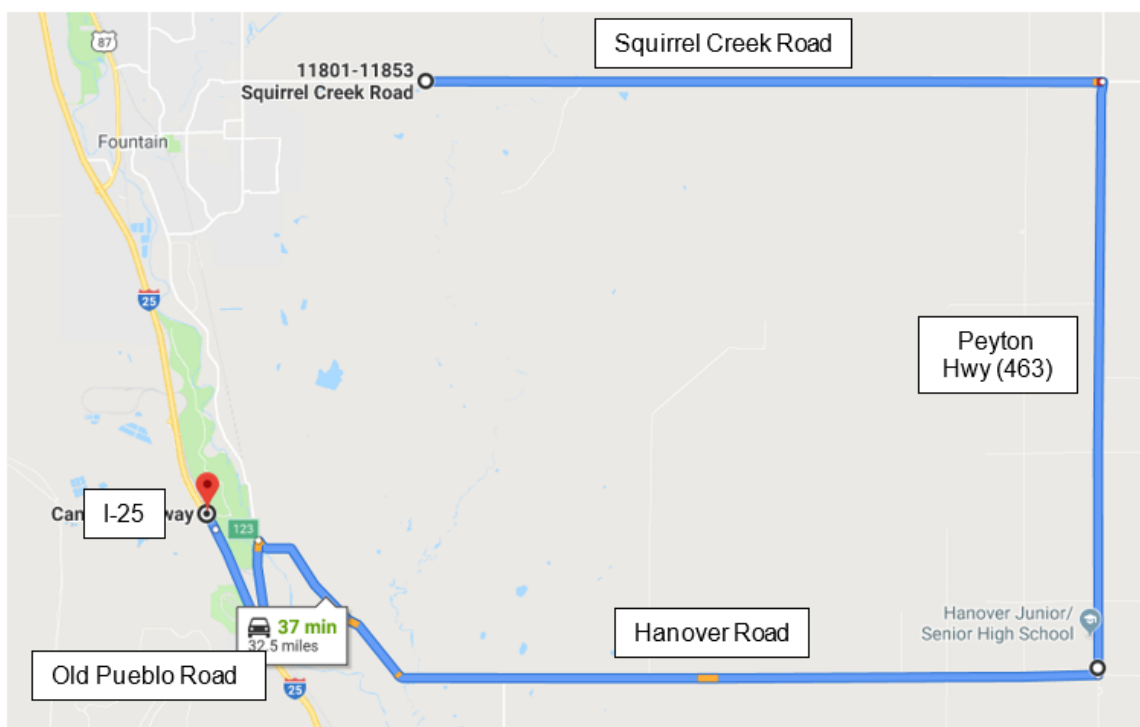
Figure 1.1: Roads Surveyed in 2019

The goal of this project is to compare the condition ratings on these streets in 2019 with that of 2018, as documented in the El Paso County (County) pavement management system (PMS). The goal of this project is to assess any accelerated damage that could have occurred on these streets due to their use by juwi to transport heavy equipment after the 2018 condition assessment took place.

1.2   PROJECT SCOPE AND OBJECTIVES

The project scope for 2019 included the following tasks:

- Conduct pavement surface distress and roughness survey on approximately 65 survey-miles of the County's impacted roads;

- Compare the newly collected pavement condition ratings to that from 2018 for the same sections; and

- Deliver a draft and a final reports documenting the test procedures, analysis results and conclusions.

The data collected was used to present the condition of the road network in terms of three performance indices:

- Riding Comfort Index (RCI) – Represents the smoothness (bumpiness) of the road.

- Surface Distress Index (SDI) – Represents the surface condition of the road (cracking, etc.

- Pavement Quality Index (PQI) – Overall condition index, a function of the indices above.

Each of the aforementioned indices is presented on a scale of 0-100. A value of 0 represents a pavement surface at the worst possible condition, whereas an index value of 100 represents a pavement surface at the best possible condition.

In addition to the three calculated indices mentioned above, two types of raw data that were collected by the automated survey equipment were also documented and used for the comparison of the surface condition and roughness data. These include the International Roughness Index (IRI), also referred to as the longitudinal profile or roughness, which is used in the calculation of the RCI index mentioned above, and also the rutting , i.e. transverse profile, which is an input in the SDI index calculations. The RCI, SDI and PQI indices are calculated from the collected condition data in the County's RoadMatrix PMS.

1.3   TESTED SECTIONS FOR COMPARISON

Excluding the short section of I-25 (3.1 CL miles) that was tested but excluded from the comparison due to not being a part of the County's PMS, the tested roads comprised of 34 road sections all of which exist in the County's PMS and were all tested in one direction (called Positive, or POS) in 2018. These 34 road sections are presented below in Table 1.1. To simplify the presentation of the comparison results, the data is presented at the Street level rather than at the section level. Performance data from all sections that make up a street were weighted based on the centerline length of each of the sections to give the Street level performance data. Data for the following four streets was compared: Squirrel Creek Road (7.6 CL miles), Peyton Hwy 463 (8 CL miles), Hanover Road (12.3 CL miles) and Old Pueblo Road (1.5 CL miles).

Table 1.1: Sections used for Comparison (RCI/SDI)

| Section #	Street Name	From	To	Length (ft)
0000374800	HANOVER RD	OLD PUEBLO RD	2642'	2,720
0000374900	HANOVER RD	2642'	9626'	6,973
0000375000	HANOVER RD	9626'	14881'	5,219
0000375100	HANOVER RD	14881'	16988'	2,102
0000375200	HANOVER RD	16988'	MERIDIAN RD	5,221
0000375300	HANOVER RD	MERIDIAN RD	5119'	5,164
0000375400	HANOVER RD	5119'	HAMMER RD	5,222
0000375500	HANOVER RD	HAMMER RD	5215'	5,205
0000375600	HANOVER RD	5215'	10591'	5,374
0000375700	HANOVER RD	10591'	SURFACE CHANGE (12	1,790
0000375800	HANOVER RD	SURFACE CHANGE	N/A	3,411
0000375900	HANOVER RD	14010'	DEGROOT RD	5,365
0000376000	HANOVER RD	DEGROOT RD	MILNE RD	5,507
0000376100	HANOVER RD	MILNE RD	PEYTON HWY	5,323
0000581400	OLD PUEBLO RD	I-25 RAMP	3398'	3,389
0000581500	OLD PUEBLO RD	3398'	HANOVER RD	4,642
0000614600	PEYTON HWY (463)	HANOVER RD	MYERS RD	5,259
0000614700	PEYTON HWY (463)	MYERS RD	5170'	5,201
0000614800	PEYTON HWY (463)	5170'	POWERS RD	5,336
0000614900	PEYTON HWY (463)	POWERS RD	SKINNER RD	5,271
0000615000	PEYTON HWY (463)	SKINNER RD	HOLMAN RD (WYE)	4,748
0000615090	PEYTON HWY (463)	HOLMAN RD (WYE)	HOLMAN RD (WYE)	711
0000615100	PEYTON HWY (463)	HOLMAN RD (WYE)	5196'	5,057
0000615200	PEYTON HWY (463)	5196'	10451'	5,249
0000615300	PEYTON HWY (463)	10451'	SQUIRREL CREEK RD	5,218
0000762100	SQUIRREL CREEK RD	3066' W OF ANDY KANE RD	ANDY KANE RD	3,066
0000762200	SQUIRREL CREEK RD	ANDY KANE RD	4175'	4,162
0000762300	SQUIRREL CREEK RD	4175'	9360'	6,416
0000762400	SQUIRREL CREEK RD	9360'	14624'	5,229
0000762500	SQUIRREL CREEK RD	14624'	19861'	5,236
0000762600	SQUIRREL CREEK RD	19861'	25159'	5,324
0000762700	SQUIRREL CREEK RD	25159'	MILNE RD	5,135
0000762800	SQUIRREL CREEK RD	MILNE RD	MILNE RD	206
0000762900	SQUIRREL CREEK RD	MILNE RD	PEYTON HWY	5,206

2.0 DATA COLLECTION

A Stantec RT3000 unit equipped with accelerometers, laser sensors, cameras, and inertial global position system (IGPS) was used to conduct the 2019 pavement condition survey for surface distress and roughness. The condition data was collected on July 18, 2019.

2.1 SURFACE DISTRESSES SURVEY

The RT3000 downward linescan camera was used to collect continuous digital images of the pavement surface in both directions of travel. The resulting pavement images are synchronized with corresponding right-of-way images, to provide a full set of digital imagery for accurately assessing the condition of the roads. The collected pavement imagery is subsequently analyzed through Stantec's Imaging Workstation, which was designed specifically for pavement surface analysis, using the linescan pavement images and ROW images collected by the RT3000 vehicles.
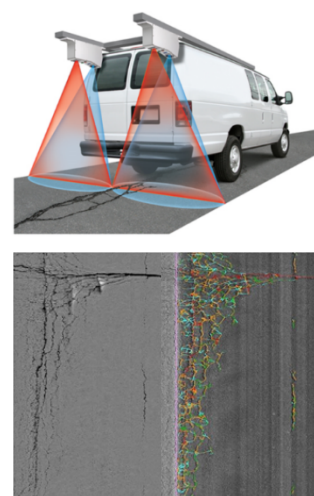
Some surface deficiencies and distresses (e.g. raveling) were collected using visual assessment. A specialized keyboard was used to collect these other distresses when applicable. This real-time event-recording keyboard is used to capture any distress/attribute information that cannot be assessed accurately by the linescan approach.

Distress Rating Protocols

For this project, pavement distresses were rated in accordance with the RoadMatrix PMA Asphalt Rating System in which 13 distresses are collected for severity and extent. This is a similar approach to that used for collecting the El Paso County pavement condition data in 2018. The collected asphalt pavement distresses included the surface distresses and deficiencies below in Table 2.1.

Table 2.1: Flexible Pavement Distresses

Flexible Pavement Distresses	
• Patching • Rippling & Shoving • Raveling/Streaking • Flushing & Bleeding • Distortion • Excessive Crown	• Progressive Edge Cracking • Alligator Cracking • Potholes • Block/Map Cracking • Longitudinal Cracking • Transverse Cracking • Wheel Track Rutting

Each defect or distress was measured based on two components: severity and extent. *Severity* is defined as '*How bad is the defect?*' in terms of the width or degree of wear associated with the condition. An example of a severity measurement includes the width of a crack.

The second component evaluates the *extent* or '*How much is there?*' in terms of the quantity of the surface the defect covers. Examples of measures used for extent would include the number or length of transverse cracks, length of longitudinal cracking, or the pavement area affected by alligator cracking. The surface distress data is collected continuously and will be summarized at *100-foot intervals*.

2.2 RUTTING AND ROUGHNESS SURVEY

The pavement rutting and roughness surveys were completed in both directions of travel at the same time as the pavement surface distress surveys. The RT-3000 incorporates an ASTM E950 *certified* Class I profiler configured to capture longitudinal profile measurements and International Roughness Index (IRI) values in both wheel paths. The IRI data is collected continuously and summarized at *100-foot* intervals. The RT3000 also measured transverse profile and rut depths, using laser-based, height-measuring sensors. All rut data are processed at 100-foot intervals as well.

2.2.1 Location Referencing System (LRS)

Stantec's RT-3000 uses two systems to measure location-referencing information, for all collected information. The *Distance Measuring Instrument (DMI)* is used to provide a reference measurement of the vehicle as it traverses the road. This measurement provides stationing references, such as milepost location, for the collected data. The RT-3000 also uses *real-time differential GPS* for the provision of spatial location data at all times. The surface distress data is collected continuously on the entire curb lane (no sampling) and are summarized at *100-foot intervals.*

3.0 ANALYSIS RESULTS AND DISCUSSION

The surface distresses and roughness data were checked for quality and completeness and were uploaded into the County's RoadMatrix PMS for analysis. This section presents the comparison results between 2018 and 2019 performance data and also between the two directions tested in 2019.

Performance results from 2018 and 2019 were compared at the following levels:

- Project Level: Compares raw and calculated 2018 data with 2019 data at the project level.

- Street Level: Compares raw and calculated 2018 data with 2019 data at the section level.

- Street/Lane Level: Compares the 2019 raw and calculated data between the two directions.

It is noted that all the results presented below are weighted by the centerline length of the section. The performance of longer sections will have more weight reflected in the average results presented.

3.1   PROJECT LEVEL COMPARISONS (2018-2019)

3.1.1   Project Level PQI, RCI and SDI Comparisons

The data in Table 3.1 and Figure 3.1 below present a comparison between the 2018 and the 2019 calculated performance data (PQI, SDI, RCI) at the project level.

Table 3.1: Project Level Performance Comparisons - 2018-2019

Survey Year	PQI	RCI	SDI
2018	69	64	61
2019	63	63	55
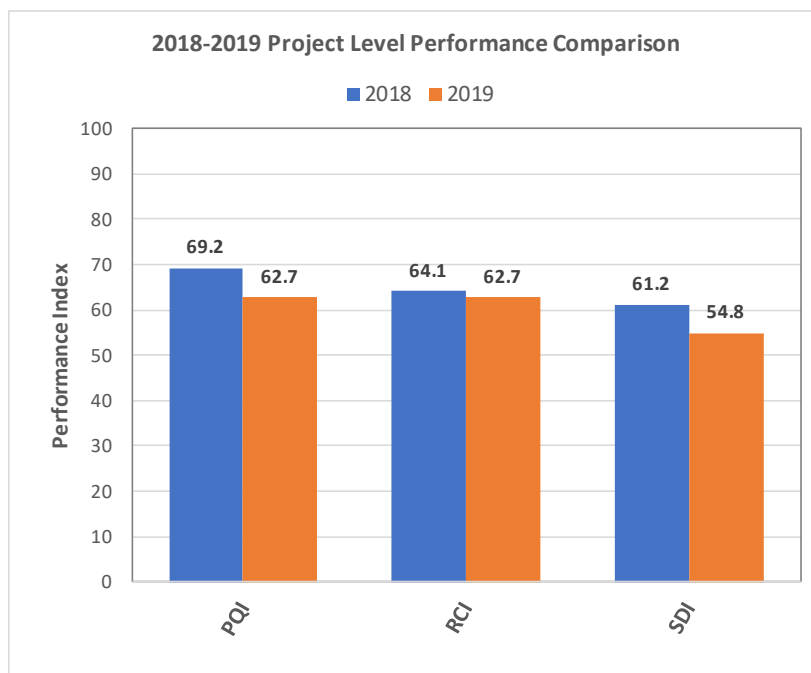
Figure 3.1: Project Level Performance Comparisons - 2018-2019

3.1.1.1   Discussion

The results presented above in Table 3.1 and Figure 3.1 indicate an overall decrease in the performance scores at the project level. PQI decreased by approximately 6 points, RCI decreased by approximately 1 point and SDI decreased by approximately 6 points. Considering the 2018 performance scores and the correspondence location on the deterioration curves that tend to decrease rapidly within this performance region, this decrease in performance could be considered reasonable. Depending on the condition of the road and the type of deterioration curve it follows, the annual performance drop could typically range between 0 and 8 points for the various performance indices.

3.1.2   Project Level IRI and Rutting Comparisons

The data in Table 3.2 and Figure 3.2 below present a comparison between the 2018 and the 2019 IRI (longitudinal profile) and rutting (transverse profile) data at the project level.

Table 3.2: Project Level IRI and Rutting Comparisons - 2018-2019

Survey Year	IRI (inches/mile)	Rutting (inches)
2018	162	0.15
2019	170	0.07

Figure 3.2: Project Level IRI and Rutting Comparisons - 2018-2019

3.1.2.1   Discussion
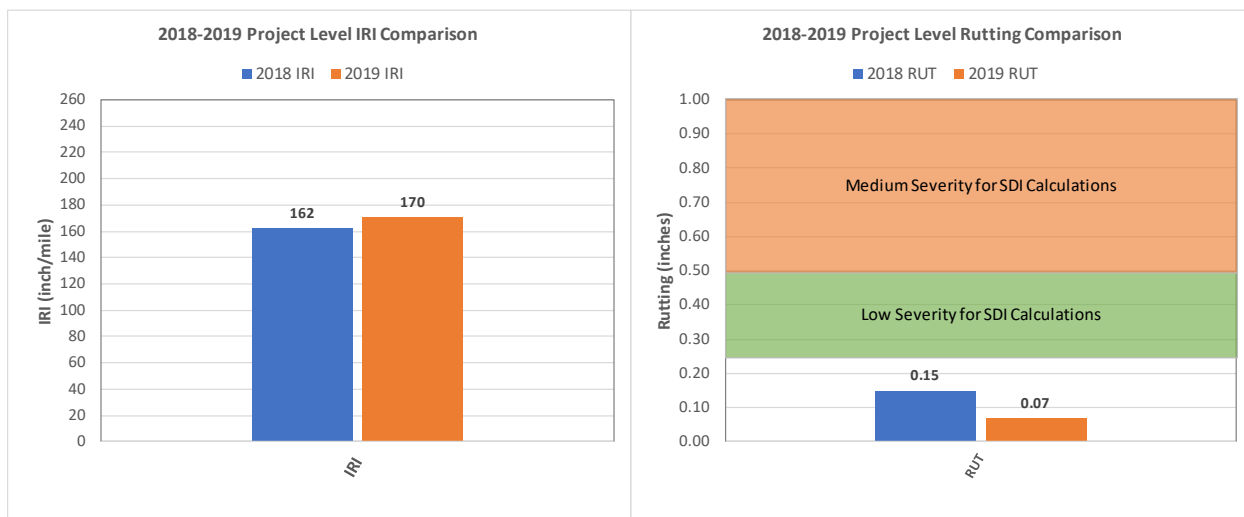
The results presented above in Table 3.2 and Figure 3.2 indicate an increase in IRI readings of approximately 8 inches/mile and a decrease of 0.08 inches in rutting readings. While an increase in IRI is an expected trend with age, a decrease in rut depth is not expected. This decrease however is small and could potentially be attributed to riding in a slightly different wheel path compared to 2018. Also considering that rutting values smaller than 0.25" are ignored when calculating the SDI, and the fact that the measured rut values on this project are small to begin with, this decrease in rut values can be ignored. The rutting side of Figure 3.2 above shows that rutting values between 0.25 inches and 0.5 inches are considered as low severity rutting for SDI calculations whereas rutting values between 0.5 inches and 1.0 inches are considered medium severity rutting for SDI calculations.

3.2   STREET LEVEL COMPARISONS (2018-2019)

3.2.1   Street Level PQI, RCI and SDI Comparisons

The data in Table 3.3 and Figure 3.3 below present a comparison between the 2018 and the 2019 IRI (longitudinal profile) and rutting (transverse profile) data at the street level.

Table 3.3: Street Level PQI, RCI and SDI Comparisons - 2018-2019

Street Name	CL Length (miles)	PQI		RCI		SDI	
		2018	2019	2018	2019	2018	2019
Hanover Road	**12.3**	69	66	58	56	57	54
Old Pueblo Road	**1.5**	43	42	62	60	76	76
Peyton Hwy 463	**8.0**	63	45	64	60	59	44
Squirrel Creek Road	**7.6**	82	79	74	76	68	64

Analysis Results and Discussion
August 16, 2019
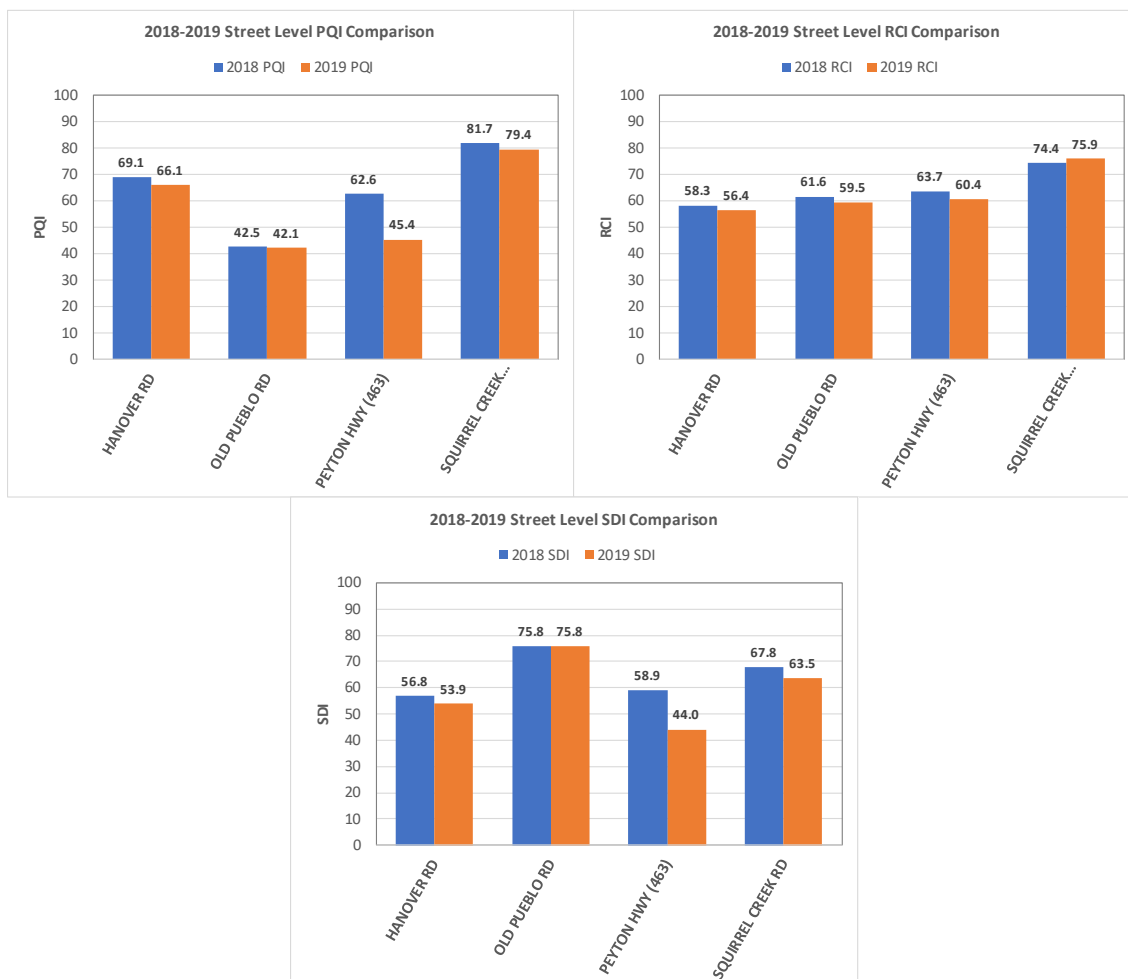
Figure 3.3: Street Level PQI, RCI and SDI Comparisons - 2018-2019

3.2.1.1   Discussion

The results presented above in Table 3.3 and Figure 3.3 indicate, as expected, a decrease in the performance scores for all four streets. With the exception of Peyton Hwy 463, PQI on the other three roads decreased between one and three points, the RCI decreased approximately 2 points and SDI decreased between zero, i.e. no decrease, and 4 points total.

As for Peyton Hwy 463, the PQI decrease was approximately 18 points and the SDI decrease was approximately 15 points. With the RCI decrease being around 4 points, it is obvious that the large PQI decrease is influenced mainly by the SDI large decrease.

In reviewing the detailed data along the various sections of Peyton Hwy 463, it was determined that light severity raveling was overrated by the field crew which have caused the SDI to drop significantly, because raveling contributes largely to the SDI score calculations.

Understanding that raveling is a surface deficiency that occurs due to aging rather than heavy loading and that raveling usually takes place over time, and also considering that the annual RCI drop was reasonable at approximately 4 points, it can be concluded that the large drop is SDI, and consequently in the PQI score is not mainly due to heavy loading for a short duration, rather for a field overrating incident. This conclusion is also supported by the IRI and rutting results as presented below under Section 3.2.2.

3.2.2 Street Level IRI and Rutting Comparisons

Table 3.4 and Figure 3.4 below present a comparison between the 2018 and the 2019 IRI (longitudinal profile) and rutting (transverse profile) data at the street level.

Table 3.4: Street Level IRI and Rutting Comparisons - 2018-2019

| Street Name	CL Length (miles)	IRI (inches/mile)		Rutting (Inches)	
		2018	2019	2018	2019
Hanover Road	**12.3**	190	201	0.15	0.07
Old Pueblo Road	**1.5**	170	174	0.19	0.09
Peyton Hwy 463	**8.0**	160	156	0.18	0.11
Squirrel Creek Road	**7.6**	116	118	0.09	0.01
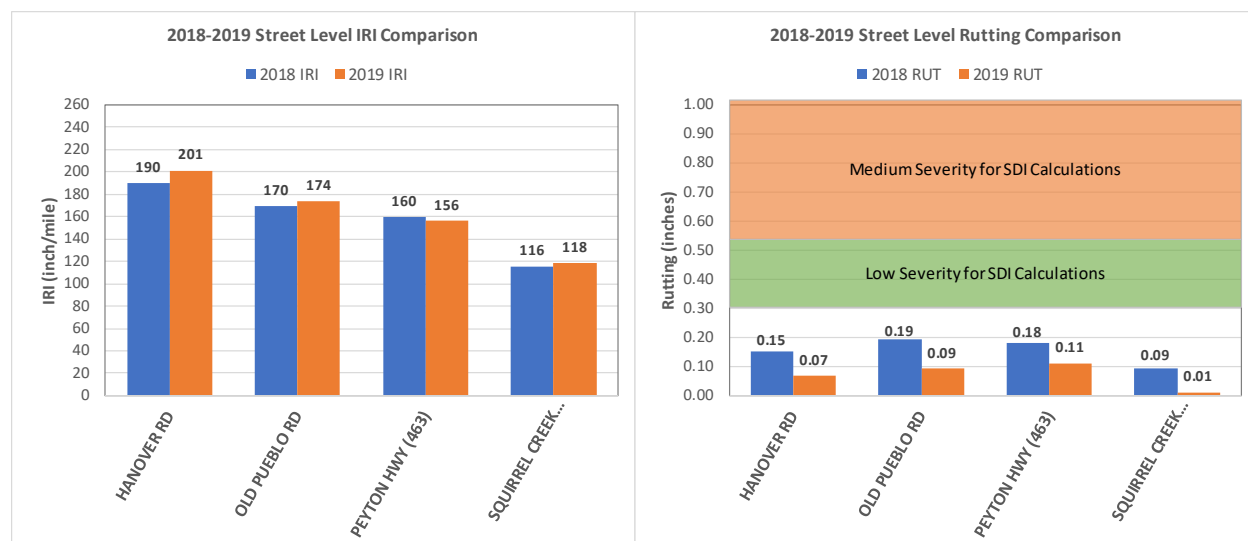
Figure 3.4: Street Level IRI and Rutting Comparisons - 2018-2019

3.2.2.1 Discussion

The results presented above in Table 3.4 and Figure 3.4 indicate an increase in IRI readings in the range of 2 to 11 inches/mile, except for Peyton Hwy 463 where the IRI slightly decreased by approximately 4 inches/mile. As for rutting, the results indicate a negligible decrease (≤ 0.1 inches) in rutting values on all 4 streets. While a decrease in rut depth is not expected. This decrease however is small and could potentially be attributed to riding in a slightly different wheel path compared to 2018. Also considering that rutting values smaller than 0.25 inches are ignored when calculating the SDI, and the fact that the measured rut values on this project are small to begin with, this decrease in rut values can be ignored.

3.3 STREET/LANE LEVEL COMPARISONS (2019 ONLY)

3.3.1 Street/Lane Level PQI, RCI and SDI Comparisons

Table 3.5 and Figure 3.5 below presents a comparison between the 2019 calculated performance data (PQI, SDI, RCI) of both directions of travel. Since only one direction of travel (Positive direction) was assessed by the County in 2018, the purpose of this comparison is to identify any major differences in performance between the two directions, which will help validate the measured performance in the positive lane's direction when compared to the 2018 condition ratings.

Table 3.5: Street/Lane Level PQI, RCI, SDI Comparisons - 2019

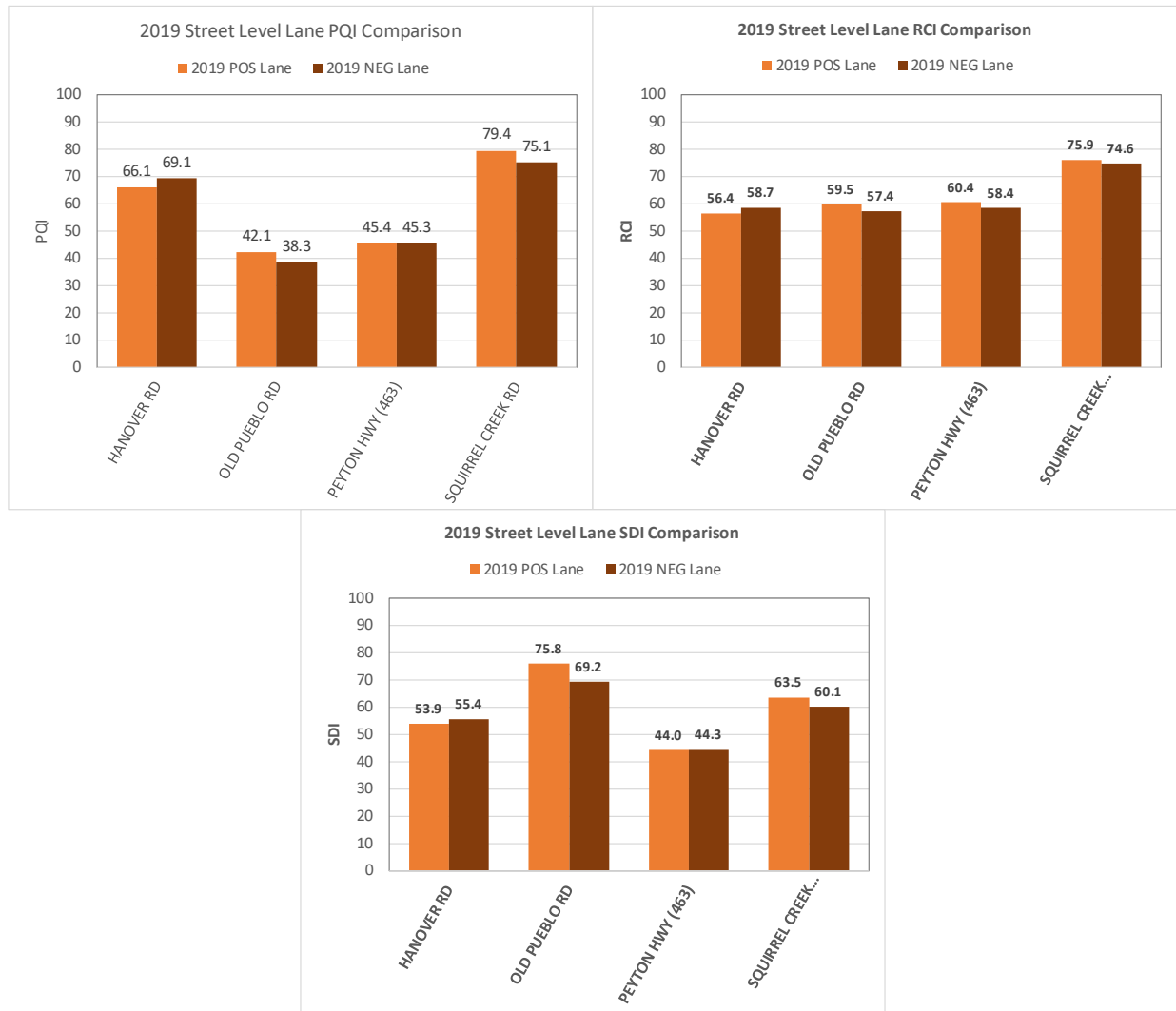| Street Name	CL Length (miles)	PQI		RCI		SDI	
		POS Lane	NEG Lane	POS Lane	NEG Lane	POS Lane	NEG Lane
Hanover Road	**12.3**	66	69	56	59	54	55
Old Pueblo Road	**1.5**	42	38	60	57	76	69
Peyton Hwy 463	**8.0**	45	45	60	58	44	44
Squirrel Creek Road	**7.6**	79	75	76	75	64	60

Figure 3.5: Street/Lane Level PQI, RCI, SDI Comparisons – 2019

3.3.1.1 Discussion

As mentioned earlier, the purpose of testing the opposite (Negative) direction lanes is to have another set of performance ratings that validate the data collected on the positive lanes, which is compared with the County's 2018 ratings. This validation assumes that the condition of the opposite lanes is expected to somewhat be similar to that of the positive lanes, which is not unreasonable to assume.

The results presented above in Table 3.5 and Figure 3.5 generally indicate comparable PQI, RCI and SDI results between the opposite direction lanes, i.e. a validation of the ratings collected on the positive lanes. The results indicate a difference in the range of 0 to 4 points in PQI, 1 to 3 points in RCI and 0 to 7 points in SDI. The results also indicate that Peyton Hwy 463 shows the closest agreement in surface distress ratings between the opposite direction lanes. In light of what was presented under Section 3.2.1.1 above,

this also indicates that the field crew may have consistently overrated raveling on Peyton Hwy 463 lanes in both directions.

3.3.2 Street/Lane Level IRI and Rutting Comparisons

Table 3.6 and Figure 3.6 below present a comparison between the 2019 IRI (longitudinal profile) and rutting (transverse profile) data in both directions of travel.

Table 3.6: Street/Lane Level IRI and Rutting Comparisons - 2019

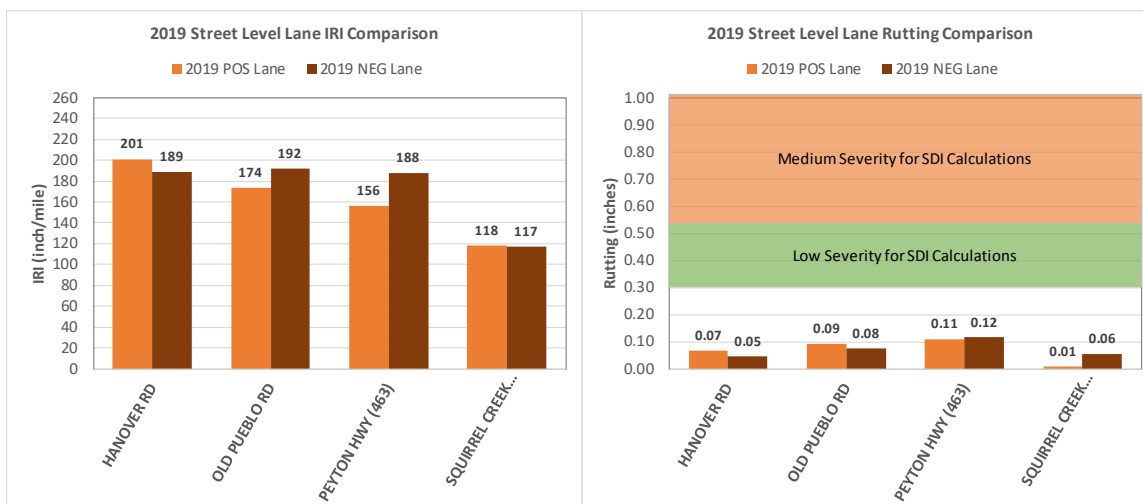| Street Name	CL Length (miles)	IRI (inches/mile)		Rutting (Inches)	
		POS Lane	NEG Lane	POS Lane	NEG Lane
Hanover Road	**12.3**	201	189	0.07	0.05
Old Pueblo Road	**1.5**	174	192	0.09	0.08
Peyton Hwy 463	**8.0**	156	188	0.11	0.12
Squirrel Creek Road	**7.6**	118	117	0.01	0.06

Figure 3.6: Street/Lane Level IRI and Rutting Comparisons - 2019

3.3.2.1 Discussion

The results presented above in Table 3.6 and Figure 3.6 indicate a somewhat comparable IRI and rutting results between the opposite direction lanes. The results indicate a difference in the range of 1 inch/mile to 32 inches/mile in IRI and a difference of ≤ 0.05 inches in rutting. The largest difference in IRI of 32 inches/mile belongs to Peyton Hwy 463 and the smallest difference in IRI of 1 inches/mile belongs to Squirrel Creek Road.

4.0   CONCLUSIONS

The following conclusions could be withdrawn from the work completed under this project, which included a condition assessment on 4 streets: Squirrel Creek Road (7.6 CL miles), Peyton Hwy 463 (8 CL miles), Hanover Road (12.3 CL miles) and Old Pueblo Road (1.5 CL miles), and then comparing the 2019 condition ratings with the 2018 ratings as documented in the El Paso County PMS.

4.1   PROJECT LEVEL 2018-2019 COMPARISONS

- The PQI, RCI and SDI centerline-weighted scores calculated at the project level indicate a reasonable decrease from 2018 to 2019. PQI decreased by approximately 6 points from 69 in 2018 to 63 in 2019, RCI decreased by approximately 1 point from 64 in 2018 to 63 in 2019, and SDI decreased by approximately 6 points from 61 in 2018 to 55 in 2019. Depending on the condition of the road and the type of deterioration curve it follows, the annual performance drop could typically range between 0 and 8 points for the various performance indices.

- The 2018 to 2019 project level comparison results for IRI and rutting indicate a reasonable trend with an increase in IRI of approximately 8 inches/mile (162 inches/mile in 2018 to 170 inches per mile in 2019). and a negligible decrease of 0.08 inches in rutting readings (0.15 inches in 2018 to 0.07 inches in 2019).

4.2   STREET LEVEL 2018-2019 COMPARISONS

- The results indicate, as expected, a decrease in the PQI, RCI and SDI performance scores from 2018 to 2019 for all four streets. With the exception of Peyton Hwy 463, PQI on the other three roads decreased between one and three points, RCI decreased approximately 2 points and SDI decreased between zero (i.e. no decrease) and 4 points.

- The results for Peyton Hwy 463A indicate a somewhat larger than expected decrease in PQI and SDI. In reviewing the detailed data along the various sections of Peyton Hwy 463, it was determined that light severity raveling was overrated by the field crew which have caused the SDI to drop significantly, because raveling contributes largely to the SDI score calculations.

- Regarding IRI and rutting, the results indicate an increase in IRI readings in the range of 2 to 11 inches/mile, except for Peyton Hwy 463 where the IRI slightly decreased by approximately 4 inches/mile. As for rutting, the results indicate a negligible decrease (≤ 0.1 inches) in rutting values on all 4 streets.

4.3 STREET/LANE LEVEL 2018-2019 COMPARISONS

The purpose of testing the opposite (Negative) direction lanes in 2019 is to have another set of performance ratings that can potentially validate the data collected on the positive lanes, which is then compared with the County's 2018 ratings. This validation assumes that the condition of the opposite lanes is expected to somewhat be similar to that of the positive lanes, which is not an unreasonable assumption.

- The results presented indicate comparable PQI, RCI and SDI results between the opposite direction lanes. The results indicate a difference in the range of 0 to 4 points in PQI, 1 to 3 points in RCI and 0 to 7 points in SDI between 2018 and 2019.

- The PQI, RCI and SDI comparison results also indicate that Peyton Hwy 463 shows the closest agreement in surface distress ratings between the opposite direction lanes.

- Regarding IRI and rutting, the results generally indicate comparable IRI and rutting results between the opposite direction lanes. The results indicate a difference in the range of 1 inch/mile to 32 inches/mile in IRI and a difference of ≤ 0.05 inches in rutting for testing completed in 2019 between lanes in the opposite directions. The largest difference in IRI of 32 inches/mile belongs to Peyton Hwy 463 and the smallest difference in IRI of 1 inch/mile belongs to Squirrel Creek Road.