Standing Rock Sioux Tribe

Pavement Management Plan

May 2017

FHWA Disclaimer

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CHAPTER 1 INTRODUCTION

The Standing Rock Sioux Tribe is responsible for maintaining over 220 miles of roadway, nearly half of which (109 miles) are paved roads. These consist almost entirely of 2-lane asphalt roads. Funding levels have not allowed for extensive regular overlays, reconstruction, seal coats, and other maintenance. Without a proactive strategy in place, roads will deteriorate faster than they can be maintained.

Understanding how road pavements age and deteriorate over time, both by environmental conditions and traffic loading, is critical in developing a sustainable roadway rehabilitation and maintenance program. Maintaining and rehabilitating infrastructure at appropriate times saves public dollars in the long term. Studies have found maintaining pavement through rehabilitation techniques has the potential to be 6 to 14 times more cost effective than rebuilding a deteriorated road.

Figure 1 - Road Maintenance Types Over Time

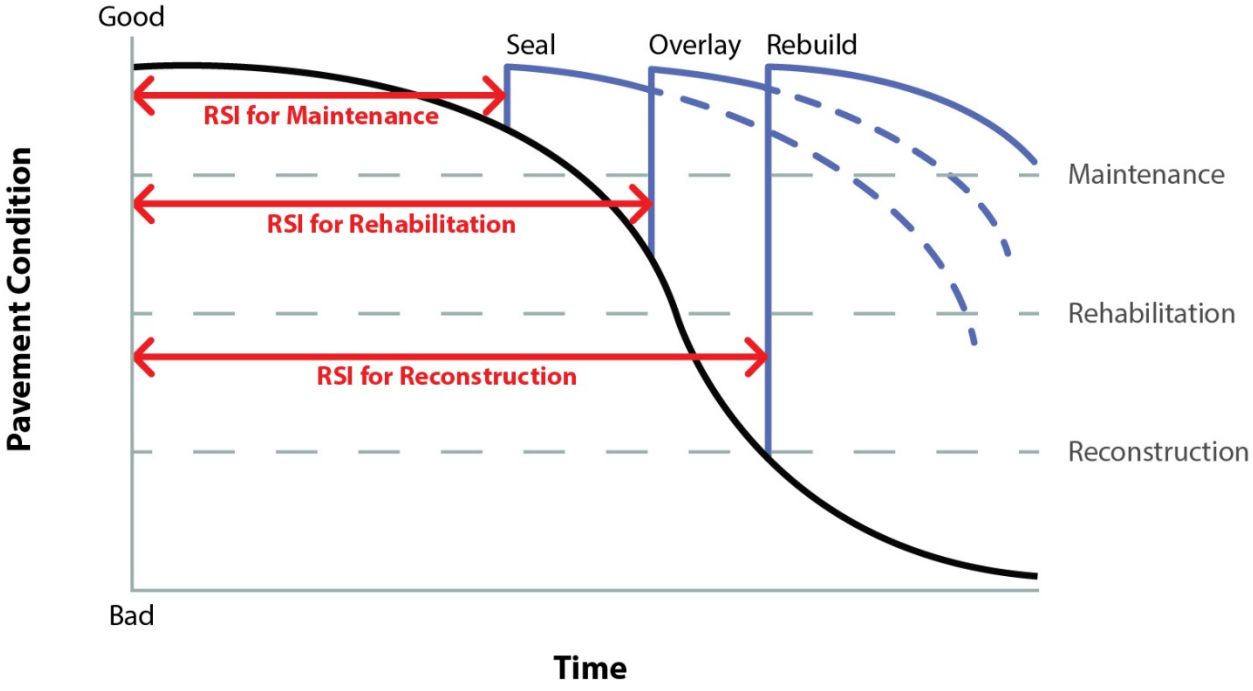


Figure 1 shows that it is easier and more cost effective to maintain good roads than it is to wait and reconstruct bad ones. Overlays or reconstruction projects have a longer Return Service Interval (RSI) and are performed less often than a chip seals. However, as the road condition deteriorates, the costs associated with restoring the road to good condition increases exponentially. See Table 1 for a comparison of cost-per-year based on RSI.

Table 1 – Treatment Cost per Year

Treatment Type	RSI (years)	Cost per Mile	Cost per Year
Seal	3	$32,500	$10,833
Overlay	12	$375,000	$31,250
Reconstruction	25	$1,125,000	$45,000

New technology and processes can streamline the maintenance scheduling process. Techniques such as Pavement Surface Evaluation and Rating (PASER) can allow a department to come up with an effective treatment plan based on the conditions of the surrounding roadways. PASER is a visual method, based on engineering principles, for evaluating paved roads in a time efficient and consistent manner. The PASER method outputs a simple 1 through 10 rating for each section of roadway studied. This provides an understandable way for an agency to communicate pavement condition to elected officials and the public, and it also allows more time to be put towards scheduling and budgeting. The ability to know the condition of all roadways under Tribal jurisdiction is an extremely useful tool. This knowledge helps to schedule all preventative maintenance to keep all roadways functioning at their current condition, instead of degrading to the point where costlier corrective and emergency maintenance treatments are required.

Photo of Pavement Condition on a Standing Rock Reservation Road

The purpose of this study is to conduct a PASER survey of all the roads in the study area and determine what maintenance strategies should be utilized by the Tribe in the short-term and longer-term time frame. This will help the Tribe effectively manage their roadways while trying to minimize the maintenance costs over time.

CHAPTER 2 EXISTING ROADWAY CONDITIONS

Methodology

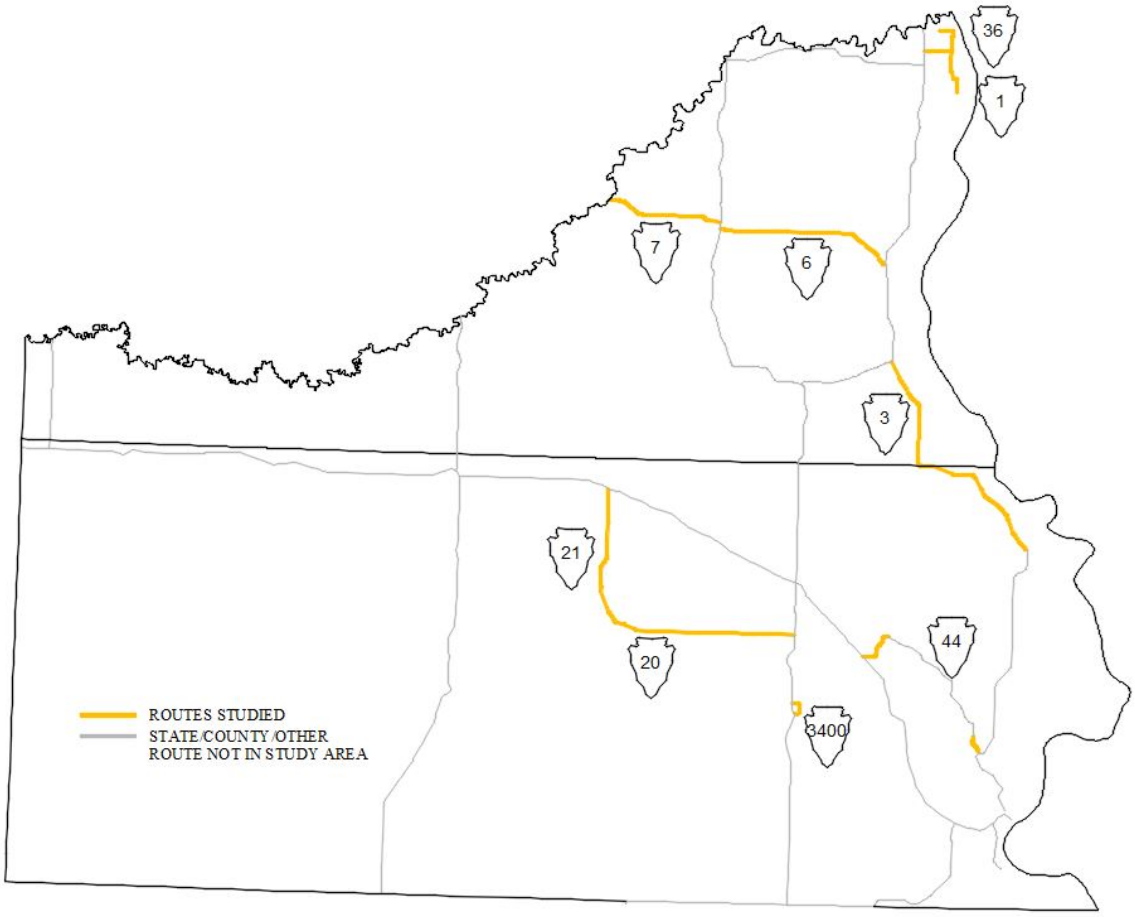
This study was focused on assessing the current condition of the main highways around the reservation and developing a maintenance strategy to improve and repair the roadways. Tribal officials identified nine main and minor routes, consisting of approximately 83 miles of 2-lane paved highway to be evaluated. Not all paved roads were to be evaluated; no urban streets were studied, the focus of the study is on high speed BIA routes. Figure 2 - Study Area Roads displays in orange the Standing Rock tribally and BIA owned roadways evaluated.

Pavement Surface Evaluation and Rating (PASER)

PASER ratings are performed in order to assist agencies in identifying roadway conditions and prioritizing improvements based on a range of factors including roughness (ride), surface distress (condition), surface skid characteristics, and structural characteristics (potholes, cracking, etc.). Based on the PASER rating, different maintenance tasks are required to maintain or raise the rating for a particular section of roadway. By continuing to ensure that a good roadway remains a good roadway, the life of a roadway can be extended for a far lower upfront cost than by waiting until a more intensive maintenance method is required.

Example Photo of Road Maintenance Activities

Figure 2 - Study Area Roads



Process

In order to determine the 1 to 10 PASER rating of each segment of BIA and tribal roadway, each mile of study area roads was mapped out and driven. As each route was driven, a windshield survey of the road condition was noted and pictures were taken and geolocated in order to help document where and why each PASER rating was given. Factors such as the amount of cracking, potholes, rutting, shoulder condition, ability to drive at full speed, and the presence of gravel were all considered in rating the road segments. The roadways were segmented every mile, measuring the properties of the first one hundred feet of each mile. Instances of shorter segments were also noted if conditions differed suddenly. For example, while driving down BIA Route 3400 the pavement condition was much worse at mile marker 1.2 near Little Eagle than it was at the northwest end. Consistency was important in the rating. Each of the rating values was defined and kept consistent throughout the PASER rating process. For example, severe cracking on a roadway rated it as a five and each instance of severe cracking was rated as a five consistently. Each mile of the 83 miles in the study area was driven and rated in April 2017.

Description of PASER Ratings

The paved study area roads were all given a PASER rating between 1 and 10 based on existing conditions. None of the roads in the study area were observed to be a 1, 2, 9 or 10. The individual PASER ratings values are described below and an example photo of each is provided.

PASER Rating 1:

No pavement. A PASER rating of 1 indicates a gravel road section with virtually no visible pavement. Example: none in the study area.

Example Photo of a PASER Rating 1 Road

PASER Rating 2:

Terrible. Heavy patching with gravel patches on failed asphalt. Limited pavement intact. No striping. Shoulders are deteriorated. You cannot drive this road at the posted speed limit. Drivers need to slow down. Example: none in the study area.

Example Photo of a PASER Rating 2 Road

PASER Rating 3:

Very poor. Severe cracking and rutting with moderate visible potholes. Heavy patching with some patches on old patches. Limited striping. Shoulders are deteriorated. Areas are marked with flags. You cannot drive this road at the posted speed limit. Drivers need to slow down. Example: BIA Route 44, two miles south of Mahto, SD.

Photo of a PASER Rating 3 Road on the Standing Rock Reservation

PASER Rating 4:

Poor. Heavy cracking and rutting with moderate visible potholes. Heavy patching with some patches on old patches. Limited striping. Shoulders are deteriorated. Cracks are not sealed. You cannot drive this entire road at the posted speed limit. Drivers need to slow down in areas. Example: BIA Route 3400, south from Little Eagle, SD.

Photo of a PASER Rating 4 Road on the Standing Rock Reservation

PASER Rating 5:

Fair. Moderate to heavy cracking with moderate rutting. Moderate patching with some patches on old patches. Limited striping. Cracks are mostly not sealed. You can still drive this road at the posted speed limit. Example: BIA Route 1, south of Cannon Ball, ND.

Photo of a PASER Rating 5 Road on the Standing Rock Reservation

PASER Rating 6:

Fair. Moderate to heavy cracking or some raveling and rutting exists. Moderate polishing with occasional patches visible. Cracks are mostly sealed. Example: BIA Route 7 near Porcupine, ND.

Photo of a PASER Rating 6 Road on the Standing Rock Reservation

PASER Rating 7:

Good. Some cracking, no raveling and little rutting. No patches are visible. Cracks are sealed. This roadway is not in need of immediate repair. Example: BIA Route 20, near Bullhead, SD.

Photo of a PASER Rating 7 Road on the Standing Rock Reservation

PASER Rating 8:

Great. No cracking, raveling or rutting present. No patches or sealed cracks are visible. This roadway is not in need of repair. Example: BIA Route 3, near Kenel, SD.

Photo of a PASER Rating 8 Road on the Standing Rock Reservation

PASER Rating 9:

Excellent. A relatively new road with new striping. This is usually a roadway that was reconstructed or overlaid recently. Example: None in the study area.

Photo of a PASER Rating 9 Road

PASER Rating 10:

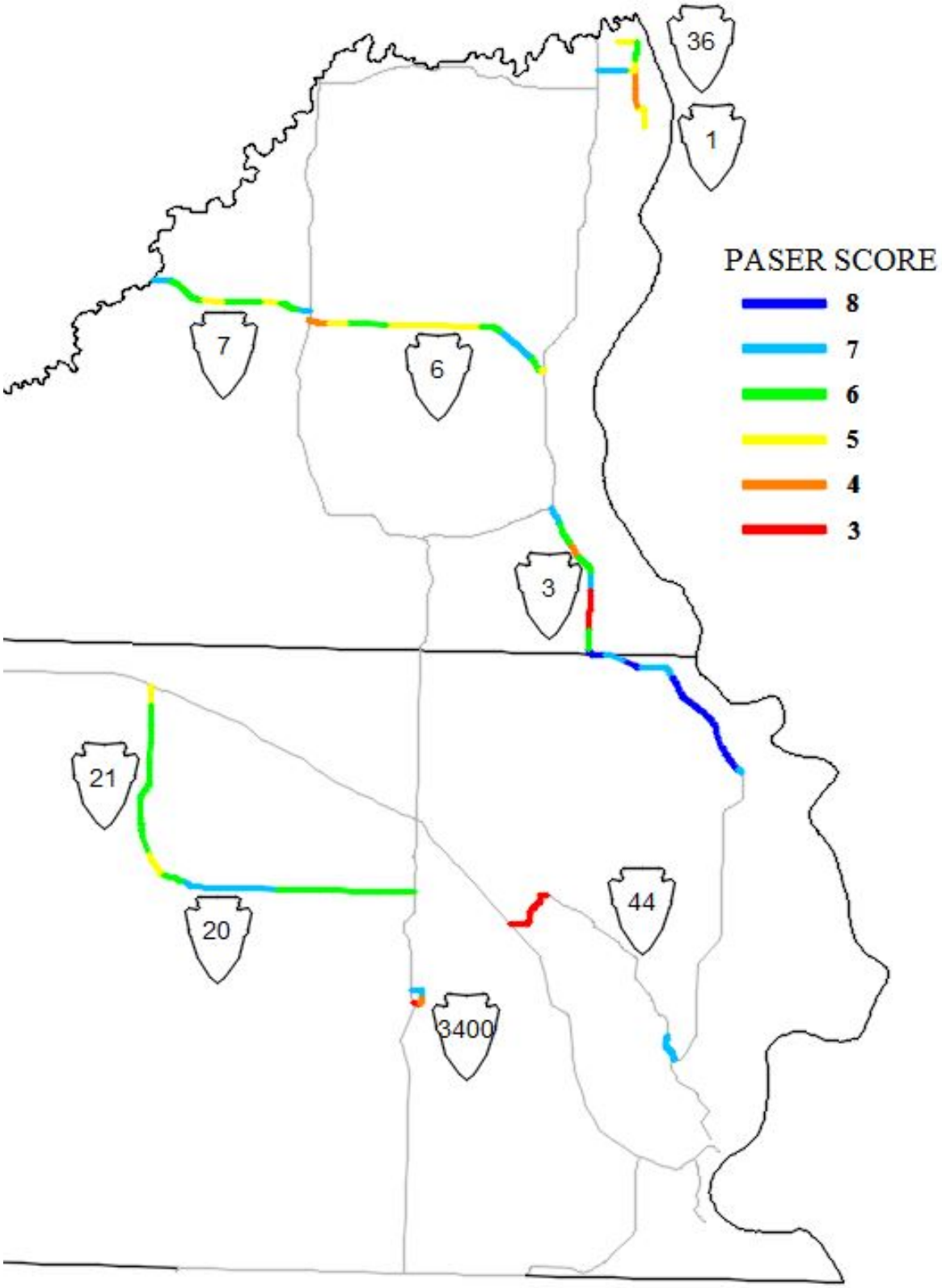
Perfect. A brand new road with appropriate striping and shoulders. This is a roadway that was most likely reconstructed or overlaid in the last year. Example: None in the study area.

Example Photo of a PASER Rating 10 Road

Map of Road Conditions

Every one-mile segment of highway was given a PASER score and the results were mapped. Figure 3 is a map that displays the PASER ratings in a color coded system. Blue being the highest values or best conditions going down through the rainbow with red and black being the lowest values or worst conditions found in the study area. Figure 3 is also attached as an 11”x17” as Exhibit 3 at the end of this report.

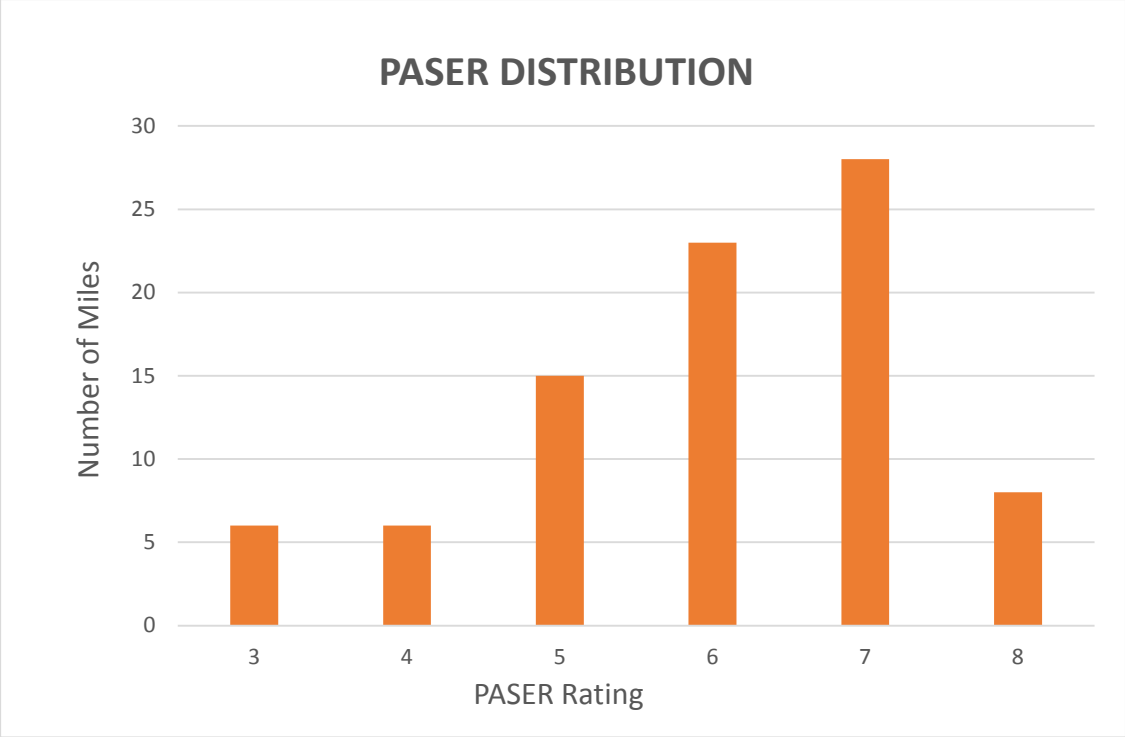
Figure 3 – Existing Pavement Conditions (2017)



Approximately 83 miles of tribal/BIA roadway were assigned PASER ratings throughout the course of the study. The average (mean) rating for the studied roadways was 5.99. That number may not signify much, but it does indicate that the Standing Rock highways scored tend to be in fair to good condition. In fact, if a rating of five is to be considered the minimum acceptable pavement condition, (able to drive at posted speed limit) then 86% of scored roads meet that standard today. This is visualized in the Figure 3 as it indicates there are more miles of orange, green, and blue than there are of red and black. There were 4 miles of roads rated an eight or nine. These miles in great or excellent condition were short intermittent segments along the southern half of BIA 3 near Kenel, SD.

The ratings per mile are broken down in Figure 4.

Figure 4 - PASER Score Distribution



CHAPTER 3 NEEDS ASSESSMENT

Methodology

In conducting the Needs Assessment it is not as easy as simply looking at the lower scoring roads and saying that they are in the worst conditions; therefore have the most need. Other factors such as traffic volume, truck traffic, roadway safety, maintenance history, level of service needed, connections, and other factors should be considered.

Traffic volume and roadway level of service are something to be considered when developing a pavement management plan. In the case of the roadways studied on the Standing Rock Sioux Reservation, average daily traffic (ADT) volumes vary from 230 vehicles per day to greater than 1,000 vehicles per day. The 1,000 vehicles per day was measured on BIA 36 in 2001; the route serves a Headstart facility and perhaps a dozen residences, so the measurement may have coincided with a special event in the area, or the count may be near the school, with the BIA 36 and BIA 1 needing clarification in the inventory. No route is experiencing a daily level of service other than A (which indicates free flowing traffic with no congestion). While traffic volumes should still be considered, because there is a difference between a road that has 1,200 ADT and one that has 80 ADT, level of service is not a factor that can help determine need in this case. KLJ did not conduct traffic counts at this time, but used traffic counts listed in RIFDS, adjusted to 2017 numbers at a 2% annual growth rate. The adjusted ADT for BIA Routes 4 and 5 was approximately 300 vehicles per day, and the adjusted ADT for BIA Routes 2 and 11 was barely more than 400 vehicles per day.

KLJ has taken into account road condition, daily traffic, and, to an extent, truck traffic to establish a level of relative need to prioritize projects for recommendation in Chapter 4.

Description of Pavement Preservation Strategies

Timing on treatments is particularly important in order to maintain an effective pavement management budget. Example: Crack sealing is best performed when temperatures are moderately cool, such as the spring or fall months. Cooler temperatures are generally when the cracks are fully open, allowing for the entire crack to be sealed. Crack sealing can also be performed with less labor involved, so a smaller crew can handle these in the fall and spring. More intensive maintenance methods (minor overlays, chip seals, etc.) can be done in the summer months can be done in the summer when maintenance departments typically have seasonal manpower as well. Generally, the state Departments of Transportation in northern regions prohibit chip sealing operations before May 1st and after August 31st so that minimum temperature guidelines can be followed for quality purposes. Higher temperatures also lessen the cure time required, thus allowing the roadway to be opened in a shorter time frame. Full reconstruction and structural overlays are generally more labor and equipment intensive and are much more expensive. Sealing does need to be performed in moderation. Extensive sealing operations can result in a loss of pavement friction, which would then lead to a chip seal in order for the roadway to function properly in winter months. It is also extremely important to keep weather factors in mind, as excessive moisture can prohibit primers and sealants from bonding properly.

PASER Rating of 1:

There were no roadways in the study area with a PASER rating 1. If there were, however, it would essentially be a gravel road, and the Tribe would have to determine if a full reconstruction is needed or if it is to remain gravel and the Tribe can provide maintenance as such.

PASER Rating of 2:

Due to severe deterioration, the roadway needs reconstruction with extensive base repair; or the decision can be made to pulverize any remaining asphalt and maintain it as a gravel road. As with PASER rating 1, no roads in the study area were severely deteriorated enough to receive a PASER rating of 2.

PASER Rating of 3:

Patching and repair will need to be done prior to a major structural overlay (greater than 2”). Milling and removing deteriorated areas will extend the life of the overlay. The Tribe has expressed interest in reverting one particular area that was given a PASER Rating of 3, BIA 44 near Mahto, back to a gravel road.

PASER Rating of 4:

Due to significant signs of aging, a structural overlay is required (greater than 2”).

PASER Rating of 5:

Primarily consists of aging asphalt, but with sound structural conditions. The roadway can benefit from patching where necessary, followed by a non-structural overlay (less than 2”).

PASER Rating of 6:

Light signs of aging. The roadway life can be extended with routine crack sealing and a sealcoat.

PASER Rating of 7:

Roadway shows very few signs of aging and can be maintained with routine crack filling.

PASER Rating of 8 and 9:

No immediate maintenance is required on these roadways. In the future, routine crack filling and maintenance should be performed to continue to extend the life of the roadway.

PASER Rating of 10:

This roadway was recently completed and no maintenance is required.

The Standing Rock Sioux Tribe already uses all of these strategies or interventions to maintain their paved roads.

It is known that costs can vary quite a bit in the study area. Approximate contracted out costs per mile for major maintenance tasks associated with work on the Standing Rock Sioux Reservation are listed in Table 2 below. It is extremely important to keep track of all associated maintenance costs (crack sealing, seal coating, etc.). No matter how minor the task being performed, accurate and concise cost tracking will enable more accurate programming, scheduling and budgeting. Costs vary by state or region, so tracking these costs enables an accurate pavement management plan to be applied to the entire reservation.

Table 2 - Cost Estimates

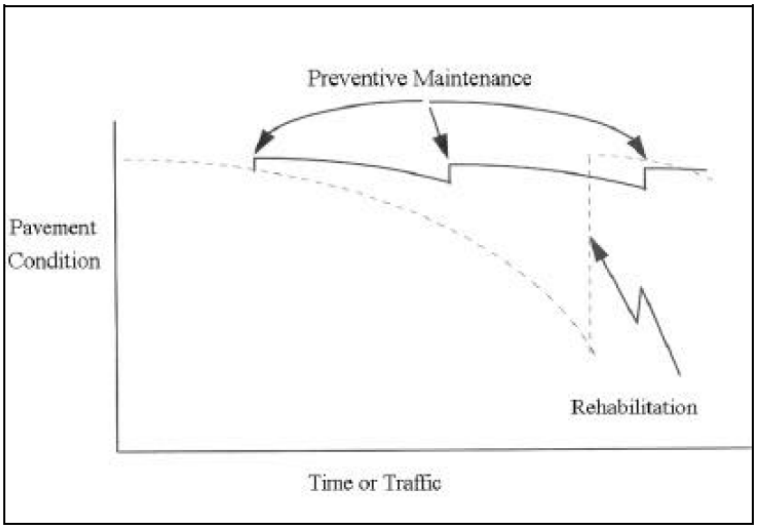
Improvement Type	Cost per Mile*
Reconstruction	$ 1,125,000.00
Structural Overlay	$ 375,000.00
Non-Structural Overlay	$ 195,000.00
Chip Seal	$ 32,500.00

*Note: Costs are planning figures based on asphalt and earth materials costs only and include gross approximations for contractor mobilization costs. Dollar amounts shown do not include costs or fees for: other incidental construction costs associated with drainage, safety improvements, lighting, or signage; right-of-way acquisition; preliminary engineering; or construction management. Assumed asphalt thicknesses for non-structural overlays, structural overlays, and reconstruction are 1 ½ inches, 4 inches, and 5 inches, respectively. Costs for overlays and reconstruction include chip seal cost.

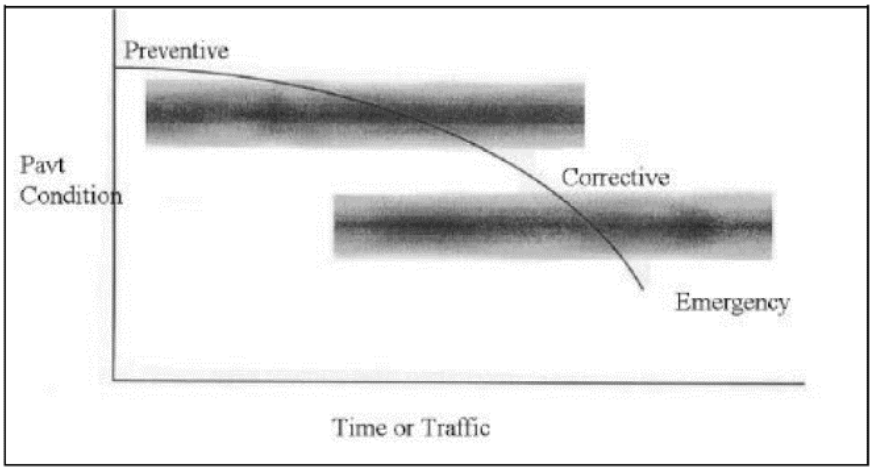
The estimated costs are assumptions in 2016 US Dollars for contracting purposes. These are estimates based on recent similar projects and NDDOT & SDDOT Average Bid Prices. For planning and budgeting purposes, construction costs should be expected to increase at a 5 to 6 percent annual inflation rate.

Feasible Strategies

There is a saying that you don't want to improve the worst roads first. This is backed up by research. It is more cost efficient to keep a good road in operating condition than to replace an aging road. By putting money upfront into seal coating, crack sealing, etc., the roadway's life can be extended far more efficiently than waiting until structural improvements are required (overlays, milling, reconstruction, etc.). Deferring repairs until a road deteriorates to poor condition costs more than double what it would cost to perform routine preventative maintenance (based on a recommended sample system preservation program published by FHWA).



Corrective and emergency repairs occur when the roads are more deteriorated or have lower PASER ratings and require costly structural improvements or reconstruction.



CHAPTER 4 RECOMMENDATIONS

The Standing Rock Sioux have contracted their road maintenance department from the BIA, and they are in the process of restarting their Tribal Transportation Program through PL93-638 contracting through the BIA as well. The Tribe has dozens of projects programmed into its Tribal Transportation Improvement Plan (TTIP) over the next 5 years, and many more projects exist on the Tribe's priority list that are not yet on the TTIP. Several projects are on the TTIP which involve pavement preservation of some form and coincide with the recommendations of this report, such as: Kenel Road Rehab (ND), Kenel Road Chip Seal (SD), Bullhead East Chip Seal, and Bullhead to Walker Chip Seal. There are, of course, other road maintenance activities such as patching and crack-sealing that are on-going.

The TTIP totals currently allocated to the above pavement preservation projects are:

- $957,077 in 2017,
- $383,613 in 2018,
- and $571,650 in 2019.

The TTIP also an allocates $250,000 annually to Road Maintenance; portions of this funding could be considered for chip seals and, to a lesser degree, non-structural overlays. The Tribe also has some older FHWA allocations that are tagged for road maintenance expenditures, and newer TTP allocations are ready to be contracted and released by the BIA Great Plains Regional Office.

Prioritized Projects

The focus for recommendations in this Pavement Management Plan is on pavement overlays and chip seals. Below in Table 3 is the priority project list. It is a 5-year (2017-2021) plan for all pavement preservation projects throughout the reservation. Funding has been allocated on the TTIP for these pavement preservation projects, although naming specific projects in the TTIP has not been completed and is dependent upon this report.

Table 3 - Five Year Priority Preservation Projects

Priority	Year	Route	Mile Markers		Average PASER Rating	Treatment Type*	Length (Miles)	Estimated Cost (2016 Dollars)
			Begin	End				
1	2017	3	5.5	7.5	3.0	Structural overlay	2.0	$675,000
2	2017	3	0	5.5	5.5	Chip Seal	5.5	$65,000
3	2017	6	0	8	6.0	Chip Seal	8.0	$286,000
4	2017	1	0	2	5.33	Chip Seal	2.0	$65,000
5	2018	3400	Sec 40	Sec 70	3.0	Structural Overlay	1.0	$395,000
6	2018	21	8.5	9.5	5	Non-Structural Overlay	1.0	$195,000
7	2018	21	0	10	5.9	Chip Seal	10.1	$295,750
8	2018	36	1	2	5.33	Non-Structural Overlay	2.1	$409,500
9	2018	1	2	5	5.5	Non-Structural Overlay	2.9	$565,500
10	2019	6	8	16	5.1	Non-Structural Overlay	8.0	$1,560,000
11	2019	6	16	21	6.2	Chip Seal	5.3	$172,250
						Allocated Totals:	47.9	$4,684,000

* It should be noted that crack seals are to be performed before chip seals and non-structural overlays.

Tables 3 and the map in Figure 6 outline a priority paving plan to focus efforts on maintaining the best tribal highway system possible, for the most users.

The priority paving plan focuses on the next five years to somewhat coincide with the current TTIP, 2017 through 2021, and to account for additional funding available for road maintenance activities.

Aside from the projects identified above, the following routes have been identified that are in need of crack sealing in the near term. These routes should be crack sealed in 2017:

Table 4 – Near-Term Crack Seal Needs

Route	Mile Markers		Average PASER Rating	Treatment Type	Length (miles)
	Begin	End			
3 – ND Line to Kenel	8	19	7.67	Crack Seal	11.4
20 – Bullhead East	0	13	6.93	Crack Seal	13.2
44 – Wakpala South	13	14	7.00	Crack Seal	1.4

2017

The highest priority recommendation is a structural overlay for portion of BIA Route 3 with the lowest PASER rating. A 5.5-mile section of BIA 3 (adjacent to the north of the structural overlay) should receive a chip seal at the same time as the overlain portion of BIA 3.

It is also recommended that BIA 7 (or the west half of BIA 6, as it may be locally referred to as) receive a chip seal in 2017.

It is recommended to chip seal BIA Route 1 from ND Highway 1806 to Cannon Ball.

It is very important to note that crack sealing should be completed before any scheduled chip seal to reduce the occurrence of existing cracks reflecting through a newly chip sealed surface.

The projects recommended for construction create a TTIP deficit of approximately $69,000 for the year. The Tribe has it's $250,000 per year TTP maintenance set-aside, as well as an old FHWA balance available to cover this small shortfall. The funding available to the Tribe may also allow for more aggressive scheduling to complete projects sooner than shown in Table 3.

2018

A structural overlay is recommended for the Little Eagle School Loop Road, BIA Route 3400.

It is also recommended to treat BIA 21 in 2018. Portions of the route just north of Bullhead, totaling approximately one mile in length, are in need of a non-structural overlay before the entire route is chip sealed.

It is recommended to complete a non-structural overlay near Cannon Ball, on BIA 36 as well as the southerly portion of BIA 1.

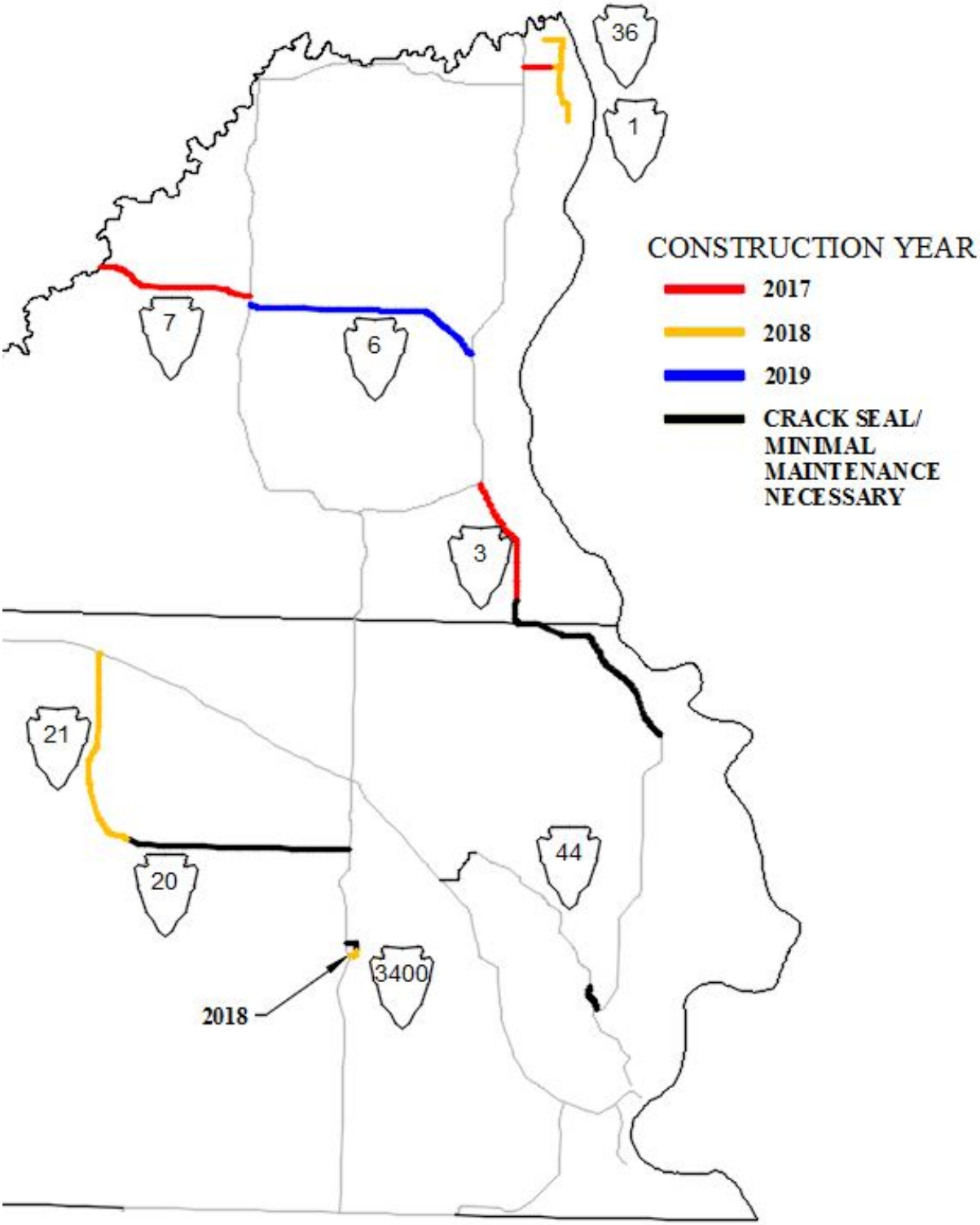
2019

A rehabilitation of BIA 6, between ND 6 and ND 1806, should be completed in 2019. The rehabilitation project should consist of approximately 5.1 miles of non-structural overlay, followed by a chip seal of the entire project.

2020-2021

No projects related to pavement preservation appeared on the current TTIP for these two years, aside from the $250,000 TTP set-aside for road maintenance. A separate PASER survey and report for city streets in tribal housing areas will also be conducted, and that report may result in several projects may appear in these years off the TTIP.

Figure 5 - Priority Paving Projects by Year



The PASER rating values were collected in early 2017. The values of the road conditions will change over time and focusing on a 5 year paving plan allows us to address known needs. The road conditions change with age and use, and the 2017 PASER ratings will offer little value far into the future.

Before the year 2021 it may be necessary to re-score the road conditions and reevaluate the paving priorities. Also the corridors that are planned to have new pavement overlays in the coming years would likely need that treatment again beyond the 10-year time frame and it is difficult to guess at which of the newly paved roads will need treatments and when. Now that the highways have been rated, the Tribe should also use the same PASER ratings on the paved residential streets in its road inventory.

CHAPTER 5 – SUPPLEMENTAL DATA

Below is a condensed version of the field data collected, summarizing existing conditions that contributed to the rating given and treatment recommended.

Table 6 – Field Data Summary by Project

Project	Route	Rutting (depth)	Transverse Cracks (width/spacing)	Longitudinal Cracks (width/extent)	Alligator/ Block Cracking (size/%)	Patches (extent)	Potholes (extent)	Comment
1	3	½" – ¾"	½" – ¾" @ 2' – 10'	¼" – ½" In wheel lines	3" @ 10%	-	Low	Severe alligator cracking and block popouts
2	3	0 – ¾"	0 – ¾" @ 3' – 30'	-	6" – 16" 10%	Moderate Overlays	-	
3	6	0 – ½"	¼" – ½" @ 30' – 50'	¼" – ¾" Low to moderate	4" – 8" 10% @ MM3	Very Low	Very Low	Bad area at mile marker 3, consider overlay
4	3400	½"	½" @ 2' – 25'	½" Moderate	2" – 6" 50%	Severe	Low	Condition changes drastically at MM0.3
5	1	0 – ½"	½" – ¾" @ 25' – 30'	-	-	Very Low	-	
6	21	¼"	½" – ¾" @ 20'	½" Moderate	8" – 2' 30%	-	-	Isolated bad section of the route
7	21	¼" – ½"	¼" – ½" @ 10' – 50'	¼" – ½" Moderate	8" – 2' 15%	-	-	
8	36	0 – 1 ½"	¼" – ¾" @ 10' – 40'	¾" Low (edge)	2" – 2' 10%	-	-	
9	1	¼" – 1"	½" – ¾" @ 15' – 30'	½" – ¾" Low to Severe	3" – 6" 20%	Low to Moderate	-	
10	6	¼" – ¾"	¼" – ¾" @ 8' – 30'	½" Low to Severe	2" – 2' 25%	Low to Moderate	Low to Moderate	
11	6	0 – ¼"	¼" – ¾" @ 30' – 100'	¼" – ½" Low to Moderate	8" – 2' 10%	Low	-	One large settlement/patch at creek crossing

References

Smart Growth America. (2011). *Repair Priorities - Transportation spending strategies to save.* Smarth Growth America and Taxpayers for Common Sense.

Walker, D., & Entine, L. (2002). *Asphalt Roads - Pavement Surface Evaluation and Rating.* Madison: Wisconsin Transportation Information Center.